City of Santa Paula

City Council Special

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CITY COUNCIL SPECIAL MEETING OF THE
SANTA PAULA CITY COUNCIL SPECIAL

WEDNESDAY, JUNE 17, 2026

4:00 PM - City Council Special Meeting

SANTA PAULA CITY HALL
970 VENTURA STREET
SANTA PAULA, CA 93060

JULIE LATSHAW, CITY CLERK
DAN SINGER, CITY MANAGER
MONICA CASTILLO, CITY ATTORNEY

BRINGING ITEMS BEFORE THE CITY COUNCIL

You are invited to participate in all Regular City Council meetings. Agendas are posted in the front of Santa Paula City Hall, 970 Ventura Street, Santa Paula, 72 hours in advance of the scheduled meetings. The City Council's regular meetings start at 6:30 p.m. the first and third Wednesday of each month in the City Hall Council Chambers located at 970 Ventura Street in Santa Paula. Special and Closed Sessions vary by date and time.

HOW TO PARTICIPATE IN PERSON DURING THE MEETING: If you wish to speak at a City Council meeting, please fill out a ***Public Comment Form*** noting your name and address and submit the form to the City Clerk. Include the Agenda item number you wish to speak on. Members of the public may address the Council on items on this agenda only. ***Public Comments are limited to 3 minutes.***

HOW TO PARTICIPATE BEFORE THE MEETING: Members of the public are encouraged to submit email correspondence on any agenda item by sending an email to cityclerk@spcity.org. All public correspondence received by three hours before the meeting date will be provided to the legislative body before the meeting. Public Comments received after, will be provided to the legislative body the next day.

Your Participation in this meeting is in the public domain; meetings are cablecast; minutes of this meeting will reflect your participation in this meeting and are posted on the city's website.

PLEASE NOTE: *Be advised that if you bring a legal challenge to an action, you may be limited to raising only those issues you or someone else raised at the meeting described in this Agenda, or in written correspondence delivered to the City Council at or before the meeting. Any action is subject to the ninety-day time period set forth in Code of Civil Procedure § 1094.6.*

In compliance with the ***Americans with Disabilities Act****, if you need special assistance to participate in this meeting, please contact the City Clerk at (805) 933-4208. Notification 48 hours before the meeting will enable the City to make reasonable arrangements to ensure accessibility to this meeting. (28 CFR 35, 102-35.104 ADA Title II). Written materials distributed to the City Council within 72 hours of the City Council meeting are available for public inspection immediately upon distribution in the City Clerk's office.*

MEETING ENVIRONMENT

To maintain a public meeting environment conductive and welcoming to receive public comments from all members of the public, the audience is discouraged from engaging in displays of support or opposition to staff reports or public comments, including clapping, yelling, booing, hissing, or cheering, that may create a disruptive environment for the public who wish to express their views during the meeting are encouraged to do so in silent, non-disruptive ways -- such as raising a hand, shaking hands, or another quiet gesture of support or opposition that does not obstruct views or interrupt proceedings.

Members of the public holding signs are asked to hold the signs on their person in front of them or move to the back of the room so as not to obstruct the view of other members of the public wishing to participate in the meeting.

SPECIAL MEETING - COUNCIL CHAMBERS

1. **CALL TO ORDER**
   REMINDER: in order to minimize distractions during public meetings, all personal communication devices should be turned off or put in a non-audible mode.

2. **ROLL CALL**

3. **PUBLIC COMMENT**
   At this time, members of the public may comment on any item appearing on the agenda only. Individual Councilmembers may briefly respond to Public Comments or ask questions for clarification. **Public Comments are limited to three minutes.**

4. **ORDER OF BUSINESS**

   4.A **DRAFT WATER MASTER PLAN AND FINAL WASTEWATER MASTER**

PLAN STUDY SESSION

RECOMMENDATION:

Receive presentations on the Draft Water Master Plan and Final Wastewater Master Plan.

5. CLOSED SESSION

The City Council may move into a closed session pursuant to applicable law, including the Brown Act (Government Code Section 54956, et seq.) for the following purpose:

5.A

CONFERENCE WITH LEGAL COUNSEL - ANTICIPATED LITIGATION - Significant exposure to litigation pursuant to Government Code §54956.9(d)(2) and (e)(1): 1 potential case

5.B

CONFERENCE WITH LEGAL COUNSEL - EXISTING LITIGATION - Pursuant to government Code § 54956.9(d)(1) Flores v. The City of Santa Paula; Ventura County Superior Court Case No. 2026CUWM062660

6. CLOSED SESSION REPORT

7. ADJOURNMENT

State of California)-

County of Ventura)- ss

City of Santa Paula)-

I declare under penalty of perjury that I posted this City Council Agenda on the bulletin board near the front door of City Hall, 970 Ventura Street, Santa Paula, California.

On_____at_____Signed:_____

Julie Latshaw

City Clerk

CITY OF SANTA PAULA
MEMORANDUM

To: Honorable Mayor and Members of the City Council Special

From: Dale Goodman, Public Works Director

Subject: DRAFT WATER MASTER PLAN AND FINAL WASTEWATER MASTER PLAN STUDY SESSION

Date: June 17, 2026

Agenda Item: 4.A

RECOMMENDATION:

Receive presentations on the Draft Water Master Plan and Final Wastewater Master Plan.

BACKGROUND:

The City hired Ardurra (formerly MKN & Associates, Inc.) to prepare updates to the City's Water Master Plan and Wastewater Master Plan. These planning documents evaluate existing infrastructure, assess future system needs, identify system deficiencies, and develop recommended capital improvement projects to support reliable utility service for existing and future customers.

The Water Master Plan evaluates the City's water supply, storage, transmission, distribution, and pumping facilities and includes an updated hydraulic model of the water system. The Wastewater Master Plan evaluates the City's wastewater collection system, projected wastewater flows, and infrastructure needs.

The Scopes of Work for these Plans are briefly listed below.

Water Master Plan

Major tasks completed as part of the Water Master Plan include:

- Updated water demand projections and planning criteria.
- Development and calibration of an updated hydraulic model.
- Evaluation of water system pressures, storage capacity, and fire flow performance.
- Condition assessment of storage tanks, booster pump stations, and well facilities Identification and prioritization of recommended capital improvement projects.

Wastewater Collection and Water Recycling Facility Master Plan

Major tasks completed as part of the Wastewater Master Plan include:

- Updated wastewater flow projections and planning criteria.
- Evaluation of the wastewater collection system.
- Assessment of existing infrastructure capacity and condition.
- Identification and prioritization of recommended capital improvement projects.

ANALYSIS:

Status of Water and Wastewater Master Plans

The final Wastewater Master Plan was presented to City Council in April, 2024. The Water Master Plan is in draft form but has been reviewed by City staff.

Ardurra will provide an overview of the major findings for both Plans. Ultimately, this work will inform the City's utility rate studies, which present the financial plan for operation, maintenance, and capital improvements for the City's water and wastewater programs.

STRATEGIC PLAN:

Infrastructure, Transportation, and Mobility

FISCAL IMPACTS:

None

OPTIONS:

ATTACHMENTS:

MKN Santa Paula SMP - Final.pdf
SP WMP - Condition Assessment TM.pdf



Wastewater Collection System and Water Recycling Facility Master Plan

April 2024

Prepared for:
City of Santa Paula
866 E. Main Street
Santa Paula, CA 93060

Prepared by:
MKN & Associates, Inc.
121 North Fir St., Ste. G
Ventura, CA 93001

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Andy Sobel - Councilmember

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Prepared by:

Becca K Bugielski

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Project Manager
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Appendix B: Detailed Flow Verification

Appendix C: Waste Discharge Requirement and Cease-and-Desist Order

Appendix D: Trussell Technologies, Inc., Evaluation of Biological Design and Process Sizing Technical Memorandum

Appendix E: Lift Station Condition Assessment

Appendix F: Treated Effluent Monthly Average Monitoring Results 2019-2023

Appendix G: WRF Condition Assessment Checklist

Appendix H: WRF Condition Assessment Photos

Appendix I: MBR Process Design Calculations

Appendix J: Annual Major Service and Replacement Budget

List of Acronyms

AF	Acre Feet
AWTF	Advanced Water Treatment Facility
ANSI	American National Standards Institute
AACE	Association for Advancement of Cost Estimating International
AV	Avenue
ADF	Average Daily Flow
ADWF	Average Dry Weather Flow
AWWF	Average Wet Weather Flow
BOD5	Biological Oxygen Demand
BL	Boulevard
CIP	Capital Improvement Plan
CDO	Cease-and-Desist Order
COD	Chemical Oxygen Demand
CIP	Clean-in-Place
CFR	Code of Federal Regulations
CCI	Construction Cost Index
ft^3	Cubic foot
ft^3/hr	Cubic Foot per Hour
d/D	Depth over Diameter
DBOF	Design-Build-Operate-Finance
DEM	Digital Elevation Model
DO	Dissolved Oxygen
DS	Dry Solids
DIP	Ductile Iron Pipe
E	East
ENR	Engineering News-Record
EQ	Equalization
EX	Existing
fps	Feet per Second
FM	Flow Meter
ft	Foot
gal	Gallons
gpd	Gallons per Day
GPDU	Gallons per Day per Housing Unit
GPD/SF	Gallons per Day per Square Foot
GPH	Gallons per Hour
gpm	Gallons per Minute
GIS	Geographic Information System
GBT	Gravity Belt Thickener
HVAC	Heating, Ventilation, and Air Conditioning
HZ	Hertz
HDPE	High Density Polyethylene
HP	Horsepower
Hr	Hour
HMI	Human Machine Interface
H2S	Hydrogen Sulfide
in	Inches
I/I	Inflow and Infiltration
ILS	Influent Lift Station
LS	Lift Station
LF	Linear Foot
L	Liter
LS	Lift Station
MMF	Maximum Month Flow
MBR	Membrane Bioreactor
mg/L	Milligrams per Liter
MG	Million Gallons
MGD	Million Gallons per Day
ML	Mixed Liquor
MLSS	Mixed Liquor Suspended Solids
MKN	MKN & Associates, Inc.
MRP	Monitoring and Reporting Program
N	North
ppm	Parts per Million
PDDWF	Peak Day Dry Weather Flow
PDF	Peak Day Flow
PDWWF	Peak Day Wet Weather Flow
PHDWF	Peak Dry Weather Flow
PHWWF	Peak Wet Weather Flow
PF	Peaking Factor
P	Phase
PVC	Polyvinyl Chloride
ppd or lbs/d	Pounds per Day
lbs/hr	Pounds per Hour
psi	Pounds per Square-Inch
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
RR	Railroad
RV	Recreational Vehicle
RHNA	Regional Housing Needs Assessment
RWQCB	Regional Water Quality Control Board
R&R	Rehabilitation and Replacement
RAS	Return Activated Sludge
RO	Reverse Osmosis
RPM	Revolutions Per Minute
SP	Santa Paula
SRT	Solids Retention Time
S	South
SOI	Sphere of Influence
sf	Square Foot
SS	Stainless Steel
SCFM	Standard Cubic Feet per Minute
SOR	Standard Oxygen Requirement
ST	Street
SCADA	Supervisory Control and Data Acquisition
TDS	Total Dissolved Solids
TDH	Total Dynamic Head
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen

TSS	Total Suspended Solids	VAC	Volts Alternating Current
UV	Ultra-Violet	WAS	Waste Activated Sludge
USGS	United States Geological Survey	WDR	Waste Discharge Requirements
UWMP	Urban Water Management Plan	WWMP	Wastewater Master Plan
VFD	Variable Frequency Drive	WRF	Water Recycling Facility
VRSD	Ventura Regional Sanitation District	W	West
VSS	Volatile Suspended Solids	yrs	Years
V	Volts		

Previous Studies and Reports

The following reports, studies, and other resources were reviewed during preparation of this Master Plan:

1. Wastewater System Master Plan Amendment Harvest at Limoneira (East Area One) dated March 2023 and prepared by Jensen Design & Survey, Inc.
2. 2020 Urban Water Management Plan (UWMP) dated July 2021 and prepared by MKN & Associates, Inc.
3. City of Santa Paula 2040 General Plan dated March 2020 and prepared by City of Santa Paula.
4. City of Santa Paula Wastewater System Master Plan dated June 2012 and prepared by City of Santa Paula.
5. Trussell Technologies, Inc., Evaluation of Biological Design and Process Sizing Technical Memorandum dated 2008 and prepared by Trussell Technologies, Inc.
6. City of Santa Paula Water Recycling Facility Record Drawings dated 2008 and prepared by Pacific Advanced Civil Engineering (PACE).





CITY OF SANTA PAULA

WASTEWATER COLLECTION SYSTEM AND WATER RECYCLING FACILITY MASTER PLAN EXECUTIVE SUMMARY

Introduction and Overview

The City of Santa Paula is located approximately 17 miles inland from the Pacific Ocean in central Ventura County and lies within the Santa Clara River Valley, approximately 65 miles northwest of Los Angeles, 44 miles southeast of Santa Barbara, 12 miles east of the City of San Buenaventura and approximately 9 miles west of the City of Fillmore. The current wastewater service area boundary encompasses approximately 5.4 square miles (3,456 acres) within the City limits and serves an estimated population of 30,389.

The City's wastewater service area is primarily single- and multi-family residential land uses, with some light commercial and industrial land uses. The City owns and operates approximately 59 miles of wastewater collection pipelines, three lift stations, and a Water Recycling Facility, which provides treatment and disposal of the City's wastewater.

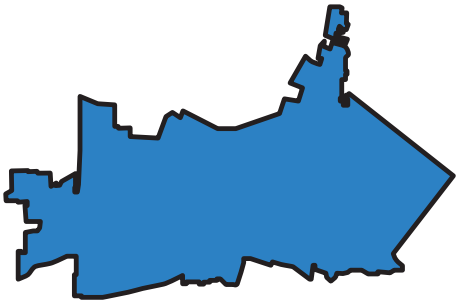
OBJECTIVES

- Evaluate Infrastructure Needs through City Buildout (2040)
- Consider Impacts from Future Flows and Loadings
- Ensure System Redundancy
- Deliver Capital Improvement Plan

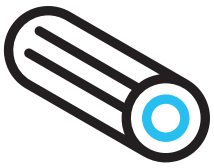
In 2023, the City authorized Michael K. Nunley (MKN) to prepare a comprehensive update to 2012 Wastewater Master Plan (Master Plan). This Master Plan includes the following major focus areas:

- Introduction and Overview
- Land Use and Future Growth
- Existing and Projected Flows and Loadings
- Collection and Treatment System Overview
- Collection System Analysis
- Condition Assessment
- Water Recycling Facility Evaluation
- Capital Improvement Plan

Wastewater System Overview



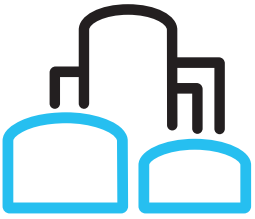
3,000 plus-acre service area



59 Miles of Pipeline



Three Lift Stations



2.5 MGD WRF





Existing and Buildout Wastewater Flows

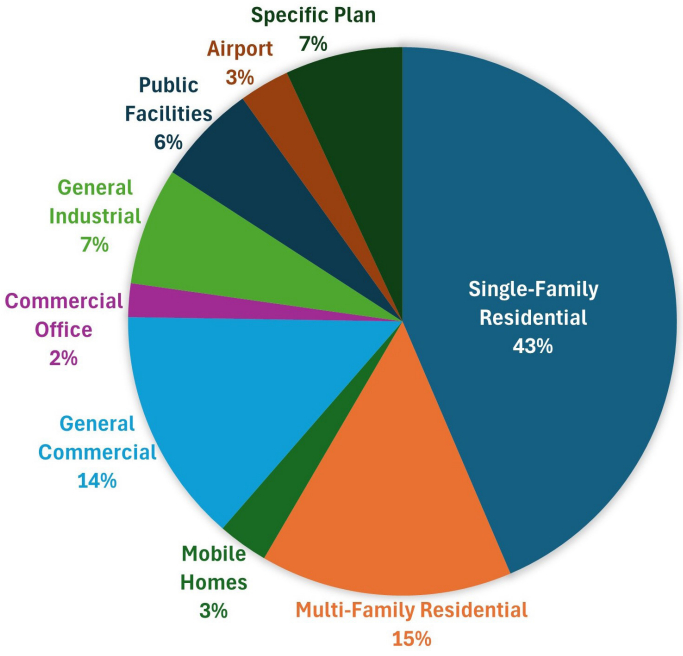
Based on the City's historical WRF influent flow data, flow monitoring data, and previous reports existing wastewater flow conditions were established as follows: average day flow of 2.6 MGD, peak hour dry weather flow of 5.2 MGD, and peak hour wet weather flow of 7.7 MGD.

MKN reviewed data from the 2020 Census, 2020 Urban Water Master Plan (UWMP), 2021-2029 Housing Element and, Land Use Element. Based on an evaluation of the service area population, major planned developments, limited infill development, and expansion areas a total of 4,600 dwelling units were assumed to be constructed at full buildout of the City.

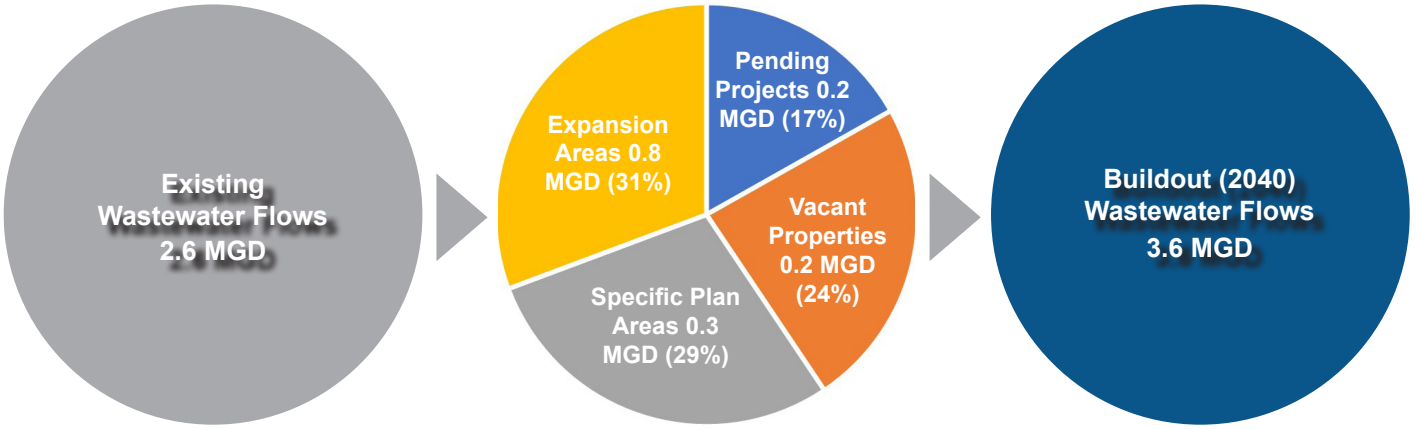
MKN developed future flow estimates for the City's approved development projects, current specific plan areas, vacant properties, and expansion areas. This established buildout wastewater flow.

Based on the findings in the Master Plan, it is anticipated the average day wastewater flows will increase by 38% at full buildout of the City (including expansion areas).

Existing Customer Land Uses (Acres)



Anticipated Growth by Development Type







CITY OF SANTA PAULA

WASTEWATER COLLECTION SYSTEM AND WATER RECYCLING FACILITY MASTER PLAN EXECUTIVE SUMMARY

Collection System Evaluation

MKN developed a collection system hydraulic model in Bentley SewerCAD that included the major trunk sewers greater than 10-inches in diameter and other critical connection points throughout the system (flows from new development areas). The model was updated to include current infrastructure improvements and model settings were configured to simulate various flow conditions.

Within the hydraulic model, scenarios were developed and evaluated with a focus on the following performance areas:

- Gravity Pipeline Capacity
- Lift Station Pumping Capacity
- Force Main Velocities

Based on an evaluation of existing, near-term, and ultimate flow conditions recommended collection system pipeline upgrade projects were identified to increase pipeline capacity to serve existing and buildout flow conditions.

FINDINGS

- **Majority of existing trunk collection system has sufficient capacity to serve existing and buildout flow conditions**
- **A total of 19 collection system pipeline upgrade projects identified to increase capacity**
- **Lift stations have sufficient pumping capacity to serve existing and future flow conditions**
- **A total of 3 rehabilitation projects identified to increase reliability of existing lift stations**

Lift Station Condition Assessment



As part of the Master Plan, MKN visited the three lift stations sites with operations staff to observe existing conditions. During these visits, MKN observed the general configuration of the lift stations and reviewed the following items:

- Configuration / Pumps
- Lift Station Safety Features
- Flood Resilience, Backup Power
- Wet Well Structure, Coatings, Instrumentation
- Access
- Bypassing Provisions
- Site Features

Based on these observations and input from operations staff, MKN developed a list of CIPs to address observed physical deficiencies at each lift station to improve system reliability and extend the useful life of the existing equipment.





CITY OF SANTA PAULA

WASTEWATER COLLECTION SYSTEM AND WATER RECYCLING FACILITY MASTER PLAN EXECUTIVE SUMMARY

Water Recycling Facility Condition Assessment and Evaluation

A visual condition assessment of the WRF was performed to review the condition of existing structures and equipment to determine necessary condition-based upgrades and improvements. MKN observed the general configuration of the WRF and reviewed the following items:

- Mechanical
- Instrumentation
- Electrical
- Structural
- Safety

In addition, MKN performed a comprehensive evaluation of the existing WRF capacity, including treatment and hydraulic capacity of process equipment and the disposal capacity of the percolation ponds for existing and ultimate flows. MKN reviewed existing relevant reports and used available information to estimate existing and ultimate flows and loadings ("strength of wastewater") based on WRF records and typical duty factors.

FINDINGS

- **Condition assessment revealed various repairs needed to extend design life of equipment.**
- **A total of 17 rehabilitation projects identified to increase reliably of existing WRF**
- **Hydraulic and treatment evaluations identified improvements necessary for efficient operation during future loading conditions**
- **A total of three WRF projects identified to increase capacity**











Capital Improvement Plan

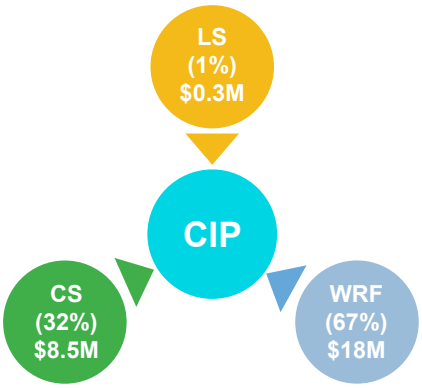
Based on the evaluations and findings of the Master Plan effort the CIP was prepared. The cost estimating approach assumed fully inclusive capitalization with costs derived from similar wastewater projects adjusting for inflation, size, complexity, and location. Project prioritization was based on the following:

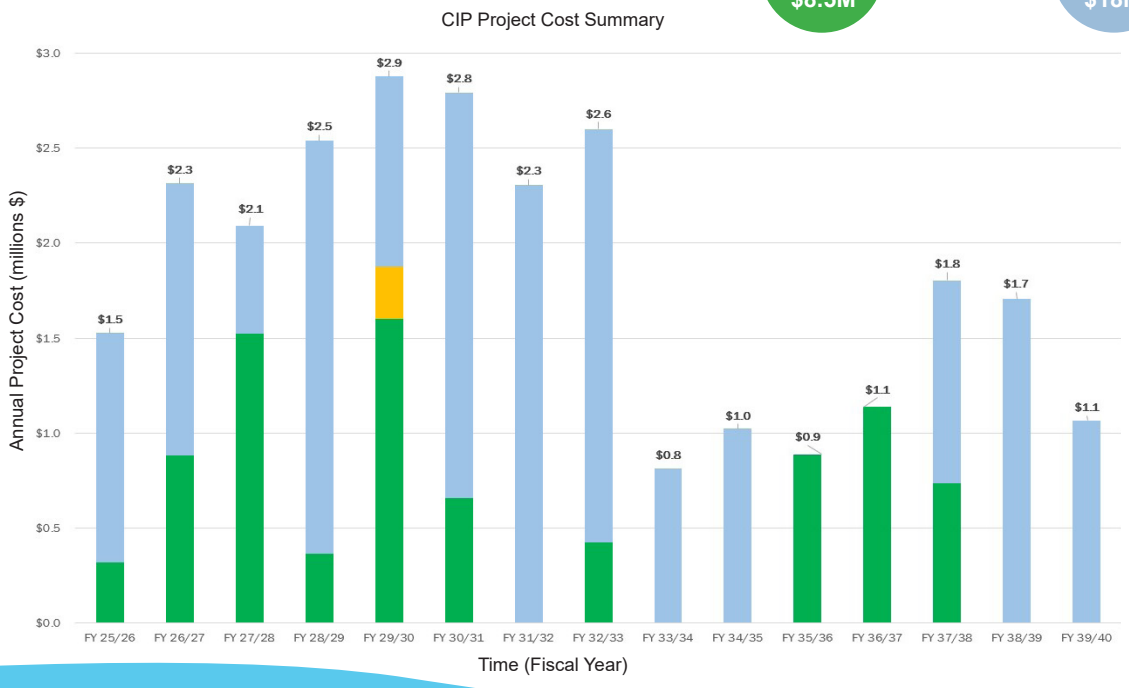
- Projects to address existing capacity deficiencies
- Projects to address condition-based deficiencies
- Projects to address near-term capacity deficiencies
- Projects to address buildout capacity deficiencies

Based on coordination with City staff, the recommended projects were identified. The proposed CIP allocates funds in proportions of 1% for Lift Station (LS) Projects, 32% for Collection System (CS) Projects, and 67% for Water Recycling Facility (WRF) Projects over the next 15-year budgeting period with an annual breakdown.

CIP SUMMARY

- 39 Projects Identified
- 3 Categories of Projects
- 15 Year Delivery Schedule
- 27.5 million Total CIP





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1.0 INTRODUCTION AND OVERVIEW

This section provides an overview of the City of Santa Paula's (City) goals, study area, and scope of work for the Wastewater Collection System and Water Recycling Facility Master Plan (Master Plan).

1.1 Project Purpose

The purpose of this Master Plan was to identify improvements to the City's existing wastewater collection, treatment, and disposal facilities necessary to meet existing and future wastewater conditions and to develop a comprehensive improvement program to assist the City in long-term planning and budgeting. The planning horizon for this Master Plan is the build-out timeframe estimated to occur in the year 2040 per the City's adopted General Plan.

1.2 Study Area

The City is located approximately 17 miles inland from the Pacific Ocean in central Ventura County within the Santa Clara River Valley, approximately 65 miles northwest of Los Angeles, 44 miles southeast of Santa Barbara, 12 miles east of the City of San Buenaventura and approximately 9 miles west of the City of Fillmore. The current wastewater service area boundary encompasses approximately 5.4 square miles (3,456 acres) within the City limits and serves an estimated population of 30,389 as reported by the California Department of Finance for 2020. The City's wastewater service area is primarily single- and multi-family residential land uses, with some light commercial and industrial land uses. The City owns and operates approximately 59 miles of wastewater collection pipelines, three lift stations, and a Water Recycling Facility (WRF), which provides wastewater treatment and disposal.

Figure 1-1 provides an overview of the current City limits, Sphere of Influence (SOI), and General Plan Expansion Areas. These combined areas define the limits of the "Study Area" for the Master Plan.

1.3 Scope of Work

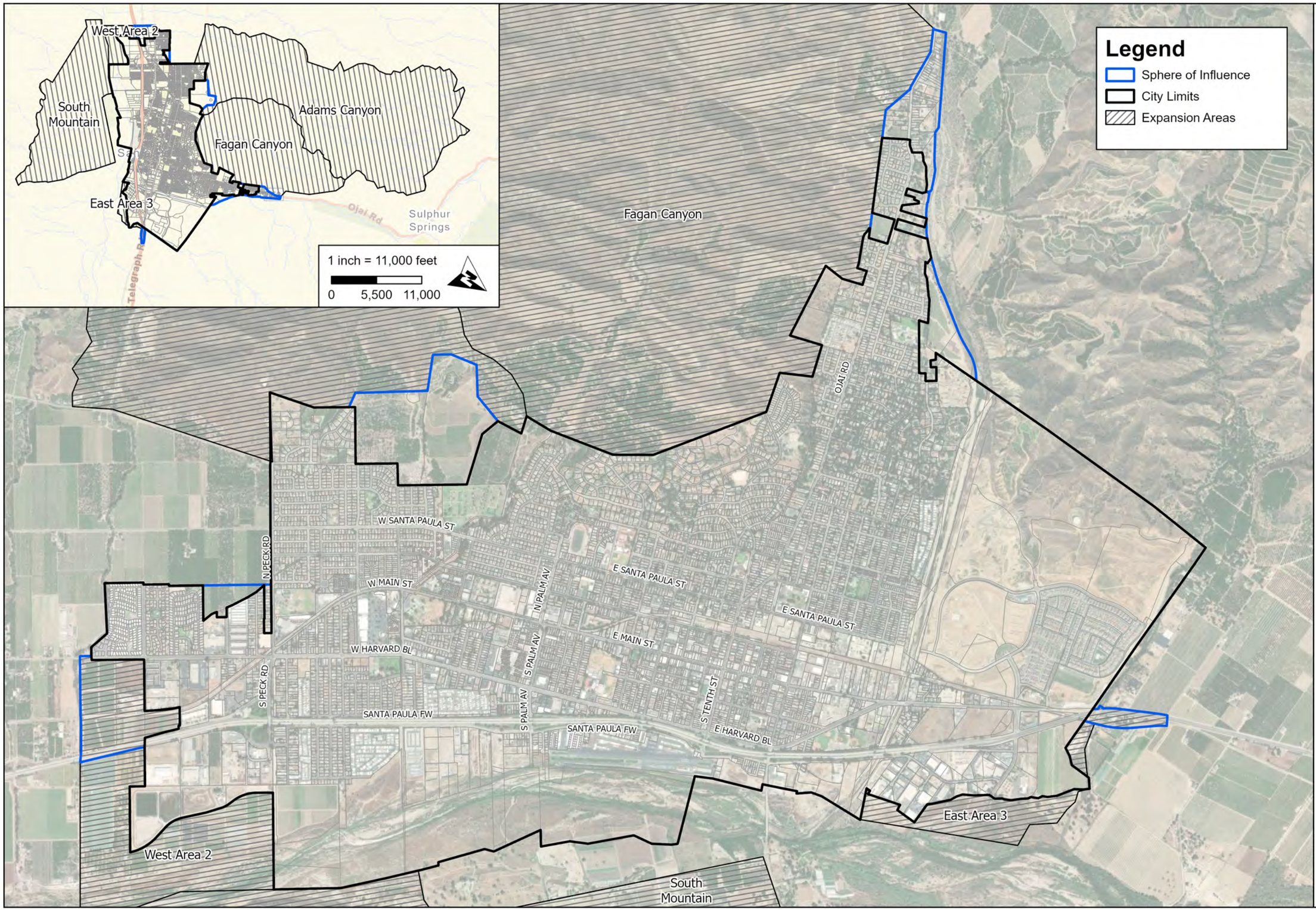
The following describes the scope of work completed to prepare the Master Plan.

Data Collection and Review

MKN reviewed and utilized the following information to develop the Master Plan:

- ❑ Approved General Plan and development plans
- ❑ Sewer system mapping
- ❑ As-built records for collection system improvements not included in the current mapping

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 1-1:

Study Area Boundary Map

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Flow Monitoring Study

MKN coordinated with Gold Coast Environmental to perform flow monitoring within the City's wastewater collection system over a four-week dry-weather period. MKN performed the following tasks as part of the flow monitoring study:

- Coordinated placement of four flow meters throughout the City's collection system to obtain representative flow information
- Coordinated sewer pipeline cleaning with Ventura Regional Sanitation District (VRSD)
- Prepared a collection system/flow monitoring site map showing the existing collection system, parcels and flow monitoring basin areas
- Received and reviewed weekly flow monitoring data provided by Gold Coast Environmental
- Collected daily rainfall data from the City
- Completed a comprehensive analysis of the flow monitoring data including a summary of the estimated average day and peak hour flows

The data from the flow monitoring study was used to determine average day conditions, and dry-weather peak hour flow conditions within the City's collection system, and used in the development of sewer generation rates. For wet weather conditions, MKN utilized a conservative wet-weather peaking factors based on available information provided by the City.

Wastewater System Mapping

Currently the City does not have their wastewater collection system data stored in Geographic Information System (GIS) or a hydraulic model. However, the City has an existing AutoCAD wastewater collection system basemap. The hydraulic model was developed using the AutoCAD basemap including information such as pipe geometry, elevations, pipe diameter, pipe material and pipe roughness coefficients. MKN completed the following tasks to develop the hydraulic model:

- Imported the existing AutoCAD layers into SewerCAD
- Added elevation data from available AutoCAD mapping and available asbuilts
- Verified elevation data with one meter resolution Digital Elevation Model (DEM) ground scan of the Santa Paula area from United States Geological Survey (USGS)

Development of Wastewater Generation Rates

To develop wastewater generation rates for residential, commercial, and industrial land uses within the Study Area, MKN acquired water billing data for all area users, assigned the users to a GIS parcel layer, developed per acre

demand factors based on land use, and estimated a preliminary wastewater generation value based on the assumption that a certain percentage of water consumed returning to the collection system as wastewater. The preliminary wastewater generation values were compared to the newly acquired flow monitoring data and return factors were adjusted as required to match recorded flow data. Once the return flow percentage was developed, wastewater generation rates for the various user categories were generated based on their water consumption.

Wastewater Flows and Allocation

MKN created a GISlayer to identify the parcels that are located upstream of each sewer manhole (otherwise referred to as a "sewershed") that were included in the hydraulic model. Each sewershed area was assigned with a sewer manhole identification number. This process allowed for automated assignment of calculated flows to manholes throughout the collection system. This allocation method has been successfully applied to other collection system modeling/master planning projects that MKN has worked on for other public agencies. Once the flow allocation process was completed, MKN imported the average daily flow (ADF) data into the collection system model.

Future Development and Expansion

MKN worked with City staff to determine the potential growth and/or redevelopment areas for the City. The City provided information with respect to where growth was anticipated to occur and the number of potential units and/or land uses. MKN developed a GIS layer to document the locations of growth, which was used to assign the future flows to locations in the updated hydraulic model. Conceptual facilities (pipeline upgrades) were sized to serve the projected growth areas and included in the model analyses.

Hydraulic Analysis

MKN developed design criteria based on City and industry standards to: 1) evaluate the existing wastewater collection system, 2) identify deficiencies to serve existing and future flows, and 3) develop recommended system improvements to address identified deficiencies. The analysis included evaluation of both the gravity collection pipelines and lift stations. With a hydraulic model developed for the Study Area, MKN ran the following model simulations to identify capacity deficiencies to serve both existing and future flow conditions:

- Existing Flow Conditions
  - Average Day Flow (ADF)
  - Peak Dry Weather Flows (PHDWF)
  - Peak Wet Weather Flows (PHWWF)
  - Capital Improvement Plan Projects Identified to Correct System Deficiencies
- Near-Term Flow Conditions
  - Average Day Flow (ADF)

- Peak Dry Weather Flows (PHDWF)
- Peak Wet Weather Flows (PHWWF)
- Capital Improvement Plan Projects Identified to Correct System Deficiencies

- Ultimate Flow Conditions
  - ADF
  - PHDWF
  - PHWWF
  - Capital Improvement Plan Projects Identified to Correct System Deficiencies

MKN used the results of the above noted evaluation to develop a City buildout collection system implementation plan with a prioritization schedule.

Lift Station Assessment

MKN completed a limited hydraulic evaluation and visual inspection of the existing lift stations including wet wells, piping, valves, control panels, and site civil improvements to document existing conditions and potential deficiencies.

WRF Capacity Analysis

MKN performed a comprehensive capacity evaluation of the existing capacity of the WRF including hydraulics, treatment, and disposal limitations of existing plant processes to serve existing and ultimate conditions. MKN reviewed existing relevant reports and available information to estimate existing and ultimate flows and loadings (strength of wastewater) based on plant records and typical duty factors. The following tasks were performed as part of the WRF capacity analysis:

- Summarize existing influent flows, loadings, and treated effluent quality
- Review design criteria for existing plant equipment
- Identify capacity deficiencies

WRF Condition Assessment

A condition assessment of the WRF was performed to review the condition of existing structures and equipment to determine necessary condition-based upgrades and improvements. As part of this effort, MKN visited the WRF site to document existing equipment conditions and interview the plant operators. MKN developed a comprehensive list of condition-based deficiencies.

Capital Improvement Project Plan

MKN developed a capital improvement project (CIP) plan for the existing collection and treatment systems that included capital projects needed to: 1) resolve existing system deficiencies, and 2) accommodate future expansion (assumed to occur by buildout). MKN developed a project list identifying the size and location of required facilities, priorities, possible cost-sharing between existing and future users, triggers (e.g. what flows or number of equivalent dwelling units), and estimated project schedules.

Estimated construction costs for the improvements were developed based on current market cost information and recent local bids for similar projects. The estimated costs include estimates for project administration, design, construction management and project contingency. MKN developed figures depicting the locations of the recommended CIPs for existing and future conditions.

Master Plan Report

A draft version of the Master Plan was compiled to summarize the efforts and results for the tasks described herein. After a consolidated set of comments were received from the City, MKN revised the draft Master Plan and presented an overview of the findings and recommendations at a regularly scheduled City council meeting. Comments on the draft Master Plan were integrated into the Final Master Plan.

2.0 LAND USE AND FUTURE GROWTH

This section provides an overview of the existing land uses, potential development, and future population growth within the Study Area.

2.1 Land Use

The City is one of the oldest cities in Ventura County, with existing land uses that reflect over 120 years of building and development. The largest land use is comprised of residential development and approximately 44% of the City is dedicated to single-family residential, multi-family residential, and mobile homes. Commercial development and industrial development make up another 11% and 7% of the City's land use, respectively, with another 17% apportioned to specific plans for future development already located within the City's SOI.

The City's SOI includes approximately 7,300 parcels. **Figure 2-1** and **Table 2-1** provide a summary of the 2040 General Plan land uses within the City's SOI.

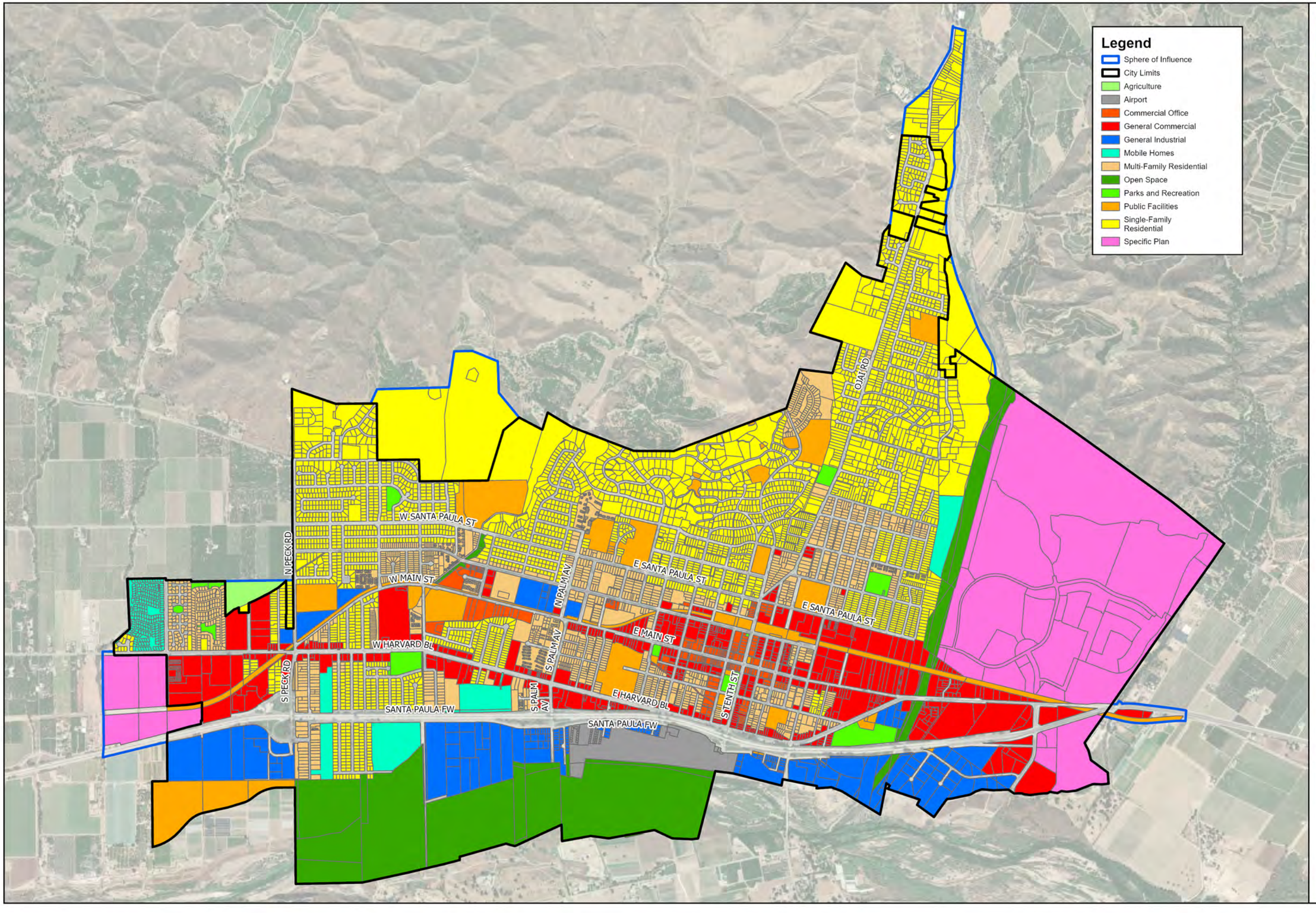
Table 2-1: Existing Development of Land Use Types

Land Use Category	Gross Acres	Percent of Total
Single-Family Residential	1,074	32%
Multi-Family Residential	334	10%
Mobile Homes	82	2%
General Commercial	349	10%
Commercial Office	43	1%
General Industrial	244	7%
Public Facilities	73	2%
Parks and Recreation	11	<1%
Open Space	168	5%
Agriculture	368	11%
Airport	53	2%
Specific Plan	584	17%
Total	**3,382**	**100%**

Notes:
1. City of Santa Paula 2040 General Plan, Section 2: Land Use Element

Figure 2-1 provides an overview of the existing land uses within the SOI.

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 2-1:

Existing Land Use Map

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2.2 Existing Sewered Parcels

The City's land uses can be divided into sewered and un-sewered parcels. Sewered parcels are parcels that are connected to the collection system and generate wastewater flow that is collected at the WRF. Sewered parcels include occupied residences, public facilities, commercial businesses and offices, and industrial facilities. Un-sewered parcels are parcels that are not connected to the collection system and include vacant lots, open space, and parks. Since the City does not maintain data to indicate which properties are connected to the collection system, MKN assumed that every parcel tied to an existing water billing account (excluding irrigation uses) within the City's SOI was a sewered parcel. All other parcels were considered un-sewered and not included in the collection system analysis, unless identified with future development potential. To identify sewered parcels, MKN reviewed 2022 billing records and assigned each billing account to the parcel it overlapped. **Table 2-2** provides a summary of sewered parcels by land use type in the City's SOI.

Table 2-2: Sewered Parcels by Land Use in the City's SOI

Land Use	Number of Parcels	Acreage
Single-Family Residential	3,405	829
Multi-Family Residential	1,890	278
Mobile Homes	6	57
General Commercial	499	266
Commercial Office	178	40
General Industrial	99	130
Public Facilities	23	114
Airport	9	47
Specific Plan	12	124
Total	**6,121**	**1,885**

Of the City's approximately 7,300 total parcels and 3,382 acres, 6,121 parcels covering an area of 1,885 acres were considered sewered parcels for the Master Plan.

2.3 Future Development

To estimate potential future residential, commercial, and industrial development within the City, MKN worked with the City's Community and Economic Development department to review existing planning documents to identify properties and/or areas with future development potential within the City's SOI. MKN also reviewed and considered areas identified as expansion areas for future annexation into the City's SOI. The planning information used to identify potential future development included the following documents:

- 2021 - 2029 Housing Element
- 2040 General Plan – Land Use Element

The only future development outside of the City's SOI included in the Master Plan capacity evaluation included the expansion areas as identified in the 2040 General Plan.

2.3.1 2021 – 2029 Housing Element

The City is required to prepare a Housing Element every eight years to identify and address housing needs, housing goals, policies, and programs. Based on forecasted growth of households in the City, the Regional Housing Needs Assessment (RHNA) determined that 657 new housing units would need to be constructed prior to the end of 2029. In response to the RHNA, the City demonstrated a significant surplus in housing capacity to meet this housing need, as summarized in **Table 2-3**.

Table 2-3: Land Inventory Summary (Within City SOI)

Development Type	Total Housing Units
Approved / Pending Projects[1]	676
Vacant Residential Sites	117
Vacant Commercial Sites[2]	812
Total Future Housing Capacity	1,605
RHNA Housing Units Required	657
RHNA Surplus / (Deficit)	948

Notes:
1. Excludes Specific Plan developments
2. The 2021 – 2029 housing development identified vacant commercial sites for residential development
3. The East Area 1 Specific Plan was not included in the land inventory summary. In addition, this did not include any future expansion area developments

2.3.2 2040 General Plan – Land Use Element

The 2040 General Plan is a fundamental policy document for the City, providing the framework for managing the City's physical and economic resources now and in the future. As part of the 2040 General Plan, the City developed a Land Use Element to guide how the City plans, develops and supports land use, which includes information on future specific plan projects and potential expansion areas to the City's SOI.

The Land Use Element identifies the following two Specific Plan developments within the City's SOI that are currently under construction or soon-to-be constructed:

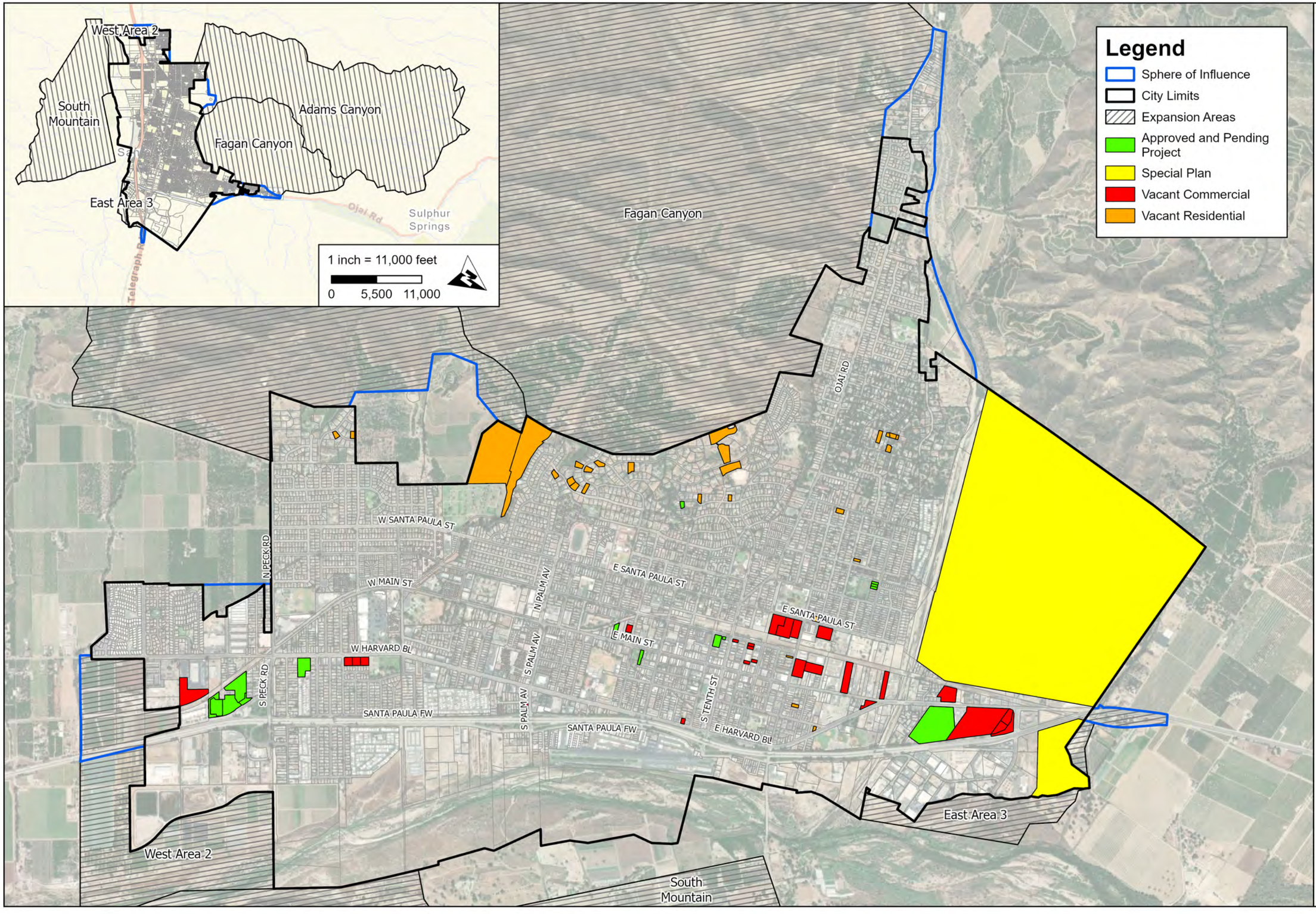
- SP-3 East Area 1 Specific Plan: The largest anticipated future development project within the City's SOI is the East Area 1 Specific Plan ("Harvest at Limoneira"). This Project encompasses approximately 495 acres in east Santa Paula, with an anticipated build out of 2,050 housing units. Per the "Wastewater System Master Plan Amendment – Harvest at Limoneira (East Area One)" report, 520 units were occupied in November 2022, leaving 1,530 housing units left to be developed for the future condition
- SP-4 East Gateway Specific Plan: The East Gateway Specific Plan Area in east Santa Paula includes 670,000 square feet of general commercial space

The Land Use Element also identified several expansion areas beyond the City's current SOI that are considered to have potential for future annexation and development. **Table 2-4** below provides a summary of the different Expansion Areas and development potential.

Table 2-4: Expansion Areas Summary	
Expansion Area	**Development Potential[1]**
Adams Canyon	495 Housing Units 1 School Site (Assumed 15 acres) 1 Resort Hotel (Assumed 100 Housing Units)
Fagan Canyon	450 Housing Units 1.8 Acres General Commercial
East Area 3	5.1 Acres General Commercial 2.8 Acres General Industrial
West Area 2	57.5 Acres General Commercial
South Mountain	N/A[2]
Notes: 1. Development potential for each expansion area only included development anticipated to have a substantial return sewer flow. The level of proposed development provided is preliminary and is subject to change once a future specific plan is developed 2. No development that will result in substantial return sewer flows is anticipated	

Figure 2-2 provides an overview of the locations throughout the City that have future development potential and were evaluated for the Master Plan.

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 2-2:

Future Development Map

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3.0 EXISTING AND PROJECTED WASTEWATER FLOWS

This section provides an overview of the estimated existing and future flow conditions within the Study Area including flow validation through a flow monitoring study.

3.1 Water Recycling Facility Historical Flows

This section provides an overview of the historical influent wastewater flows from the Water Recycling Facility (WRF). Historical influent wastewater flows are typically composed of wastewater flow form residential, commercial, and industrial uses and inflow / infiltration (I/I). I/I flows occur due to precipitation events and groundwater infiltration. Inflow is the water entering a collection system and service connections from manhole covers, roof and foundation drains, or cross connections from storm sewers and catch basins. Infiltration is groundwater entering a collection system through cracks in manhole walls, defective pipes, pipe joints, or connections. While inflow varies rapidly with rainfall conditions with flows rising and falling within minutes or hours of a significant precipitation event, infiltration is relatively constant over a period of days, weeks, or even months in areas of high groundwater near sewer services.

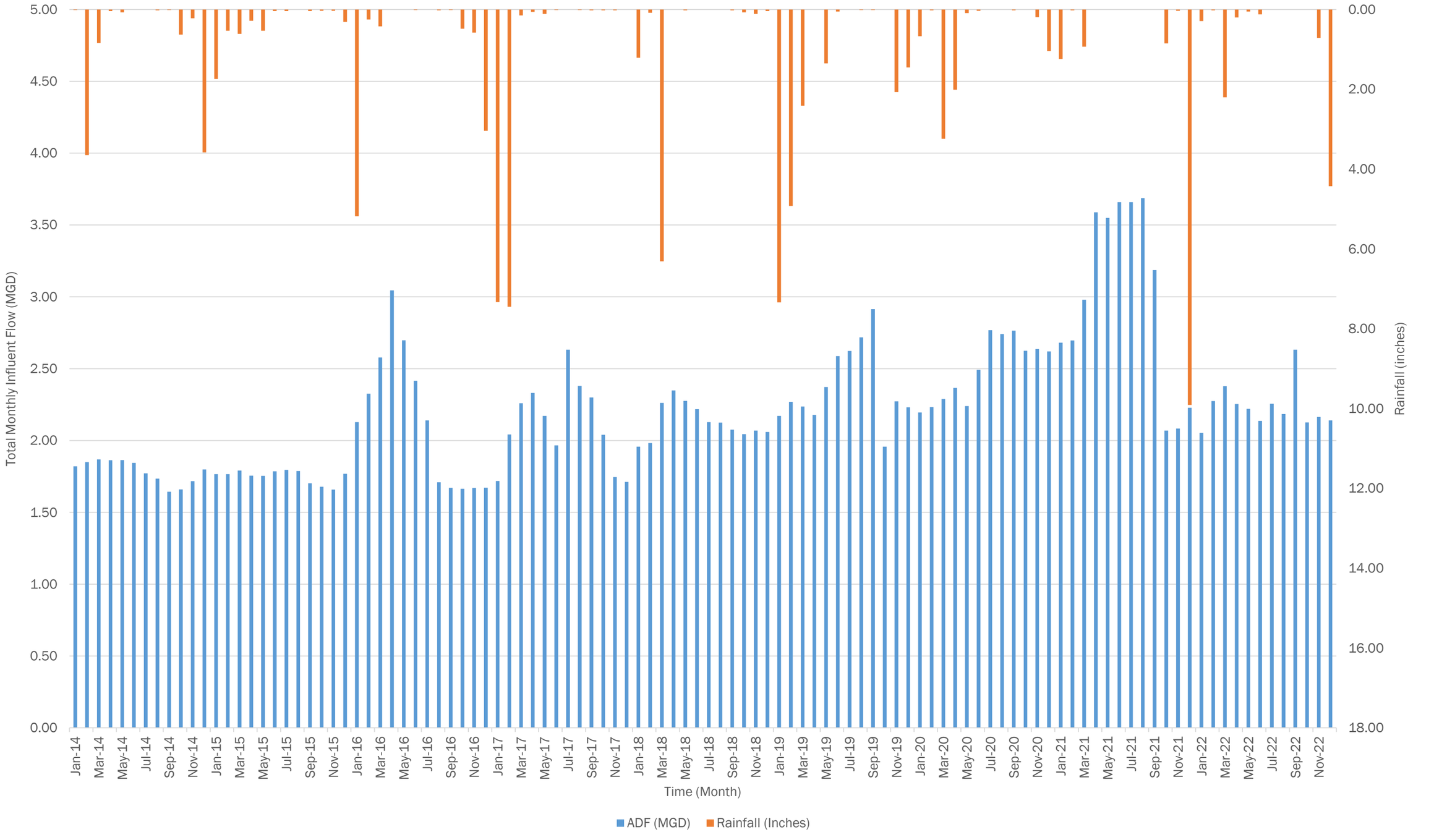
The City has not conducted a recent I/I study, but potential inflow and infiltration impacts to WRF influent wastewater flows can be inferred by comparing precipitation to wastewater flows and calculating the difference between wet weather and dry weather peak daily flows. **Figure 3-1** provides a comparison between total precipitation and average monthly WRF effluent flows.

Based on **Figure 3-1**, there does not appear to be a consistent correlation between significant precipitation events and higher than average monthly influent wastewater flows. However, VRSD staff have observed significant I&I at the WRF when the City receives more than 1 inch of rain.

Table 3-1 provides a summary of the historical wastewater influent records from 2014 to 2022. Peaking factors in the table below were determined by taking the ratio of the flow condition above the peaking factor row to the ADF.

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Figure 3-1: Average Monthly WRF Influent Flow and Rainfall – 2014 to 2022



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Table 3-1: Historical WRF Influent Flows										
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	Existing Flows[1]
Influent Flow Rate (MGD) and Flow Condition Peaking Factors										
ADF	1.79	1.75	2.24	2.08	2.13	2.38	2.50	3.01	2.23	2.58
MMF	1.87	1.80	3.05	2.63	2.35	2.91	2.77	3.69	2.63	3.00
Peaking Factor	1.05	1.03	1.36	1.26	1.10	1.23	1.11	1.23	1.18	1.16
ADWF	1.78	1.73	2.72	2.13	2.13	2.50	2.56	3.27	2.26	2.71
Peaking Factor	1.00	0.99	1.21	1.02	1.00	1.05	1.03	1.09	1.01	1.05
AWWF	1.79	1.77	2.01	1.87	2.11	2.26	2.37	2.49	2.18	2.34
Peaking Factor	1.00	1.01	0.89	0.90	0.99	0.95	0.95	0.83	0.98	0.91
PDDWF	2.36	3.21	7.04	4.74	3.67	3.33	3.82	4.93	4.66	5.68
Peaking Factor	1.32	1.83	3.14	2.27	1.72	1.40	1.53	1.64	2.09	2.20
PDWWF[2]	2.24	3.24	5.10	3.75	7.75	3.23	3.48	4.19	4.59	4.69
Peaking Factor	1.25	1.85	2.27	1.80	3.64	1.36	1.39	1.39	2.05	1.82
PDF	2.36	3.24	7.04	4.74	7.75	3.33	3.82	4.93	4.66	5.68
Peaking Factor	1.32	1.85	3.14	2.27	3.64	1.40	1.53	1.64	2.09	2.20
PHWWF	-	-	-	-	-	-	-	-	-	7.74

Notes:
1. Existing flow conditions were based on a three-year average from 2020 to 2022
2. Months with cumulative rainfall over 0,25 inches were considered wet months

3.2 Wastewater Flow Conditions

The following wastewater flow conditions were used to evaluate the City's collection, treatment, and disposal systems to serve existing and future flows.

3.2.1 Average Day Flow

Average Day Flow (ADF) is the average daily wastewater flow over the course of a year and is obtained by averaging the monthly flows conveyed to the WRF through the course of a year and converting to a daily flow rate. The ADF was determined using a three-year annual average from 2020 to 2022 influent WRF flows.

3.2.2 Maximum Month Flow

Maximum Month Flow (MMF) is the average daily flow during the month featuring the highest cumulative flow.

3.2.3 Average Dry Weather and Wet Weather Flows

Average Dry Weather (ADWF) and Wet Weather (AWWF) Flows are the average daily flow rates experienced during dry and wet weather months respectively. Consideration of average dry and wet weather flows allows analysis of

treatment systems at appropriate flow rates and temperatures for the dry and wet season. Precipitation of 0.25 inches or more per month was assumed to identify wet weather months.

3.2.4 Peak Day Dry Weather Flow and Wet Weather Flow

Peak Day Dry Weather Flow (PDDWF) and Wet Weather Flow (PDWWF) represent the highest daily flow rates experienced at the WRF during dry and wet weather months, respectively.

3.2.5 Peak Day Flow

Peak Day Flow (PDF) represents the maximum daily flow rate experienced at the WRF and issued to design or evaluate hydraulic retention times for certain treatment processes.

3.2.6 Peak Hour Dry Weather Flow

Peak Hour Dry Weather Flow (PHDWF) is the maximum flow experienced within one hour during dry conditions and is one of two flow conditions typically used for sizing collection system gravity pipe and lift stations. The existing peak dry hour flow conditions were based on the results of the flow monitoring study. As identified in **Table 3-4**, PHDWF peaking factors of 1.7 to 2.2 were observed during the flow monitoring study and the flow meters observed an average peaking factor of 2.0.

3.2.7 Peak Hour Wet Weather Flow

Peak Hour Wet Weather Flow (PHWWF) is the maximum flow experienced within one hour during wet conditions and is one of two flow conditions typically used for sizing collection system gravity pipe and lift stations. The existing peak wet hour flow conditions were based on a peaking factor of 3.0 identified in the design criteria of the previous 2012 WWMP and verified by the results of the updated flow monitoring study.

Table 3-2 provides a summary of the wastewater flow conditions utilized to evaluate the City's existing collection system and WRF facilities to serve existing and future flow conditions.

Table 3-2: Existing Flow Conditions & Peaking Factors			
Flow Condition	MGD	GPM	Peaking Factor
ADF	2.58	1,792	-
MMF	3.00	2,083	1.16 x ADF
ADWF	2.71	1,882	1.05 x ADF
AWWF	2.34	1,625	0.91 x ADF
PDDWF	5.68	3,944	2.20 x ADF
PDWWF	4.69	3,257	1.82 x ADF
PDF	5.68	3,944	2.20 x ADF
PHDWF	5.16	3,583	2.00 x ADF
PHWWF	7.74	5,375	3.00 x ADF

3.3 Flow Monitoring Study

This section describes the flow monitoring study completed as part of the Master Plan effort.

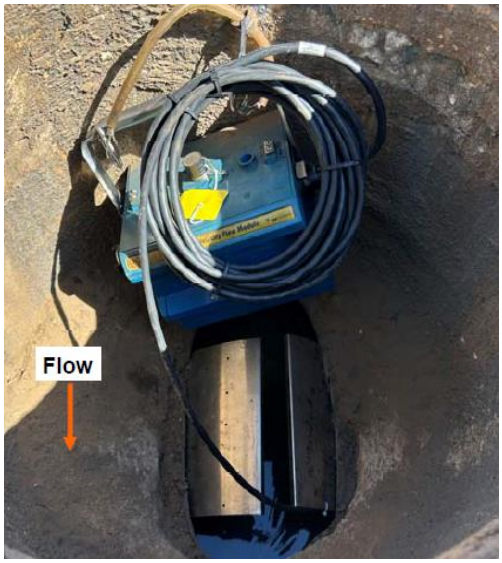
3.3.1 Flow Monitoring Equipment

To verify preliminary flow conditions and confirm a PHDWF peaking factor for the hydraulic model, a flow monitoring study was completed. MKN's subconsultant (Gold Coast Environmental), performed a flow monitoring study by placing four flow monitoring devices in sewer manholes at key locations throughout the Study Area over a 14-day monitoring period.

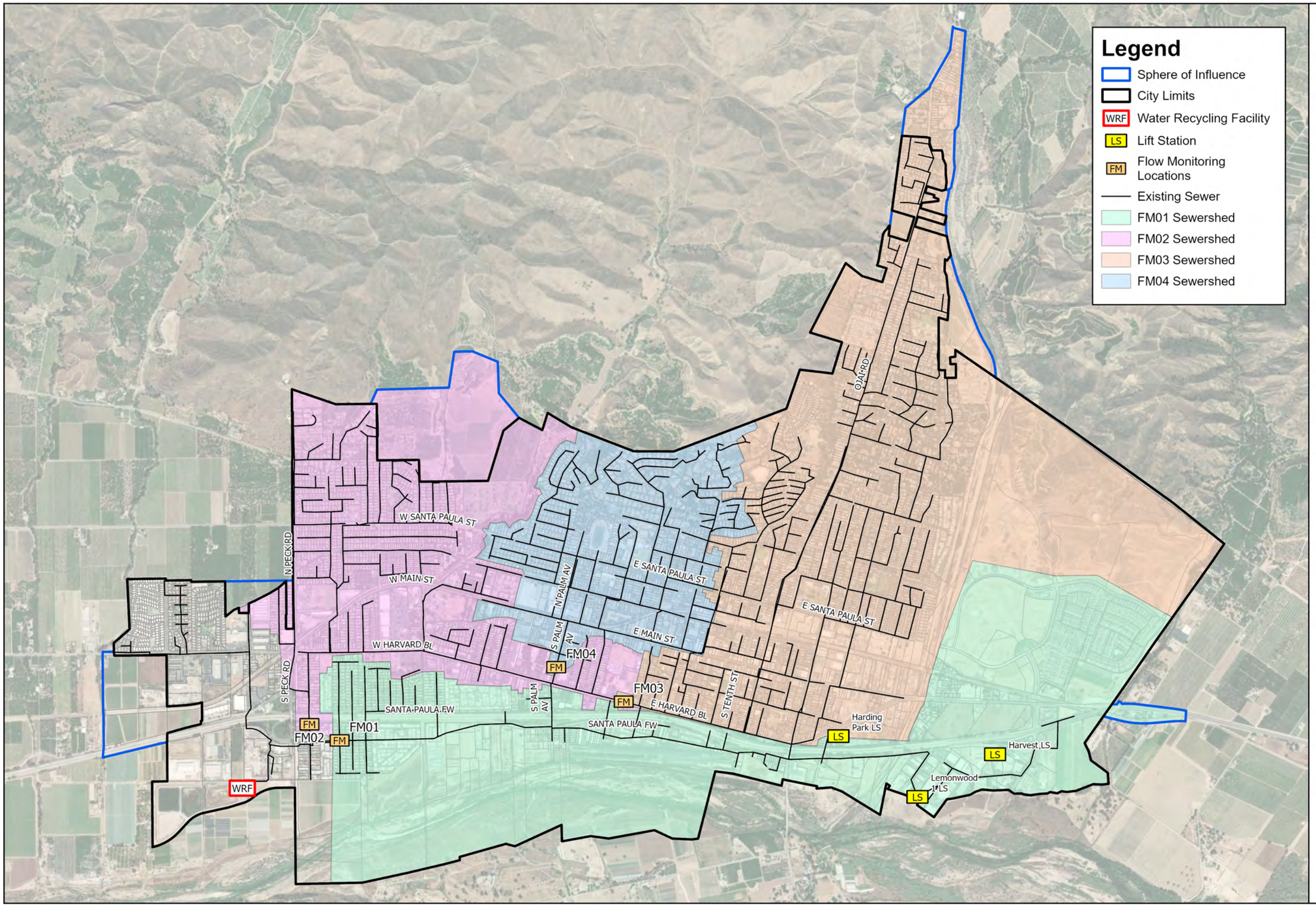
Gold Coast Environmental installed temporary Teledyne Isco 2150 Area-Velocity flow meters, as shown in **Figure 3-2**.

Figure 3-3 provides an overview of the four flow meter-locations and associated sewersheds.

Figure 3-2: Typical Flow Meter Installation



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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 3-3:

Flow Monitoring Locations

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The flow meters were programmed to acquire and store depth of flow and velocity readings at 15-minute intervals. Level measurements were acquired using a submerged pressure transducer mounted in the flow stream and velocity measurements were acquired using a doppler ultrasonic sensor. The meters were installed in the selected manholes from July 11 to July 25, 2023. The Golden State Environmental flow monitoring study is included in **Appendix A**. **Table 3-3** provides an overview of the flow meter locations, the size of the pipeline, and the estimated number of parcels upstream of each flow meter.

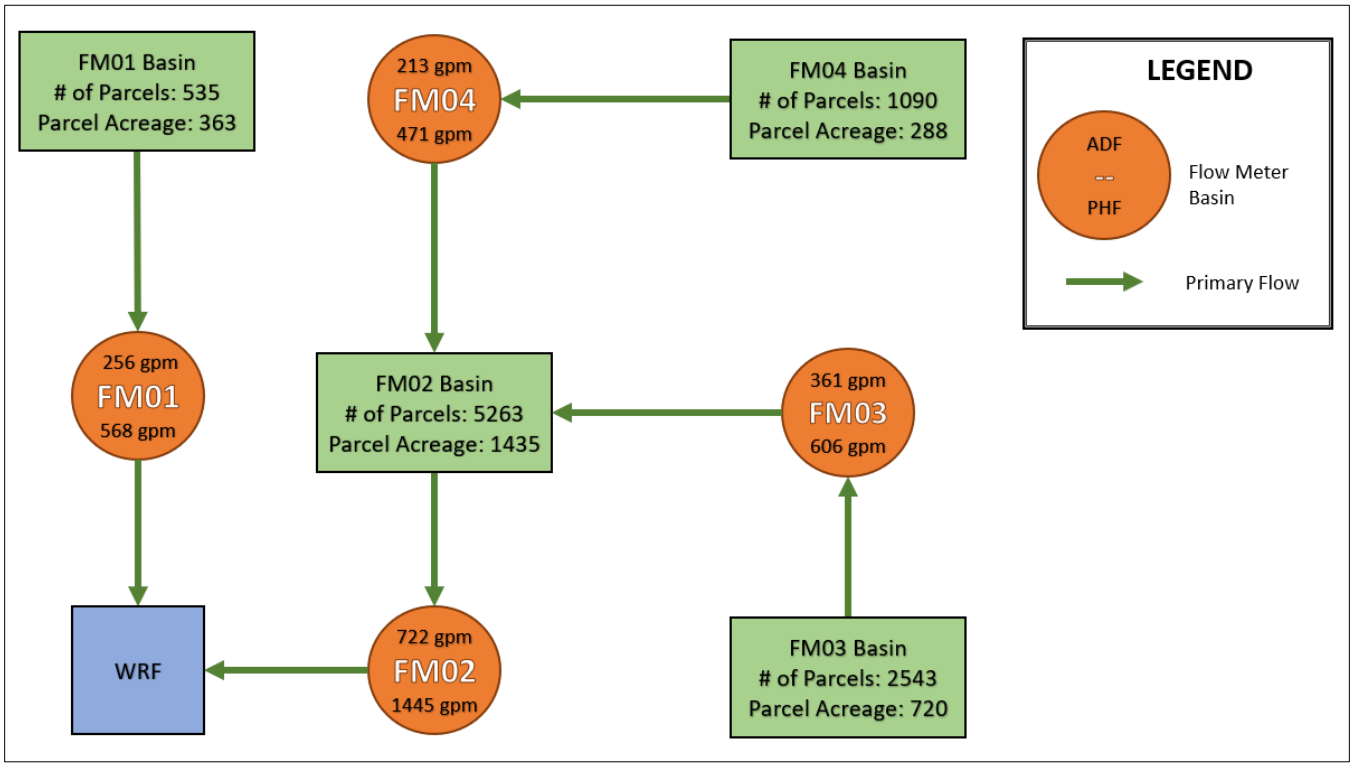
Table 3-3: Flow Meter Locations

Flow Meter	Location	Pipe Diameter (inches)	Sewered Parcels[1]	Basin Area (Acre)[2]
FM01	416 Dartmouth Road	24	535	363
FM02	500 Acacia Road[3]	24	5,263	1,435
FM03	520 Harvard Boulevard	18	2,543	720
FM04	224 South Palm Avenue	15	1,090	288

Notes:
1. Basin area only includes acreage for existing "sewered" parcels
2. FM02 sewershed includes the FM03 and FM04 sewersheds.

The flow meters captured flow data for approximately 95% of all sewered parcels within the City's SOI. **Figure 3-4** provides a schematic overview of the flow meter placement within the collection system and identifies upstream and downstream meter placements. Each circle includes the flow meter name, the measured average day, and peak hour flows.

Figure 3-4: Flow Meter Schematic



3.3.2 Flow Monitoring Results

Table 3-4 includes a summary of the flow results for the flow monitoring study. The table lists the recorded average day flow (ADF) in gallons per day (GPD) and gallons per minute (GPM); peak hour flow (PHF) in GPM, and flow depth for the flow monitoring period.

Table 3-4: Flow Monitoring Results

Parameter	Units	Flow Meter			
		FM01 Dartmouth	FM02 Acacia	FM03 Harvard	FM04 Palm
Pipe Diameter	Inches	24	24	18	15
Average Daily Flow	GPD	368,907	1,040,397	519,725	307,423
	GPM	256	722	361	213
Average Flow Depth	Inches	6.65	6.32	21.28	8.68
Peak Hour Flow	GPM	568	1,445	606	471
Peak Hour Flow Depth	Inches	8.55	8.62	23.91	10.38
Peak Hour Peaking Factor (PHF/ADF)	-	2.2	2.0	1.7	2.2
Peak Instantaneous Flow (5-minute data)	GPM	574	1,477	637	471

The following figures graphically depict the overall consistency of flow data collection during the flow monitoring study.

Figure 3-5: FM01 - Hourly Flow Conditions

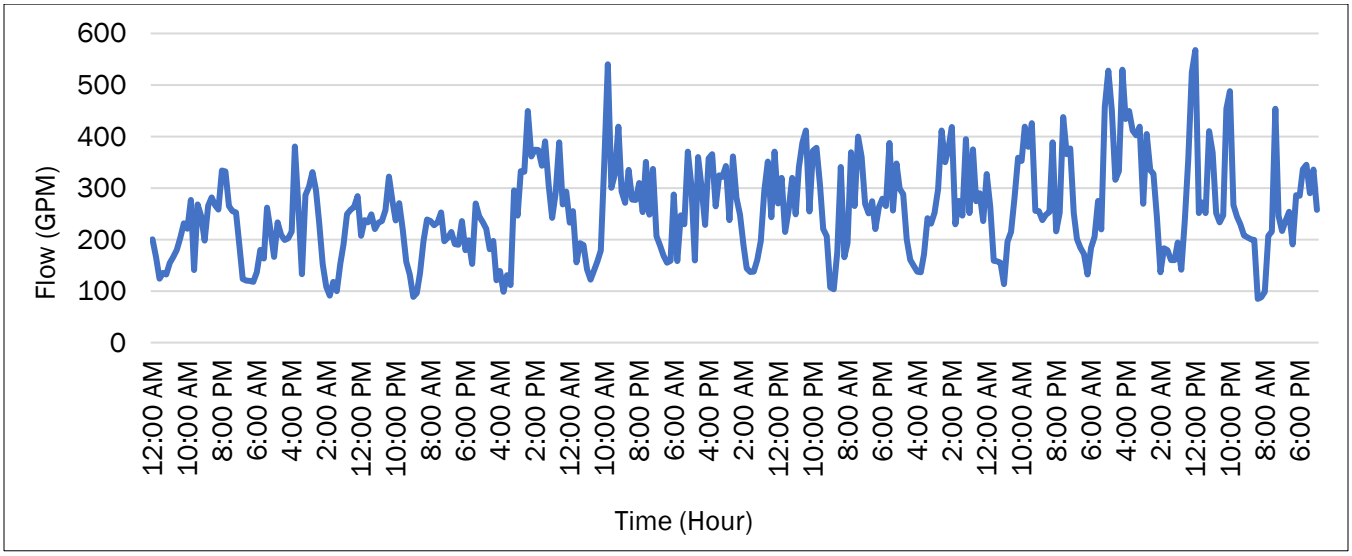


Figure 3-6: FM02 - Hourly Flow Conditions

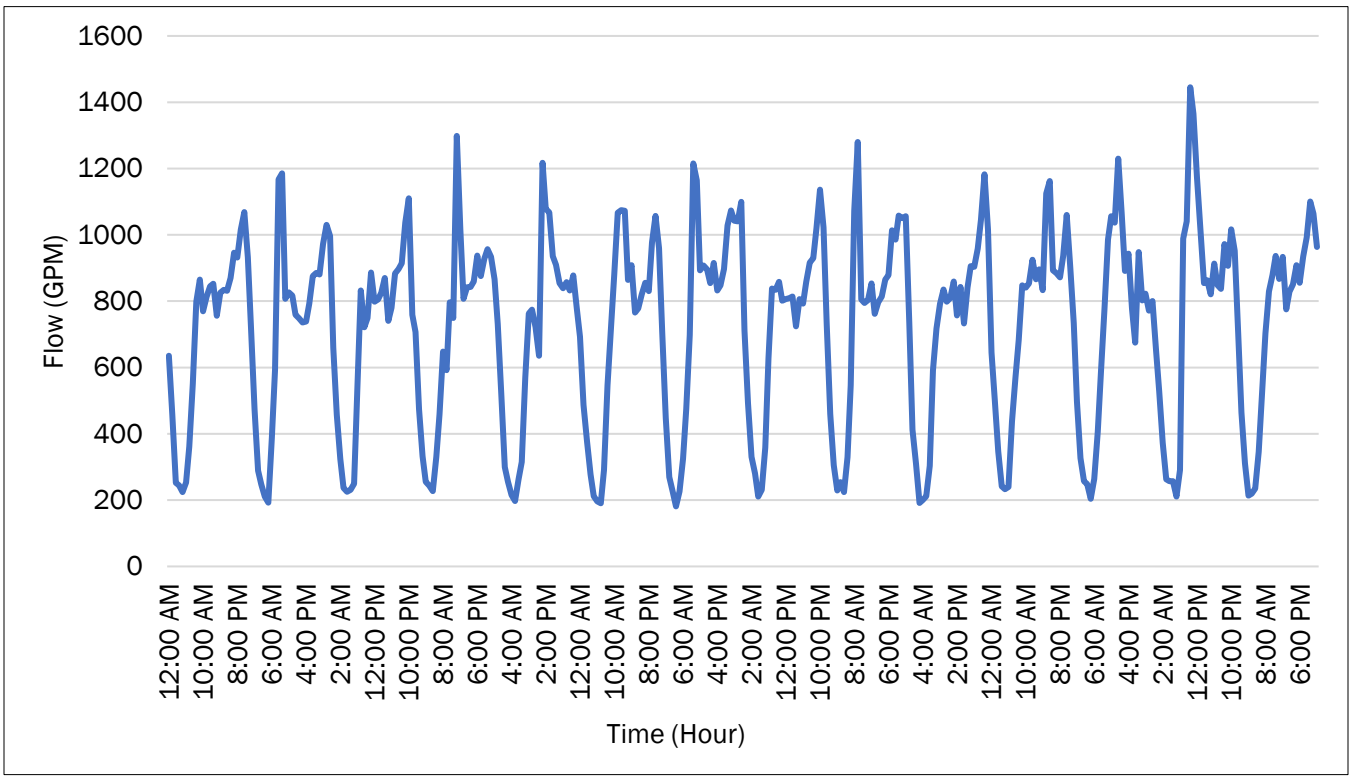


Figure 3-7: FM 03 - Hourly Flow Conditions

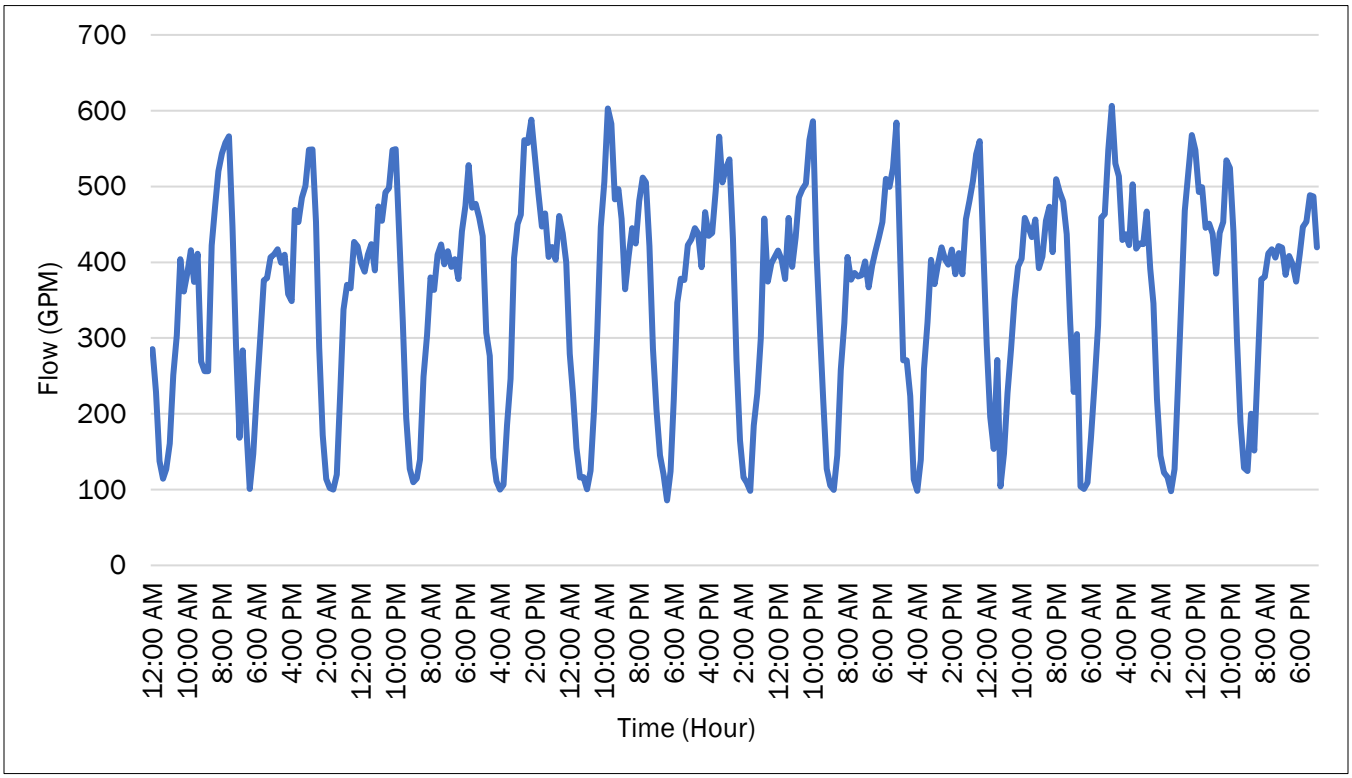
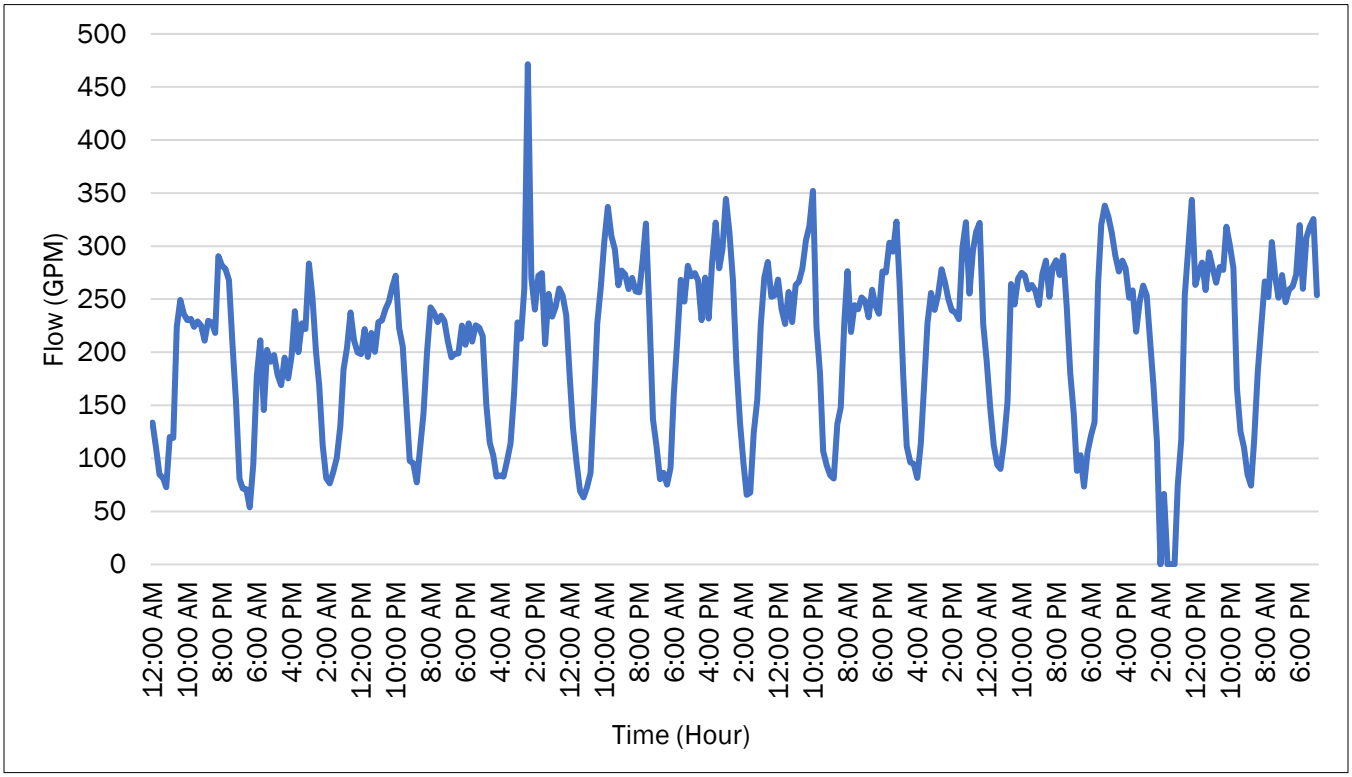


Figure 3-8: FM04 - Hourly Flow Conditions



The flow monitoring study collected baseline dry weather flow conditions within the Study Area. Existing dry weather peak hour flow conditions were based on the results of the flow monitoring study and do not include any increase in flow from rain events.

MKN was not scoped to complete wet-weather flow monitoring for this project and PHWWF conditions were based on information from factors from the City's Wastewater System Master Plan dated June 2012. To verify observed pipeline capacity deficiencies during PHWWF conditions, the City may consider completing a more comprehensive I/I in the future and updating the PHWWF conditions within the hydraulic model.

3.4 Wastewater Return Factors

To estimate the distribution of wastewater flows across the collection system and estimate future wastewater demand, MKN assigned a water to wastewater return factor to each sewered parcel based on its land use. To determine the return factor for each land use type, MKN developed preliminary wastewater return factors in **Table 3-5** based on the existing ADF from **Section 3.3.1**, 2020 to 2022 water billing data, 2020 to 2022 WRF ADF, and sewered parcel information from **Table 2-2**. These return factors were then assessed using the flow monitoring study.

Table 3-5: Preliminary Wastewater Return Factors							
Land Use	Number of Parcels	Acreage	Average Day Demand (MGD)[1]	Average Day Demand (GPM)[1]	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	3,405	829	1.19	827	80%	0.95	662
Multi-Family Residential	1,890	278	0.81	562	90%	0.73	505
Mobile Homes	6	57	0.14	99	85%	0.12	84
General Commercial	499	266	0.43	300	95%	0.41	285
Commercial Office	178	40	0.07	52	95%	0.07	49
General Industrial	99	130	0.11	80	95%	0.11	76
Public Facilities	23	114	0.12	81	80%	0.09	65
Airport	9	47	0.01	5	85%	0.01	4
Specific Plan	12	124	0.11	74	85%	0.09	63
Total	**6,121**	**1,885**	**2.99**	**2,078**	**86%**	**2.58**	**1,792**
					WRF ADF[2]	**2.58**	**1,792**

Notes:
1. Potable water usage was calculated using a three-year average from 2020 to 2022 water billing data. Water usage that did not result in return wastewater flows was not included in this average (ex: hydrant testing, landscaping-specific meters, water losses, etc.)
2. Actual existing average daily flow calculated from influent WRF data from 2020 to 2022

The preliminary return factors identified in **Table 3-5** are based on typical return factors MKN has used on similar wastewater planning projects. From 2020 to 2023, the average day water demand was 2.99 MGD and the average day flow to the WRF was 2.58 MGD, resulting in an overall average return factor of 86%. A detailed flow verification is included in **Appendix B**.

3.5 Wastewater Unit Flow Factors

The following wastewater flow factors were used for estimating future wastewater flow associated with near-term and ultimate development projects. The water and wastewater unit demand factors were developed from the City's 2020 UWMP, Wastewater System Master Plan Amendment – East Area 1, and the water to wastewater return factors identified in **Table 3-5**. The unit factors are summarized in **Table 3-6** below.

Table 3-6: Future Unit Flow Factors				
Flow Category	**Water Demand Factor**	**Return Factor[1]**	**Wastewater Flow Factor (GPDU) (gpm)**	**Source**
Residential	308 gal per day / housing unit[2]	80%	246 gal per day / housing unit	2020 UWMP
Residential (East Area 1 Only)	224 gal per day / housing unit[3]	80%	179 gal per day / housing unit	Wastewater System Master Plan Amendment – East Area 1
Commercial	2.49 gal per year / SF	95%	2.37 gal per year / SF	2020 UWMP
Industrial	15.1 gal per year / SF	95%	14.3 gal per year / SF	2020 UWMP
School	1.81 AF per year / acre	80%	1.45 AF per year / acre	2020 UWMP
Notes: 1. Return factors from Table 3-12 2. 88 gallons per day per capita x 3.5 capita per housing unit = 308 gal per day / housing unit 3. 64 gal per day per capita x 3.5 capita per housing unit = 224 gal per day / housing unit				

3.6 Future Sewer Flow

Future wastewater flows within the City's SOI will consist of redevelopment of underutilized parcels, new development of vacant land, and new development within the City's expansion areas. These future flows are described below.

3.6.1 Near-Term Flows

Wastewater flows within the City's SOI are expected to increase within the next five years as pending development projects are constructed. Near-Term flows include approved and pending development projects identified in the 2021 – 2029 Housing Element, as well as approved and pending specific plans identified in the Land Use Element of the 2040 General Plan. A summary of the estimated wastewater flows associated with near-term development projects is shown in **Table 3-7**.

Table 3-7: Near-Term Development Wastewater Flow			
Future Development	**Unit**	**Wastewater Flow Factor**	**Wastewater Flow (gpm)**
Approved / Pending Projects			
Housing Units	676	246 gal per day / housing unit	115
East Area 1 Specific Plan			
Housing Units	1530	179 gal per day / housing unit	190
East Gateway Specific Plan			
General Commercial (SF)	670,000	2.37 gal per year / SF	3
		Total Wastewater Flow (gpm)	**309**
		Total Wastewater Flow (mgd)	**0.44**
Notes: 1. GPM = Gallons per Minute 2. MGD = Million Gallons per Day 3. SF = Square Feet			

3.6.2 Ultimate Flows

Ultimate flows are associated with build-out within the existing City SOI and the City's expansion areas. These are classified as projects expected to occur at some point in the future, but these projects are at the early planning stages. Ultimate flows include vacant residential and commercial sites identified in the 2021 – 2029 Housing Element, as well as expansion areas identified in the Land Use Element of the 2040 General Plan. A summary of the estimated wastewater flows associated with ultimate development projects is shown in **Table 3-8**.

Table 3-8: Ultimate Development Wastewater Flow

Future Development	Unit	Wastewater Flow Factor	Wastewater Flow (gpm)
Vacant Residential Sites			
Housing Units	117	246 gal per day / housing unit	20
Vacant Commercial Sites			
Housing Units[1]	812	246 gal per day / housing unit	139
Adams Canyon Expansion Area			
Housing Units	595	246 gal per day / housing unit	102
School (Acres)	15	1.45 AF per year / acre	13
Fagan Canyon Expansion Area			
Housing Units	450	246 gal per day / housing unit	77
General Commercial (SF)	78,401	2.37 gal per year / SF	0
East Area 3 Expansion Area			
General Commercial (SF)	222,156	2.37 gal per year / SF	1
General Industrial (SF)	121,968	14.3 gal per year / SF	3
West Area 2 Expansion Area			
General Commercial (SF)	2,504,700	2.37 gal per year / SF	11
Total Future Development Wastewater Flow (gpm)			**367**
Total Future Development Wastewater Flow (mgd)			**0.53**

Notes:
1. Per the 2021 – 2029 Housing Element, the City identified vacant commercial lots for future residential development.
2. GPM = Gallons per Minute
3. MGD = Million Gallons per Day
4. SF = Square Feet

3.6.3 Future Sewer Flow Summary

Table 3-9 provides a summary of the total future water flows associated with the City's near-term projects (pending projects) and ultimate projects (vacant sites and expansion areas).

Table 3-9: Estimated Total Future Wastewater Flow Conditions						
Flow Condition	ADF[1]		PHDWF[2]		PHWWF	
	MGD	GPM	MGD	GPM	MGD	GPM
Existing	2.58	1,792	5.16	3,584	7.74	5,375
Near-Term	3.02	2,100	6.05	4,201	9.07	6,301
Ultimate	3.55	2,468	7.11	4,935	10.66	7,403

Notes:

1. PHDWF = 2.0 x ADF per Table 3-2
2. PHWWF = 3.0 x ADF per Table 3-2
3. ADF = Average Day Flow
4. PHDWF = Peak Hour Dry Weather Flow
5. PHWWF = Peak Hour Wet Weather Flow
6. MGD = Million Gallons per Day
7. GPM = Gallons per Minute

4.0 EXISTING SYSTEM OVERVIEW

This section provides an overview of the City's existing wastewater collection, treatment and disposal systems.

4.1 Gravity Collection System

The City's existing collection system includes 59 miles of gravity sewer pipelines (ranging from 6-inch to 42-inch diameters), 1,190 manholes, three lift stations, and associated force mains. **Figure 4-1** provides an overview of the collection system and an inventory of the existing gravity collection system by diameter is provided in **Table 4-1**.

Table 4-1: Collection System Pipeline by Size

Diameter (Inches)	Length		
	Feet	Miles	% of total
6	82,360	15.7	26%
8	172,970	32.7	55%
10	18,090	3.4	6%
12	13,280	2.5	4%
15	2,870	0.5	1%
18	8,510	1.6	3%
20	1,050	0.2	< 1%
21	3,070	0.9	1%
24	7,650	1.5	2%
30	490	0.1	< 1%
33	130	<0.1	< 1%
36	170	<0.1	< 1%
42	1,330	0.3	< 1%
Total	311,970	**59.1**	**100%**

4.2 Lift Stations

There are a total of three (3) lift stations within the City's existing collection system including the Harding Park, Harvest (Lemonwood No. 2), and Lemonwood No. 1 lift stations. **Figure 4-2** shows the lift station locations and sewersheds.

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Note: Bolded sewer lines indicate gravity sewer lines that were considered in the hydraulic evaluation

Legend

- Sphere of Influence
- City Limits
- WRF Water Recycling Facility
- LS Lift Station
- 6-inch Sewer
- 8-inch Sewer
- 10-inch Sewer
- 12-inch Sewer
- 15-inch Sewer
- 18-inch Sewer
- 20-inch Sewer
- 21-inch Sewer
- 24-inch Sewer
- 30-inch Sewer
- 33-inch Sewer
- 36-inch Sewer
- 42-inch Sewer

OJAI RD
W SANTA PAULA ST
N PECK RD
W MAIN ST
N PALM AV
E SANTA PAULA ST
E MAIN ST
W HARVARD BL
S PECK RD
S PALM AV
E HARVARD BL
S TENTH ST
SANTA PAULA FW
Harding Park LS
Harvest LS
Lemonwood 1 LS
WRF

City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

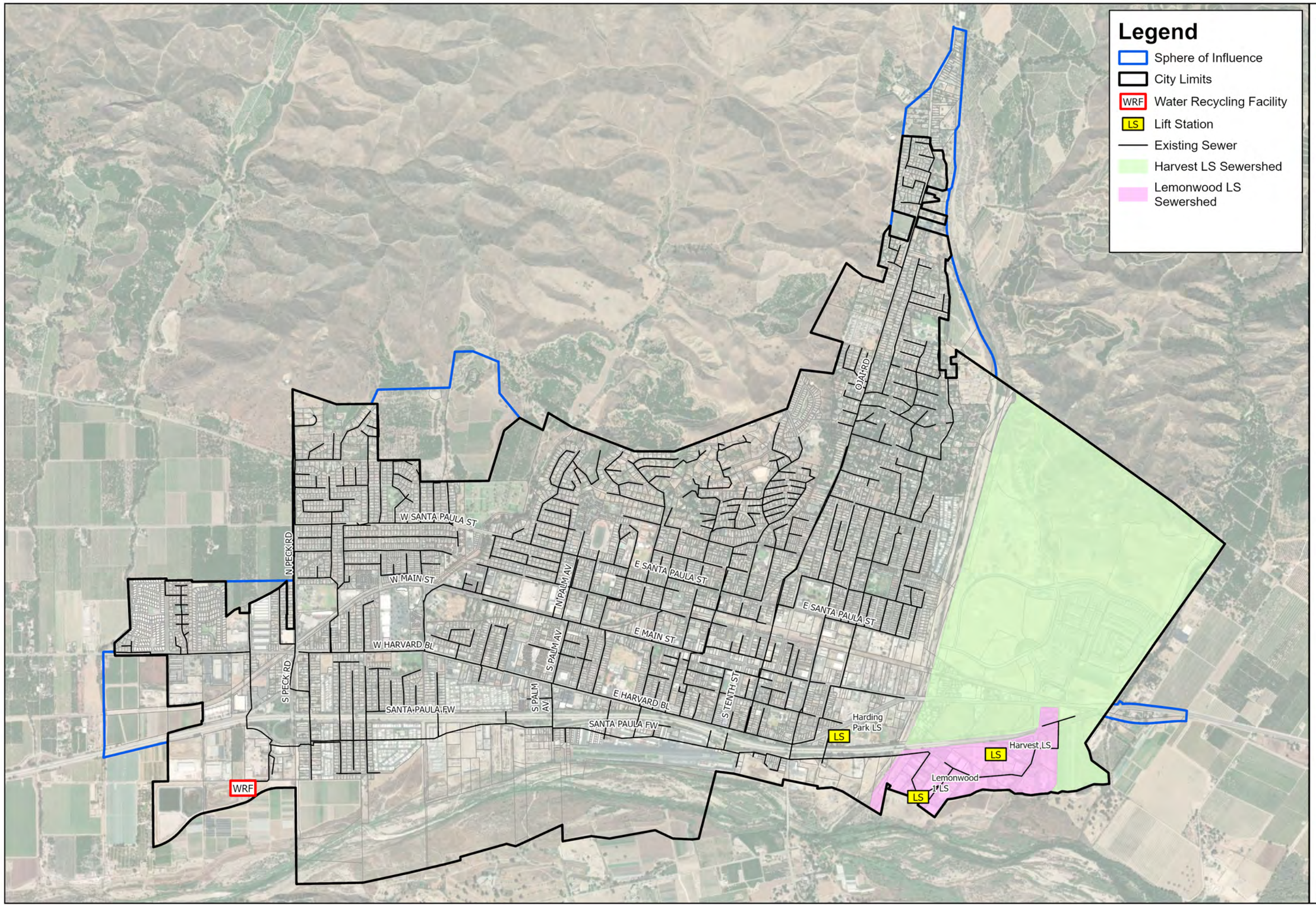
Figure 4-1:

Collection System Map

1 inch = 2,200 feet

0 1,100 2,200

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 4-2:

Lift Station Sewersheds

1 inch = 2,200 feet

0 1,100 2,200

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4.2.1 Harding Park Lift Station

Figure 4-3: Harding Park Lift Station



The Harding Park Lift Station is located in a parking lot planter, 15 feet northeast of the Harding Park restroom. This lift station collects flows from the Harding Park restroom and a residential home located on the premises of the park. A photo of the lift station wet well and valve vault is shown in **Figure 4-3**.

Access to the lift station is through the park's parking lot. This station has a two submersible pumps controlled by floats as the primary level sensors. The wet well can be accessed through a steel hatch cover set at grade.

4.2.2 Harvest Lift Station

The Harvest Lift Station is located on Old Hallock Drive, south of Highway 126, adjacent to an RV storage yard. This lift station collects mainly residential flows from the adjacent neighborhood. A photo of the lift station wet well and valve vault is shown in **Figure 4-4**.

Figure 4-4: Harvest Lift Station



The gated lift station is the newest station in the City, approximately three years old. This station houses three 15-horsepower (HP) submersible pumps. For level sensing, this system has both primary and backup level sensors. The primary is a pressure transducer and four floats act as backup level sensors. These devices, when triggered, send a signal to a PLC controller to activate the pumps.

4.2.3 Lemonwood 1 Lift Station

Figure 4-5: Lemonwood Lift Station



The Lemonwood 1 Lift Station is located south of Highway 126 in Lemonwood Industrial Park. This lift station collects industrial and commercial flows. A photo of the lift station wet well in shown in **Figure 4-5**.

Access is achieved by vehicle off Quail Court through a fenced gate entrance. This lift station consists of a 6-foot diameter wet well with two suction lift pumps, set at grade over the wet well and are controlled by a level sensor. Bypass provisions at the lift station are evident. A manual transfer switch was present along with a portable generator, to provide back-up power if needed.

4.3 Description of Water Recycling Facility

The WRF was constructed in 2010 under a design-build-operate-finance (DBOF) agreement. Phase I was completed at that time and was intended to treat an average day flow of 3.4 MGD. The facility was planned to accommodate a future Phase II expansion that would treat a total of 4.2 MGD on an average day flow basis. Currently, both the plant and collection system are operated under a contract with Ventura Regional Sanitation District (VRSD), who is responsible for daily management and permitting compliance.

Figure 4-6 depicts the process flow schematic for the WRF. Raw wastewater enters the influent lift station via a 42-inch diameter HDPE gravity sewer line. Raw influent is directed to two separate concrete channels in the headworks screening structure. These channels direct flow through coarse screening, grit removal, and fine screening equipment prior to discharge to the pre-anoxic basin splitter channel. From there, the pre-anoxic basin diversion channel controls flow into any combination of the three anoxic basins where denitrification of a mixture of raw screened wastewater and recycled activated sludge flow is achieved. Subsequently, the water progresses to the aerobic basins for oxidation of organic carbon and nitrification. Separate aeration zones allow the operators to control air flow to different areas within the basins. Mixed liquor is pumped to the membrane tank forebay/channel and distributed to the membrane bioreactor (MBR) tanks. Following MBR filtration, the tertiary-treated water undergoes Ultraviolet (UV) disinfection before flowing into a concrete splitter box, then to onsite percolation ponds for disposal. Some treated effluent is reclaimed for on-site water reuse, particularly for operations like equipment washdown. The WRF was designed to serve recycled water users in the future but users have not yet been identified.

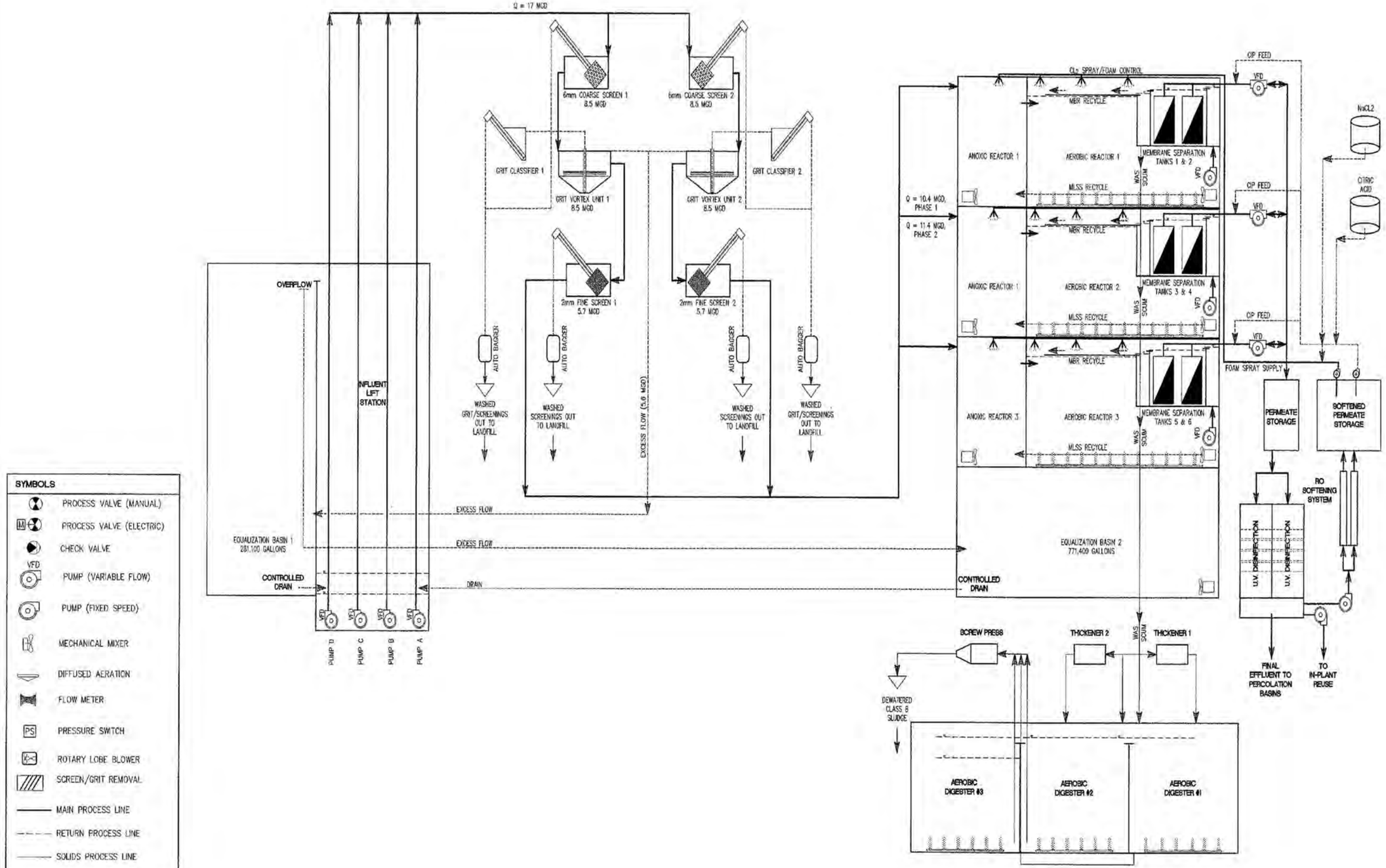
Waste Activated Sludge (WAS), is transferred from the membrane tank effluent channel to one of three aerated sludge digestion basins. In these basins, volatile organics are further oxidized. The sludge's volume is decreased through a gravity belt thickener and the sludge undergoes dewatering via a screw press before being transported offsite for disposal.

The WRF is operated in accordance with Waste Discharge Requirements (WDR), Order No. R4-2018-0022-A01, in tandem with a Cease-and-Desist Order (CDO), Order No. R4-2018-0023-A01, attached as **Appendix C**. These regulations were adopted by the Los Angeles Regional Water Quality Control Board (RWQCB) on February 8, 2018 and amended in May 2022.

As discussed later in this report, the City is currently developing a chloride removal system to improve WRF effluent quality prior to percolation. The CDO is the basis for implementing this project.

4.3.1 Influent Lift Station

An open-channel Doppler flowmeter monitors flows entering the facility through a metering manhole situated on the 42-inch diameter influent gravity pipeline prior to entering the influent lift station (ILS). The influent sewer lift station was constructed to accommodate a firm peak flow capacity of 17.0 MGD (11,800 GPM) even when one pump is out of service.



City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 4-5:

WRF Process Flow Schematic

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The station is comprised of a concrete wet well equipped with four pumps with variable frequency drives (VFDs). Excess flow above the capacity of the pumps causes an increase in the wet well level and is passively diverted into the two equalization basins by flowing over an overflow weir. Gated outlets within the surge equalization basins enable stored sewage to be redirected back to the ILS when flows are lower, then subsequently pumped through the headworks.

The ILS pumps connect to a 16-inch diameter ductile iron pipe (DIP) riser, which then manifolds into a 24-inch DIP force main. The force main transports raw sewage to the headworks inlet. The flow rate of the influent is measured at the outlet of the headworks structure. Details for the ILS major equipment are summarized in **Table 4-2**.

Table 4-2: Influent Lift Station Equipment Summary

Equipment	Quantity	Manufacturer	Description
Pumps	4	Flygt	❑ Provide the hydraulic head to lift the influent wastewater to the headworks ❑ 3,900 gpm at 35 ft TDH ❑ 45 HP, 480 VAC, 3P, 60 Hz ❑ Model NP3202-616 LT, 12-inch diameter straight discharge
Plug Valves	4	Val-matic	❑ Allow pump isolation for maintenance or removal ❑ Model #VM-5816R
Swing-Flex Check Valves	4	Val-matic	❑ Prevent the process flow from reversing backwards into the pump impeller ❑ Model VM-516
Flap Gates	2	Waterman	❑ Acts as a check valve for the process tank drain lines ❑ Model SSF-41

4.3.2 Headworks

The headworks system at the WRF utilizes two-stage screening coupled with a dedicated grit removal system. Raw wastewater is pumped from the lift station to the enclosed headworks building which also houses the sludge thickening and dewatering systems as well as the aerobic digester blowers. Each headworks train is composed of an 8.5 MGD coarse screening unit, an 8.5 MGD vortex grit separation unit, and a 6.9 MGD fine screening unit. This parallel arrangement provides redundancy and allows for maintenance of screening equipment without diverting unscreened sewage downstream.

In the headworks, wastewater flows into one of the two headworks trains where it goes through a coarse screen, grit removal chamber, and a fine screen in this sequence prior to continuing to the next treatment process.

As solids collect on both the coarse and fine screens, a collection trough with screw-type compactor and washer receives screenings from the screens and discharges them into a bagging system for offsite removal.

Following the coarse screen process, the wastewater flows through a vortex-type grit chamber. Settled grit is pumped to a cyclone vortex-type grit classifier and periodically extracted to prevent excessive hardening. With a

spray wash system, the grit classifier cleanses organics from the grit and mitigates odors. Grit is discharged to a horizontal conveyor equipped with an automated bagging system for convenient disposal. Any remaining water within the classifier is returned to the vortex chamber for further processing.

The fine screens provide a final stage of inorganic solid removal and prevent damage to downstream membranes. **Table 4-3** summarizes the major equipment associated with the headworks building.

Table 4-3: Headworks Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
Primary Screen	2	Huber	❑ Remove, convey, and dewater screened material down to 6-mm in size ❑ 480 VAC, 3 Phase, 60 Hz, 2 HP ❑ 11 MGD max rated capacity ❑ Model Rotomat (Ro2) 1600/6
Vortex Grit Chamber	2	Westech	❑ 8.5 MGD rated capacity ❑ 10 ft diameter (concrete formed) ❑ Model GVR-10
Grit Classifier	2	Westech	❑ 11-inch screw classifier ❑ Includes 250 GPM capacity Hydrocyclone seperator ❑ Model GSF3-100
Primary Screen Conveyor	2	JDV Conveyor	❑ 125 ft^3/hr at10 RPM ❑ 1.5 HP, constant speed motor ❑ Model U355 B/SS
Fine Screen	2	Huber	❑ Remove, convey, and dewater screened material down to 2-mm in size ❑ 480 VAC, 3 Phase, 60 Hz, 2 HP ❑ 6.9 MGD max rated capacity ❑ Model Rotomat (Ro2) 1800/2
Fine Screen Conveyor	2	JDV Conveyor	❑ 125 ft^3/hr @10 RPM ❑ 1.5 HP, constant speed motor ❑ Model U355 B/SS
Slide Gates	6	Waterman	❑ Controls flow into the Headworks structure, overflow, and flow out of the Headworks structure ❑ Hand wheel operated ❑ Model SS-256-1-Y-X, SS-254-1-Y, SS-251-1-Y

4.3.3 Primary and Secondary Equalization Basins

The WRF features two interconnected equalization (EQ) basins designed for management of short-term diurnal peak flows. These basins operate in series and provide a combined storage capacity of 1.05 million gallons.

The primary EQ basin, situated adjacent to the east wall of the influent lift station, is comprised of an epoxy-coated concrete tank measuring 40-feet wide by 45-feet long by 23-feet maximum liquid depth, with a working volume of 281,100 gallons. This volume was sized to attenuate a peak flow of up to 10.4 MGD over a 10-hour period per *Trussell Technologies, Inc., Evaluation of Biological Design and Process Sizing* Technical Memorandum (2008)

included in **Appendix D**. Should the excess peak flow exceed the capacity of the first basin, a gravity overflow enables screened and de-gritted wastewater to flow to the second, larger EQ basin located adjacent to the west wall of the ILS. EQ basin #2 measures 38-feet wide by 118-feet long by 23-feet maximum liquid depth, offering an additional working volume of 771,400 gallons of storage. Both basins are equipped with gated drains that feed back to the influent lift station for pumping to the headworks. **Table 4-4** summarizes the major equipment associated with the EQ basins.

Table 4-4: Equalization Basins Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
Slide Gates	2	Waterman	❑ Controls flow into and out of each of the EQ basins ❑ Electrically actuated, 460V/3P/60Hz ❑ Model SS-291-1

4.3.4 Anoxic Basins

Screened raw wastewater enters the anoxic basin diversion channel. Within this channel, manually controlled slide gates regulate the flow over three weirs, each corresponding to an anoxic basin. The anoxic basins provide denitrification of incoming screened wastewater and Recycled Activated Sludge (RAS) from the membrane basins. Each of the anoxic basins measure approximately 38 feet long by 28 feet wide by 21.7 feet in maximum liquid depth with an average working volume of approximately 172,800 gallons each. **Table 4-5** summarizes the major equipment associated with the anoxic basins.

Table 4-5: Anoxic Basins Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
Anoxic Mixer	3	Flygt	❑ Provides mixing energy for the influent prior to entering the aerobic basin ❑ Gear driven mixer per Model #4640 w/11° angle mount & 25 ft. mast length ❑ 5300 GPM, 4 HP, 460V/3P/60 Hz
Diversion Channel Slide Gates	3	Waterman	❑ Model #SS-254-1-Y-NRS
Mud Valves	6	Waterman	❑ Controls nutrient loading into each tank as well as means of controlling overflows ❑ Three 6-inch valves and three 12” valves ❑ Model MV-11

4.3.5 Aeration Basins

Biological oxidation, including carbon removal and nitrification of incoming ammonia, occurs within the aeration basins. These basins each measure approximately 72 feet in length by 38 feet in width by 21.7 feet maximum liquid depth and possess a working volume of approximately 59,400 ft^3 (~444,000 gallons each).

Aeration is provided by four dedicated blowers and a zoned fine bubble diffuser system. Within each basin, there are a total of 69 fine-pore diffuser panels organized into three zones, with decreasing diffuser density as water progresses through the basin. The initial zone ensures thorough mixing of influent from the anoxic basin and mixed

liquor channel through intense aeration. Subsequent zones maintain adequate oxygen levels for biomass growth and activity while optimizing the growth of organisms that promote aerobic digestion without causing foaming or settling issues. DO sensors allow the operators to manually adjust blower speed via VFDs. The City is currently implementing an ammonia control project to automate blower operations.

Return activated sludge (RAS) troughs are integrated into the basin centerline structure, serving as both weirs and channels to regulate high water levels and return mixed liquor to the Anoxic Basins and to the front end of the Aerobic Basins. Each aerobic basin features a 4 HP, 4,700 GPM mixed liquor suspended solids recycle pump, directing a portion of mixed liquor from the back of the aerobic basin back into the anoxic basin.

From the end of the aerobic basins, wastewater is pumped to the membrane bioreactor (MBR) forebay channel using the MBR feed pumps. **Table 4-6** summarizes the major equipment associated with the aerobic basins.

Table 4-6: Aerobic Basins Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
MBR Feed Pump	3	Flygt	❑ Pumps water from the end of the aerobic tanks to the MBR feed channel above ❑ 11,000 GPM at 3.3 ft TDH per pump ❑ 27 HP VFD 460V/3P/60 Hz, tube mounted ❑ Model PL7055
RAS Pump	3	Flygt	❑ Pumps RAS from the aerobic basin to the anoxic basin ❑ 4,700 GPM at 0.9 ft TDH per pump ❑ 4 HP, 480V/3P/60 Hz,, 16" flange mount ❑ Model PP4640
Aeration Diffusers	207	Aerostrip (now OVIVO)	❑ Entrain air into aerobic basin using fine bubbles ❑ Polyurethane membrane fine pore diffuser panels 470#/HR SOR per tank ❑ Aerostrip® Model Q3.5
Aeration Blowers	4	K-Turbo	❑ Provides aeration to each aerobic basin's aeration panels ❑ 800-1, 400 SCFM at 11.5 psi, 75 HP VFD, 460V/3P/60 Hz ❑ Model TB75-0.8S

The aeration basins were cleaned, repaired, and malfunctioning/broken diffusers and aeration piping were replaced over the past three years.

4.3.6 Mixed Liquor (ML) Collection and Mixed Liquor Suspended Solids (MLSS) Recycle Channels

The effluent from each of the MBR feed pumps is directed into the ML collection channel for distribution to each membrane basin. The water level is equalized between the forebay and each operated MBR tank by utilizing 24-inch diameter mud valves. RAS enters the MLSS recirculation channel for distribution back to the Anoxic Basins and Aeration Basins.

Both the ML collection and MLSS recirculation channels contain a network of fine bubble tube aeration diffusers. The diffusers scour the membranes to help prevent fouling and ensure that any solids in channels remain suspended, preventing accumulation of settled sludge. Each of the 72 fine bubble tube diffusers (36 in each channel) delivers 3 to 10 SCFM, with a maximum capacity of 17 SCFM. Air for this process is delivered by the membrane blowers. **Table 4-7** summarizes the major equipment associated with the ML collection and MLSS recirculation channels.

Table 4-7: MBR Feed and MLSS Channels Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
WAS Pumps	2	Flygt	❑ 480 GPM at 25 ft TDH ❑ 5 HP VFD, 460V/3P/60 Hz ❑ 4 inch diameter straight discharge ❑ Model NP3102
Mud Valves	6	Waterman	❑ Controls flow into the MBR Tanks ❑ Manually actuated ❑ Model MV-11
Slide Gates	3	Waterman	❑ Controls flow into and out of the aerobic basins ❑ Manually actuated ❑ Model SS-252-1
Channel Aeration	72	EDI	❑ Keeps secondary processed water and sludge suspended in each of the channels ❑ Model T-Series

4.3.7 MBR Basins

The WRF performs biological treatment in three parallel process trains with six membrane bioreactor (MBR) basins. After passing through the aerobic basins, MLSS is pumped into the ML collection channel which distributes flow into each pair of membrane basins.

The membranes are submerged within the membrane basins and rely on VFD-equipped rotary lobe suction pumps (permeate pumps) that create a vacuum on the permeate side of the membranes. These pumps discharge treated wastewater to a common 24-inch diameter DIP header leading to the UV tank structure.

During the permeate extraction process, solids form a sludge layer on the membranes. To prevent excessive buildup, the membrane modules' operation includes periodic backflushing with permeate water, facilitated by the permeate pumps. Membrane blowers also provide scouring of the membrane surface through diffusers mounted at the bottom of the membrane basins.

The membrane filtration modules also have a clean-in-place (CIP) system for both maintenance and recovery cleaning, carried out within the tanks. Maintenance cleaning involves periodic injection of low doses of sodium hypochlorite and citric acid into the membrane module permeate/back-flush lines.

Mixed liquor continually overflows to the ML recirculation channel for diversion back to the aerobic basins or for pumping Waste Activated Sludge (WAS) to the aerobic digesters. **Table 4-8** summarizes the major equipment associated with the MBR modules and tanks.

Table 4-8: MBR Modules and Tanks Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
MBR Feed Pump	3	Flygt	❑ Pumps water from the back end of the aerobic tanks to the MBR feed channel above ❑ 11,000 GPM at 3.3 ft TDH, 27 HP VFD, 460V/3P/60 Hz, tube mounted ❑ Model PL7055
Mud Valves	6	Waterman	❑ Controls flow into the MBR Tanks ❑ Manually actuated ❑ Model MV-11
Membrane Filtration Modules	24	Koch Membrane Systems	❑ 1,500 M2 Hollow-Fiber Microfilter Module ❑ Model Puron
Permeate Pumps	6	Vogelsang	❑ Draws water through the permeable membrane fibers and pumps the water to the UV tank structure ❑ 1,420 GPM at 14.5 PSI, 25 HP VFD, 460V/3P/60 Hz ❑ Piggyback mounted motor ❑ Gooseneck suction and discharge ❑ Model VX186-520QD
Membrane Blower	3	K-Turbo	❑ Provides aeration to each of the membrane modules for scouring of built-up cake on the membrane fibers ❑ 2,200-4,700 SCFM @ 6.5 PSI, 200 HP VFD, 460V/3P/60 Hz ❑ Model TB200-0.6T

4.3.8 UV Disinfection System

Permeate is disinfected using ultraviolet (UV) disinfection prior to discharge to percolation ponds or reuse within the WRF. The process exposes the wastewater to UV light which damages the genetic material of microorganisms, preventing their ability to reproduce, and rendering them non-infectious. The WRF uses a low pressure ultra-high output amalgam lamp to accomplish their disinfection.

This disinfection process is performed within covered concrete channels that receive flow from the 24-inch diameter DIP membrane permeate header. This flow enters the UV tank structure and discharges into a pre-UV channel wet well through which has manually controlled slide gates to control flow into the UV channels. The UV modules are positioned within a concrete channel. There are a total of 10 banks for both concrete channels with each bank

containing thirty-six UV lamps for contact disinfection. Maintaining the water level within the channel is crucial for the disinfection system to ensure full submersion of the UV lamps, as it requires an adequate contact time with UV radiation. To maintain lamp submergence, water level is regulated by weirs and a level gate. The PLC adjusts the number of activated lamps based on flow rate and baffles within the channels direct flow for optimal contact. After exiting the UV channel, treated water is discharged for plant reuse or is discharged into the 30-inch effluent pipeline that feeds the diversion structure, which then directs flow to all three percolation ponds. **Table 4-9** summarizes the major equipment associated with the UV Disinfection System.

Table 4-9: UV Disinfection System Major Equipment Summary

Equipment	Quantity	Manufacturer	Description
UV Modules	10	IDI-Ozonia	❑ Two parallel trains. Each train contains 5 x 36 400-Watt lamp modules. ❑ Aquaray 3X High output vertical lamp UV disinfection
UV Air Flush-out Compressor	1	IDI-Ozonia	❑ Compressor provides air for UV lamp cleaning operation ❑ 120 VAC
Automatic Level Gate	2	IDI-Ozonia	❑ Fluid filled counter-weight tank
Channel Weir Gates	2	Waterman	❑ Model SS-254-1-Y
UV Dip Tank	1	N/A	❑ Precast epoxy lined UV cleaning/dip tank

4.3.9 CIP Storage Tanks and Foam Spray System

The Clean-In-Place (CIP) storage tanks hold potable water designated for membrane module maintenance and recovery cleaning purposes. The two CIP storage tanks provide a storage capacity of 16,200 gallons per tank. Additionally, the water serves for the foam control system, which uses a spray system to reduce biological foaming in the basins.

Water is extracted from each CIP tank through two pumps: one for the CIP cleaning process and another for supplying the foam spray system. For each of these systems, there is one primary pump and one backup pump (for a total of four pumps), allowing them to alternate to reduce wear and provide redundancy. **Table 4-10** summarizes the major equipment associated with the CIP storage tanks and foam spray system.

Table 4-10: CIP Storage Tanks and Foam Spray System Major Equipment Summary			
Equipment	**Quantity**	**Manufacturer**	**Description**
CIP Pumps	2	Marlow	❑ Self-priming pump with 3-inch by 3-inch connections, 7.31-inch Impeller 79 GPM (Maintenance), 291 GPM (Recovery) at 14.5 PSI, 5HP, 1750 RPM VFD, 460V/3P/60 Hz
Chemical Metering/Injection Pumps	2	N/A	❑ 130 GPH at 100 PSI Chemical metering motor driven pumps w/ electric diaphragm ProMinent ❑ Model Sigma/3 S3Ca w/ 10,000 mL calibration column and PVC/Viton injection valve/lance
Foam Spray Pumps	2	Marlow	❑ Self-priming pump w/ 3-inch by 3-inch connections 7.31-inch IMP, 250 GPM at 14.5 PSI, 5HP, 1750 RPM VFD, 460V/3P/60 Hz
Foam Spray Nozzles	270	Bete	❑ Full cone spray angle PVC nozzles, ❑ Model Maxipass MP218
Storage Tank Drain - Mud Valves	2	Trumbull	❑ Non-rising stem SS Mud Valves

4.3.10 Sludge Handling System

WAS is thickened, aerobically digested, and dewatered prior to being hauled offsite for disposal. Two gravity belt thickeners (GBTs) can receive WAS from the WAS pumps. Polymer is added to enhance the thickening process.

Three 58-foot by 38-foot by 23-foot aerated sludge digestion basins receive flow from the WAS pumps installed in the MLSS recirculation channel. The aerobic digesters provide stabilization and storage of waste sludge prior to thickening, dewatering, and disposal. The key equipment components for each digester include fine bubble diffusers, sludge withdrawal pumps, rethickening pumps, and blowers. Rethickening pumps can circulate sludge from the digesters back through the gravity belt thickeners as needed.

During dewatering operations, the digested sludge is extracted from the aerated sludge storage basins and directed to the screw press via the screw press feed pumps. Polymer is added to enhance dewatering within the screw press. The sludge is released onto a conveyor system and deposited into a roll-off bin, serving as on-site storage for the sludge until it is transported away for disposal. **Table 4-11** summarizes the major equipment associated with solids handling system.

Table 4-11: Solids Handling Equipment Major Equipment Summary			
Equipment	Quantity	Manufacturer	Description
WAS Pumps	2	Flygt	❑ 480 GPM at 25 ft TDH ❑ 5 HP VFD, 460V/3P/60 Hz ❑ 4-inch diameter swept discharge ❑ Model NP3102
Gravity Belt Thickeners	2	Filtech	❑ Thickens waste sludge for improved digestion and to increase available sludge storage volume ❑ 220 GPM at 0.75% DS/825 lbs/hr ❑ 150 GPM @ 3.0% DS/2,200 lbs/hr ❑ Model FDW160
Digester Blowers	3*	K-Turbo	❑ Provide aeration to the digester aeration diffusers ❑ 800-1,400 SCFM at 11.5 PSI, 75 HP VFD, 460V/3P/60 Hz ❑ Model TB75-0.8S
Rethickening Pumps	2	Vogelsang	❑ 250 GPM at 15 PSI, 10 HP VFD, 460V/3P/60 Hz ❑ Model VX136-140Q
Screw Press Feed Pumps	1	Vogelsang	❑ 100 GPM at 15 PSI, 7.5 HP VFD, 460V/3P/60 Hz ❑ Model VX136-70Q
Screw Press	1	Huber	❑ 90 GPM at 1.5% Solids, 50 HP Drum Motor, 20 HP Screw Motor, 460V/3P/60 Hz ❑ Model ROS 3Q 800
Polymer Units	3	Siemens	❑ 240-2, 400 GPH Dilution/1-10 GPH Polymer ❑ 115VAC/60 Hz w/microcontroller ❑ Model M2400-P10-AB-V
Sludge Aeration Diffusers	360	EDI	❑ Fine bubble diffusers producing 240 lbs/hr SOR per tank
Notes: *WRF currently has two blowers operating as digester blowers. The third blower is being used as a temporary aeration blower due one aeration blower going out of service in 2022.			

4.3.11 Odor Control System

The WRF incorporates both passive (covers) and active (mechanical) odor management systems. To mitigate odor emissions, odor-generating basins include concrete covers to capture off-gases. A mechanical odor capture and biological odor control system is used to collect and treat air from the lift station, equalization basins, aerobic digesters, anoxic tanks, headworks equipment, thickener unit, and headworks/dewatering room. The odor control system was installed in 2022. **Table 4-12** summarizes the major equipment associated with the odor control system.

Table 4-12: Odor Control System Major Equipment Summary			
Equipment	Quantity	Manufacturer	Description
Foul Air Blower	1	BioAir	❑ 20,000 SCFM capacity ❑ 60 HP motor ❑ Model FAB-17-301
Biological Trickling Filter	1	BioAir	❑ 20,000 SCFM design air flow @ an average 25 ppm input H2S ❑ Model BTF-17-301
Nutrient Supply System	1	BioAir	❑ 53 GPM supply panel flow rate and 70 PSI supply panel inlet pressure ❑ 2-inch diameter flanged supply panel inlet/outlet ❑ Model NSS-17-301

4.3.12 Onsite Reuse Water System

Following UV disinfection, a portion of the treated water is extracted from the pre-discharge storage channel for operational tasks and washdown. This reuse water system incorporates a packaged hydropneumatic tank and pump system to provide pressure and storage. **Table 4-13** summarizes the major equipment associated with the onsite water reuse system.

Table 4-13: Onsite Water Reuse System Major Equipment Summary			
Equipment	Quantity	Manufacturer	Description
Plant Reuse Pumps	2	Marlow	❑ Self-priming pump with 3-inch x 3-inch connections 7.31" Impeller, 340 GPM @ 80 PSI - 30 HP, 3450 RPM, 460V/3P/60 Hz ❑ Model #MP3L3EC
Hydropneumatic Tank	1	South Gate Engineering	❑ 8,000 gal ❑ 6-inch inlet and outlet w/a 6-inch butterfly valve on outlet ❑ Air charging system (40-110 PSI Air Rite Compressor)
Pressure Relief, Sustaining, & Back Pressure Valve	1	Cla-Val	❑ Maintains line pressure w/a pilot set-point for the system ❑ Set-point 70-90 PSI (manually adjusted) ❑ Model #750-01

4.3.13 Percolation Ponds

Treated and disinfected effluent is discharged to three percolation ponds within a 34-acre site southwest of the WRF. The treated effluent from the WRF is directed to the ponds utilizing a 30-inch diameter HDPE pipe. This pipe connects to a diversion structure positioned in between ponds 1, 2 and 3. Canal gates at the diversion structure redirect the treated effluent via three 24-inch pipes into a discharge box located within each pond.

Table 4-14: Percolation Ponds Major Equipment Summary			
Equipment	Quantity	Manufacturer	Description
Canal Gates	3	Waterman	❑ 24-inch gate controls flow to the percolation ponds discharge boxes ❑ Model C-10

4.3.14 Advanced Water Treatment Facility (AWTF)

In the future, a portion of the WRF-treated water will flow to the Advanced Water Treatment Facility (AWTF), currently in design. Design flows are being confirmed at the time of this report, but the objective of the project is to provide side-stream treatment of WRF flows to reduce chlorides to below 110 mg/L in the final combined WRF effluent. This project is required to meet the WRF effluent limit for chloride, outlined in the WDR and CDO.

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5.0 EVALUATION CRITERIA

This section provides an overview of the evaluation criteria used to analyze the City's existing collection system including gravity sewer pipes, lift stations, and force mains.

5.1 Gravity Collection System Criteria

The City has adopted design standards and specifications for sewer collection system improvements. These design standards, along with industry-accepted design criteria for gravity pipelines, lift stations and force mains, were utilized (when feasible) to evaluate the ability of the City's existing sewer infrastructure to meet existing and future flows. **Table 5-1** provides a summary of the City's design standards for sewer improvements.

Table 5-1: Design Standards for Gravity Sewer Pipe

Diameter (in)	Slope (Feet/Foot)
	Minimum Acceptable
6	0.0080
8	0.0044
10	0.0036
12	0.0024
15	0.0016
18	0.0014
>=21	0.0010
Pipe Velocity (fps)	
Minimum	2.0
Maximum	10.0
Peaking Factor	
PHDWF	2.0 x ADF
PHWWF	3.0 x ADF
Depth over Diameter (d/D)	
PHDWF <=12-inch	0.50
PHDWF >=15-inch	0.67
PHWWF	0.75

Notes:
1. ADF = average day flow
2. PHDWF = Peak Dry Weather Flow
3. PHWWF =Peak Wet Weather Flow
4. Based on City of Santa Paula Wastewater System Master Plan June 2012

5.2 Lift Station Criteria

The following criteria were used to evaluate the capacity of the City's existing lift stations under existing and future flow conditions.

5.2.1 Pump Capacity

It is recommended that lift stations are designed with a minimum of two pumps, such that the pumping system can serve the full design flow with the largest pump offline, to provide full redundancy if one pump fails or requires service, to alternate pump cycles to minimize wear on the pump components, and to provide supplemental pumping capacity to convey instantaneous peak flows. Each pump should be sized to convey the peak hour flow entering the wet well.

5.2.2 Force Mains

Force mains were analyzed to determine if they are properly sized to convey the lift station pumped flow, while maintaining minimum pipeline velocities to re-suspend solids and provide pipeline cleaning. It is recommended that lift station force mains convey minimum velocities of 3.5 to 6 feet per second (fps) with maximum velocities less than 10 fps to minimize head loss and potential for surge events.

5.3 WRF Criteria

Design criteria used to evaluate the WRF treatment processes are included in **Section 9**.

6.0 HYDRAULIC COMPUTER MODEL

This section provides an overview of the collection system hydraulic model developed for this project to analyze the ability of the existing system to serve existing and future flows.

6.1 Model Development

MKN developed a hydraulic model using Bentley SewerCAD CONNECT Edition Version 10 (SewerCAD) hydraulic modeling software to simulate the operation of the gravity collection system. SewerCAD utilizes Manning's equation for open channel flow, and the Hazen-Williams formula for pressure pipes (lift station force mains). The hydraulic model was run under steady state conditions using a backwater analysis. This type of analysis starts at the collection system outlet locations (the WRF in this instance) with an assigned outlet condition (either free discharge, submerged, or tailwater control). From the outlet location SewerCAD proceeds in an upstream direction performing the hydraulic analysis. A representative model of the existing collection system was developed using the following information:

- City's existing sewer collection system AutoCAD file (pipelines, manholes, lift stations, and cleanouts) that provided the following information: Pipeline alignment, diameter, material, and length
- As-built plans

6.1.1 Sewer Flow Allocation

To distribute existing and future flows throughout the collection system model, baseline flow conditions were established as described in **Section 3**. Water demands within the Study Area were converted to sewer flows based on reduction factors and verified with flow monitoring data.

Each parcel within the Study Area was assigned an existing wastewater flow and future wastewater flow (when applicable). Each parcel was also associated with the closest manhole that it was assumed to flow to. Each manhole imported into the hydraulic model was "loaded" with the existing and future sewer flows from the upstream parcels entering the manhole (i.e. the manhole's sewershed).

Figure 6-1: Sewer Flow Allocation

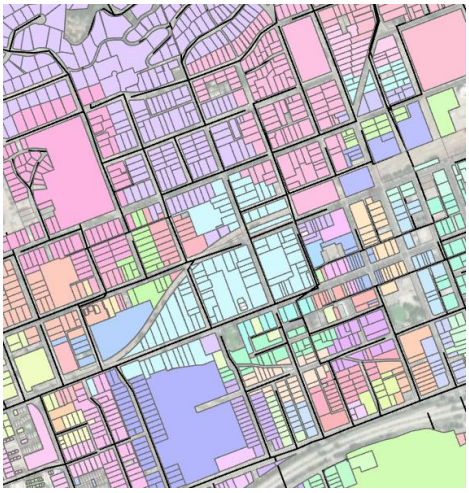
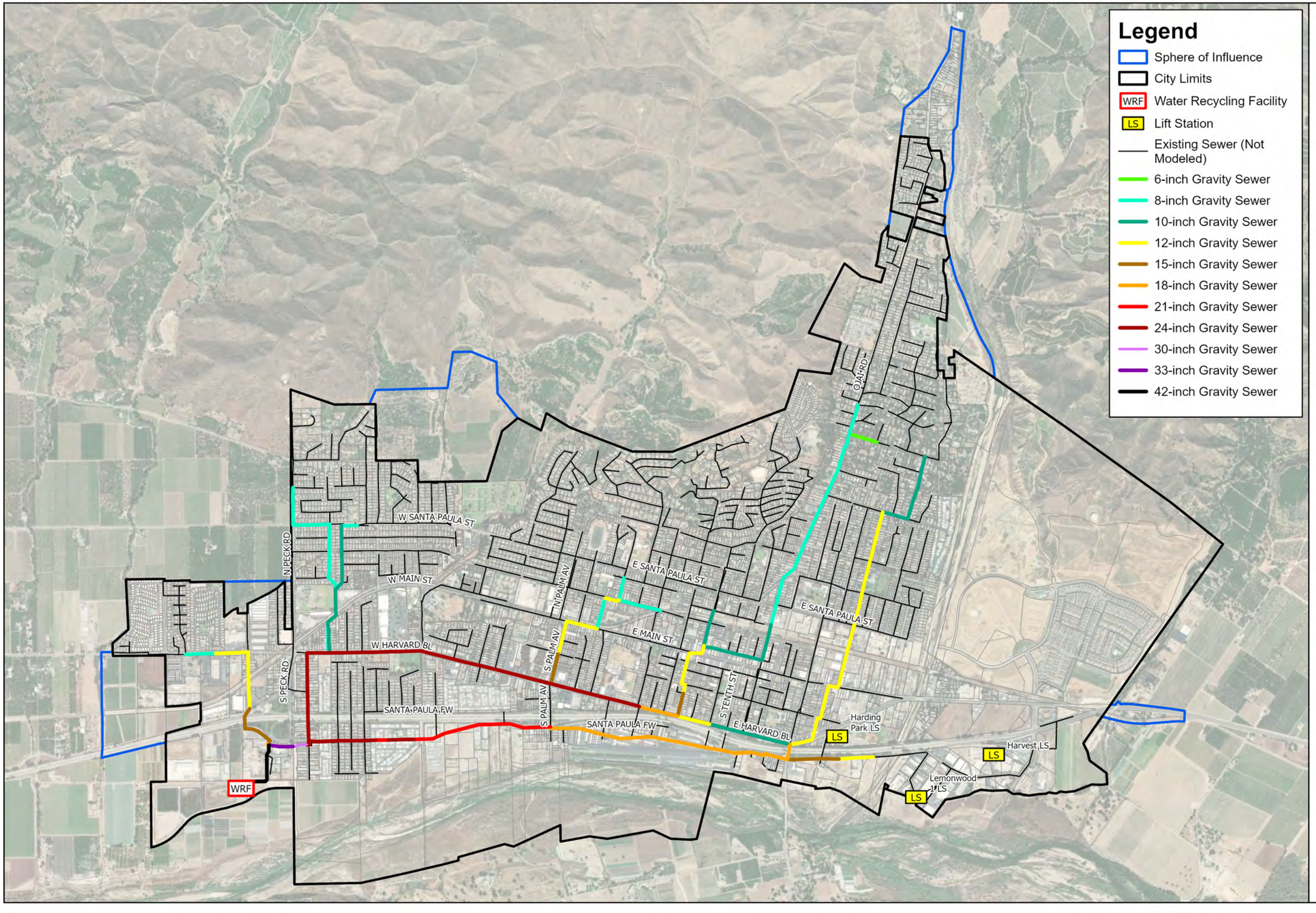


Figure 6-1 shows a sample of the sewersheds that were developed for loading existing and future flows into the hydraulic model. Major trunk pipelines throughout the City and other critical areas were included in the hydraulic model and are shown on **Figure 6-2**.

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 6-2:

Modeled Gravity Collection System

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6.1.2 Model Scenarios

The following model simulations were completed to identify existing pipe capacity and pipe velocities during existing and future flow conditions:

- Existing Flow Conditions:
  - Average Day Flow (ADF)
  - Peak Hour Dry Weather Flows (PHDWF)
  - Peak Hour Wet Weather Flows (PHWWF)
  - Capital Improvement Plan Projects Identified to Correct System Deficiencies
- Near-Term Conditions:
  - ADF, PHDWF, PHWWF
  - Capital Improvement Plan Projects Identified to Correct System Deficiencies
- Ultimate Flow Conditions:
  - ADF, PHDWF, PHWWF
  - Capital Improvement Plan Projects Identified to Correct System Deficiencies

6.1.3 Model Settings

With the collection system network configured, existing and future flows were imported into SewerCAD and the following modeling parameters were configured:

- All hydraulic simulations were completed under the following:
  - Steady state time analysis – Single instantaneous analysis
  - Analysis calculation method – Gradually Varied Flow with Convex Routing (GVF-Convex Solver)
- The following Mannings n friction coefficients were used for gravity pipelines:
  - All existing pipes: 0.013
  - New pipes: 0.011

6.2 Hydraulic Model Flow Validation

As described in **Section 3.4**, MKN used City water usage data and WRF influent treatment flows from 2020 to 2022 to estimate existing flow conditions within the hydraulic model. These initial flow estimates were verified using the newly acquired flow monitoring data.

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7.0 HYDRAULIC ANALYSIS – EXISTING CONDITIONS

This section summarizes the hydraulic evaluation of the existing collection system to serve existing flows within the Study Area.

7.1 Gravity Collection System Hydraulic Analysis

7.1.1 Evaluation Overview

The collection system was evaluated using the design criteria defined in Section 5 under PHDWF and PHWWF flow conditions and recommendations were made for pipes found to be deficient.

The existing gravity collection system includes over 59 miles of gravity sewer pipe ranging from 4-inch to 42-inch in diameter. As described in Section 6, MKN developed a hydraulic model in Bentley's SewerCAD using information from the 2012 WWMP and the City's existing collection system AutoCAD file to evaluate the City's collection system. Only pipe segments along major trunk sewer mains were evaluated, amounting to approximately 11 miles or 18% of the system (**Figure 6-2**). The pipe segments selected for the evaluation were consistent with the pipe segments selected for analysis in the previous 2012 WWMP.

The hydraulic evaluation of the gravity collection system includes the pipeline sizes, slopes, and downstream restrictions. The ratio of the depth of wastewater (d) to the diameter of the pipe (D) is a typical measure of the hydraulic capacity in gravity pipelines. Pipes were considered deficient if the pipe's d/D exceeded the following PHWDF and PHWWF conditions:

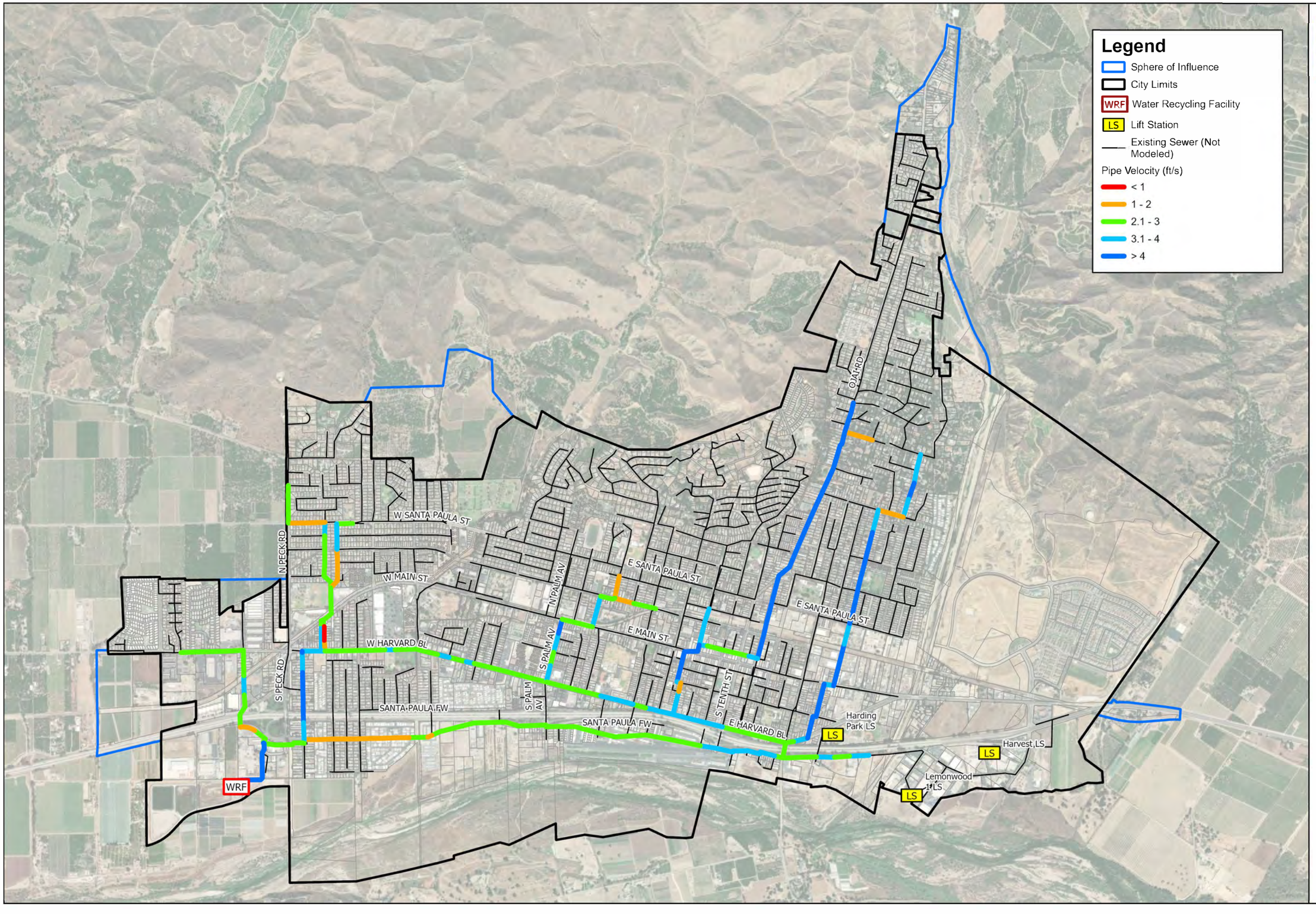
- Peak Hour Dry Weather Flow (PHDWF)
  - For a pipe 12 inches or less, a d/D of 50 or greater
  - For a pipe greater than 12 inches, a d/D of 67 or greater
- Peak Hour Wet Weather Flow (PHWWF)
  - For all pipe diameters, a d/D of 75 or greater

7.1.2 Existing Flows Hydraulic Model Evaluation Results

Figure 7-1 and **Figure 7-2** provide an overview of model results showing pipeline velocities during existing PHDWF and PHWWF conditions, respectively. Based on model results, approximately 89% of the modeled gravity pipelines achieved self-cleaning velocities equal to or greater than 2 feet per second during PHDWF conditions. During PHWWF conditions, approximately 97% of the modeled gravity sewer pipelines achieved self-cleaning velocities equal to or greater than 2 feet per second. These self-cleaning velocities are considered satisfactory, and no gravity pipeline improvements were recommended based on insufficient velocities.

Table 7-1 provides a summary of the existing gravity collection system pipeline deficiencies based on the evaluation criteria defined in Section 5. Existing system deficiencies were assigned a deficiency number, using "EX" to

designate existing flow conditions (i.e. EX-1). Based on the existing hydraulic model evaluation, there are approximately 50 pipelines that exceed the d/D capacity criteria under existing PHDWF and/or PHWWF conditions. Additionally, seven pipeline d/D deficiencies are resolved once downstream conditions are improved through recommended pipeline upgrades. Eight of the pipeline d/D deficiencies are within 5% of the design criteria, and improvements were not recommended for the marginal exceedance of the design criteria. **Figure 7-3** provides an overview of existing PHDWF pipeline d/D deficiencies and **Figure 7-4** provides an overview of existing PHWWF pipeline d/D deficiencies. **Table 7-2** provides a summary of the recommended improvements to address capacity deficiencies associated with existing PHDWF and PHWWF conditions as described in **Table 7-1**.



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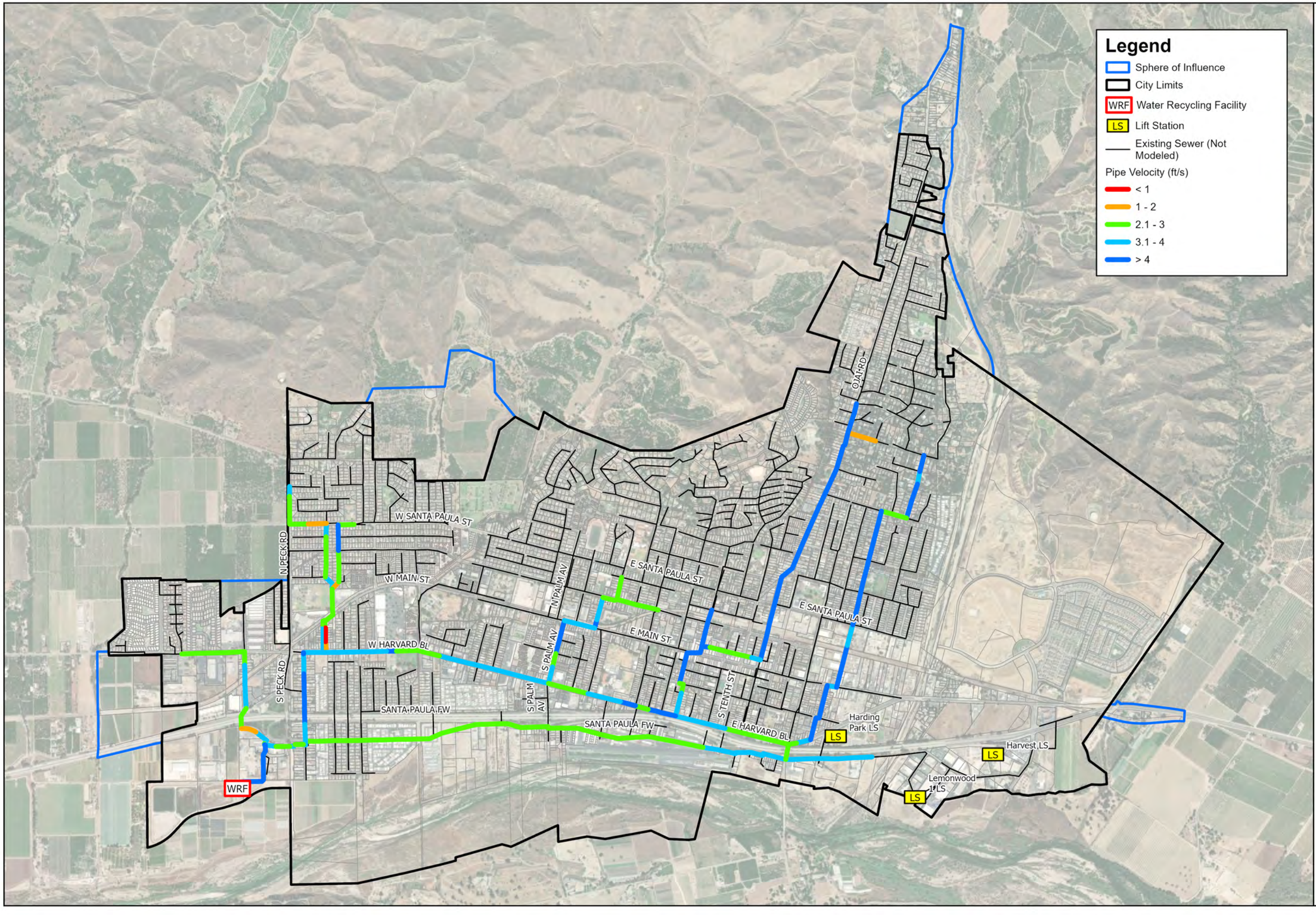
Figure 7-1:

Gravity Pipeline Velocities During Existing PHDWF Conditions

1 inch = 2,200 feet

0 1,100 2,200

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 7-2:

Gravity Pipeline Velocities During Existing PHWWF Conditions

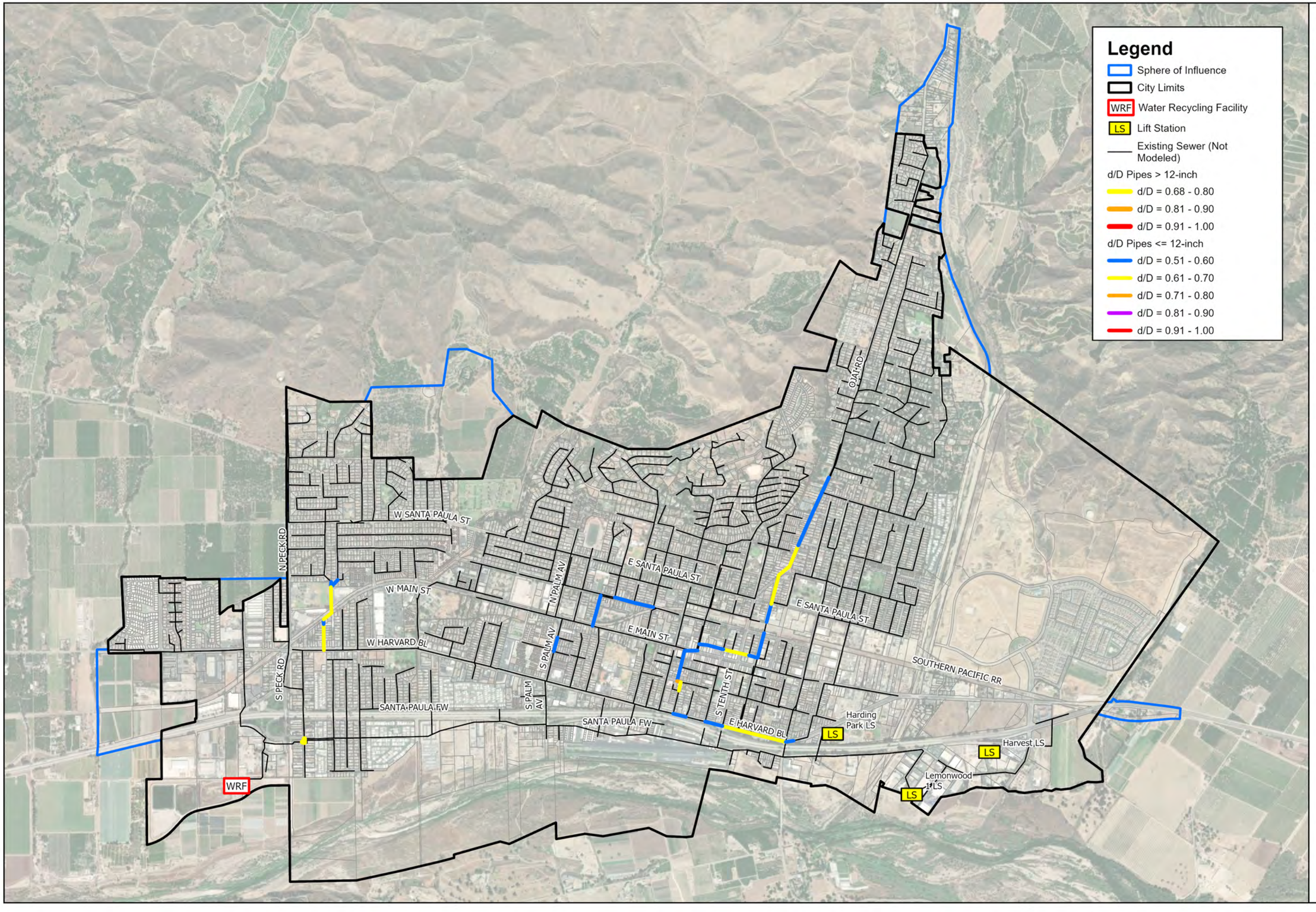
1 inch = 2,200 feet

0 1,100 2,200

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Table 7-1: Gravity Collection System Pipe Deficiencies for Existing Flow Conditions											
Deficiency No. (EX-#)	Model ID	Location	Length (ft)	Diameter (in)	Existing PHDWF			Existing PHWWF			Deficiency Description
					Flow (gpm)	d/D Criteria	d/D Result	Flow (gpm)	d/D Criteria	d/D Result	
EX-1	2686	Acacia Rd (536 Acacia Way)	45	24	3375	<= 67	68	5062	<= 75	87	Capacity deficiency for both PHDWF and PHWWF
EX-2	2685	Acacia Rd (536 Acacia Way to Acacia Way)	40	24	3369	<= 67	69	5054	<= 75	89	Capacity deficiency for both PHDWF and PHWWF
EX-3	2428	Acacia Rd (Acacia Way and Acacia Rd Intersection)	35	24	3369	<= 67	67	5054	<= 75	89	Capacity deficiency for both PHDWF and PHWWF
EX-4	2306	Acacia Way (Acacia Rd to Santa Rosa Loop)	250	24	694	<= 67	60	1041	<= 75	82	Downstream pipe creates a surcharged condition for PHWWF
EX-5	2457	Acacia Rd (Acacia Way to W Santa Maria St)	340	24	2668	<= 67	61	4002	<= 75	83	Capacity deficiency for PHWWF
EX-6	2259	Elm St (W Harvard Blvd to 220 Elm St)	525	8	374	<= 50	63	561	<= 75	84	Capacity deficiency for both PHDWF and PHWWF
EX-7	2286	Elm St (220 Elm St to W Main St)	95	10	372	<= 50	58	559	<= 75	79	Capacity deficiency for both PHDWF and PHWWF
EX-8	2295	W Main St (Elm St to 700 W Main St)	210	10	372	<= 50	65	558	<= 75	91	Capacity deficiency for both PHDWF and PHWWF
EX-9	2289	Blanchard Elementary School (W Main St to Blanchard Elementary School)	130	10	371	<= 50	65	556	<= 75	98	Capacity deficiency for both PHDWF and PHWWF
EX-10	2333	Blanchard Elementary School	390	10	371	<= 50	65	556	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-11	1690	Blanchard Elementary School	105	8	130	<= 50	59	196	<= 75	73	Capacity deficiency for PHDWF
EX-12	2294	Blanchard Elementary School (Blanchard Elementary School to Pamela Ct)	200	10	240	<= 50	57	359	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-13	2328	Pamela Ln (Pamela Ct to Venus Ave)	370	10	214	<= 50	48	321	<= 75	80	Downstream pipe creates a surcharged condition for PHWWF
EX-14	2364	S Palm Ave (E Ventura St to Yale Ct)	285	12	554	<= 50	53	831	<= 75	67	Upgrade not recommended (within 5% of d/D criteria)
EX-15	1815	N 4th St (E Main St to 122 N 4th St)	175	8	291	<= 50	54	436	<= 75	68	Upgrade not recommended (within 5% of d/D criteria)
EX-16	2248	N 4th St (122 N 4th St to E Santa Barbara St)	460	8	276	<= 50	56	413	<= 75	69	Capacity deficiency for PHDWF
EX-17	2212	E Santa Barbara St (N 5th St to N 6th St)	400	8	198	<= 50	58	297	<= 75	77	Capacity deficiency for both PHDWF and PHWWF
EX-18	2214	E Santa Barbara St (N 6th St to N 7th St)	400	8	183	<= 50	56	274	<= 75	75	Capacity deficiency for both PHDWF and PHWWF
EX-19	2502	California St (206 California St to E Ventura St)	180	12	678	<= 50	69	1017	<= 75	83	Capacity deficiency for both PHDWF and PHWWF
EX-20	2494	E Ventura St (California St to Green St)	80	12	664	<= 50	72	996	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-21	2368	Green St (E Ventura St to Yale St)	295	12	653	<= 50	54	979	<= 75	82	Downstream pipe creates a surcharged condition for both PHDWF and PHWWF
EX-22	2350	Green St (Yale St Halfway to E Main St)	165	12	643	<= 50	51	964	<= 75	63	Upgrade not recommended (within 5% of d/D criteria)
EX-23	2351	Green St (Halfway from Yale St to E Main St)	165	12	630	<= 50	50	944	<= 75	62	Upgrade not recommended (within 5% of d/D criteria)
EX-24	2361	E Main St (Green St to Davis St)	265	12	626	<= 50	50	939	<= 75	62	Upgrade not recommended (within 5% of d/D criteria)
EX-25	2287	E Main St (Davis St to 925 E Main St)	165	10	455	<= 50	57	682	<= 75	70	Capacity deficiency for PHDWF
EX-26	2317	E Main St (925 E Main St to N Mill St)	335	10	451	<= 50	60	677	<= 75	83	Capacity deficiency for both PHDWF and PHWWF
EX-27	2292	E Main St (N Mill St to 969 E Main St)	180	10	449	<= 50	65	673	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-28	2329	E Main St (969 E Main St to 1033 E Main St)	350	10	438	<= 50	64	657	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-29	2707	E Main St (1033 E Main St to N Ojai St)	180	10	432	<= 50	57	648	<= 75	92	Capacity deficiency for both PHDWF and PHWWF
EX-30	2341	N Ojai St (113 N Ojai St to E Santa Barbara St)	515	10	391	<= 50	51	586	<= 75	73	Downstream pipe creates a surcharged condition for PHDWF
EX-31	2330	N Ojai St (Railroad Ave to E Santa Paula St)	375	8	376	<= 50	57	564	<= 75	71	Capacity deficiency for PHDWF
EX-32	2488	N Ojai St (E Santa Paula St and N Ojai St Intersection)	40	8	370	<= 50	65	556	<= 75	79	Capacity deficiency for both PHDWF and PHWWF
EX-33	2708	N Ojai St (E Santa Paula St to 325 N Ojai St)	260	8	365	<= 50	64	547	<= 75	79	Capacity deficiency for both PHDWF and PHWWF
EX-34	2709	N Ojai St (325 N Ojai St to Ojai Rd)	300	8	358	<= 50	64	537	<= 75	78	Capacity deficiency for both PHDWF and PHWWF
EX-35	2020	Ojai Rd (N Ojai St to Saticoy St)	275	8	346	<= 50	63	519	<= 75	77	Capacity deficiency for both PHDWF and PHWWF
EX-36	2245	Ojai Rd (Saticoy St to E Orchard St)	455	8	312	<= 50	61	467	<= 75	75	Capacity deficiency for PHDWF
EX-37	2249	Ojai Rd (E Orchard St to Park St)	460	8	292	<= 50	58	438	<= 75	72	Capacity deficiency for PHDWF
EX-38	2224	Ojai Rd (Park St to 604 Ojai Rd)	420	8	269	<= 50	56	404	<= 75	69	Capacity deficiency for PHDWF
EX-39	2071	Ojai Rd (604 Ojai Rd to Richmond Rd)	300	8	260	<= 50	54	390	<= 75	67	Downstream pipe creates a surcharged condition for PHDWF
EX-40	2118	Ojai Rd (Richmond Rd to 725 Ojai Rd)	325	8	230	<= 50	52	345	<= 75	64	Upgrade not recommended (within 5% of d/D criteria)
EX-41	2367	E Harvard Blvd (California St to Brett Way)	265	12	488	<= 50	54	732	<= 75	67	Upgrade not recommended (within 5% of d/D criteria)
EX-42	2327	E Harvard Blvd (S Mill St to S 10th St)	365	10	473	<= 50	58	710	<= 75	77	Capacity deficiency for both PHDWF and PHWWF
EX-43	2313	E Harvard Blvd (S 10th St to S Ojai St)	320	10	464	<= 50	62	697	<= 75	93	Capacity deficiency for both PHDWF and PHWWF
EX-44	2281	E Harvard Blvd (E Harvard Blvd and Ojai St Intersection)	25	10	458	<= 50	64	687	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-45	2304	E Harvard Blvd (S Ojai St to S 11th St)	245	10	450	<= 50	63	675	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-46	2310	E Harvard Blvd (S 11th St to 1123 E Harvard Blvd)	290	10	440	<= 50	62	660	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-47	2335	E Harvard Blvd (1123 E Harvard Blvd to S 12th St)	440	10	429	<= 50	62	644	<= 75	100	Capacity deficiency for both PHDWF and PHWWF
EX-48	2629	E Harvard Blvd (E Harvard Blvd and S 12th St)	35	12	495	<= 50	52	742	<= 75	100	Downstream pipe creates a surcharged condition for PHDWF and PHWWF
EX-49	2628	E Harvard Blvd (S 12th St to 1211 Harvard Blvd)	125	12	494	<= 50	52	741	<= 75	100	Downstream pipe creates a surcharged condition for PHDWF and PHWWF
EX-50	2366	E Harvard Blvd (1211 Harvard Blvd to Garcia St)	290	12	491	<= 50	48	736	<= 75	77	Upgrade not recommended (within 5% of d/D criteria)

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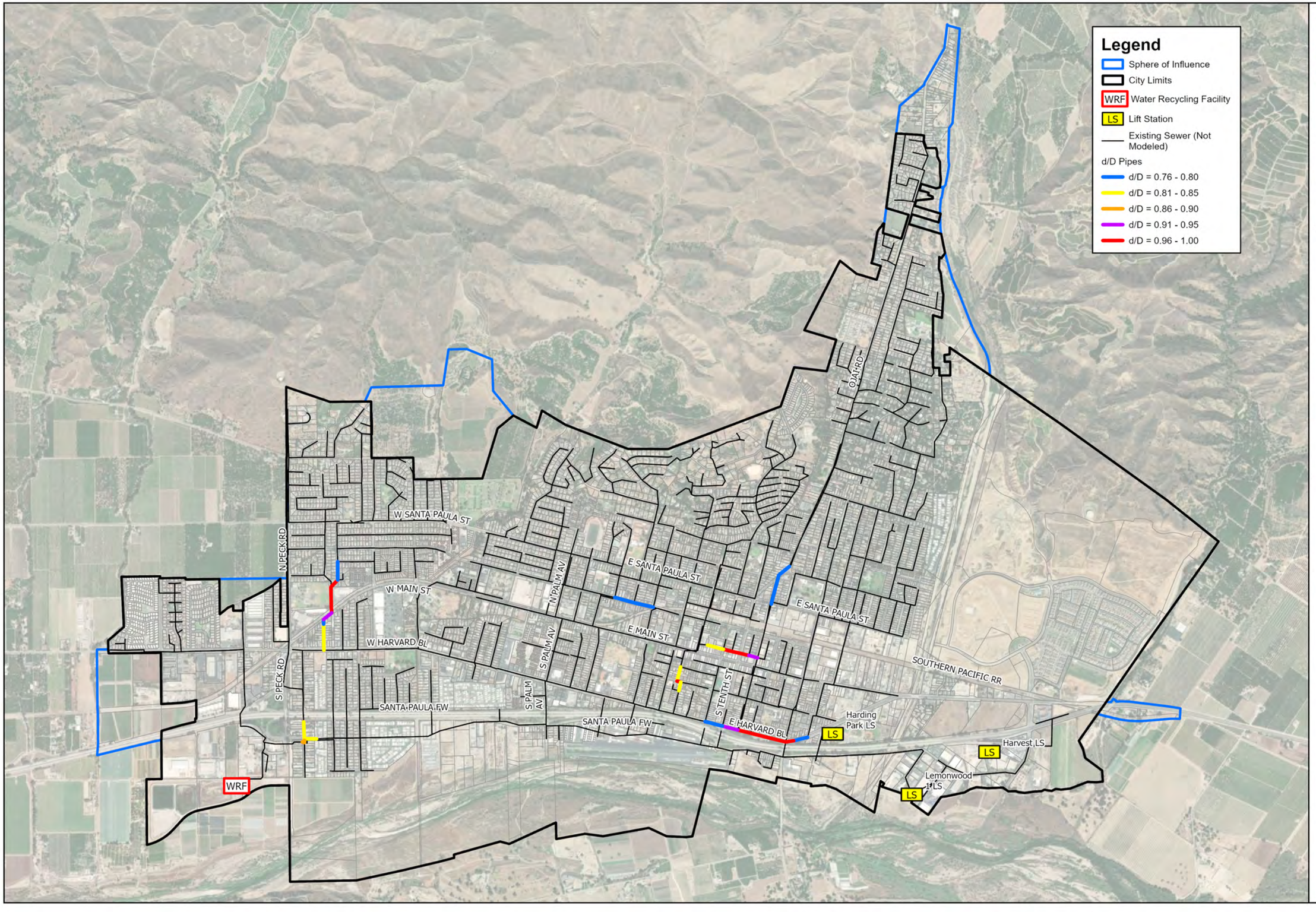
Figure 7-3:

Existing PHDWF Pipeline d/D Deficiencies

1 inch = 2,200 feet

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Wastewater Collection System and Water Recycling Facility Master Plan

Figure 7-4:

Existing PHWWF Pipeline d/D Deficiencies

1 inch = 2,200 feet

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Table 7-2: Recommended Improvements to Address Existing Flow Conditions												
Improvement (I-EX-#)	Model Deficiency Addressed	Location	Bounds	Length (ft)	Initial Diameter (in)	Proposed Diameter (in)	PHDWF Conditions			PHWWF Conditions		
							Average Flow (gpm)	Average Existing d/D	Average Improved d/D	Average Flow (gpm)	Average Existing d/D	Average Improved d/D
I-EX-1	EX-19	California St	206 California St to E Ventura St	180	12	15	678	69	50	1017	83	63
I-EX-2	EX-20	E Ventura St	California St to Green St	80	12	15	664	72	48	996	100	62
I-EX-3	EX-1	Acacia Rd	536 Acacia Way	45	24	30	3375	68	54	5062	87	68
I-EX-4	EX-2 & EX-3	Acacia Rd	536 Acacia Way to Acacia Rd Intersection	75	24	30	3369	68	52	5054	89	67
I-EX-5	EX-5	Acacia Rd	Acacia Way to W Santa Maria St	340	24	27	2668	61	50	4002	83	66
I-EX-6	EX-25, EX-26, EX-27, EX-28, EX-29	E Main St	Davis St to N Ojai St	1210	10	12	445	61	46	667	89	58
I-EX-7	EX-42, EX-43, EX-44, EX-45, EX-46, EX-47	E Harvard Blvd	S Mill St to S 12th St	1680	10	12	452	62	46	679	95	59
I-EX-8	EX-6	Elm St	W Harvard Blvd to 220 Elm St	525	8	10	374	63	46	561	84	57
I-EX-9	EX-7	Elm St	220 Elm St to W Main St	100	10	12	372	58	44	559	79	56
I-EX-10	EX-8	W Main St	Elm St to 700 W Main St	210	10	12	372	65	48	558	91	61
I-EX-11	EX-9 & EX-10	Blanchard Elementary School	W Main St to Blanchard Elementary School	520	10	12	371	65	48	556	99	61
I-EX-12	EX-11	Blanchard Elementary School	Blanchard Elementary School	110	8	10	130	59	43	196	73	54
I-EX-13	EX-12	Blanchard Elementary School	Blanchard Elementary School to Pamela Ct	200	10	12	240	57	43	359	100	54
I-EX-14	EX-31, EX-32, EX-33, EX-34	N Ojai St	Railroad Ave to Ojai Rd	980	8	10	367	62	48	551	77	60
I-EX-15	EX-17 & EX-18	E Santa Barbara St	N 5th St to N 7th St	800	8	10	190	57	42	285	76	52
I-EX-16	EX-35, EX-36, EX-37, EX-38	Ojai Rd	N Ojai St to 604 Ojai Rd	1615	8	10	305	59	44	457	73	55
I-EX-17	EX-16	N 4th St	122 N 4th St to E Santa Barbara St	460	8	10	276	56	43	413	69	54

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7.2 Lift Station and Force Main Evaluation

Table 7-3 provides a summary of the pumping capacity versus inflow for the City's three existing lift stations. Pumping capacity information for the Lemonwood 1 and Harding Park lift stations were not available. However, the Harvest lift station appears to have sufficient pumping capacity to serve existing flow conditions.

Table 7-3: Lift Station Pump Capacity for Existing Flows

Flow Condition		Lift Station		
		Lemonwood 1	Harding Park	Harvest
ADF	gpd	59,040	2,005	99,360
	gpm	41	1	69
PHDWF	Peaking Factor	2.0 x ADF		
	gpm	82	2	138
PHWWF	Peaking Factor	3.0 x ADF		
	gpm	123	3	207
Pumping Capacity	gpm	NA	NA	1,100

Notes:
1. ADF = Average Day Flow
2. PHDWF = Peak Hour Dry Weather Flow
3. PHWWF = Peak Hour Wet Weather Flow
4. gpd = gallons per day
5. gpm = gallons per minute
6. NA = Not available

For lift station force mains it is recommended that pipeline velocities be greater than 3.0 feet per second to provide self-cleaning velocities, but less than 5.0 – 10.0 feet per second to minimize head loss and surge events. **Table 7-4** provides an overview of the hydraulic analysis completed for the City's lift station force mains.

Table 7-4: Force Main Evaluation for Existing Flows

Parameter	Units	Lift Station		
		Lemonwood 1	Harding Park	Harvest
Force Main Diameter	inches	6	4 & 6	8
Force Main Material	--	PVC	PVC	PVC
Hazen Williams C	--	140	140	140
Force Main Length	feet	1,900	207 & 208	1,780
Design Flows				
Pumping Capacity	gpm	NA	NA	1,100
Total Dynamic Head	feet	NA	NA	70
Force Main Hydraulics				
Velocity	fps	NA	NA	7.0
Travel Time to Gravity system	minutes	NA	NA	4

Notes:
1. gpm = gallons per minute
2. fps = feet per second
3. NA = Not available

Pumping capacity information for the Lemonwood 1 and Harding Park lift stations was not available. However, force main velocities for the Harvest Lift Station were observed to be within the recommended design range.

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8.0 LIFT STATION CONDITION ASSESSMENT

This section summarizes the condition assessment of the City's existing lift stations facilities.

8.1 Condition Assessment

To complete an assessment of the lift station facilities, MKN visited the sites with operations staff to observe existing conditions on September 12, 2023. During these visits, MKN observed the general configuration of the lift stations and reviewed the following items:

- ❑ Configuration / Pumps
- ❑ Lift Station Safety Features
- ❑ Flood Resilience
- ❑ Backup Power
- ❑ Wet Well Structure
- ❑ Dry Well Structure
- ❑ Coatings
- ❑ Instrumentation
- ❑ Access
- ❑ Bypassing Provisions
- ❑ Site Features

During these visits, specific operational deficiencies and suggested facility improvements were discussed with the operators. Observations and staff comments from the lift station assessments are provided below. Completed lift station checklists are provided in **Appendix E**.

8.1.1 Harding Park Lift Station

The Harding Park Lift Station is located in a parking lot planter 15 feet northeast of the Harding Park restroom. A summary of condition assessment is presented in **Table 8-1**.

Table 8-1: Harding Park Lift Station Condition Assessment Summary	
Assessment Item	**Observations**
Configuration / Pumps	❑ Lift station configuration is a round concrete wet well with two submersible pumps and two inlets ❑ Collects from one house located approximately 350 ft northwest of the lift station and one restroom directly west of the lift station ❑ Per the City operator, there was a recent seal failure
Lift Station Safety Features	❑ Lighting provided by parking lot light fixtures
Flood Resilience	❑ Historical flooding issues (none recently) ❑ Rainwater infiltrates ceiling conduit and has compromised some of the safety features
Backup Power	❑ No backup power provisions ❑ Operators bring in a vactor truck and/or submersible pump as needed
Wet Well Structure	❑ The wet well experiences odor and debris issues, as well as grease build up
Valve Vault Structure	❑ Good
Coatings	❑ Good
Instrumentation	❑ Instrumentation includes a level sensor and an antenna that radio to the Lemonwood 1 lift station in the event of a high level power failure
Access	❑ Accessible from park parking lot
Bypassing Provisions	❑ None
Site Features	❑ Located in park

8.1.2 Harvest Lift Station

The Harvest Lift Station is located on Old Hallock Drive south of Highway 126 adjacent to an RV storage yard. A summary of condition assessment is presented in **Table 8-2**.

Table 8-2: Harvest Lift Station Condition Assessment Summary	
Assessment Item	**Observations**
Configuration / Pumps	❑ The lift station configuration is a round concrete wet well and includes 3 submersible pumps ❑ No issues reported with pumps
Lift Station Safety Features	❑ Fall protection
Flood Resilience	❑ Not applicable
Backup Power	❑ Permanent generator
Wet Well Structure	❑ There is H2S damage on metal piping, switches, electronics, etc. ❑ Structure in acceptable condition; coating and piping damage ❑ Has 10,000 gal overflow tank
Valve Vault Structure	❑ Not applicable
Coatings	❑ General corrosion in pipe and concrete coatings present ❑ Valve vault had previous leakage issues and H2S damage due to drain line (connected to wet well)
Instrumentation	❑ Level sensing transmitter ❑ No flow metering
Access	❑ Gated access ❑ Limited space available for equipment
Bypassing Provisions	❑ Points of connection for bypassing
Site Features	❑ Site is less than 3 years old

8.1.3 Lemonwood 1 Lift Station

The Lemonwood 1 Lift Station is located south of Highway 126 in Lemonwood Industrial Park. A summary of condition assessment is presented in **Table 8-3**.

Table 8-3: Lemonwood 1 Lift Station Condition Assessment Summary	
Assessment Item	**Observations**
Configuration / Pumps	❑ Lift station configuration is two above ground suction lift pumps in an enclosure over a wet well ❑ The current pumps are old and do not have a large pumping capacity. However, flow conditions are acceptable following the installation of the Harvest LS
Lift Station Safety Features	❑ Lighting recently upgraded
Flood Resilience	❑ No flooding issues historically, however there are runoff issues
Backup Power	❑ There is a manual transfer switch and a portable generator if needed
Wet Well Structure	❑ Low inlets
Dry Well Structure	❑ Not applicable
Coatings	❑ In acceptable condition
Instrumentation	❑ Radio condition is acceptable ❑ Other instrumentation includes a flow meter, level sensor (approximately 3 years old), and a bubbler control panel that cycles consistently
Access	❑ Pavement has some condition issues ❑ Access by homeless; fence broken ❑ Hard to turn around in vehicle; small site
Bypassing Provisions	❑ Points of connection ❑ Quick connects
Site Features	❑ Graffiti on walls

9.0 HYDRAULIC ANALYSIS – FUTURE CONDITIONS

This section summarizes the hydraulic evaluation of the existing collection system to serve Near-Term and Ultimate flows.

9.1 Gravity Collection System Hydraulic Analysis

9.1.1 Evaluation Overview

MKN evaluated the existing collection system against Near-term and Ultimate flows as defined in Section 3. The future flow scenarios included the following development within or adjacent to the City's SOI:

- Near-Term Flows
  - Approved / Pending Projects
  - East Area 1 Specific Plan
  - East Gateway Specific Plan
- Ultimate Flows
  - Vacant Residential Sites
  - Vacant Commercial Sites
  - Adams Canyon Expansion Area
  - Fagan Canyon Expansion Area
  - East Area 3 Expansion Area
  - West Area 2 Expansion Area

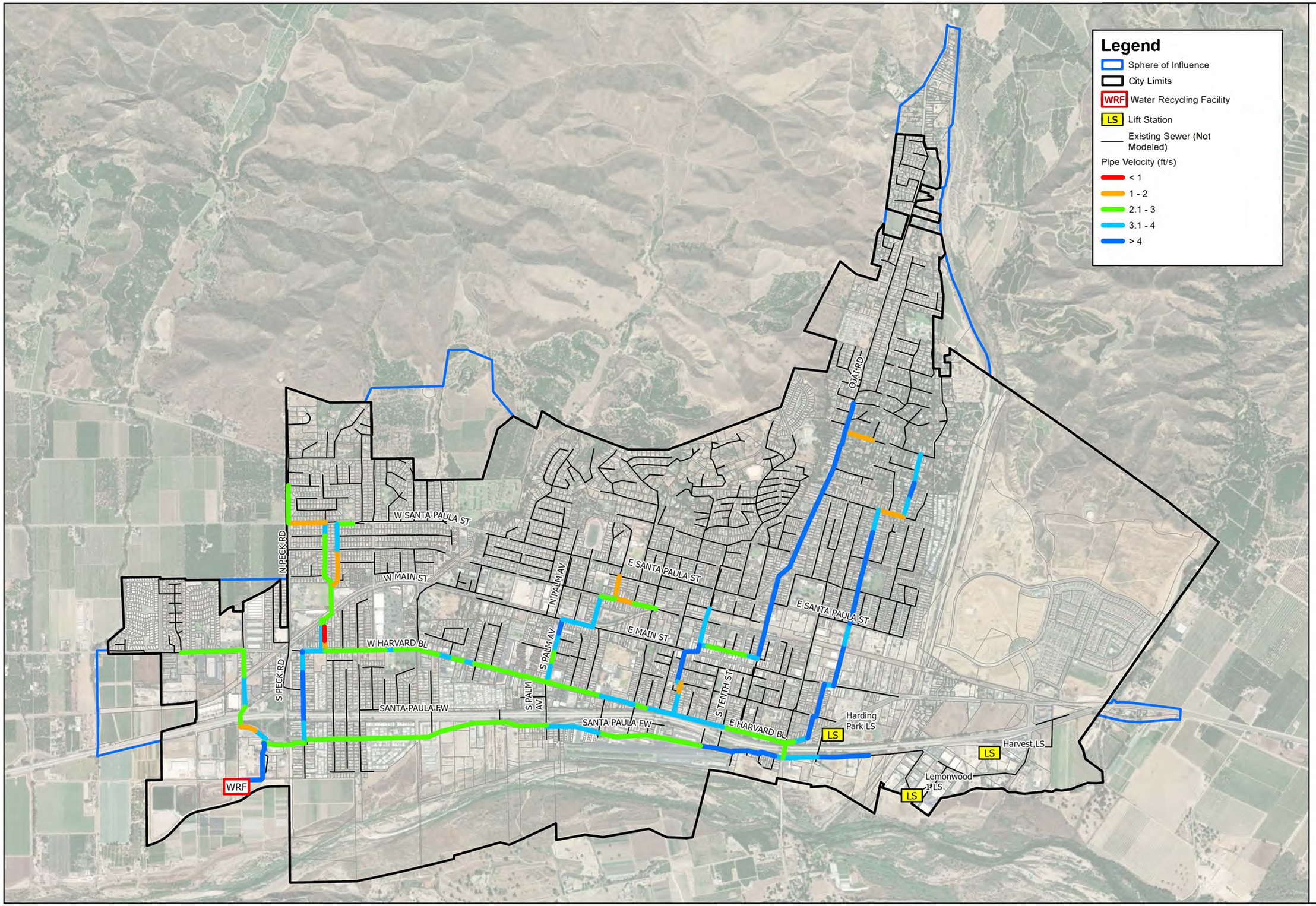
Gravity collection system deficiencies were determined based on a hydraulic evaluation of pipeline sizes, slope, and downstream restrictions. Pipes were considered deficient if the pipe's d/D was greater than the following for PHDWF and PHWWF conditions:

- Peak Hour Dry Weather Flow (PHDWF)
  - For a pipe 12 inches or less, a d/D of 50 or greater
  - For a pipe greater than 12 inches, a d/D of 67 or greater
- Peak Hour Wet Weather Flow (PHWWF)
  - For all pipe diameters, a d/D of 75 or greater

9.1.2 Near-Term Flows Hydraulic Model Evaluation Results

For near-term flows, MKN assumed that all the pipeline recommendations identified in **Table 7-2** were completed prior to conducting the hydraulic evaluation. **Figure 9-1** and **Figure 9-2** provide an overview of gravity pipeline velocities resulting from the model under near-term PHDWF and PHWWF conditions, respectively.

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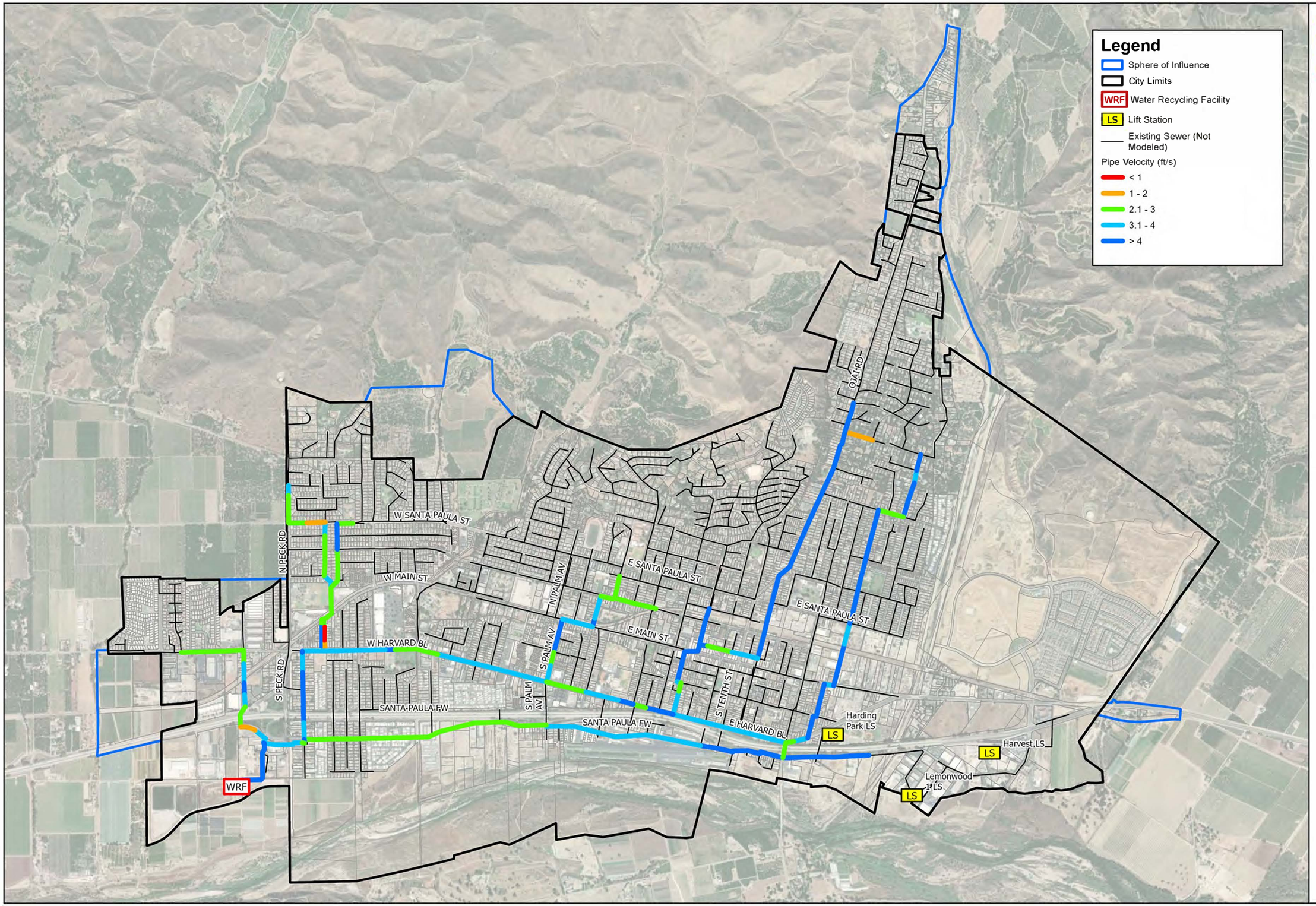
Figure 9-1:

Gravity Pipeline Velocities During Near-Term PHDWF Conditions

1 inch = 2,200 feet

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Figure 9-2:

Gravity Pipeline Velocities During Near-Term PHWWF Conditions

1 inch = 2,200 feet

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Based on model results, approximately 93% of the modeled gravity sewer pipelines within the City's SOI will achieve self-cleaning velocities equal to or greater than 2 feet per second during PHDWF conditions. During PHWWF conditions, approximately 97% of the modeled gravity sewer pipelines within the City's SOI will achieve self-cleaning velocities equal to or greater than 2 feet per second. These self-cleaning velocities are considered satisfactory, and no gravity sewer improvements are recommended based on insufficient velocities.

Table 9-1 provides a summary of the near-term gravity collection system pipe deficiencies based on the design criteria defined in Section 5. System deficiencies were assigned a deficiency number using "NT" to designate the near-term flow condition (i.e. NT-1).

Based on the near-term hydraulic model evaluation, there are 12 pipelines that exceed the d/D design criteria under near-term PHDWF and PHWWF conditions and are considered deficient. Ten pipeline d/D deficiencies that were within 3% of the design criteria were not recommended for capital improvement in the Near-Term scenario. **Figure 9-3** provides an overview of PHDWF pipeline d/D deficiencies and **Figure 9-4** provides an overview of PHWWF pipeline d/D deficiencies for the near-term scenario. These results assume the pipeline improvements identified to address deficiencies under existing flow conditions (**Table 7-2**) were completed.

Table 9-2 provides a summary of the recommended improvements to address capacity deficiencies associated with near-term PHDWF and PHWWF conditions (as described in **Table 9-1**).

9.1.3 Ultimate Flows Hydraulic Model Evaluation Results

For ultimate flows, MKN assumed that all the pipeline recommendations identified in **Table 7-2** and **Table 9-2** were completed prior to conducting the hydraulic evaluation. **Figure 9-5** and **Figure 9-6** provide an overview of typical gravity pipeline velocities during ultimate PHDWF and PHWWF conditions, respectively. Based on model results, approximately 94% of the modeled gravity sewer pipelines within the City's SOI will achieve self-cleaning velocities equal to or greater than 2 feet per second during PHDWF conditions. During PHWWF conditions, approximately 97% of the modeled gravity sewer pipelines within the City's SOI will achieve self-cleaning velocities equal to or greater than 2 feet per second. These self-cleaning velocities are considered satisfactory, and no gravity sewer improvements are recommended based on insufficient velocities.

Table 9-3 provides a summary of the ultimate gravity collection system pipe deficiencies based on the design criteria defined in Section 5. System deficiencies were assigned a deficiency number using "ULT" to designate ultimate flow condition (i.e. ULT-1).

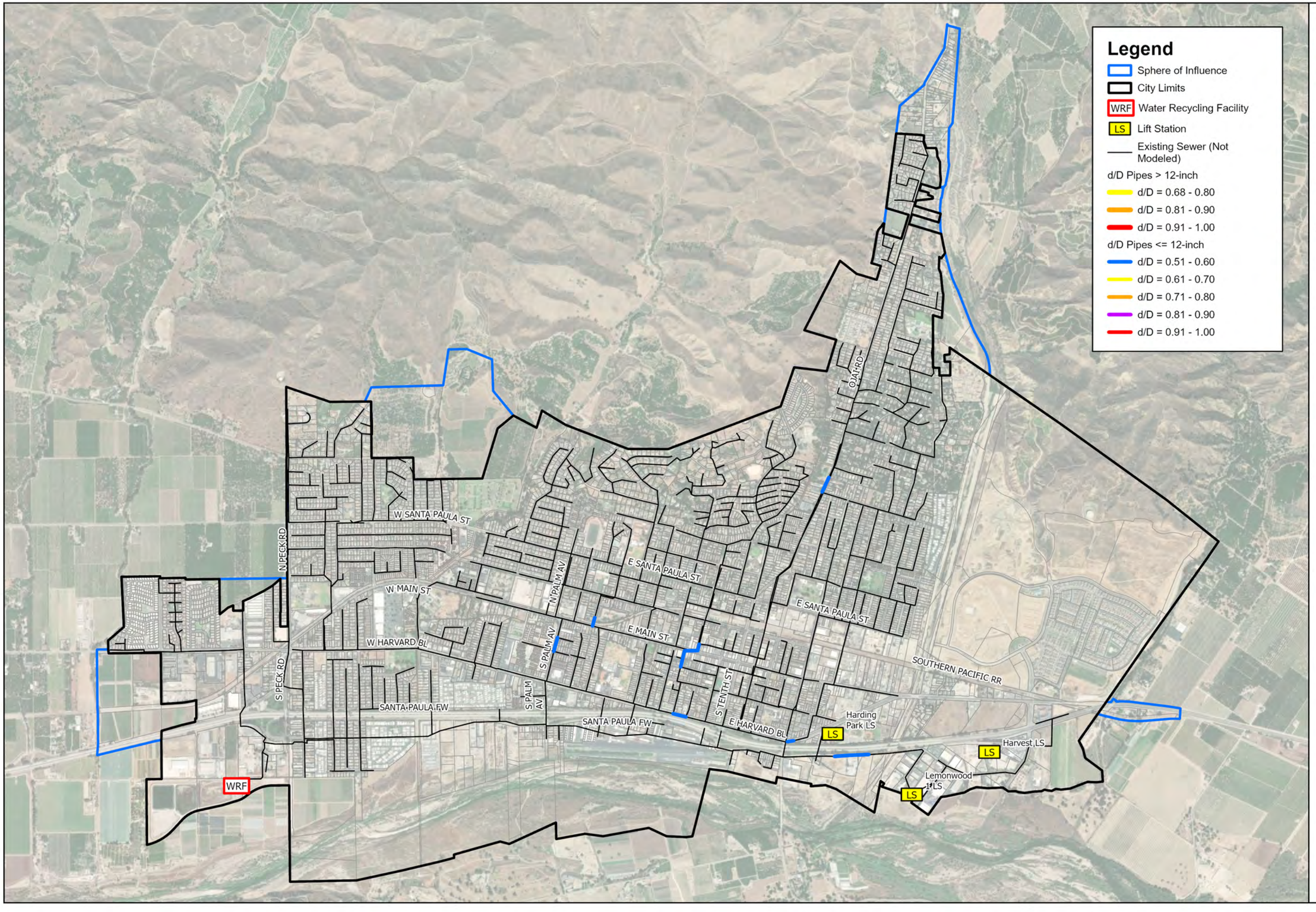
Based on the ultimate hydraulic model evaluation, there are 50 pipelines that exceed the d/D design criteria under ultimate PHDWF and/or PHWWF conditions and are considered deficient. Fourteen pipeline d/D deficiencies that were within 5% of the design criteria were not recommended for capital improvement. Additionally, ten pipeline d/D deficiencies are addressed once downstream conditions are improved through larger diameter pipelines. **Figure 9-7** provides an overview of pipeline PHDWF d/D deficiencies and **Figure 9-8** provides an overview of pipeline PHWWF

d/D deficiencies for the ultimate scenario. These results assume the pipeline improvements identified in **Table 7-2** and **Table 9-2** were completed prior to conducting the hydraulic evaluation.

Table 9-4 provides a summary of the recommended improvements to address capacity deficiencies associated with ultimate PHDWF and PHWWF conditions (as described in **Table 9-3**).

Table 9-1: Near Term Scenario Gravity Collection System Pipe Deficiencies											
Deficiency No. (NT-#)	Model ID	Location	Length (ft)	Diameter (in)	Existing PHDWF			Existing PHWWF			Deficiency Description
					Flow (gpm)	d/D Criteria	d/D Result	Flow (gpm)	d/D Criteria	d/D Result	
NT-1	2306	Acacia Way (Acacia Rd to Santa Rosa Loop)	250	24	1183	<= 67	62	1774	<= 75	84	Capacity deficiency for PHWWF
NT-2	2682	Santa Clara St	305	12	715	<= 50	52	1072	<= 75	65	Upgrade not recommended (within 5% of d/D criteria)
NT-3	2681	Santa Clara St	390	12	715	<= 50	51	1072	<= 75	64	Upgrade not recommended (within 5% of d/D criteria)
NT-4	2364	S Palm Ave (E Ventura St to Yale Ct)	285	12	568	<= 50	54	851	<= 75	68	Upgrade not recommended (within 5% of d/D criteria)
NT-5	1815	N 4th St (E Main St to 122 N 4th St)	175	8	291	<= 50	57	436	<= 75	71	Capacity deficiency for PHDWF
NT-6	2350	Green St (Yale St Halfway to E Main St)	165	12	650	<= 50	51	975	<= 75	63	Upgrade not recommended (within 5% of d/D criteria)
NT-7	2351	Green St (Halfway from Yale St to E Main St)	165	12	636	<= 50	51	955	<= 75	63	Upgrade not recommended (within 5% of d/D criteria)
NT-8	2361	E Main St (Green St to Davis St)	265	12	633	<= 50	50	950	<= 75	62	Upgrade not recommended (within 5% of d/D criteria)
NT-9	2346	Davis St (E Main St to 116 Davis St)	130	12	631	<= 50	50	947	<= 75	62	Upgrade not recommended (within 5% of d/D criteria)
NT-10	2118	Ojai Rd (Richmond Rd to 725 Ojai Rd)	325	8	230	<= 50	52	345	<= 75	64	Upgrade not recommended (within 5% of d/D criteria)
NT-11	2367	E Harvard Blvd (California St to Brett Way)	265	12	489	<= 50	54	734	<= 75	68	Upgrade not recommended (within 5% of d/D criteria)
NT-12	2628	E Harvard Blvd (S 12th St to 1211 Harvard Blvd)	125	12	496	<= 50	52	744	<= 75	68	Upgrade not recommended (within 5% of d/D criteria)

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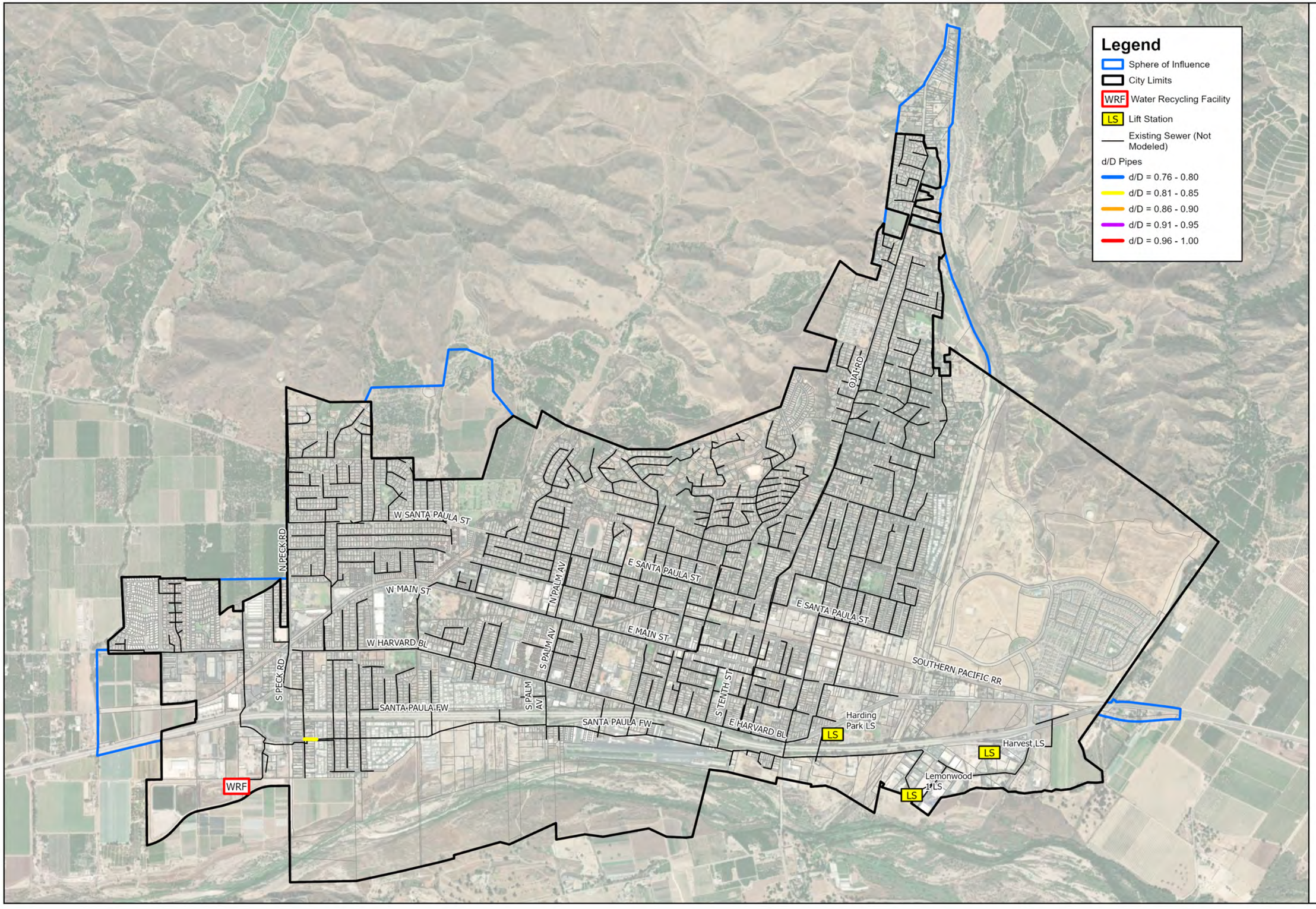
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Figure 9-3:

Near Term PHDWF Pipeline d/D Deficiencies

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Figure 9-4:

Near Term PHWWF Pipeline d/D Deficiencies

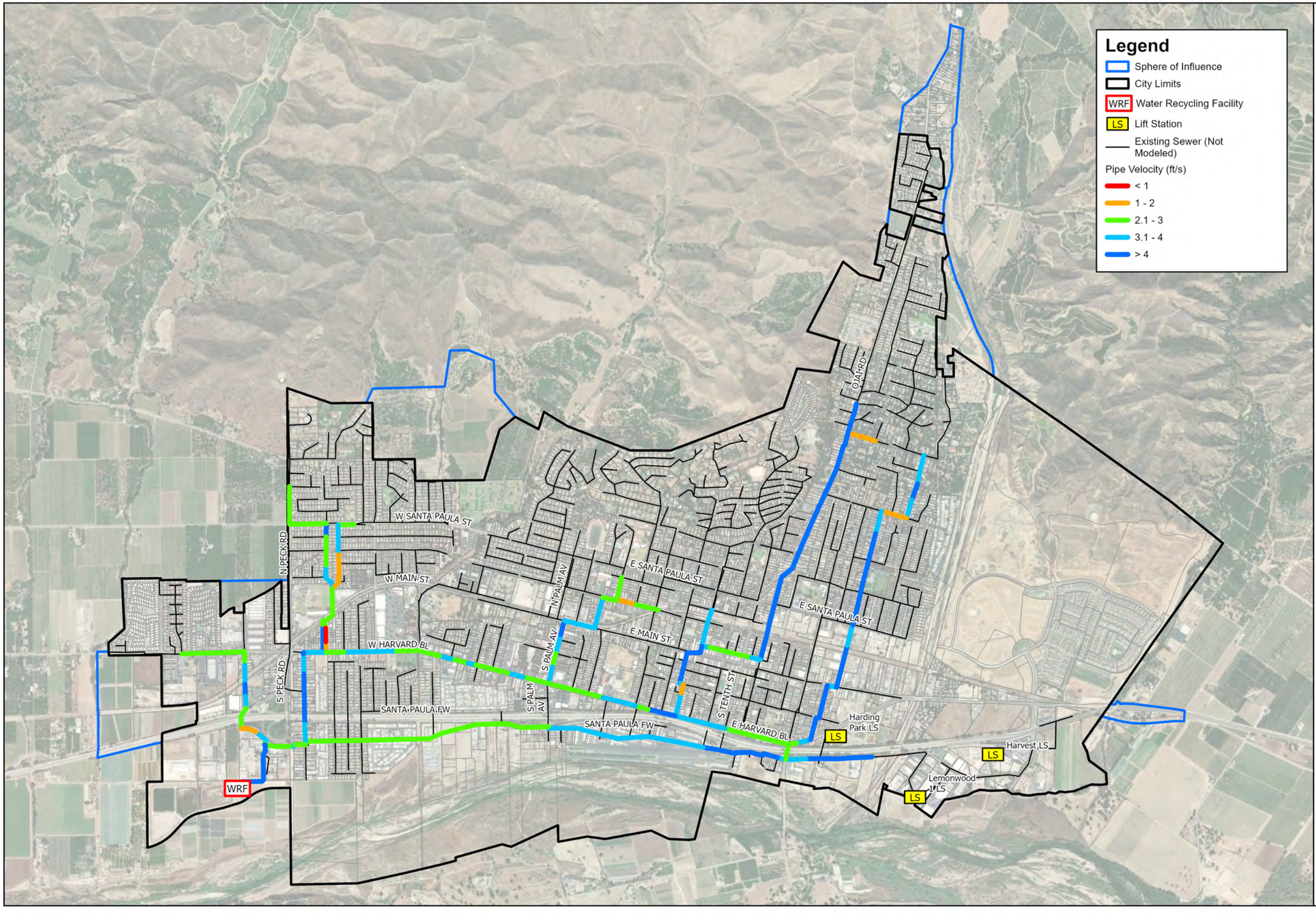
1 inch = 2,200 Feet

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Table 9-2: Recommended Improvements to Address Near Term Scenario Flows												
Improvement (I-EX-#)	Model Deficiency Addressed	Location	Bounds	Length (ft)	Existing Diameter (in)	Proposed Diameter (in)	PHDWF Conditions			PHWWF Conditions		
							Average Flow (gpm)	Average Existing d/D	Average Improved d/D	Average Flow (gpm)	Average Existing d/D	Average Improved d/D
I-NT-1	NT-1	Acacia Way	Acacia Rd to Santa Rosa Loop	250	24	27	1183	62	55	1774	84	74
I-NT-2	NT-5	N 4th St	E Main St to 122 N 4th S	175	8	10	291	57	44	436	71	55

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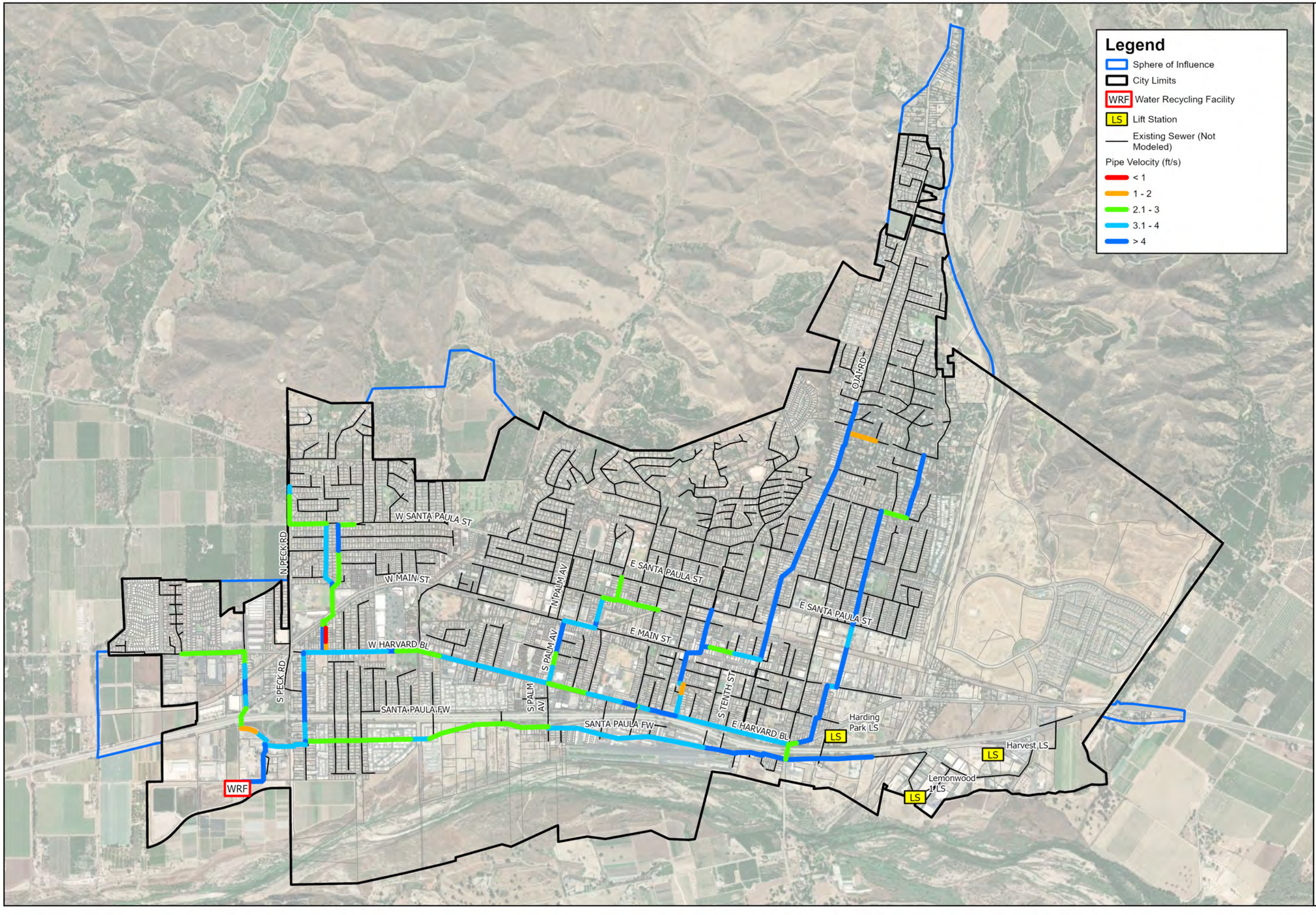
Figure 9-5:

Gravity Pipeline Velocities During Ultimate PHDWF Conditions

1 inch = 2,200 feet

0 1,100 2,200

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Figure 9-6:

Gravity Pipeline Velocities During Ultimate PHWWF Conditions

1 inch = 2,200 feet

0 1,100 2,200

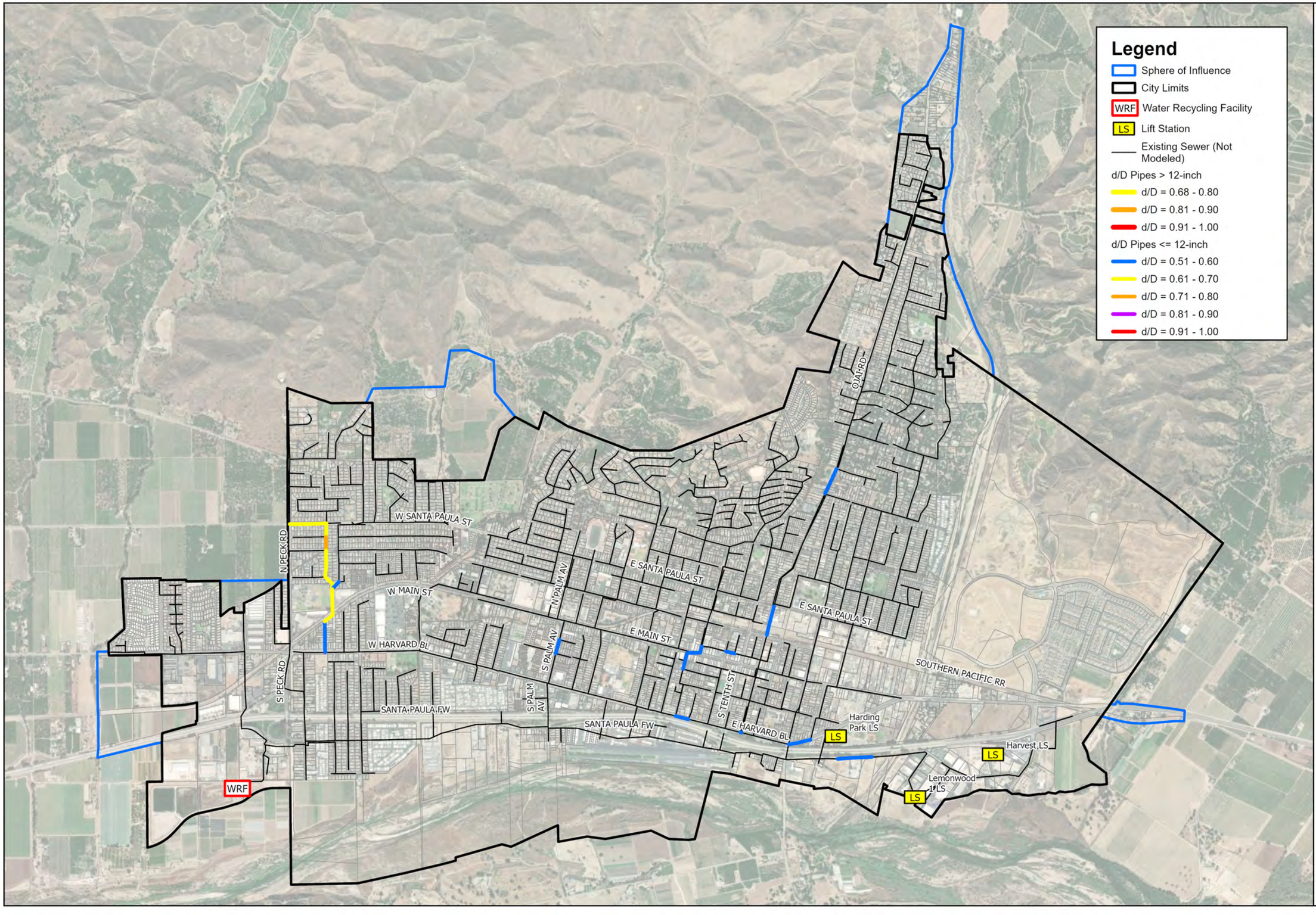
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Table 9-3: Ultimate Scenario Gravity Collection System Pipe Deficiencies											
Deficiency No. (ULT-#)	Model ID	Location	Length (ft)	Diameter (in)	Existing PHDWF			Existing PHWWF			Deficiency Description
					Flow (gpm)	d/D Criteria	d/D Result	Flow (gpm)	d/D Criteria	d/D Result	
ULT-1	2466	Acacia Way (Corporation St to Shell Rd)	85	30	4602	<= 67	61	6902	<= 75	78	Upgrade not recommended (within 5% of d/D criteria)
ULT-2	2465	Acacia Way (At Shell Rd)	45	30	4593	<= 67	62	6890	<= 76	79	Upgrade not recommended (within 5% of d/D criteria)
ULT-3	2467	Acacia Way (Shell Rd to 536 Acacia Way)	170	30	4593	<= 67	63	6890	<= 77	82	Capacity deficiency for PHWWF
ULT-4	2686	Acacia Rd (536 Acacia Way)	45	30[1]	4593	<= 67	64	6890	<= 78	84	Capacity deficiency for PHWWF
ULT-5	2685	Acacia Rd (536 Acacia Rd to Acacia Way)	40	30[1]	4587	<= 67	63	6881	<= 79	83	Downstream pipe creates a surcharged condition for PHWWF
ULT-6	2428	Acacia Rd (Acacia Way and Acacia Rd Intersection)	35	30[1]	4587	<= 67	62	6881	<= 80	82	Downstream pipe creates a surcharged condition for PHWWF
ULT-7	2306	Acacia Way (Acacia Rd to Santa Rosa Loop)	250	27[1]	1332	<= 67	62	1998	<= 81	85	Capacity deficiency for PHWWF
ULT-8	2325	Santa Rosa Loop to Dartmouth Rd	350	24	1323	<= 67	56	1985	<= 82	82	Downstream pipe creates a surcharged condition for PHWWF
ULT-9	2682	Santa Clara St	305	12	849	<= 67	57	1273	<= 83	73	Capacity deficiency for PHDWF
ULT-10	2681	Santa Clara St	390	12	849	<= 67	56	1273	<= 84	73	Capacity deficiency for PHDWF
ULT-11	2457	Acacia Rd (Acacia Way to W Santa Maria St)	340	27[1]	3249	<= 67	60	4873	<= 85	83	Capacity deficiency for PHWWF
ULT-12	2785	Acacia Rd (312 Acacia Rd to W Harvard Blvd)	125	24	3180	<= 67	62	4770	<= 86	84	Capacity deficiency for PHWWF
ULT-13	2786	Acacia Rd (At W Harvard Blvd)	25	24	3180	<= 67	60	4770	<= 87	83	Capacity deficiency for PHWWF
ULT-14	2460	W Harvard Blvd (Acacia Rd to 730 W Harvard Blvd)	220	24	3136	<= 67	61	4703	<= 88	84	Capacity deficiency for PHWWF
ULT-15	2432	W Harvard Blvd (730 W Harvard Blvd to Elm St)	215	24	3111	<= 67	64	4667	<= 89	88	Capacity deficiency for PHWWF
ULT-16	2259	Elm St (W Harvard Blvd to 220 Elm St)	525	10[1]	605	<= 50	60	908	<= 90	77	Capacity deficiency for both PHDWF and PHWWF
ULT-17	2286	Elm St (220 Elm St to W Main St)	95	12[1]	604	<= 67	58	905	<= 91	75	Capacity deficiency for PHDWF
ULT-18	2295	W Main St (Elm St to 700 W Main St)	210	12[1]	603	<= 67	64	904	<= 92	89	Capacity deficiency for both PHDWF and PHWWF
ULT-19	2289	Blanchard Elementary School (W Main St to Blanchard Elementary School)	130	12[1]	602	<= 67	65	903	<= 93	95	Capacity deficiency for both PHDWF and PHWWF
ULT-20	2333	Blanchard Elementary School	390	12[1]	602	<= 67	65	903	<= 94	99	Capacity deficiency for both PHDWF and PHWWF
ULT-21	1690	Blanchard Elementary School	105	10[1]	361	<= 50	63	542	<= 95	79	Capacity deficiency for both PHDWF and PHWWF
ULT-22	1843	Blachard Elementary School to Fillmore St	195	8	361	<= 50	63	542	<= 96	87	Capacity deficiency for both PHDWF and PHWWF
ULT-23	1945	Walden St (Filmore St to 156 Walden St)	240	8	340	<= 50	65	510	<= 97	97	Capacity deficiency for both PHDWF and PHWWF
ULT-24	2061	Walden St (156 Walden St to W Santa Barbara St)	295	8	339	<= 50	67	508	<= 98	100	Capacity deficiency for both PHDWF and PHWWF
ULT-25	2017	Walden St (W Santa Barbara St to Center Ln)	275	8	330	<= 50	71	495	<= 99	100	Capacity deficiency for both PHDWF and PHWWF
ULT-26	2008	Walden St (Center Ln to W Santa Paula St)	270	8	323	<= 50	67	484	<= 100	100	Capacity deficiency for both PHDWF and PHWWF
ULT-27	2158	W Santa Paula St (Walden St to 757 W Santa Barbara St)	365	8	297	<= 50	66	446	<= 101	100	Capacity deficiency for both PHDWF and PHWWF
ULT-28	2051	W Santa Paula St (757 W Santa Barbara St to 783 W Santa Paula St)	290	8	295	<= 50	68	442	<= 102	100	Capacity deficiency for both PHDWF and PHWWF
ULT-29	1642	W Santa Paula St (783 W Santa Paula St to N Peck Rd)	80	8	292	<= 50	63	439	<= 103	100	Capacity deficiency for both PHDWF and PHWWF
ULT-30	2294	Blanchard Elementary School (Blanchard Elementary School to Pamela Ct)	200	12[1]	240	<= 50	51	360	<= 104	92	Downstream pipe creates a surcharged condition for PHWWF
ULT-31	2328	Pamela Ln (Pamela Ct to Venus Ave)	370	10	214	<= 50	46	321	<= 105	79	Downstream pipe creates a surcharged condition for PHWWF
ULT-32	2427	W Harvard Blvd (At Elm St)	25	24	2496	<= 67	61	3744	<= 106	87	Downstream pipe creates a surcharged condition for PHWWF
ULT-33	2459	W Harvard Blvd (Elm St to Lucada St)	355	24	2489	<= 67	58	3734	<= 107	83	Downstream pipe creates a surcharged condition for PHWWF
ULT-34	2443	W Harvard Blvd (Lucada St to Laurie Ln)	300	24	2481	<= 67	57	3721	<= 108	78	Downstream pipe creates a surcharged condition for PHWWF
ULT-35	2451	W Harvard Blvd (Laurie Ln to Elizabeth Ct)	265	24	2465	<= 67	56	3698	<= 109	76	Downstream pipe creates a surcharged condition for PHWWF
ULT-36	2364	S Palm Ave (E Ventura St to Yale Ct)	285	12	576	<= 50	54	864	<= 110	68	Upgrade not recommended (within 5% of d/D criteria)
ULT-37	2350	Green St (Yale St Halfway to E Main St)	165	12	685	<= 50	53	1027	<= 111	65	Upgrade not recommended (within 5% of d/D criteria)
ULT-38	2351	Green St (Halfway from Yale St to E Main St)	165	12	671	<= 50	52	1007	<= 112	64	Upgrade not recommended (within 5% of d/D criteria)
ULT-39	2361	E Main St (Green St to Davis St)	265	12	668	<= 50	52	1002	<= 113	64	Upgrade not recommended (within 5% of d/D criteria)
ULT-40	2346	Davis St (E Main St to 107 Davis St)	130	12	666	<= 50	52	999	<= 114	64	Upgrade not recommended (within 5% of d/D criteria)
ULT-41	2292	E Main St (N Mill St to 969 E Main St)	180	12[1]	490	<= 50	51	735	<= 115	66	Upgrade not recommended (within 5% of d/D criteria)
ULT-42	2301	N Ojai St (E Santa Barbara St to 217 N 10th St)	225	10	408	<= 50	51	613	<= 116	63	Upgrade not recommended (within 5% of d/D criteria)
ULT-43	2330	N Ojai St (113 N Ojai St to 215 Raiload Ave)	375	10[1]	389	<= 50	50	584	<= 117	62	Upgrade not recommended (within 5% of d/D criteria)
ULT-44	2118	Ojai Rd (Richmond Rd to 725 Ojai Rd)	325	8	230	<= 50	52	346	<= 118	64	Upgrade not recommended (within 5% of d/D criteria)
ULT-45	1904	Ojai Rd (725 Ojai Rd to Bedford St)	225	8	226	<= 50	50	339	<= 119	62	Upgrade not recommended (within 5% of d/D criteria)
ULT-46	2367	E Harvard Blvd (California St to Brett Way)	265	12	548	<= 67	57	822	<= 120	72	Capacity deficiency for PHDWF
ULT-47	2281	E Harvard Blvd (E Harvard Blvd and Ojai St)	25	12[1]	517	<= 50	51	775	<= 121	66	Upgrade not recommended (within 5% of d/D criteria)
ULT-48	2629	E Harvard Blvd (E Harvard Blvd and S 12th St)	35	12	566	<= 50	52	849	<= 122	67	Upgrade not recommended (within 5% of d/D criteria)
ULT-49	2628	E Harvard Blvd (S 12th St to 1211 Harvard Blvd)	125	12	565	<= 67	57	847	<= 123	74	Capacity deficiency for PHDWF
ULT-50	2366	E Harvard Blvd (1211 Harvard Blvd to Garcia St)	290	12	562	<= 50	52	842	<= 124	67	Downstream pipe creates a surcharged condition for PHWWF

Notes:

1. MKN evaluated the ultimate scenario under the assumption that all Existing and Near Term Scenario recommended improvements were completed prior. The existing pipeline diameter listed is the recommended improvement for the pipeline segment from Table 7-2.

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

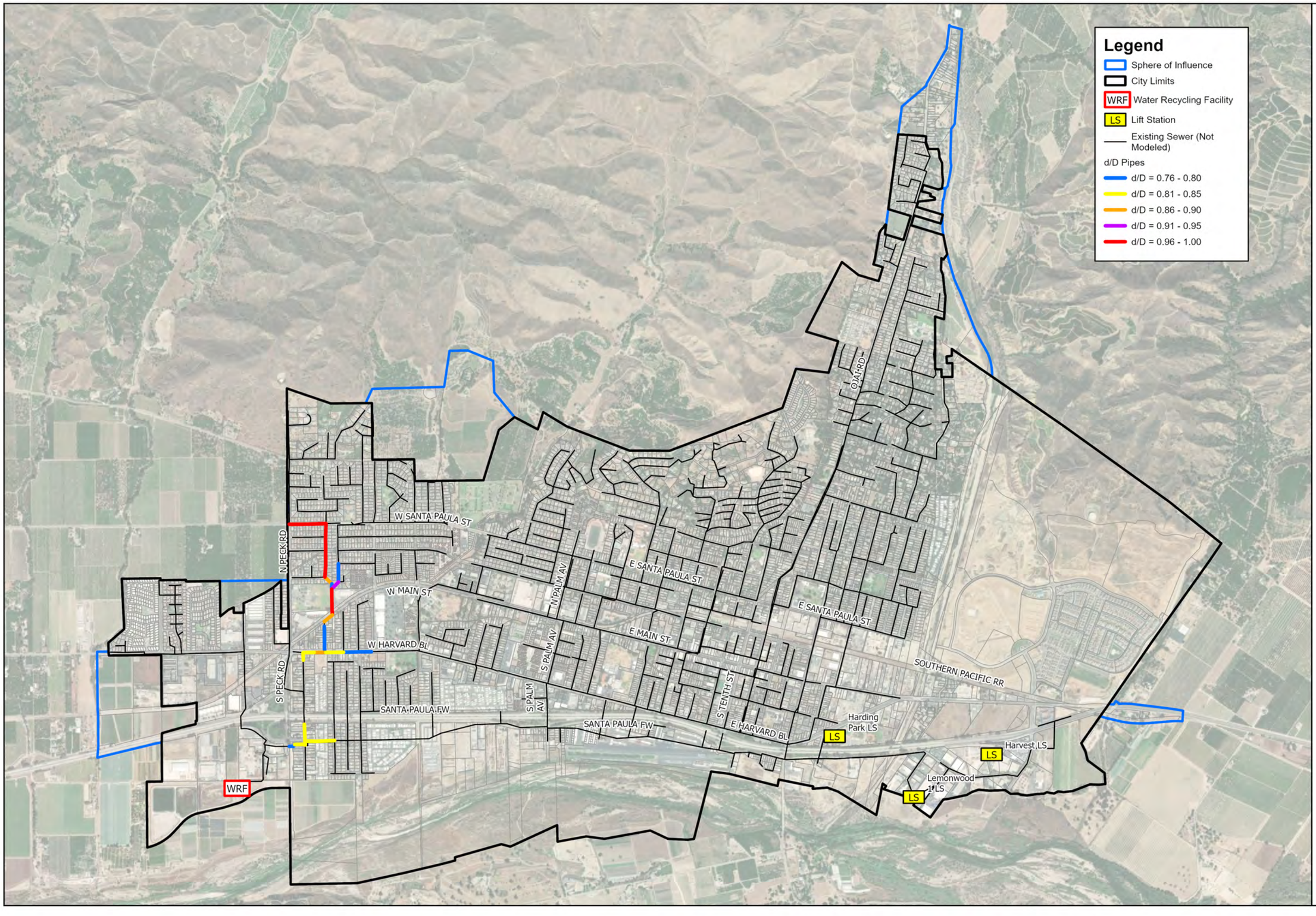
Figure 9-7:

Ultimate PHDWF Pipeline d/D Deficiencies

1 inch = 2,200 feet

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 9-8:

Ultimate PHWWF Pipeline d/D Deficiencies

1 inch = 2,200 feet

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Table 9-4: Recommended Improvements to Address Ultimate Scenario Flows												
Improvement (I-ULT-#)	Model Deficiency Addressed	Location	Bounds	Length (ft)	Existing Diameter (in)	Proposed Diameter (in)	PHDWF Conditions			PHWWF Conditions		
							Average Flow (gpm)	Average Existing d/D	Average Improved d/D	Average Flow (gpm)	Average Existing d/D	Average Improved d/D
I-ULT-1	ULT-3	Acacia Way	Shell Rd to 536 Acacia Way	170	30	36	4593	63	51	6890	82	66
I-ULT-2	ULT-4	Acacia Rd	536 Acacia Wa	45	30	36	4593	64	51	6890	84	66
I-ULT-3	ULT-7	Acacia Way	Acacia Rd to Santa Rosa Loop	250	27	30	1332	62	53	1998	85	71
I-ULT-4	ULT-9 & ULT-10	Santa Clara St	Santa Clara St	695	12	15	849	56	41	1273	73	51
I-ULT-5	ULT-11	Acacia Rd	Acacia Way to W Santa Maria St	340	27	30	3249	60	51	4873	83	69
I-ULT-6	ULT-12 & ULT-13	Acacia Rd	312 Acacia Rd to W Harvard Blvd	150	24	27	3180	61	53	4770	83	71
I-ULT-7	ULT-14 & ULT-15	W Harvard Blvd	Acacia Rd to Elm St	435	24	27	3123	62	52	4685	86	69
I-ULT-8	ULT-16	Elm St	W Harvard Blvd to 220 Elm St	526	10	12	605	60	46	908	77	58
I-ULT-9	ULT-17	Elm St	220 Elm St to W Main St	97	12	15	604	58	42	905	75	53
I-ULT-10	ULT-18	W Main St	Elm St to 700 W Main St	210	12	15	603	64	45	904	89	57
I-ULT-11	ULT-19 & ULT-20	Blanchard Elementary School	W Main St to Blanchard Elementary School	520	12	15	602	65	45	903	97	57
I-ULT-12	ULT-21	Blanchard Elementary School	Blanchard Elementary School	107	10	12	361	63	47	542	79	59
I-ULT-13	ULT-22	Blanchard Elementary School	Blachard Elementary School to Fillmore St	195	8	10	361	63	46	542	87	57
I-ULT-14	ULT-23, ULT-24, ULT-25, ULT-26	Walden St	Filmore St to W Santa Paula St	1080	8	10	333	67	47	500	99	60
I-ULT-15	ULT-27, ULT-28, ULT-29	W Santa Paula St	Walden St to N Peck Rd	735	8	10	295	65	46	442	100	58
I-ULT-16	ULT-46	E Harvard Blvd	California St to Brent Way	265	12	15	548	57	43	822	72	54
I-ULT-17	ULT-49	E Harvard Blvd	S 12th St to 1211 Harvard Blvd	125	12	15	565	57	43	847	74	54

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10.0 WATER RECYCLING FACILITY EVALUATION

This section summarizes the existing flows and loads to the WRF, condition assessment of existing facilities, and evaluation of capacity to serve existing and future flows and loads.

10.1 Historical Flows and Loadings

The following provides analysis of historical flows and influent loadings, influent concentrations, and existing effluent requirements and quality observed at the WRF.

10.1.1 Historical Influent Loading

At the WRF, influent organic and solids loading are calculated using monthly grab measurements of five-day biochemical oxygen demand (BOD_5) and Total Suspended Solids (TSS), mandated by Monitoring and Reporting Program (MRP) No. CI-9259. While the WRF has an effluent limit of 10 mg/L for Ammonia as nitrogen + nitrate as nitrogen + nitrite as nitrogen, it has not historically been required for measurement in plant influent.

The raw influent wastewater characteristics used in the original design for the WRF is summarized in **Table 10-1.** These values were obtained from the *Trussell Technologies, Inc., Evaluation of Biological Design and Process Sizing* Technical Memorandum (2008) which is attached as **Appendix F.**

Table 10-1: 2008 Raw Influent Design Criteria

Parameters	Unit	Raw Influent
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD)	mg/L	320
Total Suspended Solids (TSS)	mg/L	210

A summary of the influent monitoring data from 2014 to 2023 is presented below in **Table 10-2** and **Table 10-3**. These records indicate the plant encountered its highest BOD_5 concentration in 2022 and its highest TSS concentration in 2019. The data also show that for every year except 2014 and 2022, the BOD_5 annual average concentrations were above the original design value of 320 mg/L. Similarly, all TSS annual average concentrations were above the original design value of 210 mg/L. The maximum month values for both constituents are substantially above the design criteria. While observed concentrations are higher than the original design concentrations, the actual loads (lb/day) will determine sizing of treatment processes as discussed later in the Report.

Table 10-2: Historical Influent BOD_5 and Total Suspended Solids Concentrations										
Month	2014		2015		2016		2017		2018	
	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)
January	265	259	274	324	285	295	380	331	553	439
February	321	237	321	385	334	357	409	380	295	234
March	284	259	304	285	384	355	386	390	278	305
April	277	287	363	361	387	344	360	538	324	336
May	323	214	331	342	375	427	329	278	274	330
June[1]	350	340	361	413	320	325	407	320	-	-
July	306	329	380	357	300	258	307	288	333	303
August	266	286	315	381	320	356	332	304	325	274
September	310	301	314	351	344	344	327	311	328	272
October	271	324	349	427	322	365	372	275	326	264
November	306	364	327	305	269	276	381	300	398	346
December	314	336	351	360	294	305	404	286	185	303
Annual Avg.	299	295	333	358	328	334	366	333	329	310
Max. Month	350	364	380	427	387	427	409	538	553	439
Min. Month	265	214	274	285	269	258	307	275	185	234

Notes:
1. No data for June of 2018

Table 10-3: Historical Influent BOD_5 and Total Suspended Solids Concentrations										
Month	2019		2020		2021		2022		2023	
	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)
January	388	359	268	349	443	366	231	252	220	270
February	325	273	318	274	430	300	257	303	221	259
March	205	243	320	303	436	305	318	214	228	257
April	495	291	469	314	324	289	630	433	345	315
May	406	343	369	356	277	306	400	304	628	636
June	233	188	313	366	216	214	321	364	159	277
July	419	319	335	276	155	334	294	299	241	577
August	575	904	266	564	319	349	278	321	277	243
September	439	444	396	314	329	384	320	254	302	308
October	343	296	336	241	391	326	272	400	279	260
November	178	360	191	245	334	258	207	243	339	360
December	217	350	411	251	316	224	252	271	321	175
Annual Avg.	352	364	333	321	331	305	315	305	297	328

Max. Month	575	904	469	564	443	384	630	433	628	636
Min. Month	178	188	191	241	155	214	207	214	159	175

WRF monitoring data from 2019 through 2023 was used to estimate the BOD_5 and TSS loadings as presented in **Table 10-4** below. Because wastewater in a community can change over time, with growth and other changes within a collection system, only the most recent full four years of data was used to estimate existing conditions. The loads are calculated by multiplying the relevant flow rate by the concentration and the constant of 8.34 lbs/gal. The calculated maximum month concentrations (mg/L) are acquired by dividing the maximum month load (ppd) by the maximum month flow (MGD) times 8.34 lbs/gal.

Table 10-4: Existing Influent Flows and Loadings

Year		2019	2020	2021	2022	2023
Parameter	**Unit**	**Existing**				
ADF	MGD	2.38	2.50	3.01	2.23	2.14
MMF	MGD	2.91	2.77	3.69	2.63	2.67
Average Annual BOD_5 Concentration	mg/L	352	333	331	315	297
Average Annual BOD_5 Load (Rounded)	ppd	6990	6940	8310	5860	5300
Maximum Month BOD_5 Concentration	mg/L	575	469	443	630	628
Maximum Month BOD_5 Load (Rounded)	ppd	13035	9255	10837	11843	11333
Maximum Month BOD_5 Concentration (Calculated)	mg/L	537	401	352	540	509
Average Annual TSS Concentration	mg/L	364	321	305	305	328
Average Annual TSS Load (Rounded)	ppd	7230	6690	7650	5670	5850
Maximum Month TSS Concentration	mg/L	904	564	384	433	636
Maximum Month TSS Load (Rounded)	ppd	20492	12894	10733	8140	11478
Maximum Month TSS Concentration (Calculated)	mg/L	844	558	349	371	515

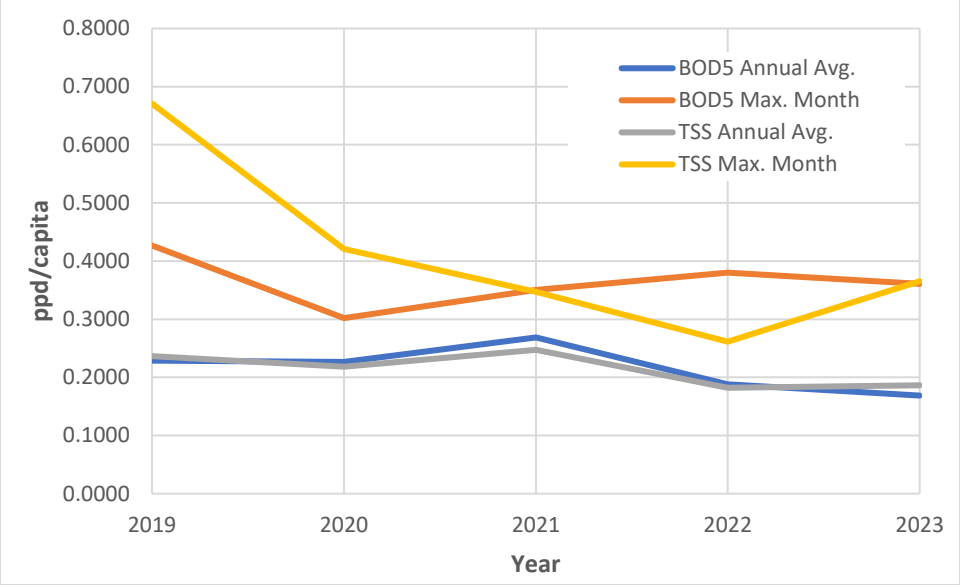
To develop wastewater loading projections, per capita loading values were calculated from the existing loading data in **Table 10-4** for 2019 through 2023. The projections are developed by dividing the loads by the population of each year mentioned. Population estimates were acquired from the State of California Department of Finance demographics estimate data. Loading per capita values are summarized in **Table 10-5**.

Table 10-5: Historical Influent BOD_5 and TSS Loadings (2019-2023)

Year	Population	ADF (MGD)	BOD_5 (ppd/capita)		TSS (ppd/capita)	
			Annual Avg.	Max. Month	Annual Avg.	Max. Month
2019	30,547	2.38	0.2288	0.4267	0.2367	0.6708
2020	30,658	2.50	0.2264	0.3019	0.2182	0.4206
2021	30,934	3.01	0.2686	0.3503	0.2473	0.3470
2022	31,145	2.23	0.1882	0.3803	0.1821	0.2614
2023	31,423	2.14	0.1687	0.3607	0.1862	0.3653
3-Year Average (2021 – 2023)	–	–	**0.209**	**0.364**	**0.205**	**0.325**

The annual average and maximum month loadings per capita for BOD_5 and TSS for 2014 to 2023 are presented in **Figure 10-1**. Average BOD_5 and TSS loading per capita increased from 2014 through 2021 but declined in 2022 and 2023. Three-year averages from 2021 to 2023 were calculated in **Table 10-5** and were used in **Section 10.3.1** to predict future loading.

Figure 10-1: Loadings per capita for BOD_5 and TSS



10.1.2 Existing Effluent Requirements and Quality

The WRF is permitted to discharge a maximum effluent volume of 4.2 MGD and the quarterly average effluent volume of 2.6 MGD. The WDR provides discharge requirements, including effluent limits and Monitoring and Reporting Program (MRP) No. CI-9259. The monthly average and daily maximum effluent limits are summarized in **Table 10-6**.

Table 10-6: Effluent Limits (Table 8 of WDR No. R4-2018-0022-A01)			
Constituents	Units	Monthly Average	Daily Maximum
Oil and Grease	mg/L	10[1]	15[1]
Total Suspended Solids	mg/L	10[1]	15[1]
	% Removal	≥ 85[2]	---
BOD_5	mg/L	10[1]	15[1]
	% Removal	≥ 85[2]	---
Ammonia-N + Nitrate-N + Nitrite-N	mg/L	10[3]	---
Nitrite-N	mg/L	1	---
Total Dissolved Solids	mg/L	2000[4]	---
Sulfate	mg/L	800[4]	---
Boron	mg/L	1[4]	---
Chloride	mg/L	110[4]	---
pH	pH units	Between 6.5 - 8.5	---

Notes:
1. Limit is based on best professional judgement. Limits adopted by this Regional Board exist in the permits for tertiary-treated wastewater treatment plants
2. Limit is based on secondary treatment requirements, 40 C.F.R. section 133.102
3. Limit is based on the Load Allocations for nonpoint sources set forth in the Santa Clara River Nitrogen Compounds TMDL, Resolution No. 2003-011
4. Limit based on Basin Plan Groundwater Quality Objective

MKN reviewed the historical effluent quality based on annual reports from 2019 to 2023 provided by the City. During this time, the exceedances that occurred were for chloride, boron and ammonia-n + nitrate-n + nitrite-n, as shown in **Appendix F**. The WRF treatment equipment is unable to reduce chlorides. The City is planning improvements to address this and is operating the WRF in compliance with CDO No. R4-2018-0023-A01 which provides a ten-year timeline by which the City must come into compliance with the chloride effluent limit of 110 mg/L. The CDO outlines a schedule with interim milestones and effluent limits. To meet the chloride effluent limit, the AWTF will be constructed at the WRF as discussed in Section 4.3.14.

The table below summarizes the BOD_5 and total suspended solids (TSS) concentrations from 2019 to 2023 and confirms that the WRF has been meeting its monthly average and daily maximum effluent limits for both constituents. Grab samples for both constituents were taken once a month.

Table 10-7: Treated Effluent BOD_5 and TSS Monthly Average and Daily Max Concentrations

Month	2019		2020		2021		2022		2023	
	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)	BOD_5 (mg/L)	TSS (mg/L)
January	1.00	1.00	1.20	0.78	1.20	1.36	1.40	0.98	1.00	1.28
February	1.70	1.00	2.10	1.10	2.43	1.37	ND[1]	0.78	1.10	1.03
March	2.00	1.00	0.94	2.56	2.30	0.77	1.60	ND[1]	2.10	0.92
April	1.30	1.00	1.80	1.28	2.90	2.72	2.50	0.98	1.00	ND[1]
May	0.70	1.00	2.00	1.54	1.20	0.50	6.60	0.96	0.50	ND[1]
June	0.50	-	2.90	1.00	1.10	ND[1]	9.10	1.60	ND[1]	ND[1]
July	1.00	1.11	1.40	1.36	1.00	ND[1]	20.90	1.79	1.00	ND[1]
August	1.50	-	0.50	1.09	0.74	ND[1]	13.50	1.74	1.20	ND[1]
September	0.40	-	4.70	0.65	0.80	0.65	4.00	1.60	ND[1]	0.70
October	0.60	1.08	1.70	1.02	0.69	1.54	0.90	0.68	1.10	0.60
November	2.50	-	0.40	1.20	0.39	0.54	1.50	0.86	ND[1]	ND[1]
December	0.80	-	2.00	7.50	0.50	1.21	2.60	1.30	1.40	1.00
Annual Avg.	1.17	1.03	1.80	1.76	1.27	1.18	5.87	1.21	1.16	0.92
Max. Month	2.50	1.11	4.70	7.50	2.90	2.72	20.90	1.79	2.10	1.28
Min. Month	0.40	1.00	0.40	0.65	0.39	0.50	0.90	0.68	0.50	0.60

Notes:
1. ND = Not detected

10.2 Condition Assessment

The following presents a summary of the visual condition assessment performed on the WRF by MKN on July 27, 2023. This assessment's purpose was to identify the facility's needs for rehabilitation and replacement (R&R, or renewal). The results obtained from this evaluation were integrated into the comprehensive capital improvement program (CIP) outlined in Section 11 of this report. The completed condition assessment checklist is provided in **Appendix G**. Photos of the condition assessment can be seen in **Appendix H.**

10.2.1 Influent Lift Station

The following observations were made at the influent lift station:

Mechanical

- ❑ Corrosion of lifting chain: replacement is recommended
- ❑ Check valves are not reliable
- ❑ Volutes are in good shape

- Lift station pumps are original pumps: evaluate pumps to repair or replace

Instrumentation

- No local control panel or HMI
- Seal failure has occurred within the low voltage conduits.

Electrical

- Worn cords: consider replacement

Structural

- Concrete/liners in bad shape
- Aluminum cover should be fiberglass: support brackets failing
- Spalling of concrete slab was observed
- Replace manhole cover and ring at influent metering station
- Influent flow weir concrete is worn, no metal protection
- Influent channel needs repairing and relining

Safety

- Confined space equipment is necessary for maintenance. VRSD currently charges for their own equipment. It is recommended to purchase harnesses, hoists, blowers, and gas detectors if City staff need to enter these areas in the future.
- Grating worn
- No fall arrest for ladders

10.2.2 Headworks

The following observations were made at the headworks structure:

Mechanical

- #2 grit classifier failing, stainless steel rotting out, and wear plates are missing and need to be replaced
- Total of 2 coarse and 2 fine screens, 2 classifiers
- Need manufacturer maintenance, bearing replacement, new screens, and augers

Instrumentation

- ❑ 2 water level transducers
- ❑ H2S gas causing problems with electrical cords and panels
- ❑ H2S will damage Huber stainless steel equipment

10.2.3 Primary and Secondary Equalization Basins

The following observations were made at the equalization basins:

Primary Equalization Basin

Mechanical

- ❑ No aeration is provided to keep stored flow mixed

Instrumentation

- ❑ Operators are unable to automate the peak shaving process. Transferring between equalization basins and ILS is a manual process.
- ❑ SCADA should be configured to automate the use of equalization storage to manage peak diurnal flows.

Electrical

- ❑ Intermittent conduit corrosion

Structural

- ❑ Concrete in equalization weirs does not have knife's edge and is worn
- ❑ Aluminum and safety grating need to be replaced

Secondary Equalization Basin

Structural

- ❑ Concrete in equalization weirs does not have knife's edge and is worn
- ❑ Aluminum and safety grating need to be replaced

Operator Notes and Observations

- ❑ Rarely used except when plant has high flow events

10.2.4 Anoxic Basins

The following observations were made at the anoxic basins:

Mechanical

- ❑ WRF exceeded nitrate limits due to failed RAS/WAS pump in April/May 2023
- ❑ Mud valve in #3 failed in April 2023
- ❑ Issues with mixers in anoxic basins include tangling, rails bending, skewed shafts, and cut cables

Structural

- ❑ Corrosion visible near top 3 feet of tanks

10.2.5 Aeration Basins

The following observations were made at the aeration basins:

Mechanical

- ❑ Operators need a spare RAS pump for redundancy

Structural

- ❑ In general, the upper 3 to 4 feet of the basins are corroded and may need coating
- ❑ Mixer has caused scarring of concrete walls in Aeration Basins

Operator Notes and Observations

- ❑ Aeration Basins are generally operating as intended.

10.2.6 Sludge Handling System

The following observations were made for equipment associated with the sludge handling system:

Digester Blowers

Mechanical

- ❑ Both blowers are operating as intended

Instrumentation

- ❑ Software not compatible with old blowers. Microsoft no longer covers HMIs resulting in needing new inverters

Thickeners & Screw Press

Mechanical

- ❑ Screw press self-clean capability is not operating. Press will not run in reverse for cleaning and its brushes are worn. Needs maintenance.
- ❑ Oil box is due for 10-year overhaul
- ❑ Feed pump does not prime well
- ❑ Rotary lobe pumps feed thickeners and screw press. Rotary lobe pumps have worn plates
- ❑ Replace bristles

Operator Notes and Observations

- ❑ Redundancy needed for screw press (second unit needed)
- ❑ The conveyor system which discharges to the roll-off needs maintenance

10.2.7 MBR Basins

The following observations were made at the MBR basins:

Mechanical

- ❑ One blower in MBR Basin #1 unexpectedly turns off

Instrumentation

- ❑ WAS #2 pump faults and turns off
- ❑ Operators recommend tying citric acid pump into MBR PLC
- ❑ MBR PLC #M needs redundant back up like PLC #A & B

Structural

- ❑ Coatings are chipped on basin concrete walls

Operator Notes and Observations

- ❑ Permeate pumps need to be evaluated and possibly rebuilt
- ❑ Operators prefer separate turbidity meters for each train on MBR

10.2.8 UV Disinfection

The following observations were made for the UV disinfection system:

Mechanical

- 3 out of 5 module banks are currently in service since flows are not at capacity
- Operators recently replaced bulbs from 2 out of the 5 module banks.
- Bulbs usage at + 30,000 hours; Per manufacturer recommendation, bulbs should be replaced at 12,000 hours

Operators Notes and Observations

- Only 3 modules in use at any time
- Shattered bulbs discovered after maintenance check-up
- Electronics need to be replaced

10.2.9 Decorative and Percolation Ponds

The WRF contains three percolation ponds located to the southwest of the facility and a decorative pond located at the entrance of the facility. The following observations were made:

Percolation Ponds

Mechanical

- Irrigation system around percolation ponds not operating as intended; Cracked pipelines were observed

Operator Notes and Observations

- Rocks and debris need to be cleared out of ponds
- Liners at percolation pond berms need to be replaced
- Recommend implementing regularly-scheduled weed removal and control

Decorative Pond

Mechanical

- Pond needs new sump pumps
- Replace exhaust fan; should be automatic when vault opens, and current fan is not
- Repair circulation pump and valves

Safety

- ❑ Major rusting on vault ladder
- ❑ Replace pond lighting
- ❑ Hatch in good condition

Operator Notes and Observations

- ❑ Accumulated sludge needs to be removed on a regular frequency
- ❑ Pond liner in good condition
- ❑ Water leaks into vault; vault should be repaired

10.2.10 Headworks/Dewatering and Controls Buildings

The following observations were made at the headworks/dewatering and the controls buildings at the WRF:

Headworks/Dewatering Building

Structural

- ❑ No insulation on the roof
- ❑ Windows do not have a proper seal
- ❑ Window screens damaged and should be replaced
- ❑ Trim and doors should be repainted
- ❑ Door locks failing and need to be repaired or replaced
- ❑ Poor lighting. City should replace ballasts and lighting with LED assemblies and bulbs

Controls Building

Mechanical

- ❑ Two HVAC units not operating as intended; Need replacement units

Structural

- ❑ No insulation on the roof
- ❑ Windows do not have a proper seal
- ❑ Window screens are damaged and should be replaced
- ❑ Trim and doors should be repainted

- Door locks failing and need to be repaired or replaced.
- Poor lighting. City should replace ballasts and lighting with LED assemblies and bulbs

Safety

- Replace panel on fire alarm system along with failing smoke detector

10.2.11 Miscellaneous Observations

General

- Crane needs maintenance and load certification
- Spalled concrete pad for abandoned odor control system should be repaired to prevent trip hazards
- New tools needed for plant operators include tap and die set (SAE and Metric), multi-functional welder for stainless steel, and electric winches for gantry cranes.
- Portable ladders are old, worn, and sun damaged. Replacement ladders recommended
- Operators using unstable 12-foot step ladder to check sludge trailer; Add rolling stairway
- Effluent meter has no weir/flume causing inaccurate measurements
- Poor paint condition throughout the facility
- Rebuild or replace blowers
- Emergency stand-by generator needs to be serviced. Fuel polish, oil change, paint and replace filters, hoses, batteries, etc.
- Automatic transfer switch needs servicing
- Irrigation system timer runs numerous cycles a day. Replacement is recommended.

10.3 Capacity Evaluation

Capacity was evaluated for each WRF process, considering various factors such as flow rates, characteristics of influent wastewater, treatment goals, operational thresholds, and redundancy requirements. An evaluation of the original design capacity for the WRF, rated capacity of each unit process from the record drawings, historical loading patterns, and performance metrics was undertaken to establish the recommended capacity ratings for individual unit processes as part of the performance assessment. Estimated peak flow values for existing, near-term, and ultimate future flows were used in this evaluation.

10.3.1 Flow and Loading Conditions

Existing flows and loading conditions were developed as described in Sections 3.1 and 10.1. Future BOD_5 and TSS loadings were projected for near-term and ultimate conditions using two methods:

- ❑ Projecting future loads using existing peak concentrations and applying to future flows; and
- ❑ Applying three-year average loads (per capita) calculated in **Table 10-5** to future population projections

These two methods are identified in **Table 10-8** and **Table 10-9** for near-term and ultimate loads.

Table 10-8: Estimated Future Influent Flows and BOD and TSS Loadings

Parameter	Unit	Flow Conditions		
		Existing	Near-Term	Ultimate
ADF	MGD	2.58	3.02	3.55
MMF	MGD	3.00	3.51	4.12
Average Annual BOD_5 Concentration	mg/L	314	314	314
Average Annual BOD_5 Load (Rounded)	ppd	6,760	7,910	9,300
Maximum Month BOD_5 Load (Rounded)	ppd	11,338	13,261	15,565
Maximum Month BOD_5 Concentration (Calculated)	mg/L	453	453	453
Average Annual TSS Concentration	mg/L	312	312	312
Average Annual TSS Load (Rounded)	ppd	6,720	7,860	9,240
Maximum Month TSS Load (Rounded)	ppd	10,117	11,826	13,882
Maximum Month TSS Concentration (Calculated)	mg/L	404	404	404

Table 10-9: Estimated Future Influent BOD and TSS Loadings

Parameter	Unit	Flow Conditions		
		Existing	Near-Term	Ultimate
Population[1]	capita	31,423	38,703	45,217
Average Annual BOD_5 Load per Capita	ppd/capita	0.209		
Maximum Month BOD_5 Load per Capita	ppd/capita	0.364		
Average Annual TSS Load per Capita	ppd/capita	0.205		
Maximum Month TSS Load (Rounded)	ppd/capita	0.325		
Average Annual BOD_5 Load	ppd	6,567	8,089	9,450
Maximum Month BOD_5 Load	ppd	11,438	14,088	16,459
Average Annual TSS Load	ppd	6,442	7,934	9,269
Maximum Month TSS Load	ppd	10,212	12,578	14,696

Notes:
1. Near-Term and Ultimate populations estimated using the current population + (3.3 capita per housing unit x number of housing units from Tables 3-14 and 3-15).

The methodology shown in **Table 10-9** was used to prevent overestimating future loads. As shown above, applying the methodology for **Table 10-10** would result in overestimating future maximum month loads used to size process equipment.

10.3.2 Influent Lift Station

The influent lift station at the WRF was designed to accommodate a PHWWF capacity of 17.0 MGD with one pump out of service. Presently, the PHWWF is approximately 7.7 MGD. Projections suggest that in the near-term and under ultimate future conditions, the PHWWF may increase to 9.0 MGD and 10.6 MGD, respectively, factoring in expected growth. Given the design capacity of the influent lift station, the existing facility can handle existing, near-term, and ultimate future conditions.

Table 10-10: Influent Lift Station Capacity (Three Pumps Operating)

Flow Condition	Units	Design Capacity	Existing Conditions	Near-Term Future Conditions	Ultimate Future Conditions
PHWWF	MGD	17.0	7.7	9.0	10.6
Available Capacity	MGD	-	9.3	8.0	6.4

10.3.3 Headworks

The current headworks at the WRF features two duplicate trains to ensure operational redundancy. Each train includes a primary coarse screening unit, a grit removal unit, and a fine screen unit. The design capacities for each of these units are as follows:

- 8.5 MGD for the primary screen
- 8.5 MGD for grit removal
- 5.7 MGD for the fine screen

The tables below outline the design capacity of each unit when both trains are operational and when one train is out of service.

Table 10-11: Headworks Primary Screen & Grit Removal Capacity (Two Screens)

Flow Condition	Units	Design Capacity	Existing Conditions	Near-term Future Conditions	Ultimate Future Conditions
Peak Day Flow	MGD	17.0	5.7	6.6	7.8
Available Capacity	MGD	-	11.3	10.4	9.2

Table 10-12: Headworks Primary Screen & Grit Removal Capacity (One Screen)					
Flow Condition	Units	Design Capacity	Existing Conditions	Near-term Future Conditions	Ultimate Future Conditions
Peak Day Flow	MGD	8.5	5.7	6.6	7.8
Available Capacity	MGD	-	2.8	1.9	0.7

Table 10-13: Headworks Fine Screening Capacity (Two Screens)					
Flow Condition	Units	Design Capacity	Existing Conditions	Near-term Future Conditions	Ultimate Future Conditions
Peak Day Flow	MGD	11.4	5.7	6.6	7.8
Available Capacity	MGD	-	5.7	4.8	3.6

Table 10-14: Headworks Fine Screening Capacity (One Screen)					
Flow Condition	Units	Design Capacity	Existing Conditions	Near-term Future Conditions	Ultimate Future Conditions
Peak Day Flow	MGD	5.7	5.7	6.6	7.8
Available Capacity	MGD	-	0	**-0.9**	**-2.1**
Notes: Capacity exceedances are bold and underlined					

As seen above, the coarse screens, grit removal system and fine screens (both trains in service) have the ability to meet existing and future peak hour flow demands. Replacing the existing fine screens with higher capacity units is recommended to meet future demands with one unit out of service, providing redundancy. The fine screens are necessary to protect the membranes in the MBR Basins from damage.

10.3.4 Primary and Secondary Equalization Basins

The WRF's two EQ basins function in series, collectively providing a storage capacity of 1.05 million gallons. They are designed to provide two hours of equalization storage at a PDF of 10.4 MGD. Basin size is summarized below:

Table 10-15: Equalization Basins		
Equalization Basin	Size (L x W x H in ft)	Storage (gals)
Primary	45 x 40 x 24	281,000
Secondary	118 38 x 24	771,400

Currently the EQ basins have sufficient storage to meet existing and future demands as shown in **Table 10-16**. However, City staff has noted that adding an additional EQ basin to the WRF would provide additional emergency storage.

Table 10-16: Primary and Secondary Equalization Basins					
Flow Condition	Units	Design Capacity	Existing Conditions	Near-term Future Conditions	Ultimate Future Conditions
Peak Day Flow	MGD	10.4	5.7	6.6	7.8
Available Capacity	MGD	-	4.7	3.8	2.6

10.3.5 Membrane Bioreactor System Process Evaluation

The WRF MBR system, including anoxic and aeration basins, was originally designed using parameters listed in the *Trussel Technologies, Inc., Evaluation of Biological Design and Process Sizing* Technical Memorandum (2008). The values used in the design are summarized in **Table 10-17**:

Table 10-17: Trussell MBR Design Parameters			
Design Influent Flows			
Flow	**Unit**	**Values**	
Average Annual Influent Flow	MGD	3.4	
Peak Day Flow	MGD	7.2	
Screened Influent Characteristics			
Parameters	**Unit**	**Values**	
Minimum Temperature	°C	19	
Biochemical Oxygen Demand (BOD_5)	mg/L	288	
Chemical Oxygen Demand (COD)	mg/L	662	
Total Kjeldahl Nitrogen (TKN)	mg/L	51	
Ammonium (NH_4-N)	mg/L	32	
Total Suspended Solids (TSS)	mg/L	189	
Alkalinity (as $CaCO_3$)	mg/L	300	
Average and Peak Day Influent Loads			
Parameters[1]	**Unit**	**3.4 MGD**	**7.2 MGD**
BOD	ppd	5400	6400
COD	ppd	8200	9800
TKN	ppd	1400	1700
TSS	ppd	18,800	22,600
Effluent			
Parameters	**Unit**	**Values**	
Biochemical Oxygen Demand (BOD_5)	mg/L	10	
Total Suspended Solids (TSS)	mg/L	10	
Ammonium (NH_4-N)	mg/L	0.5	
Notes: 1. Peak Day loadings are assumed to be 20% greater than Average Day loadings per Trussell TM.			

MKN evaluated the capacity of the MBR system, including aeration and anoxic basins, using a spreadsheet model. Results and references are included in **Appendix I**. Existing, near-term, and ultimate future condition flow and loads were applied to the model using design parameters listed in the following tables below.

Table 10-18: MBR Design Evaluation Parameters		
Design Influent Flows		
Flow	**Unit**	**Values**
Existing Flows MMF	MGD	3.00
Near-Term Development MMF	MGD	3.51
Ultimate-Term Development MMF	MGD	4.12
Screened Influent Characteristics		
Parameters	**Unit**	**Values**
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD_5)	mg/L	420
Chemical Oxygen Demand (COD)	mg/L	857
Total Kjeldahl Nitrogen (TKN)	mg/L	70
Ammonium (NH4-N)	mg/L	42
Total Suspended Solids (TSS)	mg/L	329
Alkalinity (as $CaCO_3$)	mg/L	300
Effluent		
Parameters	**Unit**	**Values**
Biochemical Oxygen Demand (BOD_5)	mg/L	10
Total Suspended Solids (TSS)	mg/L	10
Ammonium (NH4-N)	mg/L	1

MKN used data from **Table 10-5** to estimate the parameters used in **Table 10-18**. Specifically, averages from 2021-2023 for calculated maximum month concentrations for BOD_5 and TSS were used in the estimation. As recommended in the Trussel TM, MKN reduced the calculated average maximum month values for BOD_5 by 10% and TSS by 20% to account for impact of upstream screening processes. TKN was estimated assuming a ratio of BOD_5 to TKN of 6 to 1 since influent nitrogen concentrations were not available. Other ratios and coefficients used in estimating other pertinent influent parameters used in the model are presented in **Table 10-19**.

Table 10-19: Influent Fractions and Coefficients			
Fractions/Coefficients	**Value Used**	**Parameter Acquired**	**Units**
VSS/TSS Ratio	0.79	VSS = 260	mg/L
COD/VSS Ratio	3.3	COD = 857	mg/L
Ammonia/TKN Ratio	0.6	Ammonia = 42	mg/L

Using parameters discussed above, MKN determined that the full MBR process meets existing, near-term, and ultimate conditions with one treatment train out of service. For the anoxic basins, it was determined that for all conditions and with one full process train out of service, the existing system has the ability to handle the anticipated flows and loads.

Table 10-20: Aeration and Anoxic Basin - Required Volumes (2 Trains in Service)			
	Units	**Aeration Basins (2 Basins) and MBR Basins (4 Basins)**	**Anoxic Basin (2 Basins)**
Actual Aeration Volume	ft^3	59,674	23,089
Existing MMF			

Minimum Volume Required	ft³	38,755	8,066
Near-Term MMF			
Minimum Volume Required	ft³	45,343	9,437
Ultimate-Term MMF			
Minimum Volume Required	ft³	53,223	11,078

There are a total of four aeration blowers for the aeration tanks (3 running and one in standby). Each blower output supplies 1,750 SCFM. The total air flow supplied by the three active blowers is approximately 5,250 SCFM. The model indicates a required air flow of 5,920 SCFM for the ultimate-term development MMF. Therefore, it appears the current blowers do not meet the ultimate buildout conditions. An additional blower is recommended to be installed for redundancy.

There are three blowers dedicated for membrane scouring, (two running and one in standby) each supplying 4,700 SCFM of air. MKN found that the required scouring air flow rate under all flow conditions can be met by one blower (**Table 10-21**). This also confirms that the two running blowers can meet the requirements and there is no need to add membrane blowers.

Table 10-21: Blower Air Flow Requirements

Description	Type of Blower	
	Membrane	Aeration
Air Flow (SCFM) per blower	4,700	1,750
Number of Blowers	2 + 1 (Standby)	3 + 1 (Standby)
Total Air Flow (SCFM)	9400	5250
Flows Evaluated	**Required Air Flow (Modeled - SCFM)**	
Existing MMF	2,625	4,311
Near-Term MMF	3,071	5,044
Ultimate-Term MMF	3,605	5,920

MKN also evaluated maximum membrane flux capacity. The existing Koch Puron PSH-1800-36-BB membrane modules were installed in 2022 to replace the membrane cartridges installed when the plant was originally constructed in 2010. Four modules were installed in each basin and each module included 36 rows of membrane fibers, with the ability to add another eight rows to increase capacity in the future.

The goal is to stay with a peak flux rate of 15 gpd/SF at typical wastewater temperatures with all basins in service. This allows the system to operate temporarily at a maximum flux rate of 19 gpd/SF with one basin out of service, per the design specifications developed for the 2022 membrane replacement project completed by the City. The table below summarizes the PDF under existing, near-term, and ultimate conditions and compares it to the flow calculated to maintain the maximum flux rate through the existing membranes (7.2 MGD).

Table 10-22: Membrane Flow Capacity (15 gpd/SF All Membranes Operating)					
Flow Condition	**Units**	**Design Capacity**	**Existing Conditions**	**Near-term Future Conditions**	**Ultimate Future Conditions**
Peak Day Flow	MGD	7.2	5.7	6.6	7.8
Available Capacity	MGD	-	1.5	0.6	**-0.6**
Notes: Capacity exceedances are bold and underlined					

As shown above, the maximum membrane flow rate (for a maximum flux rate of 15 gpd/SF) is not exceeded until ultimate PDF. Capacity could be increased by utilizing the available space within the current membrane basins. Work will include extending the MBR feed channels and placing additional equipment such as MBR feed pumps, blowers, permeate pumps, piping and ancillary equipment. Building out the empty membrane basins would increase capacity above the ultimate PDF.

10.3.6 UV Disinfection System

The UV disinfection system has a total of two channels with five banks per channel. The capacity was assessed based on the design peak hour flow capacity of 10.4 MGD with 4 banks operating and one bank out of service in each channel. As shown in **Table 10-23**, the system does not have the capacity to handle the ultimate future loading conditions unless all five banks are in service. As presented in **Table 10-24** the system with all five banks operating can meet all existing and future flow conditions. Since peak hour is an extreme event, and the current effluent disposal permit does not require redundancy in disinfection, no expansion is necessary in the immediate future.

Table 10-23: UV Disinfection Capacity (4 Banks Per Channel)					
Flow Condition	**Units**	**Design Capacity**	**Existing Conditions**	**Near-term Future Conditions**	**Ultimate Future Conditions**
Peak Hour Flow	MGD	10.4	7.7	9.0	10.6
Available Capacity	MGD	-	2.7	1.4	**-0.2**
Notes: Capacity exceedances are bold and underlined					

Table 10-24: UV Disinfection Capacity (5 Banks Per Channel)					
Flow Condition	**Units**	**Design Capacity**	**Existing Conditions**	**Near-term Future Conditions**	**Ultimate Future Conditions**
Peak Hour Flow	MGD	11.4	7.7	9.0	10.6
Available Capacity	MGD	-	3.7	2.4	0.8

10.3.7 Sludge Thickener

The WRF currently conveys approximately 40,000 gallons of sludge per day to the existing gravity belt thickeners. each of the two thickeners is designed to process a WAS flow of 265 gpm and approximately 1,593 lbs per hour of solids, assuming WAS flow is 1.2% solids. In 2023, the WRF disposed of approximately 6.3 million pounds of sludge, or an average of 720 lbs per hour assuming 24 hour per day operation (or 14 hours per day, five days per week at

the solids handling capacity of 1,593 pounds per hour). These calculations were developed assuming only one thickener is in operation to provide redundancy. Future loads to the sludge thickener are expected to increase by 17% at near-term and 38% at ultimate conditions, respectively. This will require operating one thickener either an extra day each week at near-term conditions and increasing operating time to 20 hours per day, five days per week at ultimate conditions.

10.3.8 Aerobic Sludge Digesters

The three aerobic sludge digesters have a combined capacity of approximately 1.15 MG. They are designed to provide a solids retention time (SRT) of 18 days at 30° C (86° F), which would achieve over 50% VSS reduction per the *Trussell Technologies, Inc., Evaluation of Biological Design and Process Sizing* Technical Memorandum (2008). At ultimate conditions, since the WAS rate is anticipated to increase 38% in proportion to future loads, the future loading rate to the thickeners would increase from 50,000 gpd to approximately 62,000 gpd. Assuming the thickeners increase solids from 0.85% to 2.5%, this would reduce the thickened WAS rate to approximately 21,080 gpd and provide a SRT of 55 days with all three digesters in service or 36 days with two digesters in service. This is adequate through ultimate conditions. Adding a third gravity belt thickener is recommended to provide redundancy and reduce run times under ultimate conditions.

10.3.9 Sludge Dewatering Screw Press

The existing screw press at the WRF is used for sludge dewatering, the final step in the sludge handling process. It is designed to have a hydraulic capacity of 92 GPM and a solids handling capacity of 918 pounds per hour. The screw press is designed to produce dewatered sludge with a solids concentration of approximately 22%. It was also designed to operate five days a week, 8 hours per day (40 hours per week). Per plant operators, the current screw press is operated 5 to 7 days a week for 20 to 24 hours per day (100 to 168 hours per week).

Operations staff have noted the original design underestimated the amount of solids being produced at the WRF. As noted in Section 10.3.7, in 2023, the WRF disposed of approximately 6.3 million pounds of sludge, or an average of 720 lbs per hour assuming 24 hour per day operation (or 19 hours per day at the solids handling capacity of 918 pounds per hour). It is recommended the WRF install a second screw press, to provide redundancy and reduce wear on the screw press, especially given the additional usage anticipated in the future.

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11.0 CAPITAL IMPROVEMENT PLAN

This section provides the recommended Capital Improvement Plan (CIP) for the City's wastewater collection system, treatment, and disposal systems based on the evaluations and findings of this Master Plan. Prior to the implementation of the recommended projects, the City should consider conducting a preliminary engineering evaluation for each project to refine the scope, assess feasibility and possible alternatives, and develop a more detailed cost estimate.

11.1 Capital Improvement Plan Development

The CIP serves as a fundamental pillar for strategic planning for collection system assets, optimization of system performance, and meeting the evolving needs of wastewater customers. Through planning and analysis, the CIP sets the stage for budgeting capital investments that will result in improved reliability and system efficiency.

11.1.1 Project Identification

Recommended projects were identified through the following evaluations included in the Master Plan:

- **Collection System Hydraulic Analysis:** The hydraulic analysis identified deficiencies in the existing wastewater collection system to serve existing and future flow (near-term and ultimate) conditions during ADF conditions. Recommended improvements include replacement of existing deficient pipelines with larger diameter pipes and/or directing future flows to locations within the collection system with available hydraulic capacity.
- **WRF Evaluation:** The WRF evaluation assessed the adequacy of the existing treatment processes, hydraulic capacity of plant equipment, and the disposal system to serve existing and future flow and load (near-term and ultimate) conditions.
- **Condition Assessment:** A condition assessment of the City's existing lift stations and WRF was performed to review previous recommendations and identify observed physical deficiencies. As part of this effort, MKN visited the existing lift stations and WRF site to document the condition of the existing system and interview the plant operators. Based on the condition assessment, MKN developed a comprehensive list of recommended improvements to address observed deficiencies.

11.1.2 Basis of Costs

To develop cost estimates for the proposed improvements, MKN utilized the Association for Advancement of Cost Estimating International (AACE) guidelines for cost estimating practices and classification. The Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (AACE International Recommended Practice No. 18R-97) provides guidelines for applying the principles of estimate

classification to projects such as the Master Plan. A summary of the classification system is presented in **Table 11-1**.

Table 11-1: Cost Estimate Classification Matrix

Estimate Class	Primary Characteristic	Secondary Characteristic			
	Level of Project Definition	End Usage	Methodology	Expected Accuracy Range	Preparation Effort
	Expressed as % of complete definition	Typical purpose of estimate	Typical estimating method	Typical variation in low and high ranges[1]	Typical degree of effort relative to least cost index of 1[2]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50%, H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes:
1. The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.
2. If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

The cost estimates developed for this Master Plan are considered Class 4 Estimates, which is defined by AACE International as follows:

> *Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineering process and utility equipment lists. Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval to proceed*

to next stage. Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. American National Standards Institute (ANSI) Standard Reference Z94.2-1989 references this class as a "Budget Estimate", with an accuracy range between -15% to +30%.

The cost estimates for this Master Plan are anticipated to be within an accuracy of -20% to +30%. The accuracy of the estimates reflects the level of confidence that an estimate will be near the actual project cost. The accuracy of the estimates should not be confused with the application of a project contingency (which is applied for unknown or unforeseen project conditions).

11.1.3 Cost Estimation

The opinions of probable cost prepared by MKN represent our judgment and are supplied for the general guidance for the City. Since MKN has no control over the cost of labor and material, or over competitive bidding or market conditions, MKN does not guarantee the accuracy of such opinions as compared to contractor bids or actual project costs. For each project identified, cost opinions were generated based on the following assumptions:

- Full capitalization inclusive of engineering, design, permitting, and construction administration / management
- Costs derived from similar infrastructure projects, with adjustments for inflation, size, complexity, and location
- Construction cost opinions were developed in March 2024. Use 20-Cities Engineering News-Record (ENR) Construction Cost Index (CCI) March 2024 = 13532.01 to escalate estimated cost to present value
- Cost opinions are "planning-level" and may not fully account for site-specific conditions or design decisions
- Construction contingency was estimated at 30 percent of total construction costs
- Engineering design services was estimated at 15 percent of total construction costs
- Project administration and construction management together was estimated at 15 percent of total construction costs
- All costs rounded to the nearest $1000

Table 11-2 contains the unit construction costs for gravity collection system improvements and factors for estimating the non-construction costs associated with infrastructure improvement projects such as engineering design, project administration, and contingency to arrive at a total project cost.

Table 11-2: Pipeline Unit Construction Costs		
Pipeline Installation	**Budgetary Unit Cost**	**Unit**
8-inch	$254	LF
10-inch	$317	LF
12-inch	$343	LF
15-inch	$454	LF
18-inch	$523	LF
21-inch	$565	LF
24-inch	$639	LF
27-inch	$729	LF
30-inch	$829	LF
36-inch	$956	LF
Non-Construction Costs		
Construction Contingency	30%	
Engineering Design	15%	
Administration and Construction Management	15%	

Notes:
1. The budgetary unit costs presented above represent the construction cost only and do not include contingency or other non-construction costs.
2. Pipeline costs are based on work in existing streets and include excavation, installation, backfill, pavement repair, upstream and downstream manholes, manholes spaced at 300 ft where needed, traffic control, and connection of existing laterals to new pipe. Cost does not include bypassing.
3. LF = linear foot

11.1.4 Project Prioritization and Scheduling

Each project was evaluated and ranked to determine the significance of the improvement and provide the City with a systematic method to assign priorities for each project. For each collection system pipeline, lift station, and WRF project, a priority point scale from 1 to 4 was assigned based on whether it resolved an existing capacity deficiency, near-term capacity deficiency, improved system efficiency/operations, or resolved an ultimate (build-out) capacity deficiency. The priority scale and scheduling projects is summarized in **Table 11-3**.

Table 11-3: Project Ranking	
Priority	**Description**
1	Required to resolve existing **significant** capacity or condition-based deficiency and recommended for implementation within the next 1 - 3 years from the adoption of the Master Plan
2	Required to resolve **less significant** existing capacity or condition-based deficiency and recommended for implementation within the next 3 - 5 years from the adoption of the Master Plan
3	Required to resolve near-term capacity deficiency and recommended for implementation within the next 5 - 10 years from the adoption of the Master Plan
4	Required to meet ultimate capacity deficiency and recommended for implementation past 10 years from the adoption of the Master Plan and/or dependent on development status

11.2 Capital Improvement Plan Projects

CIP projects are based on the hydraulic, treatment, and condition-based evaluations completed for the Master Plan and were organized into four project categories based on infrastructure type. These categories include the following:

- Gravity Collection System
- Lift Station Facilities
- Water Recycling Facility

CIP projects that involved equipment replacement considered energy efficiency in the selection process.

11.2.1 Gravity Collection System Projects – Capacity Based

The following improvements address capacity deficiencies throughout the existing gravity collection system to serve existing flow conditions:

- *Acacia Road and Acacia Way Gravity Sewer Improvement:* Upgrade a total of 460 linear feet of 24-inch diameter pipeline with 36-inch and 30-inch diameter pipeline.
- *California Street and East Ventura Street Gravity Sewer Improvement:* Upgrade a total of 260 linear feet of 12-inch diameter pipeline to 15-inch diameter pipeline.
- *East Harvard Gravity Sewer Improvement:* Upgrade a total of 1,680 linear feet of 10-inch diameter pipeline to 12-inch diameter pipeline.
- *Elm Street, West Main Street, and Blanchard Elementary School Gravity Sewer Improvement:* Upgrade a total of 1,665 linear feet of 8-inch and 10-inch diameter pipeline to 12-inch and 15-inch diameter pipeline.
- *East Main Street Gravity Sewer Improvement:* Upgrade a total of 1,210 linear feet of 10-inch diameter pipeline to 12-inch diameter pipeline.
- *North 4th Street Gravity Sewer Improvement:* Upgrade a total of 460 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.
- *North Ojai Street Gravity Sewer Improvement:* Upgrade a total of 980 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.
- *East Santa Barbara Street Gravity Sewer Improvement:* Upgrade a total of 800 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.
- *Ojai Road Gravity Sewer Improvement:* Upgrade a total of 1,615 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.

The following improvements address capacity deficiencies throughout the existing gravity collection system to serve near-term flow conditions:

- *Acacia Way Gravity Sewer Improvement:* Upgrade a total of 250 linear feet of 24-inch diameter pipeline to 30-inch diameter pipeline
- *North 4th Street Gravity Sewer Improvement:* Upgrade a total of 175 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline

The following improvements address capacity deficiencies throughout the existing gravity collection system to serve ultimate flow conditions:

- *Acacia Way Gravity Sewer Improvement:* Upgrade a total of 170 linear feet of 30-inch diameter pipeline to 36-inch diameter pipeline.
- *Acacia Road and West Harvard Boulevard Gravity Sewer Improvement:* Upgrade a total of 585 linear feet of 24-inch diameter pipeline to 27-inch diameter pipeline. This project is located along a section of the City's existing system that underwent recent improvements to rehabilitate the pipeline and improve sewer slopes. This project is designated as a lower priority project and is intended to address a deficiency that exists only during peak hour wet weather flow and ultimate buildout scenario.
- *East Harvard Boulevard Gravity Sewer Improvement:* Upgrade a total of 265 linear feet of 12-inch diameter pipeline to 15-inch diameter pipeline.
- *Walden Street and West Santa Paula Street Gravity Sewer Improvement:* Upgrade a total of 1,815 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.
- *Blanchard Elementary School Gravity Sewer Improvement:* Upgrade a total of 195 linear feet of 8-inch diameter pipeline to 10-inch diameter pipeline.
- *East Harvard Boulevard Gravity Sewer Improvement:* Upgrade a total of 125 linear feet of 12-inch diameter pipeline to 15-inch diameter pipeline.
- *Santa Clara Street Gravity Sewer Improvement:* Upgrade a total of 695 linear feet of 12-inch diameter pipeline to 15-inch diameter pipeline.

11.2.2 Lift Station Facility Projects – Condition Based

Based on the condition assessment completed by MKN, several recommended improvements to address current physical deficiencies and improve facility operations were identified for the existing lift stations. The following provides a brief description of the recommended improvements for the City's lift stations:

- *Harvest Lift Station Rehabilitation:* Repair coatings within wet well to reduce the presence of hydrogen sulfide.
- *Lemonwood Lift Station Replacement:* Replace existing lift station pumps, piping, controls, and instrumentation. In addition, make improvements to site security and access.
- *Harding Park Lift Station Rehabilitation:* Repair leaking conduit penetration.

11.2.3 Water Recycling Facility Projects – Capacity and Condition Based

Based on the hydraulic and treatment evaluations completed by MKN, several recommended improvements to address these deficiencies were identified. The following provides a brief description of the recommended improvements at the WRF:

- *Headworks Screening:* Fine screening upgrade includes replacing the existing fine screening system with a larger system in order to meet near-term and ultimate flow conditions when one headworks train is not in use.
- *Flow Equalization:* Install additional flow equalization basin to meet anticipated permit requirements and/or increase in flow based on future developments within the City.
- *Membrane Basins Expansion and Aeration Improvements:* Installation of additional membrane modules in MBR Basins 7 and 8 and addition of an aeration basin blower to increase capacity to handle ultimate flow and load conditions.
- *Gravity Belt Thickener Improvements:* Install an additional gravity belt thickener to reduce run times and provide redundancy under ultimate flow and load conditions.

Based on the condition assessment completed by MKN, several recommended improvements to address existing physical deficiencies and improve facility operations were identified. The following provides a brief description of the recommended improvements at the WRF:

- *Preliminary Treatment:*
  - Influent pump station pump improvements including replacing and installing (4) new pumps; mounting components and guide rails; and installing controls and alarms.
  - Influent pump station structural improvements including performing concrete and coating rehabilitation.
  - Grit classifier replacement including replacing #2 grit classifier and appurtenances and reconnection to existing piping and its supports.
  - Screen discharge chute replacement.

- *Flow Equalization:* Flow equalization basin improvements including repairing concrete weir to give "knife's edge" and replacing aluminum and orange grating.
- *Site Improvement Projects:*
  - Controls and headworks/dewatering building repairs and improvements including replacing all lighting, windows, window screens, and locks, and repair paint site-wide.
  - Decorative pond rehabilitation including removing sludge; fixing leaks; and replacing exhaust fan, lights, transformer and sump pumps.
  - Remove and replace security fencing around perimeter of WRF.
  - Landscaping upgrades to improve WRF aesthetics.
  - Repair concrete cracks and spalling around building exteriors.
- *Major Service and Replacement for Mechanical Equipment:* See **Appendix J** for the annual major service and replacement budget.

11.2.4 Operations and Maintenance Projects

The following **Table 11-4** identifies potential projects that the City could implement to efficiently operate and manage the existing sewer collection and WRF.

Table 11-4: Operation and Maintenance Projects Allowance

Project	Improvement Name	Description	Frequency	Opinion of Cost ($)
OM-1	Updating the City Geographic Information System (GIS)	Update model with field survey data	One Time	$35,000
OM-2	Hydraulic Model Maintenance	Complete updates of existing water GIS and hydraulic model	Annual	$10,000
OM-3	CIP Evaluation	Review, update, and prioritize CIP	Annual	$10,000
OM-4	Master Plan Update	Prepare master plan update	Every 5 Years	$150,000
OM-5	Wet Weather Flow Monitoring Study	Verify wet weather conditions for pipeline capacity deficiencies	One Time	$100,000
OM-6	Crane Load Certification	Annual allowance	Annual	$3,000
OM-7	Tool Purchases	Annual allowance	Annual	$1,500
OM-8	Generator and Transfer Switch Servicing	Annual allowance	Annual	$20,000
OM-9	Basin Cleaning	Performed every 5 years	Every 5 Years	$600,000
OM-10	Decorative Pond Maintenance	Includes weed abatement, sludge removal, etc. under an annual allowance	Annual	$20,000
			Total	**$949,500**

Notes:
1. OM = Operation and Maintenance Project
2. N/A = Not Applicable

3. Costs rounded to the nearest $1,000

Operation and maintenance projects were not included in the CIP cost summary table.

11.2.5 Capital Improvement Summary

Table 11-5 provides an overall summary of the probable costs associated with existing and future gravity collection system, lift station facility, water recycling facility, and operations and maintenance CIPs. Active CIPs currently approved by the City for the WRF are also included in the table below.

Table 11-5: CIP Cost Summary

Improvement	Estimated Project Cost
Gravity Collection System	
Priority 1	$2,722,000
Priority 2	$2,627,000
Priority 3	$424,000
Priority 4	$2,763,000
Subtotal	**$8,536,000**
Lift Station	
Priority 1	$0
Priority 2	$272,000
Priority 3	$0
Priority 4	$0
Subtotal	**$272,000**
Water Recycling Facility	
Priority 1	$10,225,000
Priority 2	$1,672,000
Priority 3	$3,590,000
Priority 4	$3,200,000
Subtotal	**$18,687,000**
Total	**$27,495,000**

Under the proposed CIP, the City will spend a total of approximately $27.5 million over the next 15-year planning period (City buildout) to fund existing and future gravity collection system projects (31%), lift station facility projects (1%), and water recycling facility projects (68%). **Table 11-6** through **Table 11-8** provide a summary of all recommended CIP projects with project categorization, project type, description, planning-level cost, and prioritization scoring. **Figure 11-1** identifies the locations of each gravity collection system and lift station facility project throughout the District's system. **Table 11-9** provides a schedule for the 15-year CIP.

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Table 11-6: Collection System Capital Improvements													
Project	Improvement Name	Limits	Improvement No.	Existing Facility	Deficiency		Capital Improvement Project (CIP)		Priority Scale	Construction Cost ($)	Engineering, Project Administration, and Construction Management ($)	Construction Contingency Cost ($)	Opinion of Cost ($)
				Diameter (inches)	PHDWF d/D	PHWWF d/D	Diameter (inches)	Length (feet)					
Prioriy 1													
EX-GSCIP-1	Acacia Road Gravity Sewer Improvement	536 Acacia Way	I-EX-3 & I-ULT-2	24	68	87	36	45	1	$44,000	$14,000	$14,000	$72,000
		536 Acacia Way to Acacia Rd Intersection	I-EX-4	24	68	89	30	75		$63,000	$19,000	$19,000	$101,000
	Acacia Way Gravity Sewer Improvement	Acacia Way to W Santa Maria St	I-EX-5 & I-ULT-5	24	N/A	83	30	340		$282,000	$85,000	$85,000	$452,000
EX-GSCIP-2	California Street Gravity Sewer Improvement	206 California St to E Ventura St	I-EX-1	12	69	83	15	180	1	$82,000	$25,000	$25,000	$132,000
	East Ventura Street Gravity Sewer Improvement	California St to Green St	I-EX-2	12	72	100	15	80		$37,000	$12,000	$12,000	$61,000
EX-GSCIP-3	East Harvard Boulevard Gravity Sewer Improvement	S Mill St to S 12th St	I-EX-7	10	62	95	12	1680	1	$577,000	$174,000	$174,000	$925,000
EX-GSCIP-4	Elm Street Gravity Sewer Improvement	W Harvard Blvd to 220 Elm St	I-EX-8 & I-ULT-8	8	63	84	12	525	1	$181,000	$55,000	$55,000	$291,000
		220 Elm St to W Main St	I-EX-9 & I-ULT-9	10	58	79	15	100		$46,000	$14,000	$14,000	$74,000
	West Main Street Gravity Sewer Improvement	Elm St to 700 W Main St	I-EX-10 & I-ULT-10	10	65	91	15	210		$96,000	$29,000	$29,000	$154,000
	Blanchard Elementary School Gravity Sewer Improvement	W Main St to Blanchard Elementary School	I-EX-11 & I-ULT-11	10	65	99	12	520		$179,000	$54,000	$54,000	$287,000
		Blanchard Elementary School	I-EX-12 & I-ULT-12	8	59	N/A	12	110		$38,000	$12,000	$12,000	$62,000
		Blanchard Elementary School to Pamela Ct	I-EX-13	10	57	100	12	200		$69,000	$21,000	$21,000	$111,000
												Subtotal	**$2,722,000**
Prioriy 2													
EX-GSCIP-5	East Main Street Gravity Sewer Improvement	Davis St to N Ojai St	I-EX-6	10	61	89	12	1210	2	$416,000	$125,000	$125,000	$666,000
EX-GSCIP-6	North 4th Street Gravity Sewer Improvement	122 N 4th St to E Santa Barbara St	I-EX-17	8	56	N/A	10	460	2	$146,000	$44,000	$44,000	$234,000
EX-GSCIP-7	North Ojai Street Gravity Sewer Improvement	Railroad Avenue to Ojai Road	I-EX-14	8	62	77	10	980	2	$311,000	$94,000	$94,000	$499,000
EX-GSCIP-8	East Santa Barbara Street Gravity Sewer Improvement	N 5th St to N 7th St	I-EX-15	8	57	76	10	800	2	$254,000	$77,000	$77,000	$408,000
EX-GSCIP-9	Ojai Road Gravity Sewer Improvement	N Ojai St to 604 Ojai Rd	I-EX-16	8	59	N/A	10	1615	2	$512,000	$154,000	$154,000	$820,000
												Subtotal	**$2,627,000**

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Prioriy 3													
NT-GSCIP-1	Acacia Way Gravity Sewer Improvement	Acacia Rd to Santa Rosa Loop	I-NT-1 & I-ULT-3	24	N/A	84	30	250	3	$208,000	$63,000	$63,000	$334,000
NT-GSCIP-2	North 4th Street Gravity Sewer Improvement	E Main St to 122 N 4th S	I-NT-2	8	57	N/A	10	175	3	$56,000	$17,000	$17,000	$90,000
												Subtotal	**$424,000**
Prioriy 4													
ULT-GSCIP-1	Acacia Way Gravity Sewer Improvement	Shell Rd to 536 Acacia Way	I-ULT-1	30	N/A	82	36	170	4	$163,000	$49,000	$49,000	$261,000
ULT-GSCIP-2	Acacia Road Gravity Sewer Improvement	312 Acacia Road to West	I-ULT-6	24	N/A	83	27	150	4	$110,000	$33,000	$33,000	$176,000
	West Harvard Boulevard Gravity Sewer Improvement	Acacia Road to Elm Street	I-ULT-7	24	N/A	86	27	435		$318,000	$96,000	$96,000	$510,000
ULT-GSCIP-3	East Harvard Boulevard Gravity Sewer Improvement	California St to Brent Way	I-ULT-16	12	57	N/A	15	265	4	$121,000	$37,000	$37,000	$195,000
ULT-GSCIP-4	Walden Street Gravity Sewer Improvement	Filmore St to W Santa Paula St	I-ULT-14	8	67	99	10	1080	4	$343,000	$103,000	$103,000	$549,000
	West Santa Paula Street Gravity Sewer Improvement	Walden St to N Peck Rd	I-ULT-15	8	65	100	10	735		$233,000	$70,000	$70,000	$373,000
ULT-GSCIP-5	Blanchard Elementary School Gravity Sewer Improvement	Blanchard Elementary School to Fillmore St	I-ULT-13	8	63	87	10	195	4	$62,000	$19,000	$19,000	$100,000
ULT-GSCIP-6	East Harvard Boulevard Gravity Sewer Improvement	S 12th St to 1211 Harvard Blvd	I-ULT-17	12	57	N/A	15	125	4	$57,000	$18,000	$18,000	$93,000
ULT-GSCIP-7	Santa Clara Street Gravity Sewer Improvement	Santa Clara Street	I-ULT-4	12	56	N/A	15	695	4	$316,000	$95,000	$95,000	$506,000
												Subtotal	**$2,763,000**
												Total	**$8,536,000**

Notes:

1. EX-GSCIP = Existing Gravity Sewer Capital Improvement Project
2. NT-GSCIP = Near-Term Gravity Sewer Capital Improvement Project
3. ULT-GSCIP = Ultimate Gravity Sewer Capital Improvement Project
4. PHDWF = Peak Hour Dry Weather Flow
5. PHWWF = Peak Hour Wet Weather Flow
6. "N/A" deficiency indicates no deficiency for the given flow condition
7. Costs rounded to the nearest $1,000
8. Engineering, project administration, and construction management costs estimated at 30%. Construction contingency estimated at 30%
9. Construction cost opinions were developed in March 2024. Use 20-Cities Engineering News-Record (ENR) Construction Cost Index (CCI) March 2024 = 13532.01 to escalate estimated cost to present value

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Table 11-7: Lift Station Capital Improvements								
Project	**Improvement Name**	**Deficiency**	**Capital Improvement Project (CIP)**		**Construction Cost ($)**	**Engineering, Project Administration, and Construction Management ($)**	**Contingency Cost ($)**	**Opinion of Cost ($)**
Priority 1								
-	-	-	-	-	-	-	-	$0
							Subtotal	**$0**
Priority 2								
EX-LSCIP-1	Harvest Lift Station Improvements	Metal piping and coatings in wet well are corroded due to H2S issue despite being a new site (~ 3 yrs old).	Repair coatings within wet well; mitigate H2S.	2	$50,000	$15,000	$15,000	$80,000
EX-LSCIP-2	Lemonwood Lift Station Replacement	Aged equipment, minor wet well corrosion, pavement issues, trespassing issues.	Replace pumps and piping, controls and instrumentation, site security and access improvements.	2	$100,000	$30,000	$30,000	$160,000
EX-LSCIP-3	Harding Park Lift Station Improvements	Control panel housing room has leak in roof penetration, causing water to	Repair leaking conduit penetration.	2	$20,000	$6,000	$6,000	$32,000
							Subtotal	**$272,000**
Priority 3								
-	-	-	-	-	-	-	-	$0
							Subtotal	**$0**
Priority 4								
-	-	-	-	-	-	-	-	$0
							Subtotal	**$0**
							Total	**$272,000**

Notes:
1. EX-LSCIP = Existing Lift Station Capital Improvement Plan
2. Costs rounded to the nearest $1,000
3. Engineering, project administration, and construction management costs estimated at 30%. Construction contingency estimated at 30%
4. Construction cost opinions were developed in March 2024. Use 20-Cities Engineering News-Record (ENR) Construction Cost Index (CCI) March 2024 = 13532.01 to escalate estimated cost to present value

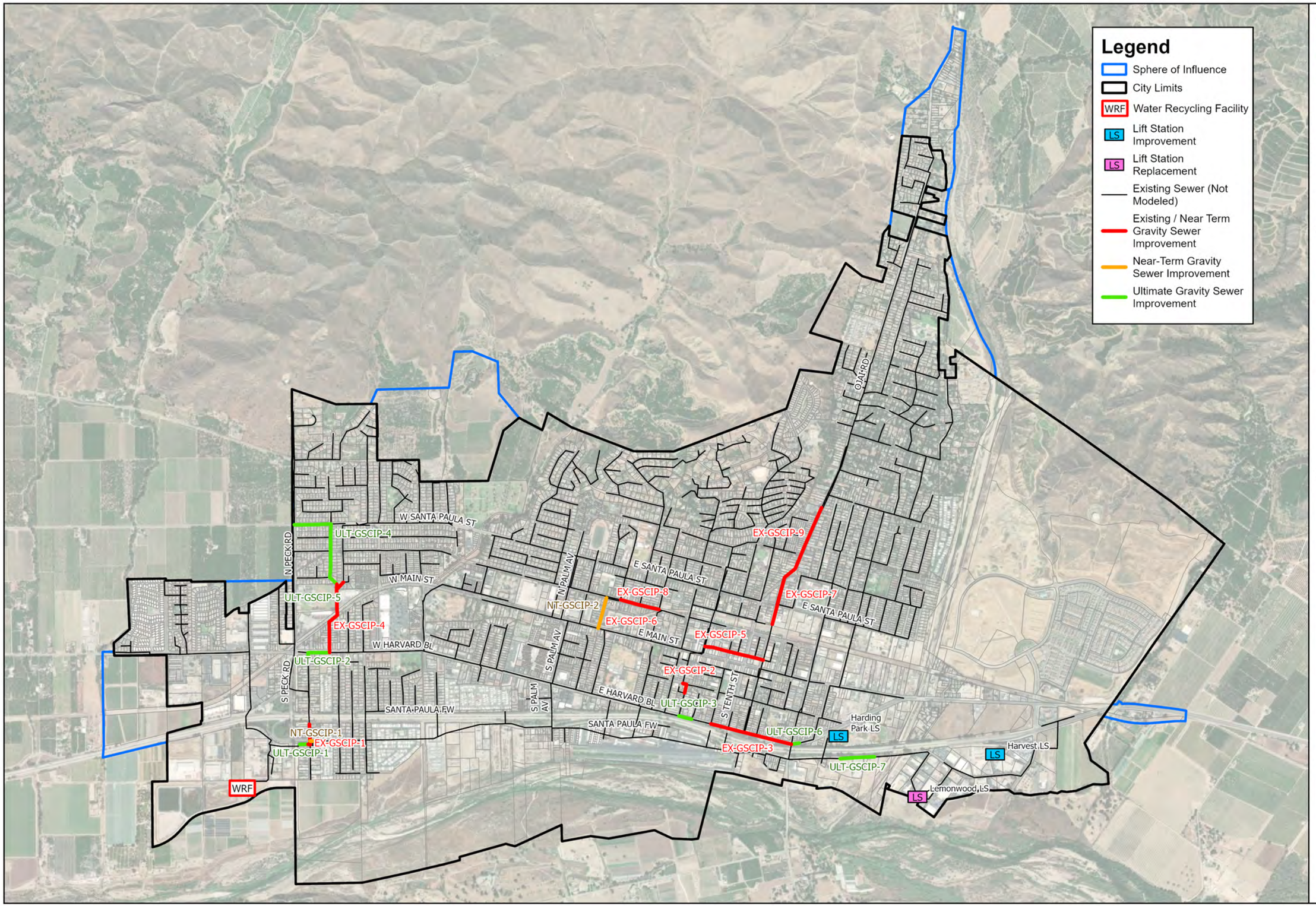
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Table 11-8: Water Recycling Facility Capital Improvements

Project	Improvement Name	Existing Facility	Deficiency	Capital Improvements Project (CIP)	Priority Scale	Construction Cost ($)	Engineering, Project Administration, and Construction Management ($)	Contingency Cost ($)	Opinion of Cost ($)
Priority 1									
EX-WRFCIP-1 (WRF-CIP-9383)	WRF Blower Replacement	(4) Aeration Blowers, (3) Membrane Blowers, (3) Digester Blowers	Existing blowers nearing end of design life and have required multiple major servicing or repairs.	Install new blowers via a 7-year blower replacement program.	1	-	-	-	$1,750,000
EX-WRFCIP-2	Grit Classifier Replacement	(2) 11" screw classifiers	#2 Grit Classifier failing, visible corrosion, wear plates missing.	Replace and install #2 Grit Classifier and appurtenances, reconnect to existing piping and its supports.	1	$250,000	$75,000	$75,000	$400,000
EX-WRFCIP-3	UV Disinfection Rehabilitation	(2) UV Disinfection Trains	Lamps shattered and past design life.	Replace lamp modules at each train.	1	$40,000	$12,000	$12,000	$64,000
EX-WRFCIP-4	Screw Press Redundancy Implementation	(1) Screw dewatering press	Lack of redundancy in the screw press.	Install additional screw press unit to provide redundancy and enhance operational reliability.	1	$800,000	$240,000	$240,000	$1,280,000
EX-WRFCIP-5	Coating Repairs	Influent Channel, Aeration and MBR Tanks	Existing protective coatings are worn and deteriorated.	Remove and replace protective coatings across influent channel, aeration and MBR tanks. Coatings applied will be designed to resist corrosion, abrasion, and chemical exposure.	1	$1,000,000	$300,000	$300,000	$1,600,000
EX-WRFCIP-6	Security Fencing and Landscaping Improvements	WRF Perimeter	Security fencing allows for easy unauthorized access. Landscaping's current appearance detracts from surrounding neighborhoods visual appeal.	Remove existing fencing and install new security barriers. Upgrade landscaping features to improve aesthetics of facility surroundings.	1	$150,000	$45,000	$45,000	$240,000
EX-WRFCIP-7	Supervisory Control and Data Acquisition (SCADA) Computer Upgrades	WRF	Current SCADA computers have performance issues, including slow operation and insufficient memory capacity.	Replace outdated SCADA computers with modern hardware and software to address deficiencies.	1	$100,000	$30,000	$30,000	$160,000
EX-WRFCIP-8 (WRF-CIP-9379)	Enhanced Aeration Control - Ammonia Analyzer	(3) Aerobic Basins	Excess power consumption and ammonia emissions.	Upgrading and installing the analyzer equipment will reduce energy and chemical consumption.	1	-	-	-	$241,000
								Subtotal	**$5,735,000**
Priority 2									
EX-WRFCIP-9	Influent Pump Station Pump Replacement	(4) 45-HP pumps with VFDs	Pumps are past design life.	Replace (4) pumps, mounting components and guide rails. Install controls and alarms.	2	$2,500,000	$750,000	$750,000	$4,000,000
EX-WRFCIP-10	Coarse and Fine Screening Repairs	(2) Fine Screens, (2) Coarse Screens	Discharge chutes damaged and covered with duct tape. Stainless steel enclosures in poor shape.	Replace discharge chutes and screening enclosures.	2	$50,000	$15,000	$15,000	$80,000
EX-WRFCIP-11	Permeate Pumps and SCADA Improvements	(6) Permeate Pumps	Pumps are nearing end of design life.	Evaluate and rebuild permeate pumps, implement controls/SCADA modifications.	2	$850,000	$255,000	$255,000	$1,360,000
EX-WRFCIP-12	Hardscape Rehabilitation	WRF	Spalling and cracks to buildings exterior surface concrete.	Repair concrete cracks and spalling around building exteriors.	2	$100,000	$30,000	$30,000	$160,000
EX-WRFCIP-13	Influent Channel Structural Improvements	Concrete Wet Well	Manhole cover and ring worn at influent metering station. Aluminum covers for influent channel to the anoxic basins in poor condition.	Replace and install new manhole cover and ring and aluminum covers.	2	$100,000	$30,000	$30,000	$160,000
EX-WRFCIP-14	Flow Equalization Basin Improvements	(2) Surge Equalization Basins	Equalization storage and reintroduction to flow stream is a manual process. Equalization weirs worn, grating damaged, and intermittent corrosion to conduit was observed.	Implement automated SCADA system for basins to automate functionality, repair concrete weir to give "knife's edge". Replace aluminum and orange grating.	2	$300,000	$90,000	$90,000	$480,000
EX-WRFCIP-15	Percolation Pond Rehabilitation	(3) Percolation ponds	Liner degradation, weed overgrowth, and irrigation system issues in the ponds.	Remove and replace existing liners. Implement effective weed control measures. Conduct assessment of irrigation system, repairing or replacing damaged components.	2	$450,000	$135,000	$135,000	$720,000
EX-WRFCIP-16	Building Repairs and Improvements	Controls and Headworks/Dewatering Buildings	Buildings do not have sufficient insulation, lack of lighting, exterior doors and locks in poor shape, paint has worn, windows and screens are damaged, smoke detector system in need of upgrades.	Install roof insulation; replace all lighting, windows and window screens; repair paint plantwide; replace exterior doors and locks.	2	$175,000	$52,500	$52,500	$280,000
EX-WRFCIP-17	Decorative Pond Rehabilitation	Decorative Pond	Water leaks into vault, faulty exhaust fan in vault, lack of lighting, sump pumps failing.	Fix vault leak, replace exhaust fan, install lights, replace/rebuild sump pumps.	2	$20,000	$6,000	$6,000	$32,000
								Subtotal	**$7,272,000**
Priority 3									
Project	**Project Name**	**Existing Facility**	**Deficiency**	**Capital Improvements Project (CIP)**	**Priority Scale**	**Construction Cost ($)**	**Engineering, Project Administration, and Construction Management ($)**	**Contingency Cost ($)**	**Opinion of Cost ($)**
NT-WRFCIP-1	Fine Screening Upgrades	(2) Fine Screens	Lack of redundancy at near-term and ultimate conditions with one headworks train out of service.	Upgrade current fine screening with a larger system in order to meet near-term and ultimate flow conditions with one headworks	3	$350,000.00	$105,000.00	$105,000.00	$560,000
NT-WRFCIP-2	Equalization Basin Implementation	(2) Equalization Basins	Potential lack of influent storage in future buildout conditions.	Install additional equalization basin to act as an influent bypass to provide redundancy and ability to store extra flows.	3	$800,000	$240,000	$240,000	$1,280,000
								Subtotal	**$1,840,000**
Priority 4									
ULT-WRFCIP-1	Membrane System Expansion	(3) MBR Trains	Lack of redundancy at ultimate term conditions.	Install new membrane modules in MBR Basins 7 and 8. Extend the MBR feed channel into Basins 7 and 8 and install new permeate pumps, one MBR blower, and all supporting piping, electrical, and instrumentation system to provide redundancy at future buildout.	4	$2,000,000	$600,000	$600,000	$3,200,000
ULT-WRFCIP-2 (WRF-CIP-9379)	Gravity Belt Thickener Improvements	(2) Gravity Belt Thickener	Lack of redundancy in the gravity belt thickeners to handle anticipated increase at ultimate flows and loadings conditions.	Install additional gravity belt thickener to provide redundancy at ultimate flow conditions.	4	$400,000	$120,000	$120,000	$640,000
								Subtotal	**$3,840,000**
								Total	**$18,687,000**

Notes:
1. EX-WRFCIP = Existing Water Recycling Facility Capital Improvement Project
1. NT-WRFCIP = Near-Term Water Recycling Facility Capital Improvement Project
1. ULT-WRFCIP = Ultimate Water Recycling Facility Capital Improvement Project
2. WRF-CIP = Water Recycling Facility Capital Improvement Project (Currently in City CIP)
3. Costs rounded to the nearest $1,000
4. Engineering, project administration, and construction management costs estimated at 30%. Construction contingency estimated at 30%
5. Construction cost opinions were developed in March 2024. Use 20-Cities Engineering News-Record (ENR) Construction Cost Index (CCI) March 2024 = 13532.01 to escalate estimated cost to present value

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City of Santa Paula

Wastewater Collection System and Water Recycling Facility Master Plan

Figure 11-1:

Collection System CIP Project Locations

1 inch = 2,200 feet

0 1,100 2,200

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Table 11-9: 15-Year CIP Summary																	
Project	**Priority Scale**	**Opinion of Cost ($)**	**FY 25/26**	**FY 26/27**	**FY 27/28**	**FY 28/29**	**FY 29/30**	**FY 30/31**	**FY 31/32**	**FY 32/33**	**FY 33/34**	**FY 34/35**	**FY 35/36**	**FY 36/37**	**FY 37/38**	**FY 38/39**	**FY 39/40**
Collection System																	
EX-GSCIP-1	1	$625,000	**$125,000**	**$500,000**													
EX-GSCIP-2	1	$193,000	**$193,000**														
EX-GSCIP-3	1	$925,000		**$185,000**	**$740,000**												
EX-GSCIP-4	1	$979,000		**$195,800**	**$783,200**												
EX-GSCIP-5	2	$666,000				**$133,200**	**$532,800**										
EX-GSCIP-6	2	$234,000				**$234,000**											
EX-GSCIP-7	2	$499,000					**$499,000**										
EX-GSCIP-8	2	$408,000					**$408,000**										
EX-GSCIP-9	2	$820,000					**$164,000**	**$656,000**									
NT-GSCIP-1	3	$334,000								**$334,000**							
NT-GSCIP-2	3	$90,000								**$90,000**							
ULT-GSCIP-1	4	$261,000											**$261,000**				
ULT-GSCIP-2	4	$686,000											**$137,200**	**$548,800**			
ULT-GSCIP-3	4	$195,000											**$195,000**				
ULT-GSCIP-4	4	$922,000												**$184,400**	**$737,600**		
ULT-GSCIP-5	4	$100,000											**$100,000**				
ULT-GSCIP-6	4	$93,000											**$93,000**				
ULT-GSCIP-7	4	$506,000											**$101,200**	**$404,800**			
	Subtotal	**$8,536,000**	**$318,000**	**$880,800**	**$1,523,200**	**$367,200**	**$1,603,800**	**$656,000**	**$0**	**$424,000**	**$0**	**$0**	**$887,400**	**$1,138,000**	**$737,600**	**$0**	**$0**
Lift Station																	
EX-LSCIP-1	2	$80,000					**$80,000**										
EX-LSCIP-2	2	$160,000					**$160,000**										
EX-LSCIP-3	2	$32,000					**$32,000**										
	Subtotal	**$272,000**	**$0**	**$0**	**$0**	**$0**	**$272,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Water Recycling Facility																	
EX-WRFCIP-1 (WRF-CIP-9383)	1	$1,750,000	**$250,000**	**$250,000**	**$250,000**	**$250,000**	**$250,000**	**$250,000**	**$250,000**								
EX-WRFCIP-2	1	$400,000	**$400,000**														
EX-WRFCIP-3	1	$64,000	**$64,000**														
EX-WRFCIP-4	1	$1,280,000	**$256,000**	**$1,024,000**													
EX-WRFCIP-5	1	$1,600,000			**$320,000**	**$1,280,000**											
EX-WRFCIP-6	1	$240,000	**$240,000**														
EX-WRFCIP-7	1	$160,000		**$160,000**													
EX-WRFCIP-8 (WRF-CIP-9379)	1	$241,000				**$241,000**											
EX-WRFCIP-9	2	$4,000,000						**$800,000**	**$1,600,000**	**$1,600,000**							
EX-WRFCIP-10	2	$80,000				**$80,000**											
EX-WRFCIP-11	2	$1,360,000					**$272,000**	**$1,088,000**									
EX-WRFCIP-12	2	$160,000				**$160,000**											
EX-WRFCIP-13	2	$160,000				**$160,000**											
EX-WRFCIP-14	2	$480,000					**$480,000**										
EX-WRFCIP-15	2	$720,000							**$144,000**	**$576,000**							
EX-WRFCIP-16	2	$280,000							**$280,000**								
EX-WRFCIP-17	2	$32,000							**$32,000**								
NT-WRFCIP-1	3	$560,000									**$560,000**						
NT-WRFCIP-2	3	$1,280,000									**$256,000**	**$1,024,000**					
ULT-WRFCIP-1	4	$3,200,000													**$1,066,667**	**$1,066,667**	**$1,066,667**
ULT-WRFCIP-2 (WRF-CIP-9379)	4	$640,000														**$640,000**	
	Subtotal	**$18,687,000**	**$1,210,000**	**$1,434,000**	**$570,000**	**$2,171,000**	**$1,002,000**	**$2,138,000**	**$2,306,000**	**$2,176,000**	**$816,000**	**$1,024,000**	**$0**	**$0**	**$1,066,667**	**$1,706,667**	**$1,066,667**
	Total	$27,495,000	$1,528,000	$2,314,800	$2,093,200	$2,538,200	$2,877,800	$2,794,000	$2,306,000	$2,600,000	$816,000	$1,024,000	$887,400	$1,138,000	$1,804,267	$1,706,667	$1,066,667

Priority	Description
1	Required to resolve existing **significant** capacity or condition-based deficiency and recommended for implementation within the next 1 - 3 years from the adoption of the Master Plan
2	Required to resolve **less significant** existing capacity or condition-based deficiency and recommended for implementation within the next 3 - 5 years from the adoption of the Master Plan
3	Required to resolve near-term capacity deficiency and recommended for implementation within the next 5 - 10 years from the adoption of the Master Plan
4	Required to meet ultimate capacity deficiency and recommended for implementation past 10 years from the adoption of the Master Plan and/or dependent on development status

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Appendix A – Flow Monitoring Study

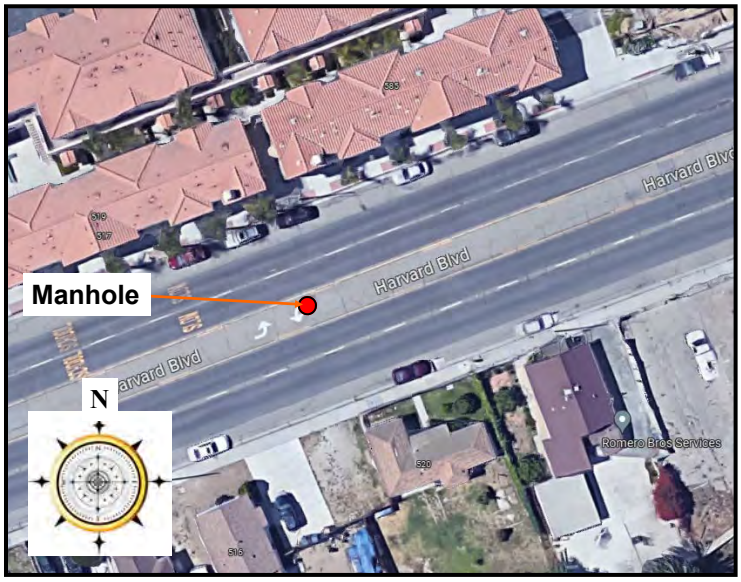
CITY OF SANTA PAULA - SEWER FLOW STUDY

MH Location: **520 Harvard Blvd.**
Santa Paula, CA 93060

Pipe Size: **18" VCP**

Time Period: **7/11/2023 - 12:00 a.m. to**
7/25/2023- 12:00 a.m.

GPS: **34.348436, -119.065191**



Manhole - Layout



- Manhole walls are made of stacked brick and mortar. Pipe transitions are in good condition inside of manhole
- Meter was placed inside downstream pipe in order to capture the flow from the tie in.

Equipment

Teledyne Isco 2150 Area Velocity Flow Meter with 10' measuring range:
Level Measurement:

- Method - Submerged pressure transducer mounted in the flow stream
- Transducer Type - Differential linear integrated circuit pressure transducer
- Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); Maximum Allowable Level 34 ft (10.5 m)
- Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,)
- Long-Term Stability ±0.023 ft/yr (±0.007 m/yr)
- Compensated Range 32° to 122°F (0° to 50°C)

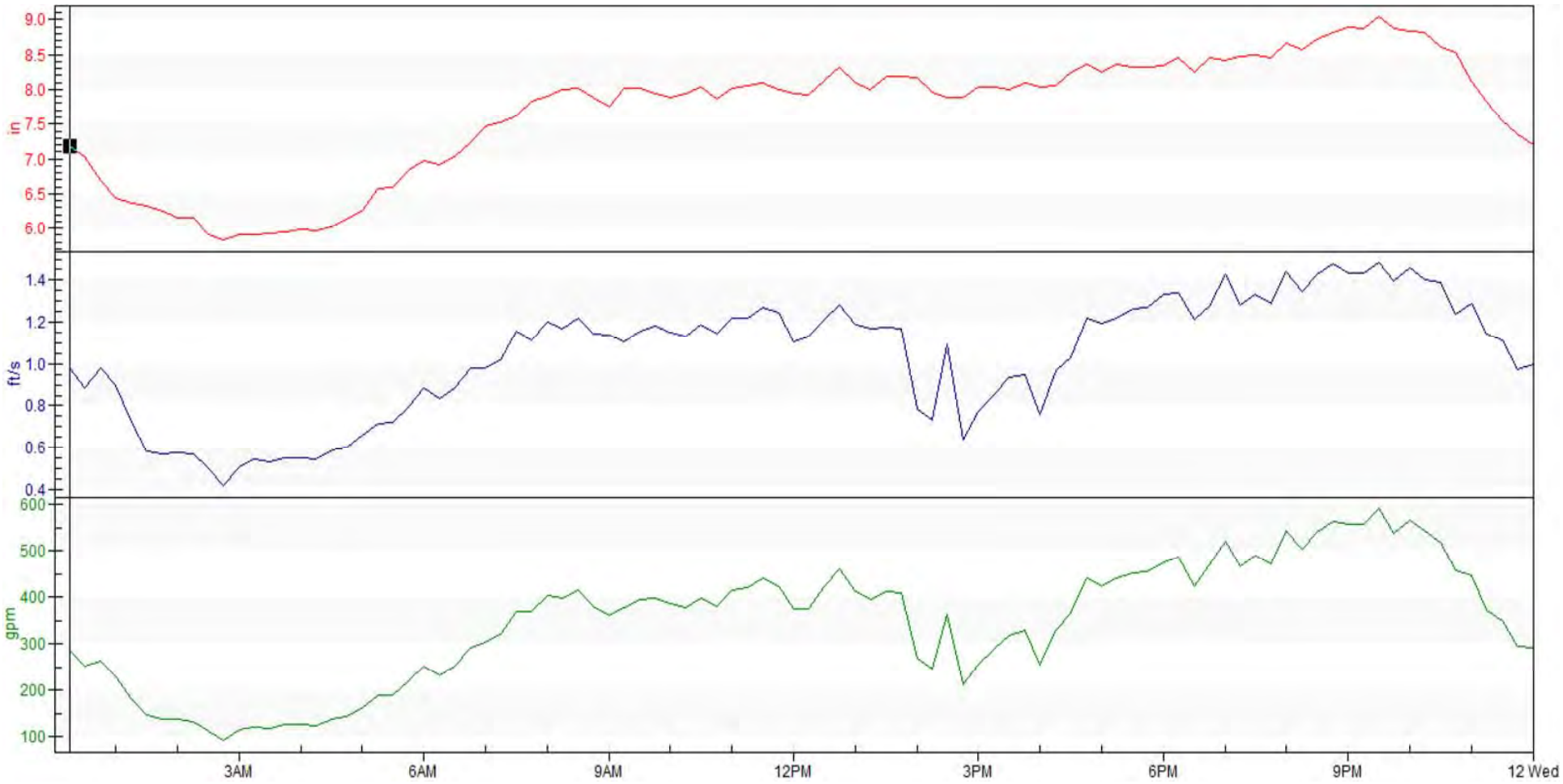
Velocity Measurement:

- Method - Doppler ultrasonic, frequency 500 kHz
- Typical Minimum Depth 0.08 ft (25 mm)
- Range -5 to +20 ft/s (-1.5 to +6.1 m/s)
- Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from— 1.5 to +1.5 m/s)
- ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)

Method Of Insertion:

- 18 inch line requires Confined Space Entry.

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/11/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Tuesday- A.M. 7/11/2023

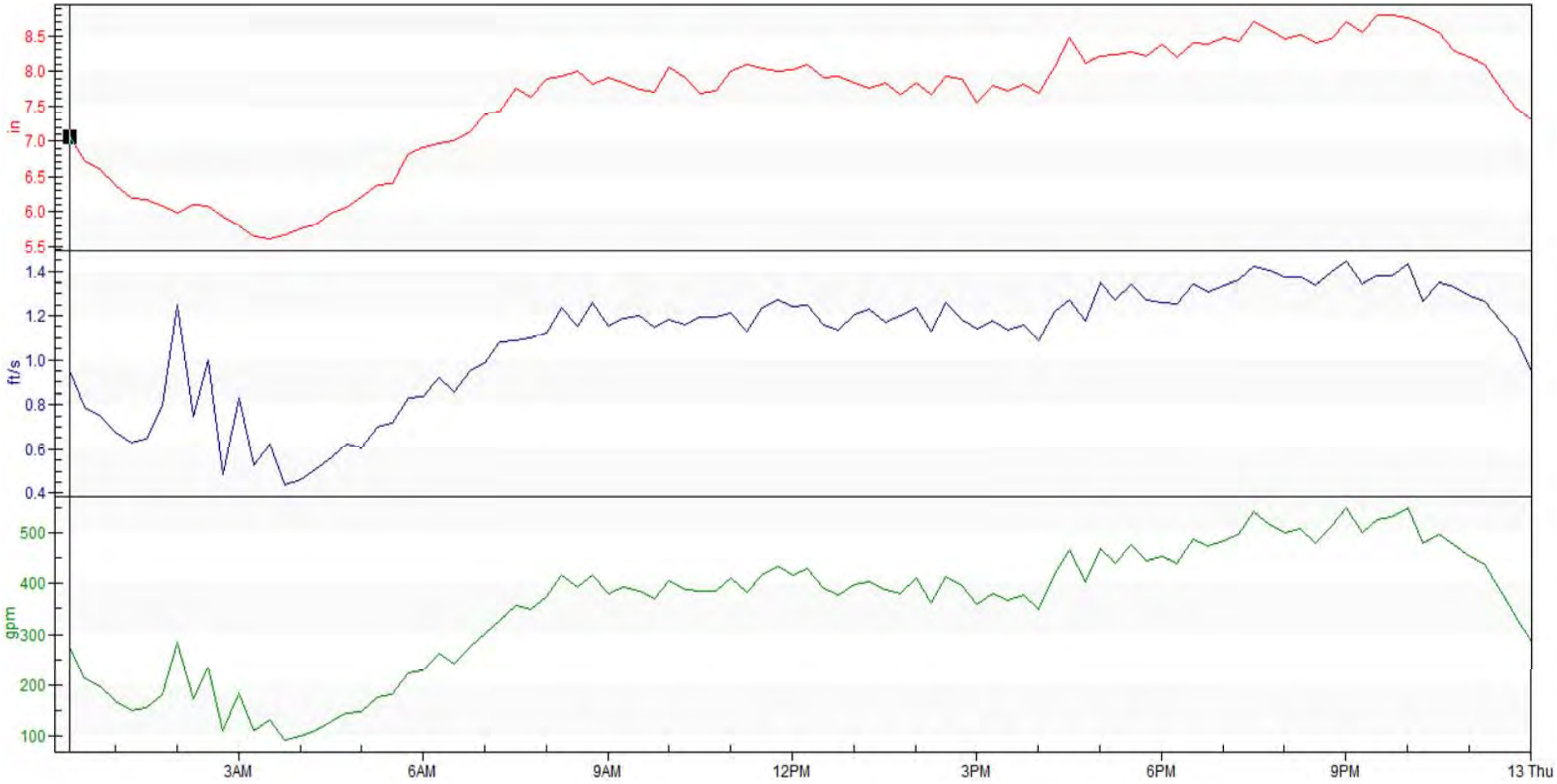
Time	Level	Velocity	Flow
12:15:00 AM	7.176	0.982	285.171
12:30:00 AM	7.02	0.883	252.86
12:45:00 AM	6.684	0.978	262.146
1:00:00 AM	6.442	0.897	228.816
1:15:00 AM	6.364	0.721	180.816
1:30:00 AM	6.333	0.582	145.09
1:45:00 AM	6.252	0.57	137.604
2:00:00 AM	6.156	0.574	137.649
2:15:00 AM	6.145	0.57	133.583
2:30:00 AM	5.903	0.501	113.486
2:45:00 AM	5.828	0.418	92.864
3:00:00 AM	5.899	0.505	114.22
3:15:00 AM	5.904	0.541	121.559
3:30:00 AM	5.927	0.529	117.895
3:45:00 AM	5.938	0.549	125.205
4:00:00 AM	5.978	0.551	126.914
4:15:00 AM	5.971	0.544	124.278
4:30:00 AM	6.015	0.589	136.878
4:45:00 AM	6.139	0.599	143.092
5:00:00 AM	6.24	0.659	160.937
5:15:00 AM	6.574	0.717	187.884
5:30:00 AM	6.599	0.718	188.9
5:45:00 AM	6.831	0.799	220.672
6:00:00 AM	6.97	0.886	251.299
6:15:00 AM	6.91	0.833	233.275
6:30:00 AM	7.03	0.882	252.726
6:45:00 AM	7.245	0.979	292.397
7:00:00 AM	7.463	0.979	303.501
7:15:00 AM	7.529	1.017	319.625
7:30:00 AM	7.628	1.159	369.612
7:45:00 AM	7.822	1.114	368.409
8:00:00 AM	7.914	1.203	403.953
8:15:00 AM	8.008	1.167	397.994
8:30:00 AM	8.021	1.221	415.67
8:45:00 AM	7.885	1.143	380.289
9:00:00 AM	7.749	1.137	361.494
9:15:00 AM	8.022	1.108	378.761
9:30:00 AM	8.014	1.157	395.114
9:45:00 AM	7.949	1.179	397.148
10:00:00 AM	7.895	1.153	385.795
10:15:00 AM	7.935	1.134	377.751
10:30:00 AM	8.033	1.19	398.148
10:45:00 AM	7.873	1.145	381.772
11:00:00 AM	8.015	1.218	415.983
11:15:00 AM	8.059	1.223	420.433
11:30:00 AM	8.097	1.271	439.855
11:45:00 AM	7.991	1.242	422.478

Tuesday- P.M. 7/11/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.943	1.109	374.206
12:15:00 PM	7.915	1.133	373.468
12:30:00 PM	8.132	1.215	422.74
12:45:00 PM	8.33	1.283	460.71
1:00:00 PM	8.103	1.188	411.419
1:15:00 PM	8.003	1.172	394.073
1:30:00 PM	8.196	1.172	412.057
1:45:00 PM	8.196	1.166	408.752
2:00:00 PM	8.177	0.784	268.728
2:15:00 PM	7.968	0.731	246.496
2:30:00 PM	7.877	1.093	364.433
2:45:00 PM	7.878	0.639	213.252
3:00:00 PM	8.047	0.773	256.147
3:15:00 PM	8.04	0.852	288.172
3:30:00 PM	8.001	0.934	318.272
3:45:00 PM	8.104	0.948	328.399
4:00:00 PM	8.033	0.759	256.072
4:15:00 PM	8.048	0.966	330.345
4:30:00 PM	8.244	1.033	365.917
4:45:00 PM	8.369	1.221	440.122
5:00:00 PM	8.246	1.192	422.317
5:15:00 PM	8.367	1.22	440.383
5:30:00 PM	8.328	1.261	452.693
5:45:00 PM	8.317	1.267	453.401
6:00:00 PM	8.346	1.333	474.869
6:15:00 PM	8.453	1.339	487.1
6:30:00 PM	8.239	1.211	422.99
6:45:00 PM	8.459	1.279	468.46
7:00:00 PM	8.427	1.427	520.169
7:15:00 PM	8.476	1.281	465.367
7:30:00 PM	8.5	1.333	487.504
7:45:00 PM	8.46	1.286	471.059
8:00:00 PM	8.67	1.438	543.462
8:15:00 PM	8.578	1.347	502.431
8:30:00 PM	8.722	1.428	539.631
8:45:00 PM	8.82	1.478	562.773
9:00:00 PM	8.901	1.432	557.871
9:15:00 PM	8.874	1.434	558.465
9:30:00 PM	9.048	1.485	590.916
9:45:00 PM	8.874	1.396	538.714
10:00:00 PM	8.844	1.46	566.303
10:15:00 PM	8.819	1.406	543.13
10:30:00 PM	8.605	1.393	516.29
10:45:00 PM	8.528	1.237	457.915
11:00:00 PM	8.123	1.286	446.952
11:15:00 PM	7.837	1.143	372.211
11:30:00 PM	7.539	1.114	348.878
11:45:00 PM	7.351	0.975	295.419

	Inches	Feet/Sec	GPM
Daily Avg:	7.671	1.040	346.773
Daily Min:	5.828	0.418	92.864
Daily Max:	9.048	1.485	590.916
Peak to Avg:			1.70

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/12/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Wednesday - A.M. 7/12/2023

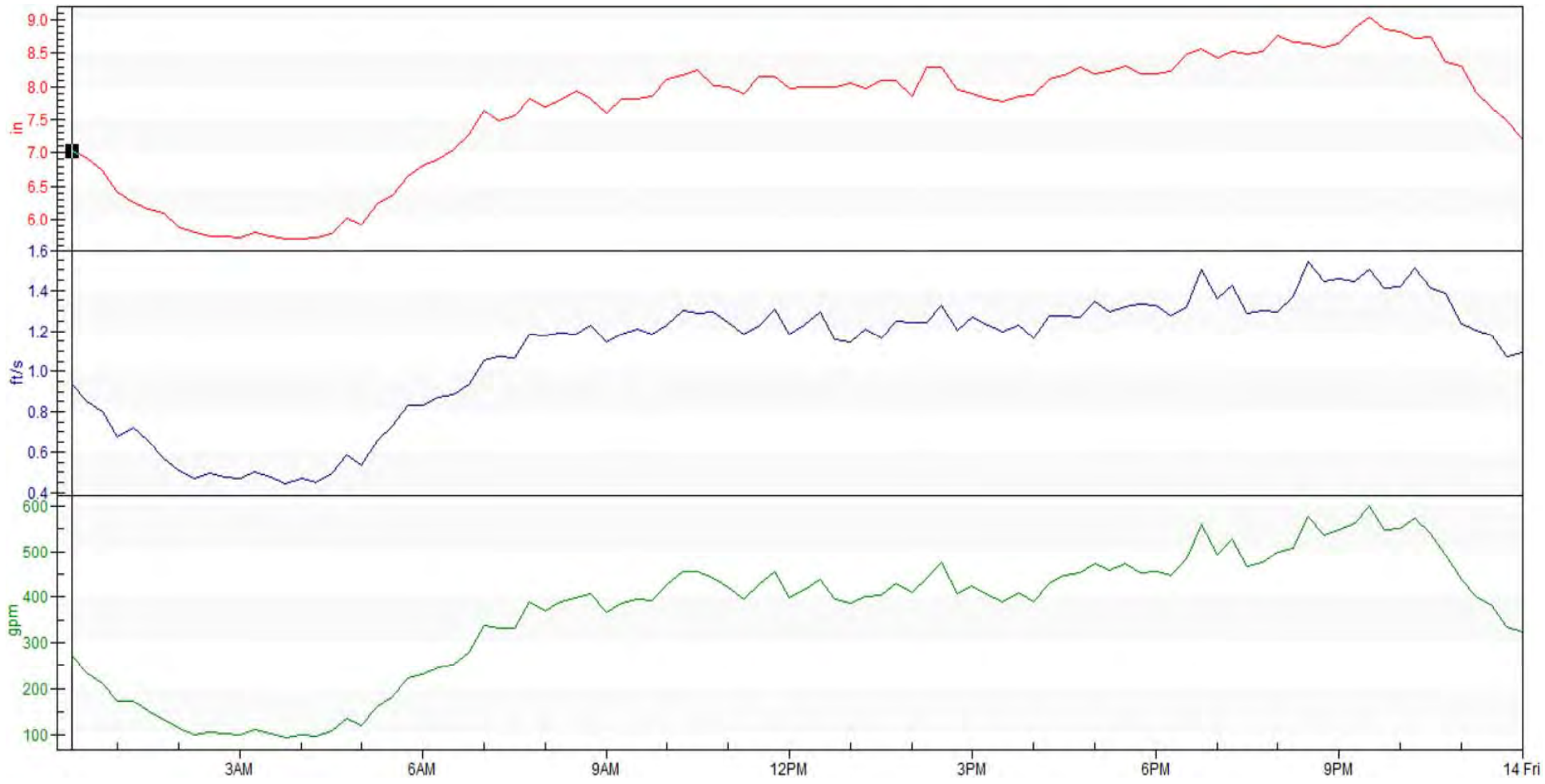
Time	Level	Velocity	Flow
12:00:00 AM	7.207	0.998	290.826
12:15:00 AM	7.066	0.952	275.095
12:30:00 AM	6.725	0.791	213.704
12:45:00 AM	6.595	0.747	196.791
1:00:00 AM	6.377	0.674	168.364
1:15:00 AM	6.194	0.626	149.838
1:30:00 AM	6.174	0.646	155.433
1:45:00 AM	6.082	0.796	182.799
2:00:00 AM	5.987	1.248	283.493
2:15:00 AM	6.092	0.75	173.27
2:30:00 AM	6.074	0.998	234.815
2:45:00 AM	5.937	0.488	111.237
3:00:00 AM	5.792	0.833	183.746
3:15:00 AM	5.648	0.53	111.521
3:30:00 AM	5.606	0.623	131.267
3:45:00 AM	5.667	0.438	93.759
4:00:00 AM	5.757	0.461	100.775
4:15:00 AM	5.812	0.507	112.332
4:30:00 AM	5.979	0.566	130.267
4:45:00 AM	6.056	0.623	146.046
5:00:00 AM	6.217	0.608	147.291
5:15:00 AM	6.373	0.703	176.655
5:30:00 AM	6.395	0.72	181.892
5:45:00 AM	6.819	0.829	222.609
6:00:00 AM	6.917	0.84	228.794
6:15:00 AM	6.965	0.923	261.568
6:30:00 AM	7.002	0.858	241.386
6:45:00 AM	7.137	0.95	274.548
7:00:00 AM	7.375	0.988	301.162
7:15:00 AM	7.416	1.083	328.748
7:30:00 AM	7.767	1.089	356.689
7:45:00 AM	7.623	1.098	349.259
8:00:00 AM	7.895	1.123	375.996
8:15:00 AM	7.938	1.235	415.255
8:30:00 AM	8.014	1.154	394.057
8:45:00 AM	7.826	1.262	417.075
9:00:00 AM	7.918	1.151	379.325
9:15:00 AM	7.834	1.192	392.61
9:30:00 AM	7.748	1.198	384.007
9:45:00 AM	7.711	1.144	369.064
10:00:00 AM	8.056	1.183	406.625
10:15:00 AM	7.911	1.158	388.522
10:30:00 AM	7.679	1.194	385.454
10:45:00 AM	7.731	1.197	385.96
11:00:00 AM	7.998	1.213	410.473
11:15:00 AM	8.101	1.127	381.492
11:30:00 AM	8.037	1.238	416.561
11:45:00 AM	8.009	1.274	434.642

Wednesday - P.M. 7/12/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.028	1.245	417.246
12:15:00 PM	8.091	1.248	428.656
12:30:00 PM	7.913	1.159	389.177
12:45:00 PM	7.935	1.136	376.022
1:00:00 PM	7.836	1.205	399.478
1:15:00 PM	7.762	1.228	402.134
1:30:00 PM	7.829	1.169	386.879
1:45:00 PM	7.666	1.201	379.839
2:00:00 PM	7.83	1.238	410.071
2:15:00 PM	7.658	1.129	362.477
2:30:00 PM	7.929	1.258	412.561
2:45:00 PM	7.886	1.185	396.14
3:00:00 PM	7.558	1.138	357.937
3:15:00 PM	7.802	1.178	379.068
3:30:00 PM	7.716	1.135	366.023
3:45:00 PM	7.813	1.161	376.82
4:00:00 PM	7.681	1.089	348.894
4:15:00 PM	8.069	1.219	419.225
4:30:00 PM	8.484	1.269	466.699
4:45:00 PM	8.125	1.178	403.482
5:00:00 PM	8.217	1.351	469.265
5:15:00 PM	8.238	1.27	440.792
5:30:00 PM	8.275	1.346	476.884
5:45:00 PM	8.216	1.273	446.338
6:00:00 PM	8.375	1.259	452.824
6:15:00 PM	8.188	1.253	439.891
6:30:00 PM	8.398	1.341	486.445
6:45:00 PM	8.393	1.31	474.787
7:00:00 PM	8.48	1.337	485.301
7:15:00 PM	8.416	1.363	495.969
7:30:00 PM	8.708	1.423	540.967
7:45:00 PM	8.595	1.404	514.296
8:00:00 PM	8.45	1.374	500.771
8:15:00 PM	8.512	1.374	507.315
8:30:00 PM	8.409	1.339	479.567
8:45:00 PM	8.465	1.4	513.041
9:00:00 PM	8.696	1.445	548.426
9:15:00 PM	8.561	1.346	500.543
9:30:00 PM	8.8	1.38	525.912
9:45:00 PM	8.797	1.381	532
10:00:00 PM	8.766	1.431	548.79
10:15:00 PM	8.674	1.263	477.884
10:30:00 PM	8.546	1.351	497.584
10:45:00 PM	8.289	1.332	475.118
11:00:00 PM	8.195	1.289	452.92
11:15:00 PM	8.092	1.264	437.024
11:30:00 PM	7.76	1.178	385.406
11:45:00 PM	7.472	1.099	336.141

	Inches	Feet/Sec	GPM
Daily Avg:	7.564	1.094	356.666
Daily Min:	5.606	0.438	93.759
Daily Max:	8.8	1.445	548.79
Peak to Avg:			1.54

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/13/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Thursday - A.M. 7/13/2023

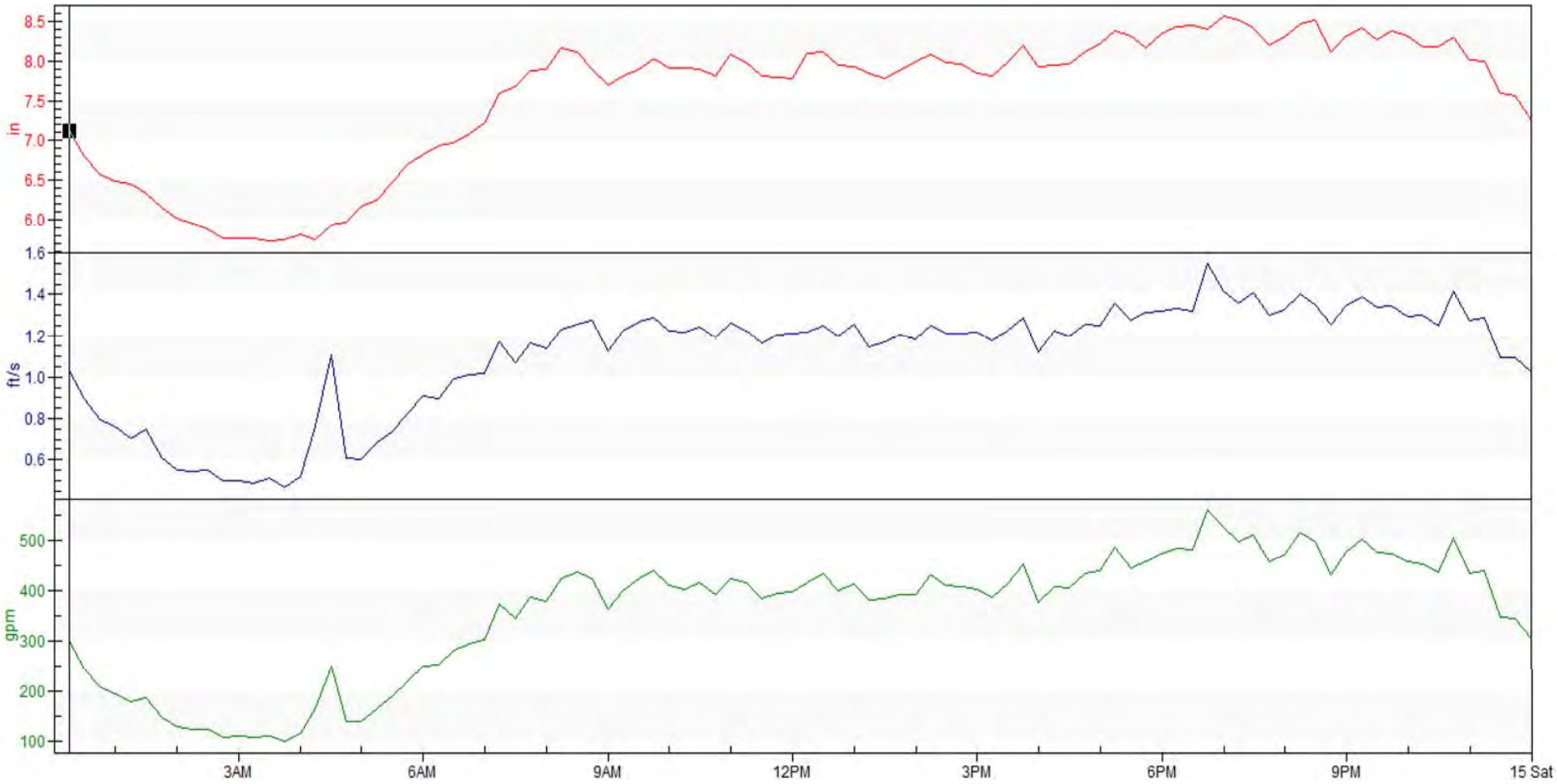
Time	Level	Velocity	Flow
12:00:00 AM	7.3	0.952	287.283
12:15:00 AM	7.034	0.94	269.821
12:30:00 AM	6.93	0.855	234.765
12:45:00 AM	6.722	0.804	210.013
1:00:00 AM	6.421	0.676	171.63
1:15:00 AM	6.256	0.722	173.297
1:30:00 AM	6.156	0.656	152.618
1:45:00 AM	6.101	0.568	132.452
2:00:00 AM	5.883	0.507	113.897
2:15:00 AM	5.796	0.468	101.699
2:30:00 AM	5.753	0.493	106.855
2:45:00 AM	5.753	0.477	104.114
3:00:00 AM	5.733	0.47	102.256
3:15:00 AM	5.805	0.503	111.277
3:30:00 AM	5.745	0.479	104.34
3:45:00 AM	5.712	0.443	95.792
4:00:00 AM	5.704	0.468	100.02
4:15:00 AM	5.722	0.449	96.956
4:30:00 AM	5.774	0.497	109.087
4:45:00 AM	6.021	0.587	136.454
5:00:00 AM	5.932	0.534	119.993
5:15:00 AM	6.235	0.657	160.348
5:30:00 AM	6.348	0.727	180.757
5:45:00 AM	6.652	0.832	221.72
6:00:00 AM	6.818	0.835	230.055
6:15:00 AM	6.906	0.875	245.196
6:30:00 AM	7.038	0.886	250.13
6:45:00 AM	7.28	0.938	279.839
7:00:00 AM	7.645	1.053	337.746
7:15:00 AM	7.473	1.074	331.51
7:30:00 AM	7.553	1.064	332.456
7:45:00 AM	7.817	1.185	388.727
8:00:00 AM	7.704	1.175	370.397
8:15:00 AM	7.804	1.191	389.091
8:30:00 AM	7.938	1.186	399.221
8:45:00 AM	7.822	1.227	405.668
9:00:00 AM	7.609	1.147	365.666
9:15:00 AM	7.812	1.186	386.345
9:30:00 AM	7.827	1.208	395.29
9:45:00 AM	7.853	1.182	392.207
10:00:00 AM	8.106	1.231	426.671
10:15:00 AM	8.169	1.303	455.16
10:30:00 AM	8.251	1.285	455.662
10:45:00 AM	8.015	1.293	441.434
11:00:00 AM	8	1.246	420.868
11:15:00 AM	7.888	1.186	395.284
11:30:00 AM	8.152	1.224	427.348
11:45:00 AM	8.151	1.305	455.508

Thursday - P.M. 7/13/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.968	1.183	399.025
12:15:00 PM	8.002	1.229	414.956
12:30:00 PM	7.987	1.294	439.686
12:45:00 PM	8.001	1.16	395.056
1:00:00 PM	8.045	1.147	387.772
1:15:00 PM	7.982	1.207	400.813
1:30:00 PM	8.095	1.166	403.248
1:45:00 PM	8.085	1.248	429.527
2:00:00 PM	7.857	1.24	410.055
2:15:00 PM	8.282	1.242	442.609
2:30:00 PM	8.294	1.33	474.803
2:45:00 PM	7.957	1.201	406.268
3:00:00 PM	7.894	1.266	423.798
3:15:00 PM	7.824	1.23	402.513
3:30:00 PM	7.781	1.199	390.614
3:45:00 PM	7.861	1.229	409.065
4:00:00 PM	7.877	1.167	389.443
4:15:00 PM	8.104	1.272	430.943
4:30:00 PM	8.174	1.276	447.055
4:45:00 PM	8.292	1.271	453.418
5:00:00 PM	8.19	1.349	473.871
5:15:00 PM	8.241	1.292	457.397
5:30:00 PM	8.318	1.32	471.692
5:45:00 PM	8.194	1.335	453.862
6:00:00 PM	8.194	1.325	454.508
6:15:00 PM	8.233	1.273	448.055
6:30:00 PM	8.485	1.321	483.958
6:45:00 PM	8.569	1.503	559.806
7:00:00 PM	8.424	1.361	492.157
7:15:00 PM	8.532	1.425	527.371
7:30:00 PM	8.482	1.287	467.629
7:45:00 PM	8.529	1.303	476.261
8:00:00 PM	8.772	1.297	497.807
8:15:00 PM	8.662	1.374	508.543
8:30:00 PM	8.638	1.542	576.668
8:45:00 PM	8.593	1.447	536.583
9:00:00 PM	8.652	1.459	548.05
9:15:00 PM	8.88	1.442	562.032
9:30:00 PM	9.042	1.502	599.131
9:45:00 PM	8.861	1.412	548.481
10:00:00 PM	8.83	1.42	549.425
10:15:00 PM	8.729	1.508	574.926
10:30:00 PM	8.744	1.412	539.615
10:45:00 PM	8.373	1.383	493.741
11:00:00 PM	8.309	1.238	437.008
11:15:00 PM	7.923	1.202	399.717
11:30:00 PM	7.689	1.178	380.95
11:45:00 PM	7.482	1.075	335.321

	Inches	Feet/Sec	GPM
Daily Avg:	7.608	1.093	363.083
Daily Min:	5.704	0.443	95.792
Daily Max:	9.042	1.542	599.131
Peak to Avg:			1.65

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/14/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Friday - A.M. 7/14/2023

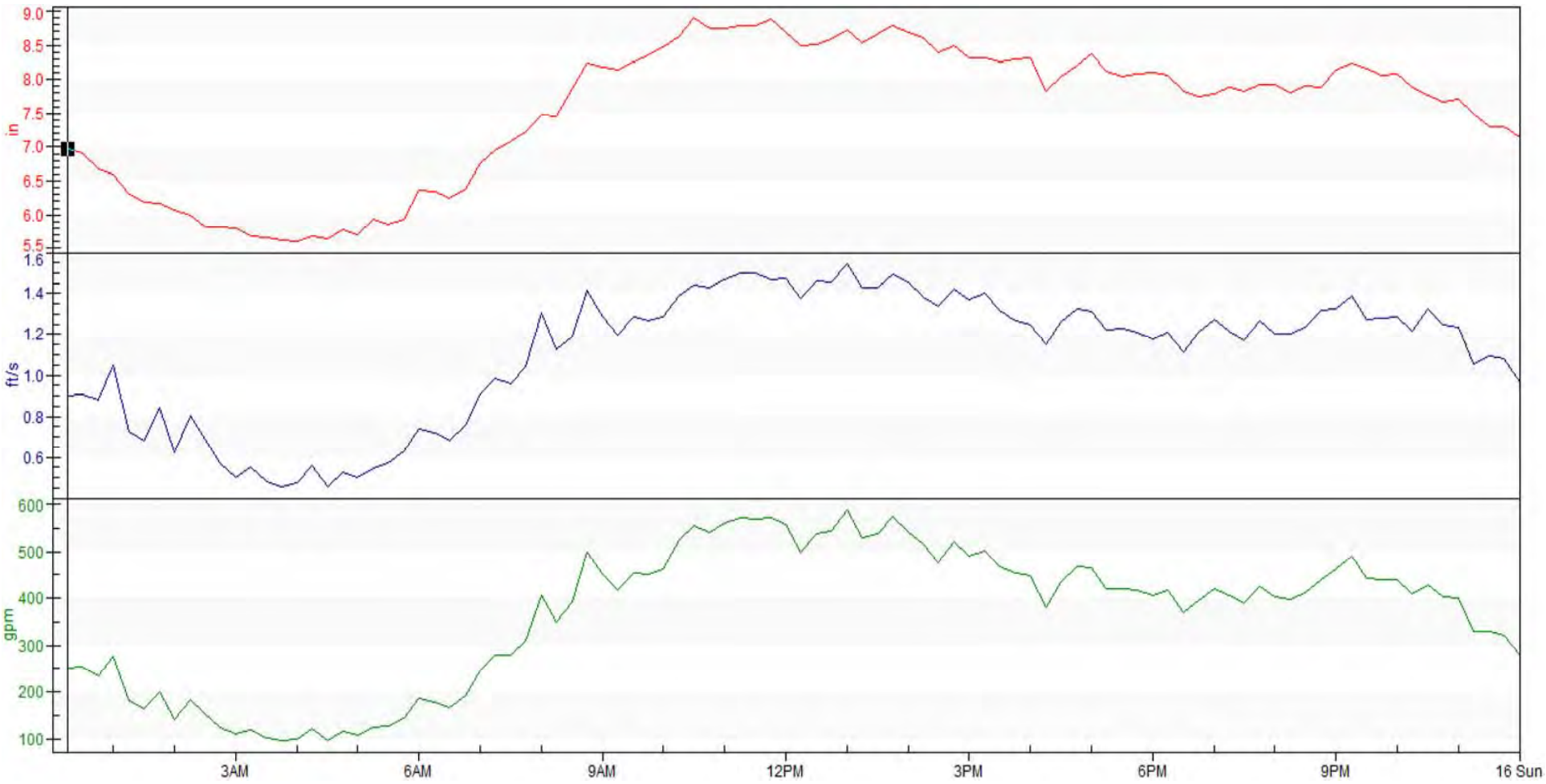
Time	Level	Velocity	Flow
12:00:00 AM	7.206	1.093	324.121
12:15:00 AM	7.117	1.029	300.318
12:30:00 AM	6.807	0.895	245.859
12:45:00 AM	6.568	0.793	207.599
1:00:00 AM	6.487	0.759	194.054
1:15:00 AM	6.448	0.704	179.692
1:30:00 AM	6.333	0.748	186.39
1:45:00 AM	6.143	0.61	145.888
2:00:00 AM	6.022	0.55	127.338
2:15:00 AM	5.943	0.544	123.551
2:30:00 AM	5.878	0.551	123.991
2:45:00 AM	5.757	0.497	108.721
3:00:00 AM	5.765	0.501	109.754
3:15:00 AM	5.768	0.488	106.501
3:30:00 AM	5.73	0.51	110.876
3:45:00 AM	5.75	0.466	100.128
4:00:00 AM	5.816	0.518	114.758
4:15:00 AM	5.749	0.764	166.756
4:30:00 AM	5.941	1.107	250.766
4:45:00 AM	5.966	0.606	139.159
5:00:00 AM	6.167	0.598	139.912
5:15:00 AM	6.251	0.681	164.939
5:30:00 AM	6.473	0.733	188.017
5:45:00 AM	6.7	0.827	221.547
6:00:00 AM	6.819	0.91	249.182
6:15:00 AM	6.938	0.896	252.369
6:30:00 AM	6.975	0.994	282.294
6:45:00 AM	7.098	1.013	294.568
7:00:00 AM	7.226	1.021	303.506
7:15:00 AM	7.594	1.173	373.046
7:30:00 AM	7.684	1.071	345.849
7:45:00 AM	7.885	1.163	388.523
8:00:00 AM	7.905	1.139	380.175
8:15:00 AM	8.166	1.231	425.286
8:30:00 AM	8.119	1.258	436.821
8:45:00 AM	7.893	1.271	425.473
9:00:00 AM	7.694	1.128	363.633
9:15:00 AM	7.81	1.22	400.268
9:30:00 AM	7.894	1.267	423.944
9:45:00 AM	8.028	1.288	440.815
10:00:00 AM	7.908	1.222	409.899
10:15:00 AM	7.91	1.216	403.511
10:30:00 AM	7.903	1.244	416.898
10:45:00 AM	7.81	1.192	393.349
11:00:00 AM	8.073	1.26	423.533
11:15:00 AM	7.977	1.225	415.705
11:30:00 AM	7.813	1.168	385.765
11:45:00 AM	7.791	1.205	396.261

Friday - P.M. 7/14/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.782	1.21	397.29
12:15:00 PM	8.103	1.219	416.249
12:30:00 PM	8.113	1.25	433.558
12:45:00 PM	7.948	1.195	401.343
1:00:00 PM	7.936	1.255	414.397
1:15:00 PM	7.838	1.149	380.998
1:30:00 PM	7.775	1.175	385.402
1:45:00 PM	7.881	1.204	392.222
2:00:00 PM	8.001	1.183	393.781
2:15:00 PM	8.076	1.251	431.479
2:30:00 PM	7.972	1.211	410.471
2:45:00 PM	7.956	1.21	409.255
3:00:00 PM	7.846	1.217	403.99
3:15:00 PM	7.813	1.175	386.447
3:30:00 PM	7.982	1.221	414.55
3:45:00 PM	8.199	1.29	453.557
4:00:00 PM	7.926	1.123	377.972
4:15:00 PM	7.952	1.222	408.422
4:30:00 PM	7.961	1.197	404.782
4:45:00 PM	8.108	1.258	436.108
5:00:00 PM	8.213	1.25	440.778
5:15:00 PM	8.388	1.355	486.655
5:30:00 PM	8.315	1.272	446.69
5:45:00 PM	8.162	1.315	459.943
6:00:00 PM	8.352	1.317	474.619
6:15:00 PM	8.429	1.333	484.286
6:30:00 PM	8.453	1.318	482.121
6:45:00 PM	8.393	1.551	561.023
7:00:00 PM	8.568	1.418	527.982
7:15:00 PM	8.511	1.356	499.358
7:30:00 PM	8.418	1.411	511.206
7:45:00 PM	8.204	1.303	458.724
8:00:00 PM	8.303	1.328	471.86
8:15:00 PM	8.475	1.405	515.915
8:30:00 PM	8.514	1.349	498.18
8:45:00 PM	8.107	1.252	431.86
9:00:00 PM	8.32	1.348	477.032
9:15:00 PM	8.42	1.389	503.712
9:30:00 PM	8.266	1.339	475.941
9:45:00 PM	8.385	1.343	473.621
10:00:00 PM	8.319	1.293	459.08
10:15:00 PM	8.179	1.3	454.275
10:30:00 PM	8.18	1.248	437.308
10:45:00 PM	8.304	1.414	505.701
11:00:00 PM	8.019	1.272	434.634
11:15:00 PM	8.004	1.29	439.545
11:30:00 PM	7.588	1.095	347.079
11:45:00 PM	7.562	1.095	346.215

	Inches	Feet/Sec	GPM
Daily Avg:	7.547	1.099	358.366
Daily Min:	5.73	0.466	100.128
Daily Max:	8.568	1.551	561.023
Peak to Avg:			1.57

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/15/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Saturday - A.M. 7/15/2023

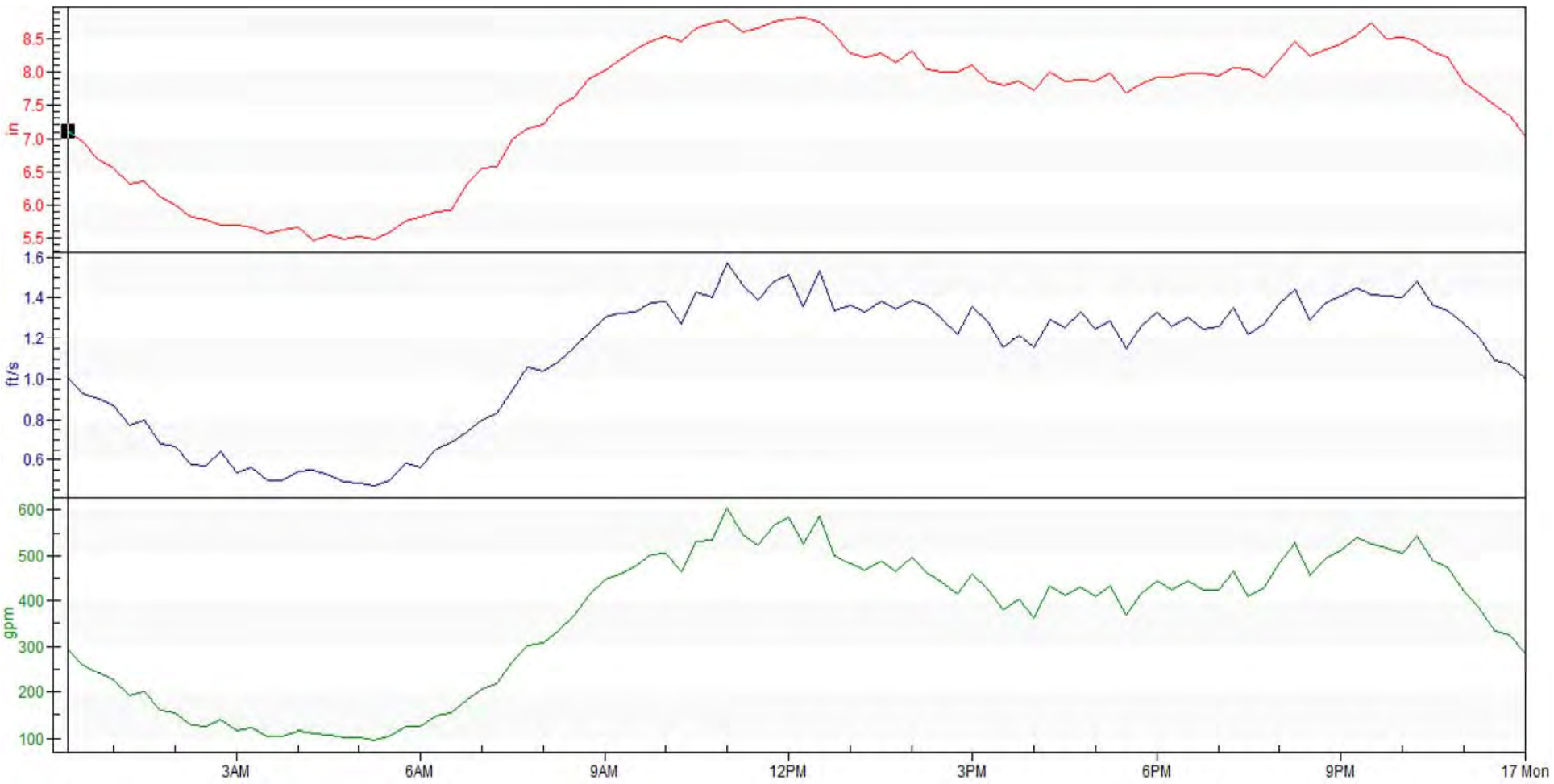
Time	Level	Velocity	Flow
12:00:00 AM	7.259	1.024	306.8
12:15:00 AM	6.967	0.902	249.981
12:30:00 AM	6.902	0.905	253.344
12:45:00 AM	6.67	0.883	234.728
1:00:00 AM	6.597	1.05	276.536
1:15:00 AM	6.312	0.727	179.457
1:30:00 AM	6.194	0.681	164.677
1:45:00 AM	6.16	0.841	201.19
2:00:00 AM	6.069	0.625	142.073
2:15:00 AM	5.987	0.801	182.565
2:30:00 AM	5.824	0.69	153.276
2:45:00 AM	5.808	0.57	125.378
3:00:00 AM	5.8	0.502	110.853
3:15:00 AM	5.686	0.552	118.567
3:30:00 AM	5.654	0.48	102.156
3:45:00 AM	5.628	0.459	97.359
4:00:00 AM	5.602	0.476	100.043
4:15:00 AM	5.687	0.561	120.708
4:30:00 AM	5.649	0.456	96.897
4:45:00 AM	5.771	0.526	114.723
5:00:00 AM	5.706	0.499	106.49
5:15:00 AM	5.935	0.547	124.393
5:30:00 AM	5.861	0.575	127.178
5:45:00 AM	5.932	0.631	143.851
6:00:00 AM	6.369	0.739	185.503
6:15:00 AM	6.345	0.721	176.571
6:30:00 AM	6.247	0.682	166.841
6:45:00 AM	6.376	0.762	191.504
7:00:00 AM	6.751	0.906	246.247
7:15:00 AM	6.957	0.987	278.385
7:30:00 AM	7.091	0.959	278.281
7:45:00 AM	7.218	1.041	309.349
8:00:00 AM	7.474	1.303	405.641
8:15:00 AM	7.45	1.123	348.151
8:30:00 AM	7.86	1.187	392.666
8:45:00 AM	8.232	1.414	499.899
9:00:00 AM	8.178	1.285	450.55
9:15:00 AM	8.146	1.199	415.809
9:30:00 AM	8.25	1.288	453.564
9:45:00 AM	8.354	1.266	452.05
10:00:00 AM	8.472	1.286	462.776
10:15:00 AM	8.631	1.391	522.714
10:30:00 AM	8.904	1.441	554.26
10:45:00 AM	8.755	1.427	541.144
11:00:00 AM	8.738	1.469	560.93
11:15:00 AM	8.796	1.499	573.092
11:30:00 AM	8.777	1.497	570.259
11:45:00 AM	8.876	1.466	571.03

Saturday - P.M. 7/15/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.688	1.47	557.368
12:15:00 PM	8.484	1.374	497.585
12:30:00 PM	8.514	1.459	538.619
12:45:00 PM	8.594	1.455	543.742
1:00:00 PM	8.719	1.544	588.003
1:15:00 PM	8.54	1.427	529.104
1:30:00 PM	8.671	1.431	538.451
1:45:00 PM	8.794	1.492	574.572
2:00:00 PM	8.697	1.453	539.774
2:15:00 PM	8.608	1.38	516.795
2:30:00 PM	8.386	1.339	477.036
2:45:00 PM	8.498	1.42	521.752
3:00:00 PM	8.325	1.369	491.075
3:15:00 PM	8.314	1.401	501.705
3:30:00 PM	8.25	1.318	467.428
3:45:00 PM	8.298	1.269	453.203
4:00:00 PM	8.324	1.247	447.236
4:15:00 PM	7.825	1.153	381.246
4:30:00 PM	8.047	1.263	433.323
4:45:00 PM	8.209	1.326	467.232
5:00:00 PM	8.366	1.314	464.367
5:15:00 PM	8.125	1.223	419.752
5:30:00 PM	8.044	1.226	418.831
5:45:00 PM	8.092	1.209	417.911
6:00:00 PM	8.098	1.177	407.133
6:15:00 PM	8.063	1.209	416.173
6:30:00 PM	7.82	1.114	368.167
6:45:00 PM	7.744	1.208	394.153
7:00:00 PM	7.791	1.277	419.971
7:15:00 PM	7.889	1.217	404.853
7:30:00 PM	7.826	1.174	388.308
7:45:00 PM	7.931	1.266	426.312
8:00:00 PM	7.932	1.203	403.108
8:15:00 PM	7.816	1.203	397.294
8:30:00 PM	7.899	1.234	412.283
8:45:00 PM	7.884	1.318	440.213
9:00:00 PM	8.144	1.323	461.045
9:15:00 PM	8.235	1.389	491.124
9:30:00 PM	8.16	1.276	441.059
9:45:00 PM	8.068	1.28	440.924
10:00:00 PM	8.081	1.284	438.163
10:15:00 PM	7.895	1.219	407.901
10:30:00 PM	7.767	1.324	427.835
10:45:00 PM	7.673	1.249	402.659
11:00:00 PM	7.705	1.233	399.828
11:15:00 PM	7.501	1.054	329.692
11:30:00 PM	7.305	1.093	330.221
11:45:00 PM	7.308	1.08	320.876

	Inches	Feet/Sec	GPM
Daily Avg:	7.533	1.108	365.148
Daily Min:	5.602	0.456	96.897
Daily Max:	8.904	1.544	588.003
Peak to Avg:			1.61

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/16/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Sunday - A.M. 7/16/2023

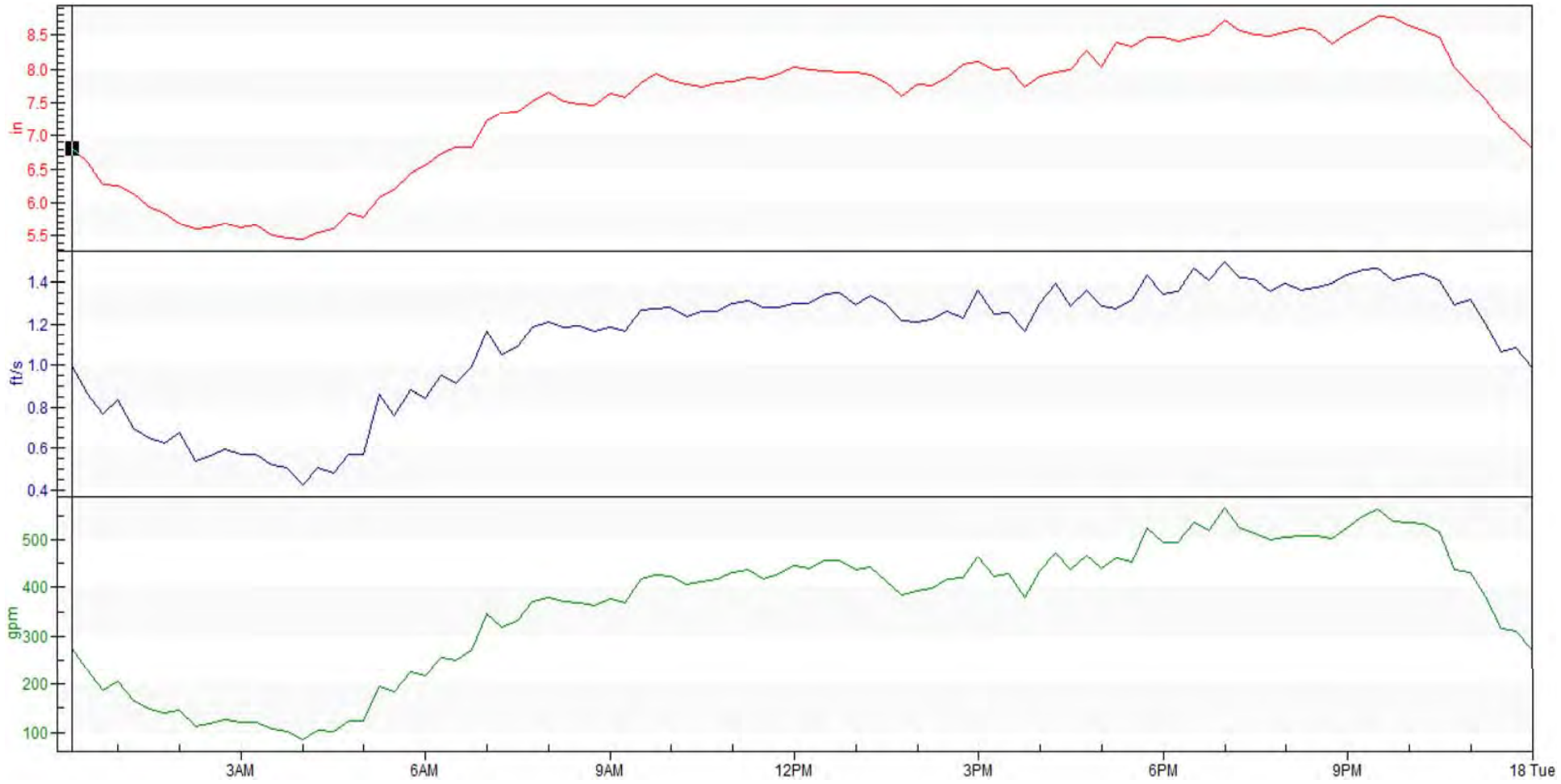
Time	Level	Velocity	Flow
12:00:00 AM	7.137	0.966	278.839
12:15:00 AM	7.104	1.008	293.251
12:30:00 AM	6.962	0.93	257.546
12:45:00 AM	6.665	0.903	240.646
1:00:00 AM	6.548	0.87	226.703
1:15:00 AM	6.322	0.774	192.295
1:30:00 AM	6.357	0.799	200.073
1:45:00 AM	6.118	0.678	159.765
2:00:00 AM	5.996	0.67	154.971
2:15:00 AM	5.83	0.578	128.511
2:30:00 AM	5.789	0.569	125.288
2:45:00 AM	5.712	0.642	138.256
3:00:00 AM	5.713	0.537	116.257
3:15:00 AM	5.666	0.566	120.867
3:30:00 AM	5.56	0.497	103.583
3:45:00 AM	5.62	0.498	104.628
4:00:00 AM	5.658	0.546	116.569
4:15:00 AM	5.467	0.548	110.622
4:30:00 AM	5.544	0.523	108.632
4:45:00 AM	5.491	0.492	100.553
5:00:00 AM	5.529	0.485	100.257
5:15:00 AM	5.479	0.472	96.351
5:30:00 AM	5.581	0.5	104.445
5:45:00 AM	5.755	0.58	124.601
6:00:00 AM	5.832	0.562	125.048
6:15:00 AM	5.897	0.652	147.299
6:30:00 AM	5.932	0.684	154.806
6:45:00 AM	6.311	0.738	183.018
7:00:00 AM	6.559	0.798	205.997
7:15:00 AM	6.574	0.83	216.951
7:30:00 AM	6.996	0.949	266.703
7:45:00 AM	7.153	1.056	301.071
8:00:00 AM	7.2	1.041	308.455
8:15:00 AM	7.496	1.086	333.228
8:30:00 AM	7.628	1.158	369.277
8:45:00 AM	7.897	1.227	410.84
9:00:00 AM	8.013	1.308	446.521
9:15:00 AM	8.184	1.322	458.327
9:30:00 AM	8.333	1.329	475.344
9:45:00 AM	8.457	1.375	503.507
10:00:00 AM	8.526	1.385	505.707
10:15:00 AM	8.455	1.275	464.355
10:30:00 AM	8.651	1.428	530.652
10:45:00 AM	8.741	1.405	532.909
11:00:00 AM	8.767	1.573	603.097
11:15:00 AM	8.599	1.46	546.01
11:30:00 AM	8.656	1.389	521.303
11:45:00 AM	8.746	1.48	565.724

Sunday - P.M. 7/16/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.799	1.512	582.705
12:15:00 PM	8.813	1.36	525.062
12:30:00 PM	8.75	1.531	585.686
12:45:00 PM	8.555	1.341	498.31
1:00:00 PM	8.286	1.364	482.83
1:15:00 PM	8.217	1.333	468.535
1:30:00 PM	8.277	1.383	487.265
1:45:00 PM	8.147	1.344	464.526
2:00:00 PM	8.31	1.387	496.361
2:15:00 PM	8.04	1.362	460.616
2:30:00 PM	8	1.301	442.053
2:45:00 PM	7.995	1.223	416.215
3:00:00 PM	8.091	1.354	457.399
3:15:00 PM	7.865	1.279	423.354
3:30:00 PM	7.802	1.158	380.114
3:45:00 PM	7.853	1.214	403.369
4:00:00 PM	7.729	1.156	364.215
4:15:00 PM	7.991	1.292	433.858
4:30:00 PM	7.867	1.251	411.676
4:45:00 PM	7.887	1.331	428.862
5:00:00 PM	7.856	1.245	408.428
5:15:00 PM	7.983	1.288	431.317
5:30:00 PM	7.684	1.148	368.885
5:45:00 PM	7.814	1.262	415.416
6:00:00 PM	7.922	1.334	445.102
6:15:00 PM	7.918	1.26	422.787
6:30:00 PM	7.979	1.308	443.853
6:45:00 PM	7.984	1.244	422.601
7:00:00 PM	7.946	1.259	424.83
7:15:00 PM	8.055	1.351	464.117
7:30:00 PM	8.038	1.218	409.236
7:45:00 PM	7.928	1.272	428.23
8:00:00 PM	8.185	1.37	480.782
8:15:00 PM	8.465	1.442	526.953
8:30:00 PM	8.247	1.289	456.932
8:45:00 PM	8.33	1.374	493.411
9:00:00 PM	8.423	1.406	511.702
9:15:00 PM	8.552	1.45	538.726
9:30:00 PM	8.728	1.414	526.522
9:45:00 PM	8.502	1.41	517.547
10:00:00 PM	8.506	1.402	505.188
10:15:00 PM	8.455	1.481	541.954
10:30:00 PM	8.306	1.364	487.218
10:45:00 PM	8.221	1.337	471.705
11:00:00 PM	7.848	1.271	421.159
11:15:00 PM	7.693	1.208	384.837
11:30:00 PM	7.498	1.091	335.164
11:45:00 PM	7.339	1.068	324.741

	Inches	Feet/Sec	GPM
Daily Avg:	7.471	1.108	362.349
Daily Min:	5.467	0.472	96.351
Daily Max:	8.813	1.573	603.097
Peak to Avg:			1.66

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/17/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Monday - A.M. 7/17/2023

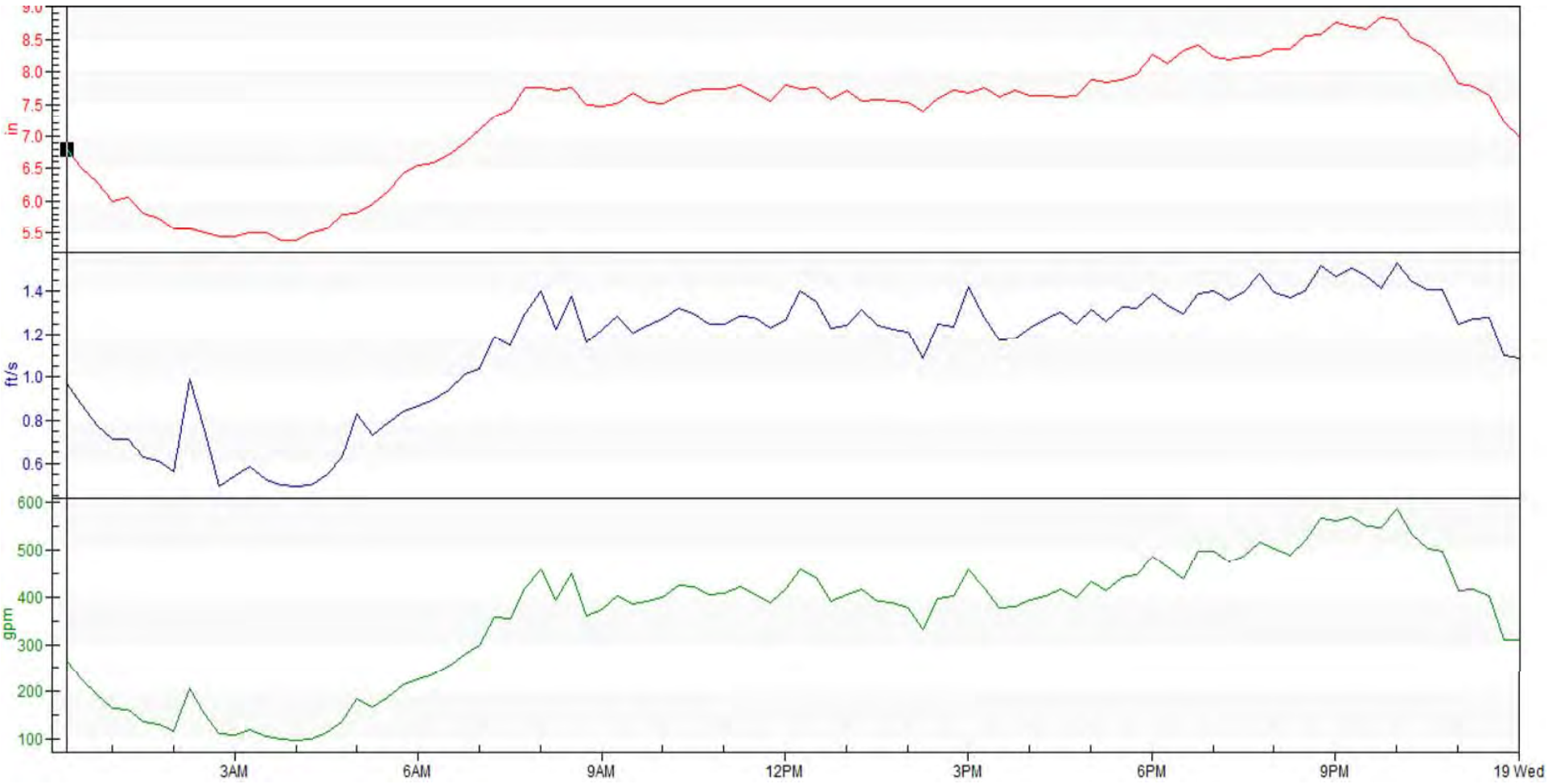
Time	Level	Velocity	Velocity
12:10:00 AM	7.024	0.997	285.655
12:15:00 AM	6.819	0.994	273.663
12:30:00 AM	6.606	0.87	229.548
12:45:00 AM	6.272	0.765	186.796
1:00:00 AM	6.264	0.835	205.052
1:15:00 AM	6.143	0.695	166.154
1:30:00 AM	5.949	0.652	148.35
1:45:00 AM	5.843	0.625	139.38
2:00:00 AM	5.695	0.674	145.235
2:15:00 AM	5.6	0.536	112.381
2:30:00 AM	5.624	0.561	118.238
2:45:00 AM	5.682	0.592	126.837
3:00:00 AM	5.626	0.568	120.329
3:15:00 AM	5.668	0.568	121.033
3:30:00 AM	5.502	0.521	106.622
3:45:00 AM	5.477	0.504	102.46
4:00:00 AM	5.449	0.423	85.754
4:15:00 AM	5.545	0.507	104.02
4:30:00 AM	5.603	0.478	100.776
4:45:00 AM	5.845	0.569	124.226
5:00:00 AM	5.783	0.571	124.119
5:15:00 AM	6.081	0.862	194.159
5:30:00 AM	6.201	0.76	183.93
5:45:00 AM	6.444	0.88	224.48
6:00:00 AM	6.558	0.842	218.032
6:15:00 AM	6.725	0.947	256.044
6:30:00 AM	6.839	0.914	250.19
6:45:00 AM	6.825	0.995	272.989
7:00:00 AM	7.221	1.169	346.77
7:15:00 AM	7.334	1.051	319.23
7:30:00 AM	7.366	1.093	333.661
7:45:00 AM	7.52	1.182	370.05
8:00:00 AM	7.65	1.209	378.115
8:15:00 AM	7.523	1.182	370.968
8:30:00 AM	7.475	1.191	369.546
8:45:00 AM	7.46	1.168	362.68
9:00:00 AM	7.634	1.187	376.626
9:15:00 AM	7.581	1.169	367.347
9:30:00 AM	7.79	1.268	417.026
9:45:00 AM	7.929	1.273	425.727
10:00:00 AM	7.832	1.279	422.819
10:15:00 AM	7.772	1.237	405.488
10:30:00 AM	7.747	1.261	411.685
10:45:00 AM	7.805	1.264	416.881
11:00:00 AM	7.822	1.302	430.376
11:15:00 AM	7.883	1.31	437.471
11:30:00 AM	7.858	1.281	417.625
11:45:00 AM	7.933	1.283	429.77

Monday - P.M. 7/17/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.028	1.301	445.008
12:15:00 PM	7.994	1.296	441.094
12:30:00 PM	7.974	1.344	455.858
12:45:00 PM	7.959	1.352	457.294
1:00:00 PM	7.963	1.295	438.375
1:15:00 PM	7.91	1.34	442.056
1:30:00 PM	7.804	1.292	411.667
1:45:00 PM	7.597	1.214	385.269
2:00:00 PM	7.781	1.212	393.493
2:15:00 PM	7.758	1.222	399.819
2:30:00 PM	7.869	1.264	417.005
2:45:00 PM	8.083	1.228	420.878
3:00:00 PM	8.114	1.36	465.959
3:15:00 PM	7.985	1.249	424.23
3:30:00 PM	8.011	1.257	428.753
3:45:00 PM	7.736	1.165	379.776
4:00:00 PM	7.901	1.297	434.651
4:15:00 PM	7.948	1.397	471.697
4:30:00 PM	7.992	1.287	435.74
4:45:00 PM	8.265	1.362	467.545
5:00:00 PM	8.035	1.288	438.527
5:15:00 PM	8.382	1.275	461.361
5:30:00 PM	8.322	1.316	454.244
5:45:00 PM	8.466	1.434	525.883
6:00:00 PM	8.468	1.346	493.78
6:15:00 PM	8.414	1.357	493.528
6:30:00 PM	8.459	1.464	536.009
6:45:00 PM	8.513	1.407	519.432
7:00:00 PM	8.723	1.496	565.725
7:15:00 PM	8.558	1.419	525.835
7:30:00 PM	8.516	1.414	514.526
7:45:00 PM	8.496	1.357	499.595
8:00:00 PM	8.539	1.395	505.396
8:15:00 PM	8.607	1.361	509.799
8:30:00 PM	8.572	1.378	509.452
8:45:00 PM	8.373	1.392	503.166
9:00:00 PM	8.523	1.435	523.794
9:15:00 PM	8.644	1.461	550.08
9:30:00 PM	8.785	1.465	563.201
9:45:00 PM	8.77	1.406	537.479
10:00:00 PM	8.648	1.429	535.75
10:15:00 PM	8.566	1.441	532.106
10:30:00 PM	8.472	1.409	517.219
10:45:00 PM	8.035	1.292	436.813
11:00:00 PM	7.784	1.317	430.799
11:15:00 PM	7.568	1.204	381.009
11:30:00 PM	7.241	1.062	317.047
11:45:00 PM	7.046	1.082	311.452

	Inches	Feet/Sec	GPM
Daily Avg:	7.453	1.125	363.788
Daily Min:	5.449	0.423	85.754
Daily Max:	8.785	1.496	565.725
Peak to Avg:			1.56

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/18/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Tuesday- A.M. 7/18/2023

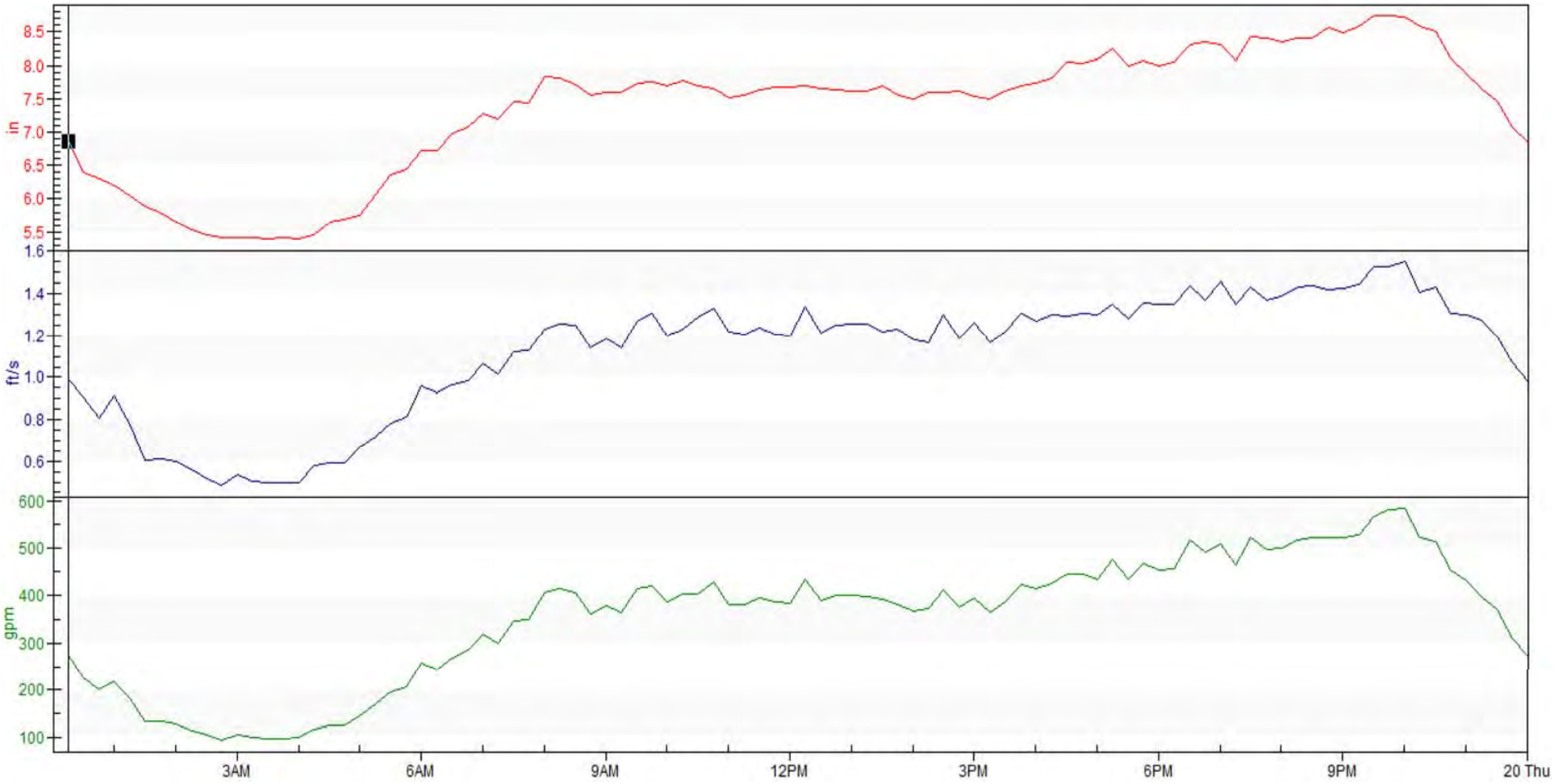
Time	Level	Velocity	Flow
12:00:00 AM	6.82	0.987	271.734
12:15:00 AM	6.784	0.973	266.128
12:30:00 AM	6.509	0.87	225.112
12:45:00 AM	6.286	0.778	191.783
1:00:00 AM	6	0.714	165.247
1:15:00 AM	6.049	0.713	163.326
1:30:00 AM	5.81	0.625	137.192
1:45:00 AM	5.738	0.607	130.003
2:00:00 AM	5.565	0.563	116.214
2:15:00 AM	5.562	0.991	206.689
2:30:00 AM	5.511	0.759	154.624
2:45:00 AM	5.434	0.493	111.483
3:00:00 AM	5.432	0.542	109.406
3:15:00 AM	5.494	0.584	118.726
3:30:00 AM	5.495	0.522	105.669
3:45:00 AM	5.382	0.502	99.977
4:00:00 AM	5.38	0.494	98.41
4:15:00 AM	5.503	0.501	101.623
4:30:00 AM	5.564	0.549	114.504
4:45:00 AM	5.785	0.627	136.621
5:00:00 AM	5.808	0.833	184.318
5:15:00 AM	5.961	0.733	168.048
5:30:00 AM	6.131	0.788	187.786
5:45:00 AM	6.421	0.845	214.285
6:00:00 AM	6.554	0.869	226.877
6:15:00 AM	6.582	0.901	236.545
6:30:00 AM	6.704	0.942	253.475
6:45:00 AM	6.896	1.017	279.998
7:00:00 AM	7.101	1.036	299.751
7:15:00 AM	7.304	1.187	358.33
7:30:00 AM	7.417	1.147	353.404
7:45:00 AM	7.765	1.295	420.126
8:00:00 AM	7.749	1.401	457.69
8:15:00 AM	7.723	1.225	393.989
8:30:00 AM	7.751	1.377	450.056
8:45:00 AM	7.49	1.161	360.382
9:00:00 AM	7.472	1.222	374.634
9:15:00 AM	7.513	1.286	403.168
9:30:00 AM	7.68	1.204	384.211
9:45:00 AM	7.526	1.243	390.33
10:00:00 AM	7.514	1.272	398.473
10:15:00 AM	7.642	1.322	423.281
10:30:00 AM	7.721	1.296	421.276
10:45:00 AM	7.739	1.248	405.545
11:00:00 AM	7.741	1.246	406.565
11:15:00 AM	7.789	1.283	421.803
11:30:00 AM	7.678	1.281	406.349
11:45:00 AM	7.556	1.227	386.879

Tuesday- P.M. 7/18/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.799	1.268	415.493
12:15:00 PM	7.746	1.404	458.257
12:30:00 PM	7.762	1.354	441.195
12:45:00 PM	7.581	1.228	389.692
1:00:00 PM	7.723	1.241	403.669
1:15:00 PM	7.56	1.314	415.236
1:30:00 PM	7.564	1.244	391.654
1:45:00 PM	7.559	1.226	387.447
2:00:00 PM	7.525	1.21	377.918
2:15:00 PM	7.381	1.088	333.233
2:30:00 PM	7.585	1.248	396.241
2:45:00 PM	7.726	1.232	400.944
3:00:00 PM	7.682	1.42	458.552
3:15:00 PM	7.755	1.279	418.112
3:30:00 PM	7.622	1.176	375.77
3:45:00 PM	7.709	1.181	380.328
4:00:00 PM	7.638	1.229	393.861
4:15:00 PM	7.637	1.27	401.26
4:30:00 PM	7.611	1.303	415.12
4:45:00 PM	7.63	1.247	398.905
5:00:00 PM	7.874	1.316	433.231
5:15:00 PM	7.834	1.261	413.97
5:30:00 PM	7.871	1.325	441.788
5:45:00 PM	7.958	1.322	447.083
6:00:00 PM	8.266	1.387	485.483
6:15:00 PM	8.122	1.335	463.724
6:30:00 PM	8.338	1.295	438.429
6:45:00 PM	8.403	1.386	498.423
7:00:00 PM	8.234	1.404	496.541
7:15:00 PM	8.196	1.36	474.471
7:30:00 PM	8.224	1.392	485.319
7:45:00 PM	8.258	1.48	515.797
8:00:00 PM	8.357	1.398	503.879
8:15:00 PM	8.341	1.373	489.457
8:30:00 PM	8.552	1.401	520.584
8:45:00 PM	8.573	1.519	566.214
9:00:00 PM	8.759	1.466	561.687
9:15:00 PM	8.692	1.504	570.521
9:30:00 PM	8.659	1.466	550.981
9:45:00 PM	8.843	1.411	547.322
10:00:00 PM	8.796	1.53	585.837
10:15:00 PM	8.515	1.445	533.59
10:30:00 PM	8.411	1.404	501.716
10:45:00 PM	8.222	1.408	497.103
11:00:00 PM	7.826	1.251	413.846
11:15:00 PM	7.787	1.269	417.257
11:30:00 PM	7.627	1.276	402.962
11:45:00 PM	7.221	1.1	310.997

	Inches	Feet/Sec	GPM
Daily Avg:	7.324	1.136	358.331
Daily Min:	5.38	0.493	98.41
Daily Max:	8.843	1.53	585.837
Peak to Avg:			1.63

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/19/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Wednesday - A.M. 7/19/2023

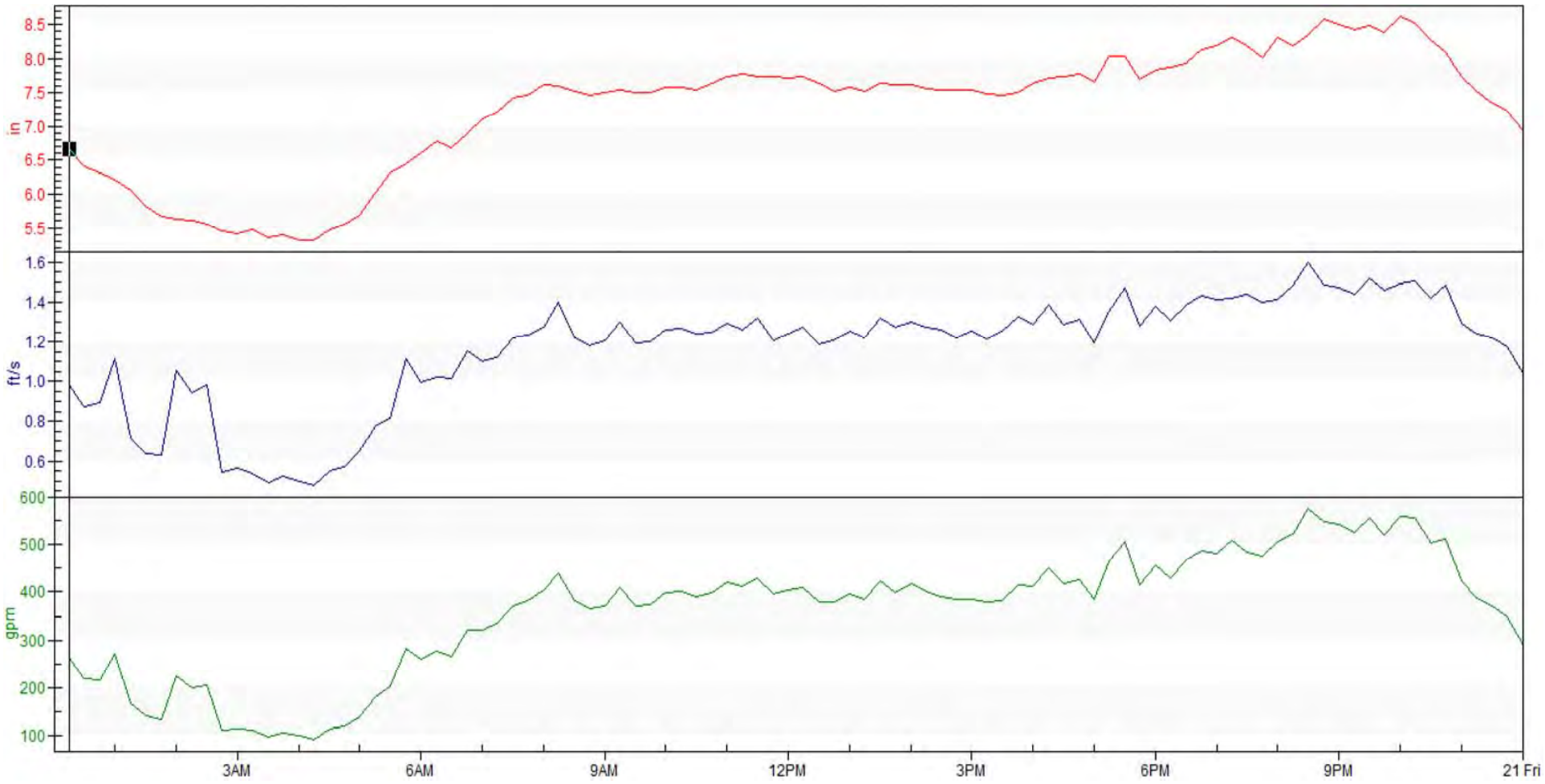
Time	Level	Velocity	Flow
12:00:00 AM	6.987	1.085	308.873
12:15:00 AM	6.867	0.988	274.581
12:30:00 AM	6.402	0.908	226.835
12:45:00 AM	6.312	0.808	200.299
1:00:00 AM	6.205	0.917	218.738
1:15:00 AM	6.041	0.775	181.153
1:30:00 AM	5.886	0.601	133.939
1:45:00 AM	5.786	0.608	133.859
2:00:00 AM	5.646	0.6	127.667
2:15:00 AM	5.535	0.559	115.67
2:30:00 AM	5.45	0.517	104.839
2:45:00 AM	5.41	0.484	95.341
3:00:00 AM	5.411	0.534	105.705
3:15:00 AM	5.424	0.502	100.982
3:30:00 AM	5.404	0.496	98.002
3:45:00 AM	5.414	0.5	98.335
4:00:00 AM	5.393	0.499	99.752
4:15:00 AM	5.448	0.581	117.733
4:30:00 AM	5.66	0.592	126.38
4:45:00 AM	5.697	0.59	126.624
5:00:00 AM	5.748	0.666	145.311
5:15:00 AM	6.073	0.721	169.563
5:30:00 AM	6.372	0.779	195.618
5:45:00 AM	6.439	0.812	206.972
6:00:00 AM	6.725	0.955	258.267
6:15:00 AM	6.715	0.926	243.224
6:30:00 AM	6.983	0.965	268.349
6:45:00 AM	7.073	0.984	284.795
7:00:00 AM	7.269	1.064	319.387
7:15:00 AM	7.199	1.015	300.61
7:30:00 AM	7.457	1.122	348.231
7:45:00 AM	7.444	1.127	349.114
8:00:00 AM	7.836	1.228	406.963
8:15:00 AM	7.807	1.256	414.213
8:30:00 AM	7.723	1.25	406.429
8:45:00 AM	7.55	1.144	361.029
9:00:00 AM	7.596	1.185	377.102
9:15:00 AM	7.598	1.145	364.433
9:30:00 AM	7.735	1.268	413.048
9:45:00 AM	7.749	1.303	420.332
10:00:00 AM	7.703	1.199	385.71
10:15:00 AM	7.781	1.234	404.131
10:30:00 AM	7.69	1.284	403.701
10:45:00 AM	7.654	1.33	427.447
11:00:00 AM	7.514	1.217	381.192
11:15:00 AM	7.547	1.203	379.573
11:30:00 AM	7.63	1.235	395.173
11:45:00 AM	7.673	1.208	386.974

Wednesday - P.M. 7/19/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.664	1.2	382.739
12:15:00 PM	7.693	1.338	432.953
12:30:00 PM	7.649	1.21	388.509
12:45:00 PM	7.626	1.249	399.281
1:00:00 PM	7.619	1.256	401.012
1:15:00 PM	7.618	1.256	396.991
1:30:00 PM	7.685	1.216	392.801
1:45:00 PM	7.553	1.228	379.865
2:00:00 PM	7.488	1.178	366.858
2:15:00 PM	7.589	1.167	370.842
2:30:00 PM	7.601	1.301	412.486
2:45:00 PM	7.623	1.186	375.992
3:00:00 PM	7.542	1.265	395.706
3:15:00 PM	7.502	1.166	364.761
3:30:00 PM	7.615	1.216	386.72
3:45:00 PM	7.702	1.306	423.027
4:00:00 PM	7.743	1.27	414.221
4:15:00 PM	7.806	1.299	424.08
4:30:00 PM	8.052	1.296	445.233
4:45:00 PM	8.031	1.304	446.21
5:00:00 PM	8.093	1.3	432.626
5:15:00 PM	8.248	1.348	476.625
5:30:00 PM	7.985	1.278	434.285
5:45:00 PM	8.063	1.356	466.709
6:00:00 PM	7.998	1.352	453.045
6:15:00 PM	8.046	1.352	456.437
6:30:00 PM	8.317	1.441	516.414
6:45:00 PM	8.341	1.367	491.771
7:00:00 PM	8.303	1.459	509.952
7:15:00 PM	8.069	1.35	465.064
7:30:00 PM	8.431	1.435	523.245
7:45:00 PM	8.399	1.372	497.857
8:00:00 PM	8.341	1.389	499.58
8:15:00 PM	8.399	1.432	517.187
8:30:00 PM	8.398	1.441	522.944
8:45:00 PM	8.57	1.42	523.299
9:00:00 PM	8.479	1.427	524.065
9:15:00 PM	8.587	1.445	528.637
9:30:00 PM	8.745	1.527	567.964
9:45:00 PM	8.737	1.528	583.285
10:00:00 PM	8.733	1.553	584.352
10:15:00 PM	8.581	1.407	522.113
10:30:00 PM	8.511	1.431	515.943
10:45:00 PM	8.119	1.309	453.97
11:00:00 PM	7.867	1.297	432.186
11:15:00 PM	7.654	1.272	398.159
11:30:00 PM	7.463	1.19	369.897
11:45:00 PM	7.073	1.072	310.275

	Inches	Feet/Sec	GPM
Daily Avg:	7.343	1.119	354.542
Daily Min:	5.393	0.484	95.341
Daily Max:	8.745	1.553	584.352
Peak to Avg:			1.65

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/20/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Thursday - A.M. 7/20/2023

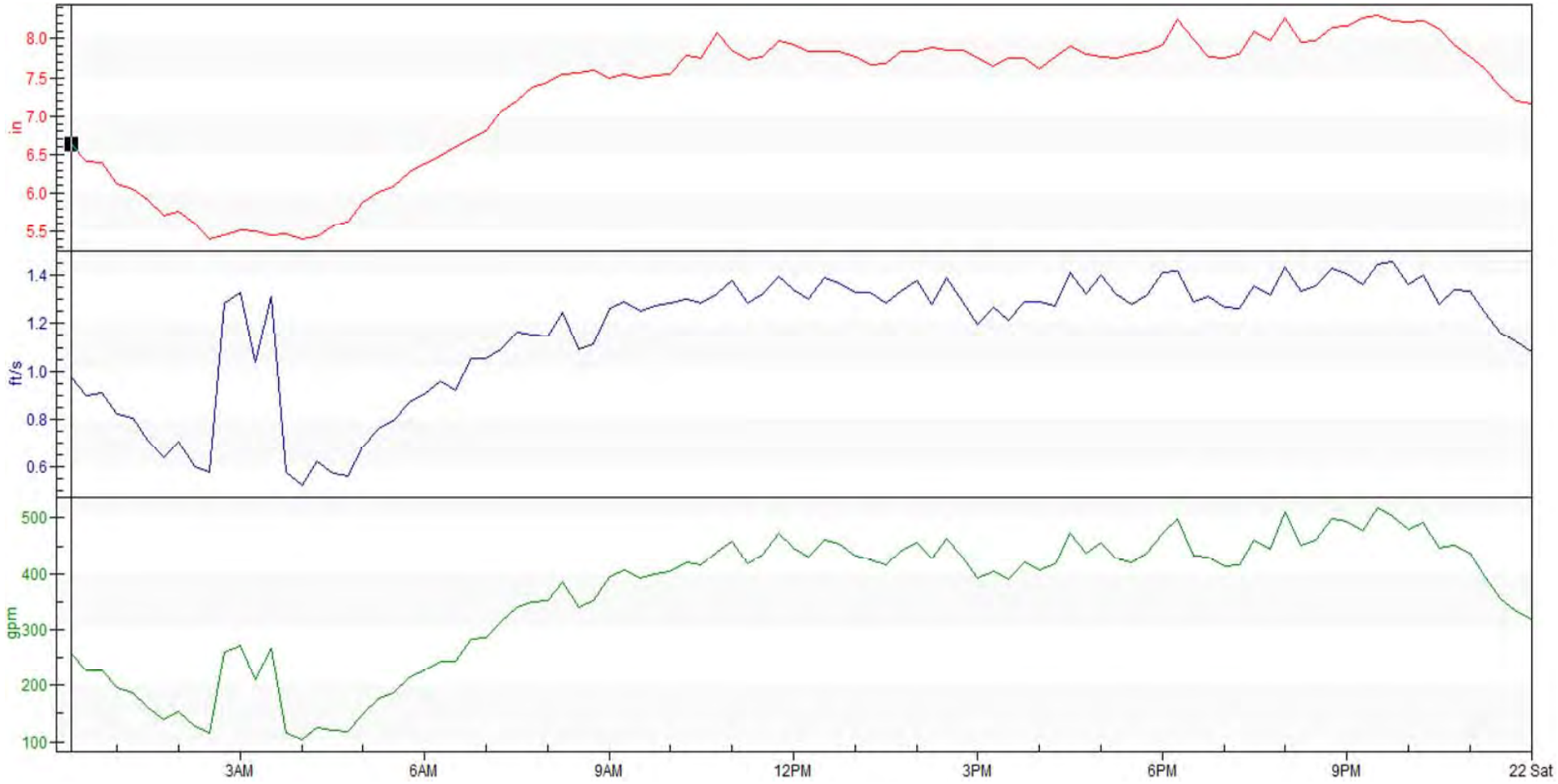
Time	Level	Velocity	Flow
12:00:00 AM	6.832	0.979	270.443
12:15:00 AM	6.674	0.981	262.38
12:30:00 AM	6.404	0.874	219.85
12:45:00 AM	6.317	0.898	215.257
1:00:00 AM	6.216	1.115	270.756
1:15:00 AM	6.059	0.717	166.003
1:30:00 AM	5.814	0.636	140.861
1:45:00 AM	5.663	0.629	134.068
2:00:00 AM	5.625	1.054	223.157
2:15:00 AM	5.615	0.941	198.705
2:30:00 AM	5.541	0.985	203.909
2:45:00 AM	5.45	0.546	110.742
3:00:00 AM	5.412	0.566	113.628
3:15:00 AM	5.476	0.539	109.59
3:30:00 AM	5.35	0.494	97.631
3:45:00 AM	5.391	0.527	105.317
4:00:00 AM	5.322	0.501	98.197
4:15:00 AM	5.313	0.478	91.846
4:30:00 AM	5.479	0.551	112.419
4:45:00 AM	5.556	0.573	119.225
5:00:00 AM	5.677	0.649	139.14
5:15:00 AM	6.023	0.778	180.913
5:30:00 AM	6.308	0.813	201.493
5:45:00 AM	6.451	1.111	283.411
6:00:00 AM	6.607	0.993	259.116
6:15:00 AM	6.776	1.018	278.022
6:30:00 AM	6.691	1.016	266.814
6:45:00 AM	6.91	1.153	322.137
7:00:00 AM	7.114	1.101	321.055
7:15:00 AM	7.223	1.122	333.765
7:30:00 AM	7.431	1.22	371.447
7:45:00 AM	7.476	1.232	380.991
8:00:00 AM	7.619	1.271	403.242
8:15:00 AM	7.613	1.4	440.218
8:30:00 AM	7.537	1.221	381.527
8:45:00 AM	7.463	1.179	365.203
9:00:00 AM	7.517	1.206	370.946
9:15:00 AM	7.549	1.3	410.096
9:30:00 AM	7.509	1.193	370.555
9:45:00 AM	7.508	1.201	374.905
10:00:00 AM	7.596	1.258	398.223
10:15:00 AM	7.587	1.268	400.913
10:30:00 AM	7.538	1.237	389.521
10:45:00 AM	7.637	1.244	398.657
11:00:00 AM	7.75	1.292	419.586
11:15:00 AM	7.789	1.257	413.307
11:30:00 AM	7.736	1.32	430.022
11:45:00 AM	7.74	1.209	394.405

Thursday - P.M. 7/20/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.716	1.242	403.422
12:15:00 PM	7.752	1.27	408.908
12:30:00 PM	7.651	1.187	379.232
12:45:00 PM	7.535	1.208	378.911
1:00:00 PM	7.58	1.251	396.884
1:15:00 PM	7.532	1.22	383.703
1:30:00 PM	7.651	1.32	423.82
1:45:00 PM	7.629	1.275	399.634
2:00:00 PM	7.633	1.302	416.738
2:15:00 PM	7.565	1.272	401.503
2:30:00 PM	7.541	1.262	391.419
2:45:00 PM	7.54	1.22	384.309
3:00:00 PM	7.547	1.253	384.046
3:15:00 PM	7.498	1.216	380.264
3:30:00 PM	7.461	1.251	380.727
3:45:00 PM	7.51	1.327	415.144
4:00:00 PM	7.648	1.283	411.99
4:15:00 PM	7.725	1.383	449.926
4:30:00 PM	7.734	1.286	418.994
4:45:00 PM	7.778	1.316	427.261
5:00:00 PM	7.672	1.192	384.253
5:15:00 PM	8.038	1.353	463.595
5:30:00 PM	8.044	1.474	505.66
5:45:00 PM	7.697	1.281	414.588
6:00:00 PM	7.839	1.378	456.974
6:15:00 PM	7.883	1.305	428.844
6:30:00 PM	7.933	1.388	467.41
6:45:00 PM	8.133	1.433	486.407
7:00:00 PM	8.19	1.409	480.958
7:15:00 PM	8.312	1.419	508.026
7:30:00 PM	8.192	1.441	483.561
7:45:00 PM	8.022	1.396	477.167
8:00:00 PM	8.32	1.416	507.407
8:15:00 PM	8.193	1.485	521.941
8:30:00 PM	8.343	1.598	575.023
8:45:00 PM	8.58	1.487	548.321
9:00:00 PM	8.499	1.473	542.687
9:15:00 PM	8.434	1.439	524.876
9:30:00 PM	8.484	1.516	556.647
9:45:00 PM	8.384	1.46	521.472
10:00:00 PM	8.626	1.49	559.774
10:15:00 PM	8.518	1.502	555.158
10:30:00 PM	8.277	1.421	503.461
10:45:00 PM	8.104	1.482	513.196
11:00:00 PM	7.752	1.293	422.516
11:15:00 PM	7.529	1.242	386.038
11:30:00 PM	7.352	1.221	371.927
11:45:00 PM	7.238	1.172	349.748

	Inches	Feet/Sec	GPM
Daily Avg:	7.268	1.164	361.545
Daily Min:	5.313	0.478	91.846
Daily Max:	8.626	1.598	575.023
Peak to Avg:			1.59

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/21/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Friday - A.M. 7/21/2023

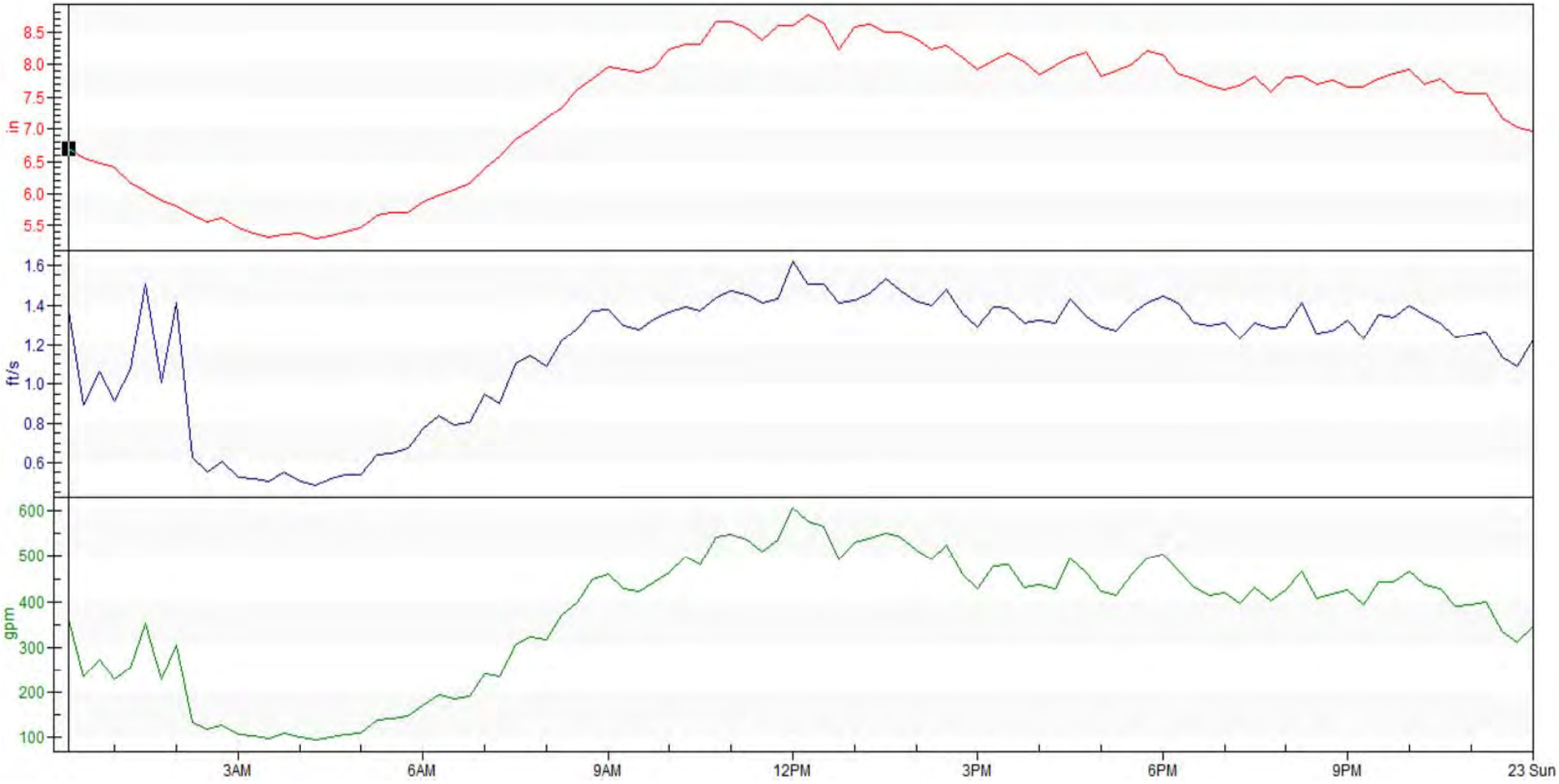
Time	Level	Velocity	Flow
12:00:00 AM	6.942	1.042	291.292
12:15:00 AM	6.64	0.979	257.115
12:30:00 AM	6.407	0.897	227.199
12:45:00 AM	6.397	0.909	227.714
1:00:00 AM	6.123	0.823	195.762
1:15:00 AM	6.06	0.803	187.181
1:30:00 AM	5.921	0.71	161.303
1:45:00 AM	5.718	0.638	138.016
2:00:00 AM	5.754	0.704	153.805
2:15:00 AM	5.6	0.603	126.9
2:30:00 AM	5.409	0.578	116.005
2:45:00 AM	5.446	1.283	259.821
3:00:00 AM	5.515	1.328	271.205
3:15:00 AM	5.502	1.036	209.526
3:30:00 AM	5.451	1.314	266.442
3:45:00 AM	5.478	0.577	115.998
4:00:00 AM	5.4	0.523	104.2
4:15:00 AM	5.434	0.624	124.518
4:30:00 AM	5.575	0.571	119.425
4:45:00 AM	5.629	0.563	118.643
5:00:00 AM	5.876	0.686	147.62
5:15:00 AM	6.021	0.759	175.854
5:30:00 AM	6.081	0.795	185.277
5:45:00 AM	6.274	0.874	214.892
6:00:00 AM	6.376	0.906	227.734
6:15:00 AM	6.479	0.961	243.988
6:30:00 AM	6.595	0.922	242.621
6:45:00 AM	6.711	1.055	283.695
7:00:00 AM	6.808	1.053	285.284
7:15:00 AM	7.059	1.089	314.301
7:30:00 AM	7.201	1.162	339.177
7:45:00 AM	7.382	1.154	349.412
8:00:00 AM	7.436	1.149	351.183
8:15:00 AM	7.537	1.245	386.067
8:30:00 AM	7.566	1.09	341.171
8:45:00 AM	7.596	1.116	350.833
9:00:00 AM	7.498	1.261	394.151
9:15:00 AM	7.548	1.289	406.736
9:30:00 AM	7.489	1.254	391.409
9:45:00 AM	7.53	1.274	399.558
10:00:00 AM	7.542	1.283	404.296
10:15:00 AM	7.787	1.299	421.581
10:30:00 AM	7.757	1.286	416.814
10:45:00 AM	8.069	1.325	440.046
11:00:00 AM	7.86	1.378	458.63
11:15:00 AM	7.737	1.286	419.205
11:30:00 AM	7.777	1.323	434.19
11:45:00 AM	7.966	1.397	473.066

Friday - P.M. 7/21/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.915	1.343	446.623
12:15:00 PM	7.829	1.3	430.324
12:30:00 PM	7.842	1.388	460.611
12:45:00 PM	7.834	1.369	453.689
1:00:00 PM	7.762	1.331	433.098
1:15:00 PM	7.672	1.327	426.248
1:30:00 PM	7.677	1.286	414.951
1:45:00 PM	7.83	1.333	441.25
2:00:00 PM	7.834	1.378	456.513
2:15:00 PM	7.882	1.282	428.212
2:30:00 PM	7.85	1.392	462.603
2:45:00 PM	7.849	1.293	429.426
3:00:00 PM	7.754	1.199	392.039
3:15:00 PM	7.653	1.266	402.838
3:30:00 PM	7.757	1.214	388.745
3:45:00 PM	7.747	1.289	420.699
4:00:00 PM	7.616	1.291	407.259
4:15:00 PM	7.764	1.277	418.076
4:30:00 PM	7.914	1.409	471.541
4:45:00 PM	7.796	1.326	436.654
5:00:00 PM	7.76	1.398	454.883
5:15:00 PM	7.751	1.321	428.273
5:30:00 PM	7.801	1.282	420.413
5:45:00 PM	7.84	1.32	436.126
6:00:00 PM	7.916	1.409	473.378
6:15:00 PM	8.242	1.419	499.157
6:30:00 PM	7.998	1.29	431.677
6:45:00 PM	7.774	1.313	430.751
7:00:00 PM	7.747	1.268	413.436
7:15:00 PM	7.804	1.261	415.708
7:30:00 PM	8.094	1.358	460.289
7:45:00 PM	7.977	1.317	444.303
8:00:00 PM	8.263	1.434	509.579
8:15:00 PM	7.959	1.334	451.116
8:30:00 PM	7.97	1.356	459.686
8:45:00 PM	8.146	1.429	498.24
9:00:00 PM	8.167	1.408	492.656
9:15:00 PM	8.258	1.362	476.4
9:30:00 PM	8.301	1.446	516.849
9:45:00 PM	8.234	1.456	503.255
10:00:00 PM	8.208	1.363	480.232
10:15:00 PM	8.237	1.398	490.589
10:30:00 PM	8.131	1.28	445.39
10:45:00 PM	7.929	1.342	451.866
11:00:00 PM	7.761	1.336	437.098
11:15:00 PM	7.62	1.247	394.649
11:30:00 PM	7.375	1.16	354.878
11:45:00 PM	7.208	1.124	333.383

	Inches	Feet/Sec	GPM
Daily Avg:	7.255	1.167	359.002
Daily Min:	5.4	0.523	104.2
Daily Max:	8.301	1.456	516.849
Peak to Avg:			1.44

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/22/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Saturday - A.M. 7/22/2023

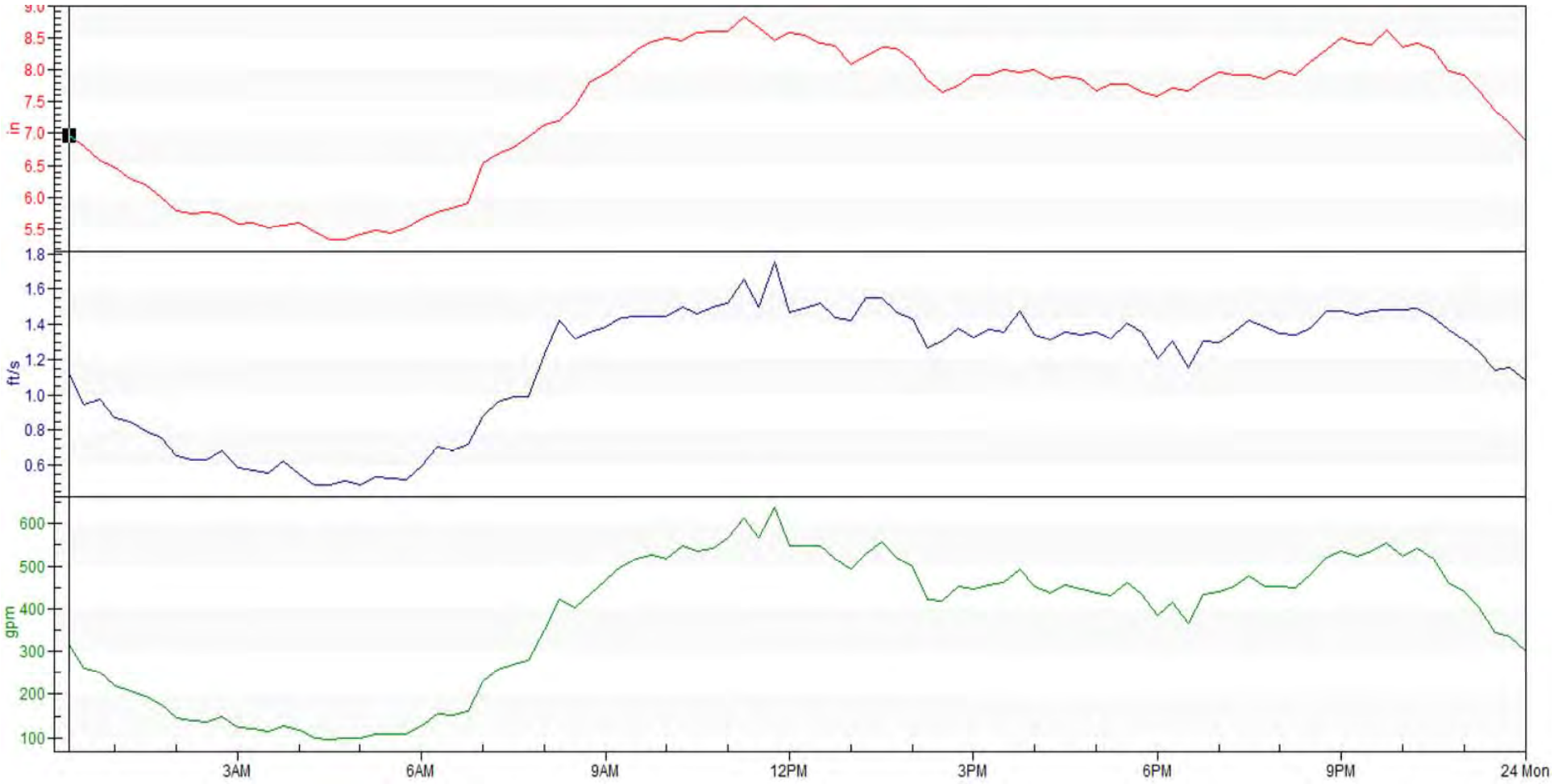
Time	Level	Velocity	Flow
12:00:00 AM	7.175	1.082	319.028
12:15:00 AM	6.696	1.371	360.572
12:30:00 AM	6.561	0.896	233.561
12:45:00 AM	6.459	1.065	272.528
1:00:00 AM	6.408	0.917	228.843
1:15:00 AM	6.154	1.077	253.454
1:30:00 AM	6.042	1.509	352.5
1:45:00 AM	5.903	1.007	227.954
2:00:00 AM	5.819	1.411	305.224
2:15:00 AM	5.664	0.622	132.916
2:30:00 AM	5.577	0.554	115.84
2:45:00 AM	5.624	0.605	126.724
3:00:00 AM	5.463	0.523	104.41
3:15:00 AM	5.382	0.519	102.091
3:30:00 AM	5.316	0.501	97.83
3:45:00 AM	5.358	0.549	108.659
4:00:00 AM	5.382	0.505	100.645
4:15:00 AM	5.302	0.483	94.153
4:30:00 AM	5.351	0.514	100.452
4:45:00 AM	5.4	0.534	105.531
5:00:00 AM	5.46	0.538	109.298
5:15:00 AM	5.675	0.635	136.147
5:30:00 AM	5.706	0.647	139.755
5:45:00 AM	5.704	0.673	145.278
6:00:00 AM	5.871	0.77	169.89
6:15:00 AM	5.987	0.841	194.037
6:30:00 AM	6.058	0.79	185.307
6:45:00 AM	6.168	0.809	189.166
7:00:00 AM	6.388	0.949	239.34
7:15:00 AM	6.571	0.902	235.423
7:30:00 AM	6.831	1.101	303.992
7:45:00 AM	6.99	1.14	323.425
8:00:00 AM	7.165	1.087	316.402
8:15:00 AM	7.334	1.219	370.14
8:30:00 AM	7.607	1.285	398.727
8:45:00 AM	7.774	1.371	449.743
9:00:00 AM	7.966	1.378	459.07
9:15:00 AM	7.914	1.297	427.77
9:30:00 AM	7.879	1.279	422.896
9:45:00 AM	7.971	1.328	441.667
10:00:00 AM	8.228	1.368	463.504
10:15:00 AM	8.309	1.394	498.701
10:30:00 AM	8.307	1.372	482.259
10:45:00 AM	8.663	1.438	543.222
11:00:00 AM	8.655	1.472	548.582
11:15:00 AM	8.563	1.452	536.933
11:30:00 AM	8.368	1.41	509.106
11:45:00 AM	8.594	1.433	535.839

Saturday - P.M. 7/22/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.599	1.621	606.353
12:15:00 PM	8.762	1.505	576.68
12:30:00 PM	8.644	1.504	566.402
12:45:00 PM	8.237	1.415	493.556
1:00:00 PM	8.571	1.424	530.484
1:15:00 PM	8.613	1.461	539.243
1:30:00 PM	8.494	1.533	552.582
1:45:00 PM	8.505	1.47	541.835
2:00:00 PM	8.39	1.419	513.513
2:15:00 PM	8.219	1.397	492.745
2:30:00 PM	8.297	1.481	524.506
2:45:00 PM	8.097	1.359	460.427
3:00:00 PM	7.918	1.29	429.256
3:15:00 PM	8.059	1.391	478.303
3:30:00 PM	8.167	1.387	480.083
3:45:00 PM	8.036	1.313	431.169
4:00:00 PM	7.836	1.321	436.992
4:15:00 PM	7.979	1.309	428.689
4:30:00 PM	8.103	1.43	495.164
4:45:00 PM	8.181	1.342	462.565
5:00:00 PM	7.827	1.291	422.694
5:15:00 PM	7.895	1.273	412.203
5:30:00 PM	7.995	1.356	461.466
5:45:00 PM	8.212	1.41	496.81
6:00:00 PM	8.145	1.443	503.015
6:15:00 PM	7.869	1.412	467.949
6:30:00 PM	7.787	1.311	430.978
6:45:00 PM	7.67	1.295	414.792
7:00:00 PM	7.623	1.308	418.139
7:15:00 PM	7.679	1.233	394.38
7:30:00 PM	7.812	1.31	432.343
7:45:00 PM	7.577	1.283	402.378
8:00:00 PM	7.793	1.291	424.888
8:15:00 PM	7.815	1.41	465.373
8:30:00 PM	7.689	1.26	407.412
8:45:00 PM	7.756	1.272	415.801
9:00:00 PM	7.653	1.322	423.732
9:15:00 PM	7.664	1.233	392.236
9:30:00 PM	7.784	1.348	443.05
9:45:00 PM	7.853	1.336	444.136
10:00:00 PM	7.923	1.401	466.884
10:15:00 PM	7.704	1.349	437.29
10:30:00 PM	7.784	1.31	428.136
10:45:00 PM	7.574	1.24	390.827
11:00:00 PM	7.551	1.251	391.556
11:15:00 PM	7.55	1.263	398.413
11:30:00 PM	7.157	1.139	334.867
11:45:00 PM	7.028	1.09	311.007

	Inches	Feet/Sec	GPM
Daily Avg:	7.312	1.172	369.187
Daily Min:	5.302	0.483	94.153
Daily Max:	8.762	1.621	606.353
Peak to Avg:			1.64

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/23/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Sunday - A.M. 7/23/2023

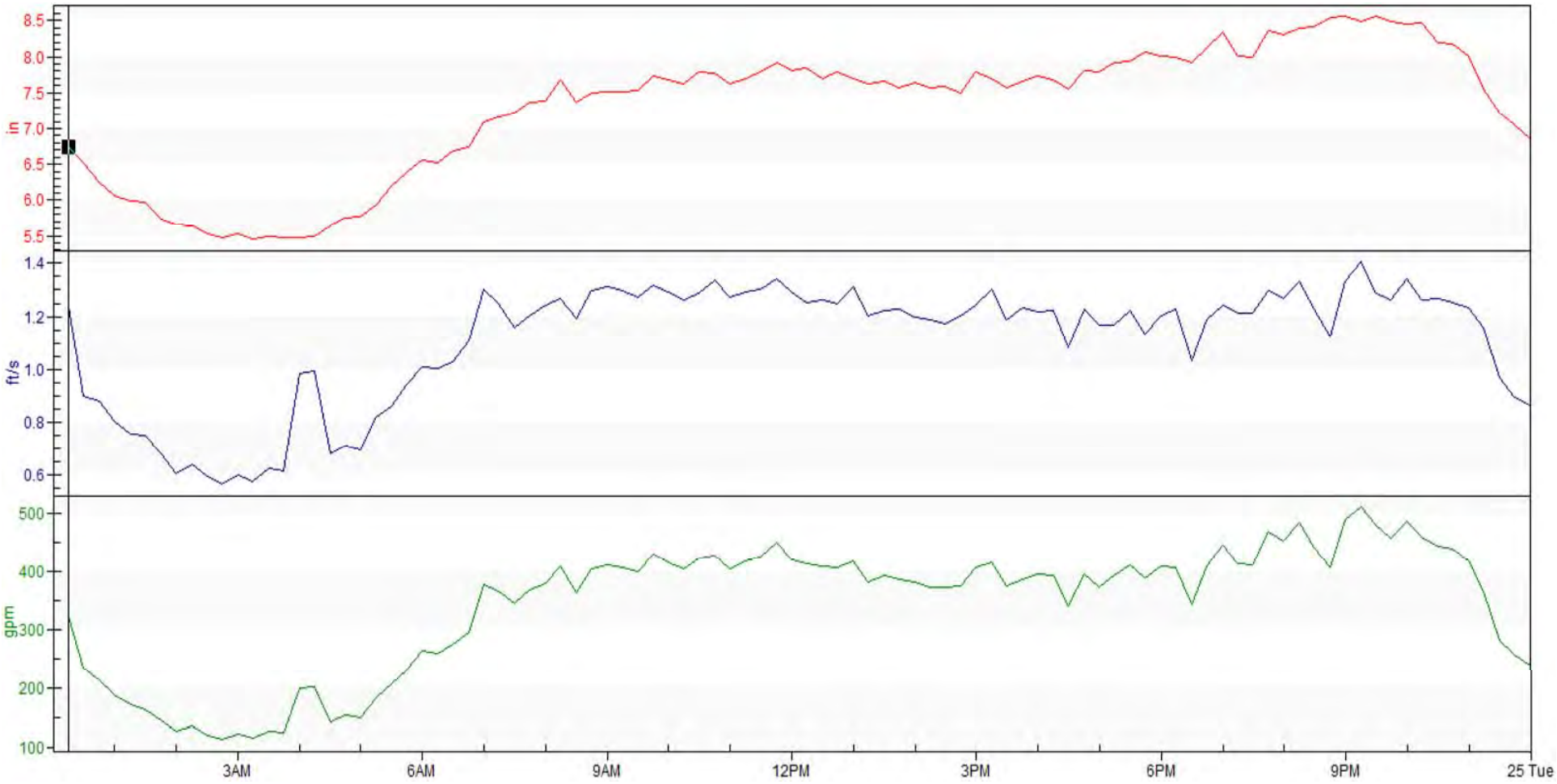
Time	Level	Velocity	Flow
12:00:00 AM	6.961	1.22	345.596
12:15:00 AM	6.974	1.116	316.689
12:30:00 AM	6.8	0.947	259.878
12:45:00 AM	6.572	0.972	252.351
1:00:00 AM	6.47	0.869	220.113
1:15:00 AM	6.28	0.851	208.485
1:30:00 AM	6.204	0.8	193.803
1:45:00 AM	6.009	0.756	175.304
2:00:00 AM	5.788	0.658	144.891
2:15:00 AM	5.757	0.635	138.264
2:30:00 AM	5.775	0.628	137.533
2:45:00 AM	5.732	0.687	149.353
3:00:00 AM	5.588	0.587	122.306
3:15:00 AM	5.614	0.575	121.356
3:30:00 AM	5.534	0.558	115.475
3:45:00 AM	5.567	0.621	127.818
4:00:00 AM	5.609	0.552	116.389
4:15:00 AM	5.465	0.493	98.772
4:30:00 AM	5.346	0.49	96.635
4:45:00 AM	5.34	0.51	100.421
5:00:00 AM	5.416	0.489	97.858
5:15:00 AM	5.476	0.537	108.454
5:30:00 AM	5.438	0.53	107.029
5:45:00 AM	5.516	0.521	107.346
6:00:00 AM	5.678	0.592	127.101
6:15:00 AM	5.777	0.705	153.487
6:30:00 AM	5.844	0.681	151.443
6:45:00 AM	5.92	0.719	162.067
7:00:00 AM	6.546	0.882	229.879
7:15:00 AM	6.683	0.958	256.846
7:30:00 AM	6.778	0.99	270.319
7:45:00 AM	6.944	0.987	278.598
8:00:00 AM	7.127	1.227	348.507
8:15:00 AM	7.2	1.421	421.012
8:30:00 AM	7.438	1.323	402.495
8:45:00 AM	7.813	1.356	432.628
9:00:00 AM	7.944	1.388	468.276
9:15:00 AM	8.105	1.442	499.017
9:30:00 AM	8.302	1.447	517.358
9:45:00 AM	8.423	1.444	526.026
10:00:00 AM	8.499	1.445	518.494
10:15:00 AM	8.447	1.502	546.912
10:30:00 AM	8.572	1.461	535.785
10:45:00 AM	8.6	1.502	542.28
11:00:00 AM	8.587	1.52	567.674
11:15:00 AM	8.825	1.653	614.296
11:30:00 AM	8.669	1.496	565.471
11:45:00 AM	8.455	1.754	637.3

Sunday - P.M. 7/23/2023

Time	Level	Velocity	Flow
12:00:00 PM	8.568	1.472	548.167
12:15:00 PM	8.545	1.49	549.244
12:30:00 PM	8.406	1.521	549.154
12:45:00 PM	8.371	1.435	518.632
1:00:00 PM	8.081	1.428	492.781
1:15:00 PM	8.197	1.554	530.939
1:30:00 PM	8.341	1.551	557.584
1:45:00 PM	8.336	1.466	520.042
2:00:00 PM	8.152	1.429	498.836
2:15:00 PM	7.844	1.267	420.445
2:30:00 PM	7.641	1.308	419.261
2:45:00 PM	7.753	1.383	451.945
3:00:00 PM	7.919	1.33	445.547
3:15:00 PM	7.921	1.37	455.462
3:30:00 PM	7.99	1.36	462.388
3:45:00 PM	7.964	1.475	491.9
4:00:00 PM	7.994	1.344	450.768
4:15:00 PM	7.865	1.311	435.99
4:30:00 PM	7.892	1.356	453.828
4:45:00 PM	7.845	1.343	445.753
5:00:00 PM	7.661	1.36	437.602
5:15:00 PM	7.779	1.317	430.822
5:30:00 PM	7.781	1.406	461.729
5:45:00 PM	7.649	1.353	434.525
6:00:00 PM	7.593	1.21	384.875
6:15:00 PM	7.714	1.306	416.009
6:30:00 PM	7.676	1.153	366.781
6:45:00 PM	7.825	1.307	432.394
7:00:00 PM	7.953	1.297	438.447
7:15:00 PM	7.921	1.361	453.43
7:30:00 PM	7.924	1.422	477.934
7:45:00 PM	7.858	1.385	452.202
8:00:00 PM	7.979	1.346	452.871
8:15:00 PM	7.916	1.342	449.732
8:30:00 PM	8.132	1.378	479.402
8:45:00 PM	8.301	1.479	520.61
9:00:00 PM	8.501	1.48	534.322
9:15:00 PM	8.407	1.451	522.993
9:30:00 PM	8.392	1.479	535.958
9:45:00 PM	8.609	1.484	555.896
10:00:00 PM	8.357	1.485	524.356
10:15:00 PM	8.42	1.491	543.016
10:30:00 PM	8.317	1.44	515.823
10:45:00 PM	7.978	1.375	462.017
11:00:00 PM	7.91	1.313	440.493
11:15:00 PM	7.674	1.245	401.357
11:30:00 PM	7.366	1.141	344.553
11:45:00 PM	7.153	1.156	335.013

	Inches	Feet/Sec	GPM
Daily Avg:	7.366	1.173	376.775
Daily Min:	5.34	0.489	96.635
Daily Max:	8.825	1.754	637.3
Peak to Avg:			1.69

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd., Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/24/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 520 Harvard Blvd.

Monday - A.M. 7/24/2023

Time	Level	Velocity	Velocity
12:10:00 AM	6.895	1.082	298.847
12:15:00 AM	6.735	1.237	324.137
12:30:00 AM	6.531	0.9	233.844
12:45:00 AM	6.251	0.88	215.535
1:00:00 AM	6.06	0.805	188.626
1:15:00 AM	5.992	0.757	173.082
1:30:00 AM	5.979	0.749	165.337
1:45:00 AM	5.739	0.681	147.13
2:00:00 AM	5.653	0.604	128.757
2:15:00 AM	5.636	0.643	136.608
2:30:00 AM	5.532	0.597	122.481
2:45:00 AM	5.481	0.566	115.223
3:00:00 AM	5.536	0.6	124.389
3:15:00 AM	5.455	0.578	117.278
3:30:00 AM	5.501	0.624	128.177
3:45:00 AM	5.475	0.618	126.093
4:00:00 AM	5.481	0.985	200.228
4:15:00 AM	5.486	0.995	202.827
4:30:00 AM	5.634	0.682	144.795
4:45:00 AM	5.742	0.713	155.246
5:00:00 AM	5.759	0.696	151.645
5:15:00 AM	5.93	0.82	185.426
5:30:00 AM	6.192	0.858	207.395
5:45:00 AM	6.402	0.943	233.123
6:00:00 AM	6.55	1.01	263.506
6:15:00 AM	6.515	1.003	259.616
6:30:00 AM	6.693	1.029	276.465
6:45:00 AM	6.738	1.111	296.512
7:00:00 AM	7.085	1.301	377.293
7:15:00 AM	7.162	1.246	366.678
7:30:00 AM	7.229	1.16	345.587
7:45:00 AM	7.374	1.202	367.69
8:00:00 AM	7.392	1.242	380.661
8:15:00 AM	7.687	1.267	409.454
8:30:00 AM	7.362	1.192	363.687
8:45:00 AM	7.501	1.296	405.483
9:00:00 AM	7.519	1.312	411.835
9:15:00 AM	7.517	1.299	407.655
9:30:00 AM	7.527	1.275	400.627
9:45:00 AM	7.728	1.318	428.986
10:00:00 AM	7.688	1.29	416.957
10:15:00 AM	7.628	1.265	404.572
10:30:00 AM	7.795	1.287	423.504
10:45:00 AM	7.776	1.336	428.527
11:00:00 AM	7.616	1.272	405.954
11:15:00 AM	7.695	1.293	418.562
11:30:00 AM	7.794	1.304	424.494
11:45:00 AM	7.911	1.343	450.58

Monday - P.M. 7/24/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.807	1.293	421.347
12:15:00 PM	7.839	1.25	414.605
12:30:00 PM	7.704	1.261	408.583
12:45:00 PM	7.795	1.249	406.465
1:00:00 PM	7.695	1.313	419.381
1:15:00 PM	7.618	1.201	383.493
1:30:00 PM	7.66	1.221	392.784
1:45:00 PM	7.562	1.225	386.087
2:00:00 PM	7.641	1.198	383.517
2:15:00 PM	7.57	1.187	373.335
2:30:00 PM	7.582	1.174	372.26
2:45:00 PM	7.503	1.202	376.256
3:00:00 PM	7.795	1.241	408.343
3:15:00 PM	7.692	1.301	415.384
3:30:00 PM	7.578	1.188	374.569
3:45:00 PM	7.658	1.233	387.186
4:00:00 PM	7.742	1.217	397.111
4:15:00 PM	7.678	1.221	392.934
4:30:00 PM	7.55	1.086	342.081
4:45:00 PM	7.804	1.227	395.667
5:00:00 PM	7.795	1.17	374.289
5:15:00 PM	7.922	1.171	393.604
5:30:00 PM	7.928	1.223	411.562
5:45:00 PM	8.063	1.132	389.555
6:00:00 PM	8.014	1.201	409.879
6:15:00 PM	7.998	1.228	406.386
6:30:00 PM	7.91	1.032	344.381
6:45:00 PM	8.127	1.19	408.586
7:00:00 PM	8.342	1.242	446.87
7:15:00 PM	8.017	1.215	415.063
7:30:00 PM	7.983	1.212	411.646
7:45:00 PM	8.365	1.297	468.171
8:00:00 PM	8.303	1.268	453.53
8:15:00 PM	8.395	1.333	483.372
8:30:00 PM	8.406	1.227	440.868
8:45:00 PM	8.538	1.121	407.898
9:00:00 PM	8.561	1.332	488.331
9:15:00 PM	8.485	1.407	511.168
9:30:00 PM	8.563	1.29	479.825
9:45:00 PM	8.497	1.262	456.536
10:00:00 PM	8.457	1.341	486.644
10:15:00 PM	8.473	1.263	459.768
10:30:00 PM	8.191	1.269	442.903
10:45:00 PM	8.168	1.252	438.086
11:00:00 PM	8.007	1.23	419.485
11:15:00 PM	7.549	1.16	365.875
11:30:00 PM	7.216	0.967	282.855
11:45:00 PM	7.049	0.896	257.542

	Inches	Feet/Sec	GPM
Daily Avg:	7.289	1.112	343.877
Daily Min:	5.455	0.566	115.223
Daily Max:	8.563	1.407	511.168
Peak to Avg:			1.49

Sewer Line Flow Study Summary

Project: **City of Santa Paula - Sewer Flow Study**
Location: **520 Harvard Blvd, Santa Paula, CA**
Pipe Size: **18” VCP**
Time Period: **7/11/2023, 12:00 a.m. - 7/25/2023, 12:00 a.m.**

Level - Inches

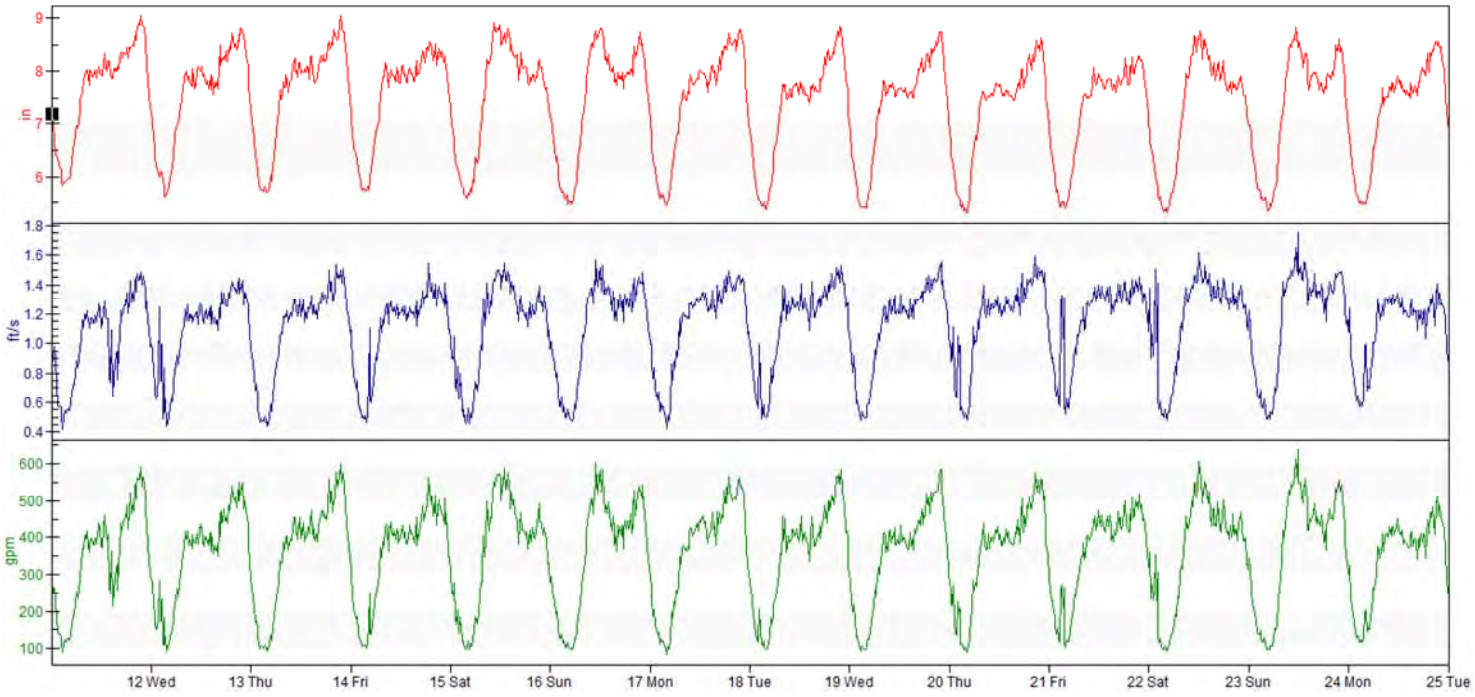
Average:	7.362
Maximum:	9.048
Minimum:	5.248
Max d/D:	50.3%

Velocity - Feet per Second

Average:	1.066
Maximum:	1.754
Minimum:	0.408

Flow Rate - Gallons Per Minute

Average:	340.898
Maximum::	637.300
Minimum:	73.445
Peak to Average	1.70



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

CITY OF SANTA PAULA - SEWER FLOW STUDY

MH Location: **500 Acacia**
Santa Paula, CA 93060

Pipe Size: **24" VCP**

Time Period: **7/11/2023 - 12:00 a.m. to**
7/25/2023- 12:00 a.m.

GPS: **34.337539, -119.081607**



Manhole - Layout



Equipment

Teledyne Isco 2150 Area Velocity Flow Meter with 10' measuring range:
Level Measurement:

- Method - Submerged pressure transducer mounted in the flow stream
- Transducer Type - Differential linear integrated circuit pressure transducer
- Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); Maximum Allowable Level 34 ft (10.5 m)
- Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,)
- Long-Term Stability ±0.023 ft/yr (±0.007 m/yr)
- Compensated Range 32° to 122°F (0° to 50°C)

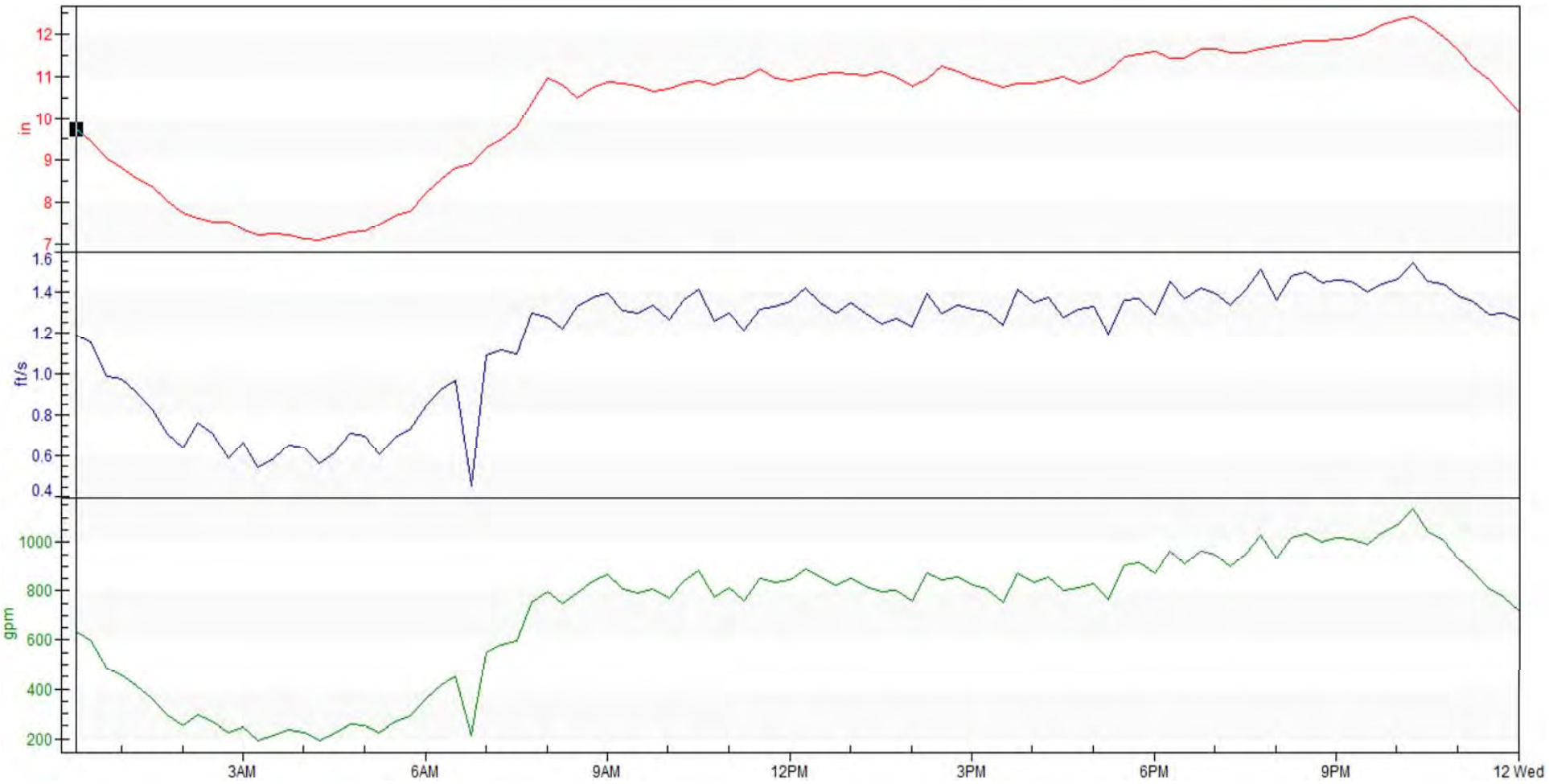
Velocity Measurement:

- Method - Doppler ultrasonic, frequency 500 kHz
- Typical Minimum Depth 0.08 ft (25 mm)
- Range -5 to +20 ft/s (-1.5 to +6.1 m/s)
- Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from— 1.5 to +1.5 m/s)
- ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)

Method Of Insertion:

- 24 inch line requires Confined Space Entry.

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/11/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Tuesday- A.M. 7/11/2023

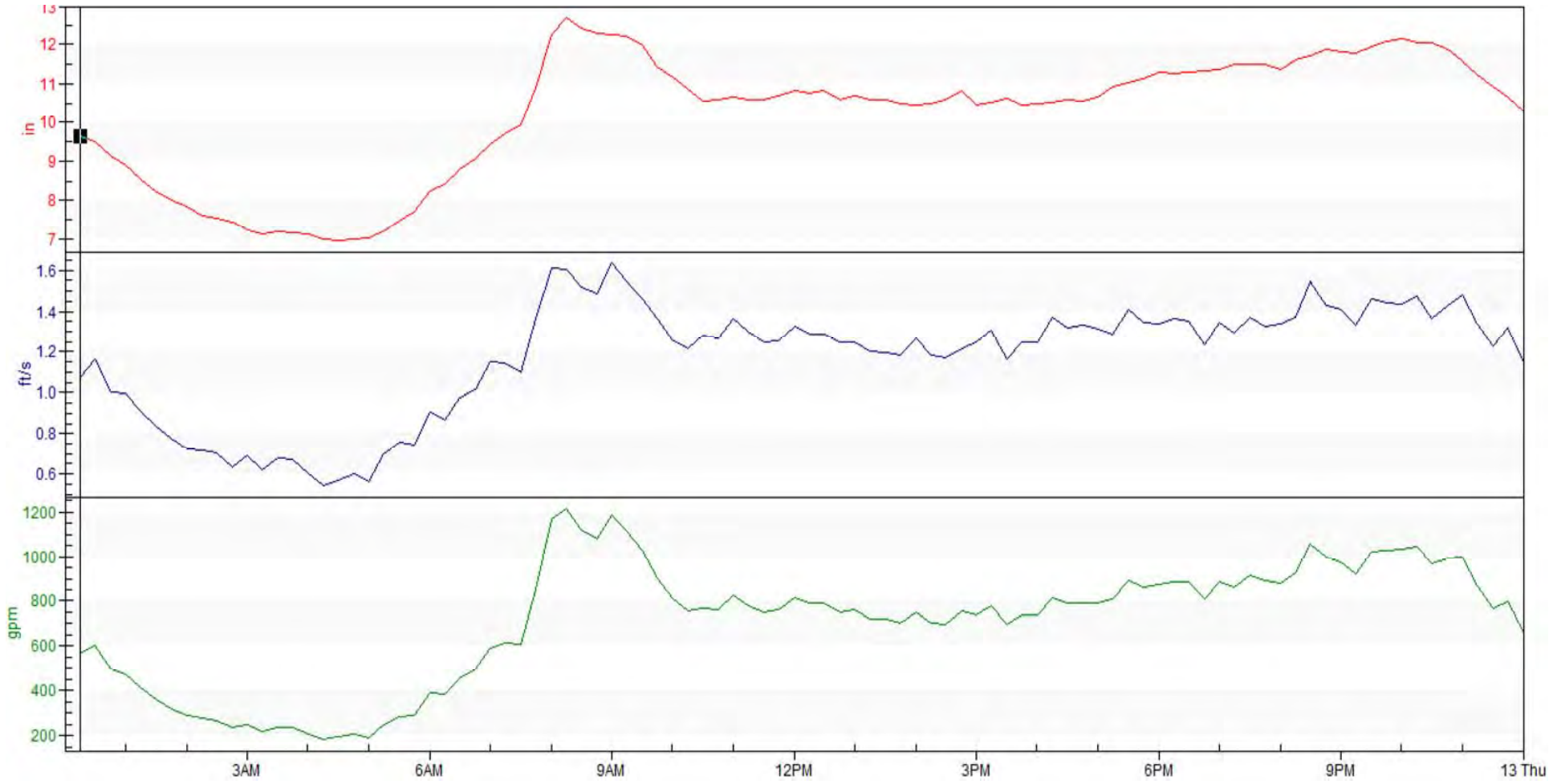
Time	Level	Velocity	Flow
12:15:00 AM	9.734	1.184	635.376
12:30:00 AM	9.453	1.155	595.643
12:45:00 AM	9.056	0.989	481.778
1:00:00 AM	8.825	0.972	457.009
1:15:00 AM	8.572	0.91	411.633
1:30:00 AM	8.379	0.826	362.212
1:45:00 AM	8.025	0.711	293.95
2:00:00 AM	7.751	0.64	252.256
2:15:00 AM	7.623	0.764	293.942
2:30:00 AM	7.539	0.709	268.773
2:45:00 AM	7.536	0.592	224.171
3:00:00 AM	7.345	0.669	244.713
3:15:00 AM	7.215	0.545	194.373
3:30:00 AM	7.254	0.59	212.218
3:45:00 AM	7.215	0.655	233.581
4:00:00 AM	7.119	0.641	224.525
4:15:00 AM	7.082	0.562	195.359
4:30:00 AM	7.169	0.616	217.835
4:45:00 AM	7.274	0.709	255.729
5:00:00 AM	7.318	0.696	253.264
5:15:00 AM	7.454	0.609	227.363
5:30:00 AM	7.695	0.69	269.216
5:45:00 AM	7.781	0.732	289.765
6:00:00 AM	8.222	0.846	361.288
6:15:00 AM	8.546	0.925	416.648
6:30:00 AM	8.815	0.968	454.356
6:45:00 AM	8.918	0.454	216.404
7:00:00 AM	9.295	1.091	550.083
7:15:00 AM	9.495	1.116	579.244
7:30:00 AM	9.809	1.099	595.975
7:45:00 AM	10.359	1.297	755.473
8:00:00 AM	10.952	1.274	798.281
8:15:00 AM	10.795	1.217	748.355
8:30:00 AM	10.5	1.331	789.119
8:45:00 AM	10.757	1.371	839.113
9:00:00 AM	10.886	1.391	864.907
9:15:00 AM	10.844	1.307	808.319
9:30:00 AM	10.779	1.293	793.823
9:45:00 AM	10.639	1.336	806.189
10:00:00 AM	10.708	1.265	769.545
10:15:00 AM	10.843	1.358	840.213
10:30:00 AM	10.918	1.412	881.265
10:45:00 AM	10.811	1.26	776.691
11:00:00 AM	10.951	1.297	812.61
11:15:00 AM	10.956	1.211	759.125
11:30:00 AM	11.194	1.317	849.139
11:45:00 AM	10.977	1.329	835.116

Tuesday- P.M. 7/11/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.904	1.356	845.223
12:15:00 PM	10.968	1.418	890.063
12:30:00 PM	11.073	1.347	856.621
12:45:00 PM	11.097	1.296	826.204
1:00:00 PM	11.046	1.345	852.329
1:15:00 PM	11.019	1.298	819.984
1:30:00 PM	11.127	1.243	795.54
1:45:00 PM	10.989	1.272	800.844
2:00:00 PM	10.767	1.234	756.263
2:15:00 PM	10.927	1.394	871.18
2:30:00 PM	11.25	1.299	842.646
2:45:00 PM	11.132	1.338	856.459
3:00:00 PM	10.979	1.314	826.037
3:15:00 PM	10.868	1.306	810.057
3:30:00 PM	10.752	1.236	755.972
3:45:00 PM	10.831	1.415	873.822
4:00:00 PM	10.842	1.349	834.198
4:15:00 PM	10.906	1.372	855.379
4:30:00 PM	10.986	1.274	801.615
4:45:00 PM	10.851	1.315	814.484
5:00:00 PM	10.947	1.327	831.396
5:15:00 PM	11.123	1.196	764.582
5:30:00 PM	11.457	1.363	905.363
5:45:00 PM	11.53	1.368	916.654
6:00:00 PM	11.585	1.291	870.367
6:15:00 PM	11.455	1.448	961.964
6:30:00 PM	11.444	1.369	908.49
6:45:00 PM	11.655	1.417	962.4
7:00:00 PM	11.647	1.395	946.414
7:15:00 PM	11.558	1.334	896.604
7:30:00 PM	11.574	1.415	952.36
7:45:00 PM	11.673	1.511	1028.52
8:00:00 PM	11.74	1.358	931.272
8:15:00 PM	11.803	1.474	1017.37
8:30:00 PM	11.84	1.495	1036.24
8:45:00 PM	11.864	1.444	1003.08
9:00:00 PM	11.885	1.458	1015.67
9:15:00 PM	11.912	1.452	1014.34
9:30:00 PM	12.039	1.398	989.995
9:45:00 PM	12.227	1.439	1039.15
10:00:00 PM	12.355	1.461	1068.97
10:15:00 PM	12.421	1.541	1134.83
10:30:00 PM	12.226	1.449	1045.95
10:45:00 PM	11.934	1.44	1007.95
11:00:00 PM	11.634	1.377	933.162
11:15:00 PM	11.229	1.352	875.305
11:30:00 PM	10.944	1.288	806.527
11:45:00 PM	10.545	1.299	774.781

	Inches	Feet/Sec	GPM
Daily Avg:	10.242	1.174	707.585
Daily Min:	7.082	0.454	194.373
Daily Max:	12.421	1.541	1134.83
Peak to Avg:			1.60

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/12/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Wednesday - A.M. 7/12/2023

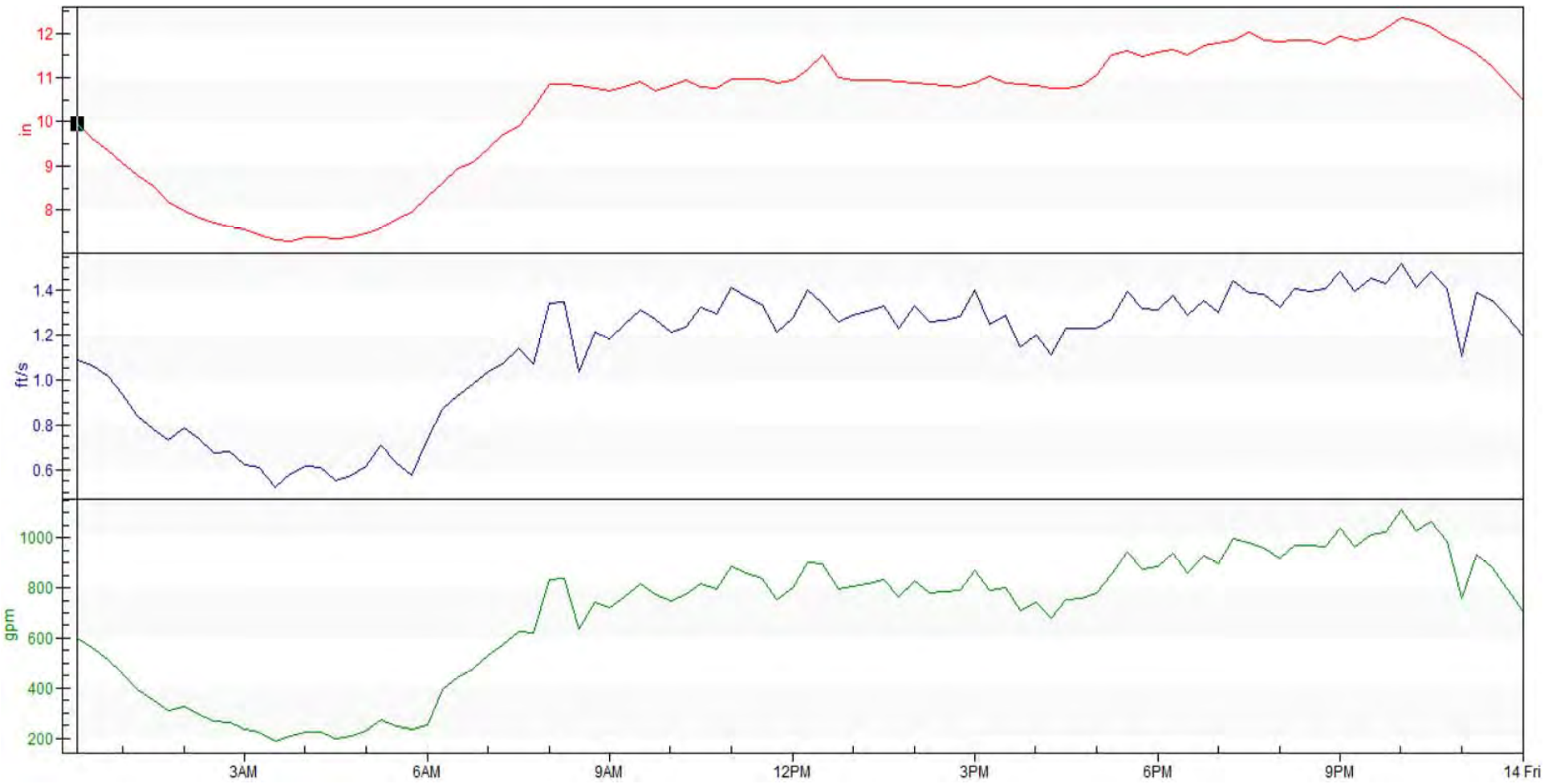
Time	Level	Velocity	Flow
12:00:00 AM	10.138	1.266	717.048
12:15:00 AM	9.658	1.072	569.21
12:30:00 AM	9.49	1.166	604.568
12:45:00 AM	9.141	1.003	494.757
1:00:00 AM	8.902	0.994	473.136
1:15:00 AM	8.568	0.911	411.57
1:30:00 AM	8.236	0.837	358.402
1:45:00 AM	7.999	0.777	319.484
2:00:00 AM	7.839	0.722	288.878
2:15:00 AM	7.604	0.719	275.871
2:30:00 AM	7.55	0.704	267.582
2:45:00 AM	7.436	0.632	235.252
3:00:00 AM	7.248	0.689	247.379
3:15:00 AM	7.148	0.62	218.476
3:30:00 AM	7.198	0.676	240.466
3:45:00 AM	7.16	0.672	237.111
4:00:00 AM	7.147	0.598	210.595
4:15:00 AM	7.007	0.543	185.876
4:30:00 AM	6.964	0.57	193.729
4:45:00 AM	6.999	0.602	205.837
5:00:00 AM	7.02	0.561	192.808
5:15:00 AM	7.207	0.699	248.934
5:30:00 AM	7.485	0.754	283.195
5:45:00 AM	7.714	0.744	291.29
6:00:00 AM	8.251	0.904	387.822
6:15:00 AM	8.43	0.866	382.619
6:30:00 AM	8.801	0.977	457.915
6:45:00 AM	9.058	1.016	494.772
7:00:00 AM	9.423	1.154	592.776
7:15:00 AM	9.701	1.147	612.587
7:30:00 AM	9.955	1.097	606.34
7:45:00 AM	10.91	1.363	850.104
8:00:00 AM	12.26	1.611	1166.9
8:15:00 AM	12.693	1.604	1213.71
8:30:00 AM	12.411	1.522	1120.13
8:45:00 AM	12.287	1.485	1078.54
9:00:00 AM	12.259	1.637	1185.81
9:15:00 AM	12.227	1.547	1117.08
9:30:00 AM	11.992	1.46	1028.56
9:45:00 AM	11.446	1.365	905.573
10:00:00 AM	11.151	1.258	807.06
10:15:00 AM	10.875	1.218	756.585
10:30:00 AM	10.568	1.28	765.366
10:45:00 AM	10.581	1.267	759.049
11:00:00 AM	10.669	1.365	826.589
11:15:00 AM	10.595	1.3	780.139
11:30:00 AM	10.592	1.246	747.411
11:45:00 AM	10.676	1.254	760.153

Wednesday - P.M. 7/12/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.818	1.325	817.152
12:15:00 PM	10.757	1.287	788.197
12:30:00 PM	10.815	1.287	793.376
12:45:00 PM	10.605	1.248	749.987
1:00:00 PM	10.699	1.248	758.803
1:15:00 PM	10.595	1.201	720.996
1:30:00 PM	10.596	1.196	718.024
1:45:00 PM	10.502	1.186	703.459
2:00:00 PM	10.458	1.269	748.507
2:15:00 PM	10.485	1.186	701.979
2:30:00 PM	10.574	1.169	699.727
2:45:00 PM	10.842	1.217	752.919
3:00:00 PM	10.451	1.249	736.119
3:15:00 PM	10.526	1.308	778.166
3:30:00 PM	10.609	1.164	699.776
3:45:00 PM	10.456	1.25	737.319
4:00:00 PM	10.495	1.246	738.563
4:15:00 PM	10.511	1.369	812.994
4:30:00 PM	10.574	1.322	791.127
4:45:00 PM	10.549	1.33	793.442
5:00:00 PM	10.655	1.312	793.132
5:15:00 PM	10.936	1.289	806.584
5:30:00 PM	11.021	1.407	889.121
5:45:00 PM	11.124	1.347	861.335
6:00:00 PM	11.305	1.341	875.603
6:15:00 PM	11.274	1.362	886.429
6:30:00 PM	11.299	1.354	883.86
6:45:00 PM	11.353	1.232	809.292
7:00:00 PM	11.376	1.344	885.003
7:15:00 PM	11.491	1.293	862.622
7:30:00 PM	11.499	1.374	917.055
7:45:00 PM	11.519	1.328	888.786
8:00:00 PM	11.367	1.339	880.828
8:15:00 PM	11.62	1.372	928.18
8:30:00 PM	11.707	1.549	1057.82
8:45:00 PM	11.882	1.429	994.896
9:00:00 PM	11.796	1.409	971.915
9:15:00 PM	11.787	1.335	919.929
9:30:00 PM	11.937	1.461	1023.17
9:45:00 PM	12.076	1.441	1024.08
10:00:00 PM	12.152	1.438	1029.92
10:15:00 PM	12.055	1.473	1044.54
10:30:00 PM	12.049	1.367	969.03
10:45:00 PM	11.866	1.428	992.415
11:00:00 PM	11.573	1.48	996.403
11:15:00 PM	11.245	1.34	868.958
11:30:00 PM	10.914	1.227	765.463
11:45:00 PM	10.67	1.318	798.408

	Inches	Feet/Sec	GPM
Daily Avg:	10.210	1.175	706.562
Daily Min:	6.964	0.543	185.876
Daily Max:	12.693	1.637	1213.71
Peak to Avg:			1.72

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/13/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Thursday - A.M. 7/13/2023

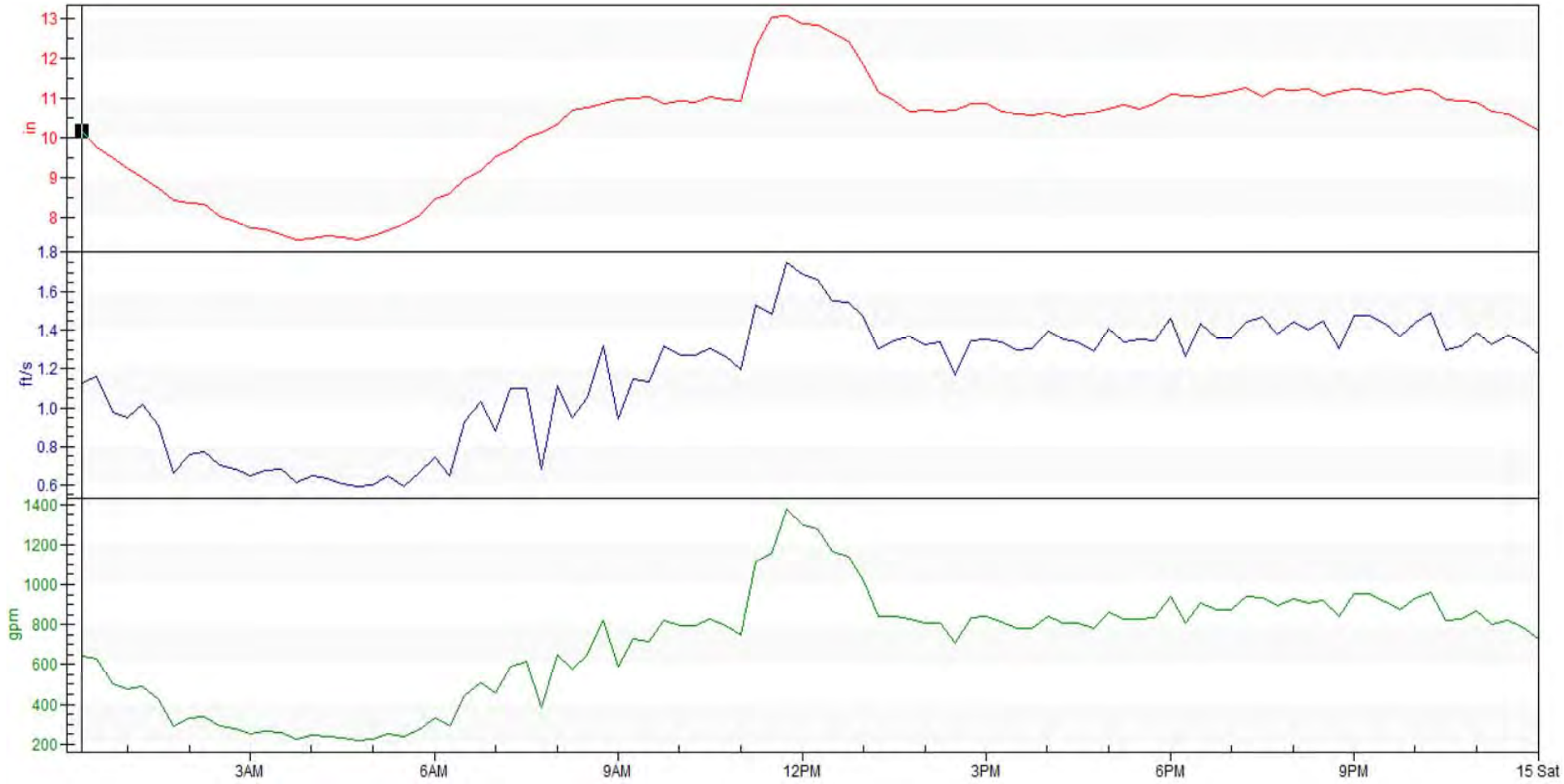
Time	Level	Velocity	Flow
12:00:00 AM	10.274	1.144	659.515
12:15:00 AM	9.952	1.089	601.785
12:30:00 AM	9.611	1.065	561.961
12:45:00 AM	9.362	1.016	517.5
1:00:00 AM	9.067	0.936	456.66
1:15:00 AM	8.789	0.842	394.036
1:30:00 AM	8.54	0.78	350.713
1:45:00 AM	8.195	0.733	311.57
2:00:00 AM	7.993	0.789	324.11
2:15:00 AM	7.834	0.741	296.297
2:30:00 AM	7.725	0.676	264.911
2:45:00 AM	7.634	0.682	263.191
3:00:00 AM	7.556	0.623	236.794
3:15:00 AM	7.437	0.609	226.606
3:30:00 AM	7.308	0.522	189.496
3:45:00 AM	7.291	0.578	209.272
4:00:00 AM	7.368	0.614	225.665
4:15:00 AM	7.376	0.609	224.127
4:30:00 AM	7.354	0.55	201.392
4:45:00 AM	7.373	0.575	211.247
5:00:00 AM	7.461	0.617	230.769
5:15:00 AM	7.594	0.709	271.553
5:30:00 AM	7.802	0.626	248.785
5:45:00 AM	7.941	0.576	234.57
6:00:00 AM	8.312	0.74	249.72
6:15:00 AM	8.612	0.871	396.406
6:30:00 AM	8.925	0.928	442.976
6:45:00 AM	9.097	0.979	479.904
7:00:00 AM	9.38	1.037	529.358
7:15:00 AM	9.708	1.07	572.089
7:30:00 AM	9.883	1.142	625.403
7:45:00 AM	10.317	1.07	620.009
8:00:00 AM	10.857	1.344	832.706
8:15:00 AM	10.86	1.349	836.295
8:30:00 AM	10.836	1.034	639.165
8:45:00 AM	10.759	1.211	741.754
9:00:00 AM	10.716	1.184	721.206
9:15:00 AM	10.782	1.245	764.567
9:30:00 AM	10.904	1.309	815.958
9:45:00 AM	10.699	1.272	773.173
10:00:00 AM	10.829	1.214	749.701
10:15:00 AM	10.933	1.234	771.638
10:30:00 AM	10.806	1.322	814.119
10:45:00 AM	10.765	1.294	792.987
11:00:00 AM	10.958	1.413	886.297
11:15:00 AM	10.975	1.37	860.807
11:30:00 AM	10.957	1.337	838.701
11:45:00 AM	10.892	1.213	754.526

Thursday - P.M. 7/13/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.94	1.275	798.287
12:15:00 PM	11.194	1.398	901.548
12:30:00 PM	11.514	1.343	897.803
12:45:00 PM	11.011	1.256	792.957
1:00:00 PM	10.938	1.287	804.983
1:15:00 PM	10.939	1.308	818.432
1:30:00 PM	10.954	1.33	833.505
1:45:00 PM	10.903	1.228	765.167
2:00:00 PM	10.874	1.329	825.37
2:15:00 PM	10.865	1.26	781.307
2:30:00 PM	10.828	1.267	782.295
2:45:00 PM	10.788	1.282	787.964
3:00:00 PM	10.881	1.399	869.647
3:15:00 PM	11.036	1.248	790.049
3:30:00 PM	10.881	1.286	799.009
3:45:00 PM	10.843	1.146	708.684
4:00:00 PM	10.824	1.2	740.608
4:15:00 PM	10.755	1.11	679.31
4:30:00 PM	10.747	1.232	753.236
4:45:00 PM	10.827	1.232	760.497
5:00:00 PM	11.07	1.227	779.898
5:15:00 PM	11.52	1.273	851.739
5:30:00 PM	11.592	1.395	940.621
5:45:00 PM	11.466	1.315	874.843
6:00:00 PM	11.557	1.315	883.306
6:15:00 PM	11.642	1.379	935.485
6:30:00 PM	11.498	1.29	860.753
6:45:00 PM	11.715	1.354	925.575
7:00:00 PM	11.791	1.301	896.526
7:15:00 PM	11.834	1.439	996.649
7:30:00 PM	12.014	1.386	978.614
7:45:00 PM	11.838	1.383	958.095
8:00:00 PM	11.798	1.325	913.942
8:15:00 PM	11.825	1.404	971.641
8:30:00 PM	11.826	1.397	966.867
8:45:00 PM	11.757	1.406	965.967
9:00:00 PM	11.936	1.48	1036.67
9:15:00 PM	11.83	1.392	963.645
9:30:00 PM	11.902	1.452	1013.33
9:45:00 PM	12.097	1.433	1020.33
10:00:00 PM	12.348	1.519	1110.27
10:15:00 PM	12.269	1.414	1025.76
10:30:00 PM	12.142	1.486	1063.08
10:45:00 PM	11.902	1.408	982.671
11:00:00 PM	11.746	1.107	759.24
11:15:00 PM	11.528	1.391	931.342
11:30:00 PM	11.238	1.354	877.152
11:45:00 PM	10.891	1.28	796.166

	Inches	Feet/Sec	GPM
Daily Avg:	10.310	1.142	691.930
Daily Min:	7.291	0.522	189.496
Daily Max:	12.348	1.519	1110.27
Peak to Avg:			1.60

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/14/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Friday - A.M. 7/14/2023

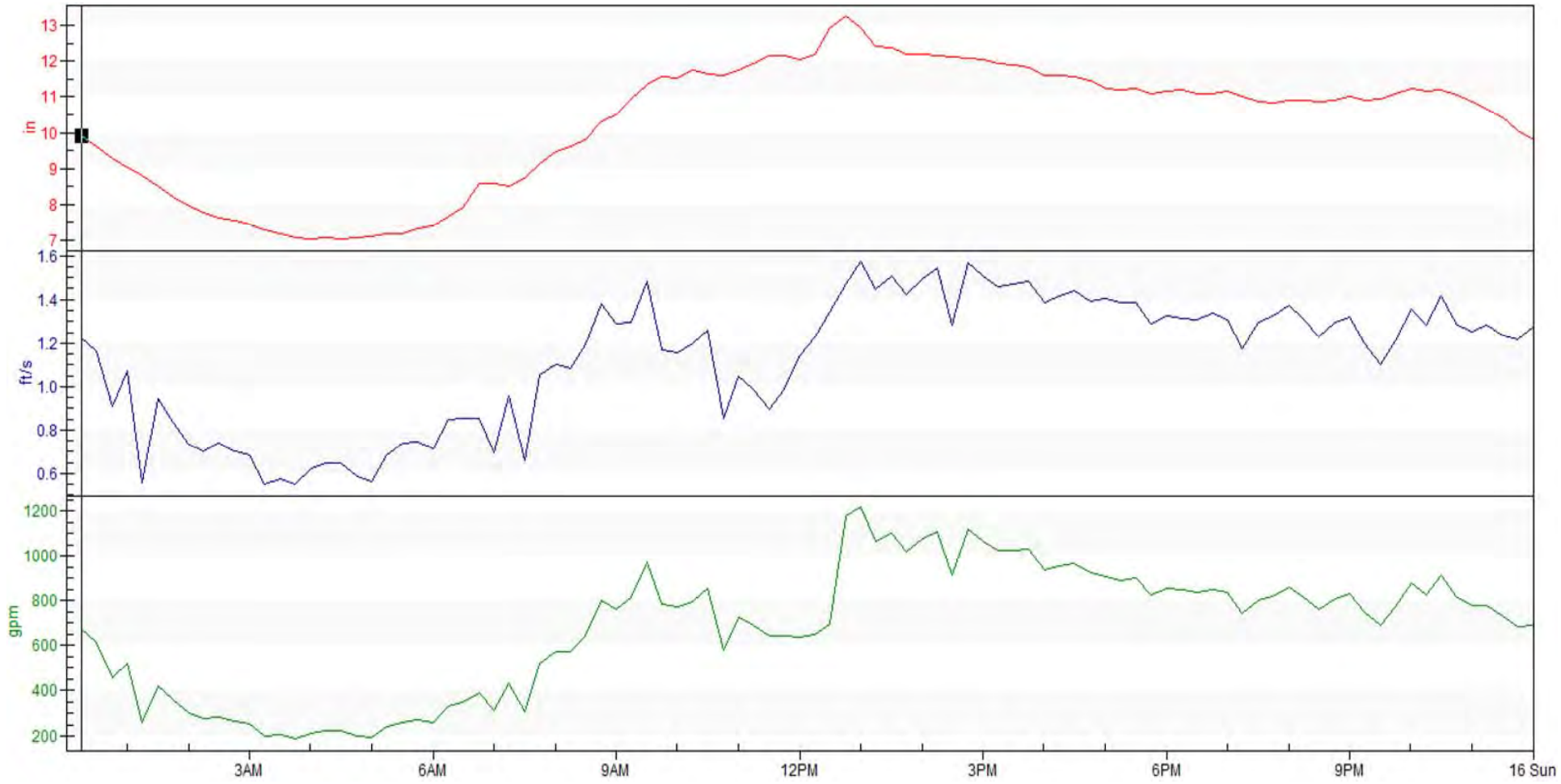
Time	Level	Velocity	Flow
12:00:00 AM	10.49	1.193	706.655
12:15:00 AM	10.158	1.13	641.421
12:30:00 AM	9.787	1.165	629.34
12:45:00 AM	9.489	0.975	505.678
1:00:00 AM	9.24	0.949	474.687
1:15:00 AM	9	1.017	491.252
1:30:00 AM	8.747	0.909	422.482
1:45:00 AM	8.445	0.66	292.387
2:00:00 AM	8.385	0.757	332.154
2:15:00 AM	8.328	0.773	335.997
2:30:00 AM	8.06	0.698	290.151
2:45:00 AM	7.901	0.683	276.13
3:00:00 AM	7.751	0.647	254.685
3:15:00 AM	7.713	0.677	264.944
3:30:00 AM	7.584	0.68	259.851
3:45:00 AM	7.452	0.612	228.202
4:00:00 AM	7.49	0.648	243.44
4:15:00 AM	7.56	0.63	239.962
4:30:00 AM	7.498	0.608	228.816
4:45:00 AM	7.443	0.591	220.148
5:00:00 AM	7.541	0.598	227.017
5:15:00 AM	7.669	0.646	250.854
5:30:00 AM	7.856	0.591	237.334
5:45:00 AM	8.043	0.66	273.376
6:00:00 AM	8.465	0.743	330.148
6:15:00 AM	8.606	0.647	294.058
6:30:00 AM	8.959	0.925	443.865
6:45:00 AM	9.166	1.029	509.615
7:00:00 AM	9.534	0.88	459.096
7:15:00 AM	9.717	1.101	589.198
7:30:00 AM	10.017	1.103	614.953
7:45:00 AM	10.135	0.682	385.924
8:00:00 AM	10.351	1.113	647.765
8:15:00 AM	10.709	0.947	576.56
8:30:00 AM	10.782	1.053	646.654
8:45:00 AM	10.853	1.322	818.935
9:00:00 AM	10.983	0.94	591.552
9:15:00 AM	11.016	1.151	726.812
9:30:00 AM	11.027	1.136	718.387
9:45:00 AM	10.873	1.318	818.485
10:00:00 AM	10.938	1.273	796.789
10:15:00 AM	10.908	1.27	791.985
10:30:00 AM	11.032	1.309	828.265
10:45:00 AM	10.984	1.262	794.081
11:00:00 AM	10.942	1.198	749.722
11:15:00 AM	12.302	1.531	1113.58
11:30:00 AM	13.013	1.483	1157.54
11:45:00 AM	13.064	1.753	1375.59

Friday - P.M. 7/14/2023

Time	Level	Velocity	Flow
12:00:00 PM	12.849	1.689	1298.19
12:15:00 PM	12.826	1.665	1276.64
12:30:00 PM	12.619	1.555	1168.37
12:45:00 PM	12.437	1.547	1141.05
1:00:00 PM	11.824	1.471	1018
1:15:00 PM	11.158	1.307	839.424
1:30:00 PM	10.92	1.347	840.807
1:45:00 PM	10.673	1.365	827.133
2:00:00 PM	10.715	1.326	807.518
2:15:00 PM	10.664	1.339	810.644
2:30:00 PM	10.713	1.166	710.061
2:45:00 PM	10.868	1.344	834.026
3:00:00 PM	10.864	1.357	841.887
3:15:00 PM	10.682	1.343	814.807
3:30:00 PM	10.619	1.302	783.692
3:45:00 PM	10.564	1.308	781.979
4:00:00 PM	10.626	1.399	842.585
4:15:00 PM	10.534	1.352	805.126
4:30:00 PM	10.604	1.343	807.053
4:45:00 PM	10.646	1.29	779.109
5:00:00 PM	10.727	1.409	859.417
5:15:00 PM	10.846	1.34	829.362
5:30:00 PM	10.729	1.357	828.189
5:45:00 PM	10.855	1.351	836.692
6:00:00 PM	11.109	1.468	937.07
6:15:00 PM	11.068	1.268	805.842
6:30:00 PM	11.027	1.435	907.545
6:45:00 PM	11.114	1.364	871.131
7:00:00 PM	11.182	1.36	876.021
7:15:00 PM	11.254	1.444	937.668
7:30:00 PM	11.049	1.472	933.31
7:45:00 PM	11.238	1.38	894.064
8:00:00 PM	11.187	1.44	928.015
8:15:00 PM	11.23	1.401	907.208
8:30:00 PM	11.082	1.45	922.995
8:45:00 PM	11.159	1.306	838.769
9:00:00 PM	11.239	1.476	956.68
9:15:00 PM	11.199	1.475	951.764
9:30:00 PM	11.095	1.435	914.709
9:45:00 PM	11.154	1.365	876.156
10:00:00 PM	11.237	1.441	933.655
10:15:00 PM	11.197	1.492	962.044
10:30:00 PM	10.985	1.301	818.49
10:45:00 PM	10.92	1.321	824.882
11:00:00 PM	10.896	1.391	865.739
11:15:00 PM	10.658	1.329	803.526
11:30:00 PM	10.59	1.372	822.944
11:45:00 PM	10.419	1.338	785.6

	Inches	Feet/Sec	GPM
Daily Avg:	10.267	1.171	705.868
Daily Min:	7.443	0.591	220.148
Daily Max:	13.064	1.753	1375.59
Peak to Avg:			1.95

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/15/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Saturday - A.M. 7/15/2023

Time	Level	Velocity	Flow
12:00:00 AM	10.188	1.282	730.785
12:15:00 AM	9.892	1.222	669.576
12:30:00 AM	9.605	1.163	612.757
12:45:00 AM	9.278	0.908	457.064
1:00:00 AM	9.039	1.071	520.21
1:15:00 AM	8.798	0.556	260.408
1:30:00 AM	8.493	0.942	420.363
1:45:00 AM	8.229	0.837	357.831
2:00:00 AM	7.955	0.733	299.264
2:15:00 AM	7.793	0.705	279.869
2:30:00 AM	7.634	0.74	285.49
2:45:00 AM	7.568	0.703	268.075
3:00:00 AM	7.429	0.687	255.302
3:15:00 AM	7.288	0.554	200.442
3:30:00 AM	7.181	0.578	204.865
3:45:00 AM	7.076	0.551	191.3
4:00:00 AM	7.052	0.624	215.54
4:15:00 AM	7.093	0.65	226.642
4:30:00 AM	7.037	0.648	223.207
4:45:00 AM	7.062	0.59	204.307
5:00:00 AM	7.126	0.563	197.5
5:15:00 AM	7.171	0.683	241.582
5:30:00 AM	7.188	0.737	261.54
5:45:00 AM	7.32	0.748	272.189
6:00:00 AM	7.39	0.714	263.311
6:15:00 AM	7.671	0.845	328.2
6:30:00 AM	7.917	0.854	346.183
6:45:00 AM	8.601	0.854	388.003
7:00:00 AM	8.578	0.697	315.314
7:15:00 AM	8.522	0.958	429.584
7:30:00 AM	8.749	0.661	307.509
7:45:00 AM	9.125	1.056	519.716
8:00:00 AM	9.457	1.103	569.527
8:15:00 AM	9.602	1.083	570.682
8:30:00 AM	9.799	1.19	644.312
8:45:00 AM	10.322	1.382	801.436
9:00:00 AM	10.485	1.288	762.692
9:15:00 AM	10.952	1.294	810.893
9:30:00 AM	11.358	1.483	974.546
9:45:00 AM	11.566	1.166	783.995
10:00:00 AM	11.535	1.156	774.81
10:15:00 AM	11.745	1.198	793.001
10:30:00 AM	11.628	1.258	852.01
10:45:00 AM	11.609	0.855	577.89
11:00:00 AM	11.767	1.05	722.057
11:15:00 AM	11.924	0.988	690.706
11:30:00 AM	12.138	0.896	641.264
11:45:00 AM	12.145	0.984	641.71

Saturday - P.M. 7/15/2023

Time	Level	Velocity	Flow
12:00:00 PM	12.045	1.145	635.013
12:15:00 PM	12.202	1.227	645.543
12:30:00 PM	12.929	1.342	694.25
12:45:00 PM	13.26	1.474	1177.58
1:00:00 PM	12.915	1.574	1217.35
1:15:00 PM	12.423	1.445	1064.15
1:30:00 PM	12.357	1.509	1103.85
1:45:00 PM	12.191	1.42	1021.61
2:00:00 PM	12.201	1.498	1078.34
2:15:00 PM	12.155	1.542	1104.72
2:30:00 PM	12.124	1.282	915.492
2:45:00 PM	12.091	1.57	1117.74
3:00:00 PM	12.044	1.508	1068.21
3:15:00 PM	11.951	1.461	1024.8
3:30:00 PM	11.88	1.469	1022.37
3:45:00 PM	11.841	1.484	1028.77
4:00:00 PM	11.611	1.384	935.217
4:15:00 PM	11.591	1.416	954.982
4:30:00 PM	11.553	1.441	968.019
4:45:00 PM	11.451	1.393	924.635
5:00:00 PM	11.231	1.405	909.924
5:15:00 PM	11.189	1.383	891.331
5:30:00 PM	11.228	1.388	898.595
5:45:00 PM	11.094	1.291	822.991
6:00:00 PM	11.179	1.327	854.058
6:15:00 PM	11.209	1.317	850.315
6:30:00 PM	11.097	1.308	834.074
6:45:00 PM	11.074	1.337	849.982
7:00:00 PM	11.143	1.309	839.292
7:15:00 PM	11.014	1.176	742.583
7:30:00 PM	10.867	1.296	803.858
7:45:00 PM	10.828	1.327	819.393
8:00:00 PM	10.903	1.376	857.185
8:15:00 PM	10.898	1.31	815.537
8:30:00 PM	10.868	1.229	762.407
8:45:00 PM	10.89	1.295	805.766
9:00:00 PM	11.008	1.319	832.226
9:15:00 PM	10.91	1.197	746.291
9:30:00 PM	10.947	1.099	688.348
9:45:00 PM	11.104	1.208	770.852
10:00:00 PM	11.224	1.356	877.642
10:15:00 PM	11.178	1.282	825.1
10:30:00 PM	11.183	1.415	911.202
10:45:00 PM	11.051	1.285	814.675
11:00:00 PM	10.873	1.253	777.897
11:15:00 PM	10.658	1.282	775.442
11:30:00 PM	10.435	1.237	727.885
11:45:00 PM	10.072	1.218	683.857

	Inches	Feet/Sec	GPM
Daily Avg:	10.264	1.126	675.011
Daily Min:	7.037	0.551	191.3
Daily Max:	13.26	1.574	1217.35
Peak to Avg:			1.80

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/16/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Sunday - A.M. 7/16/2023

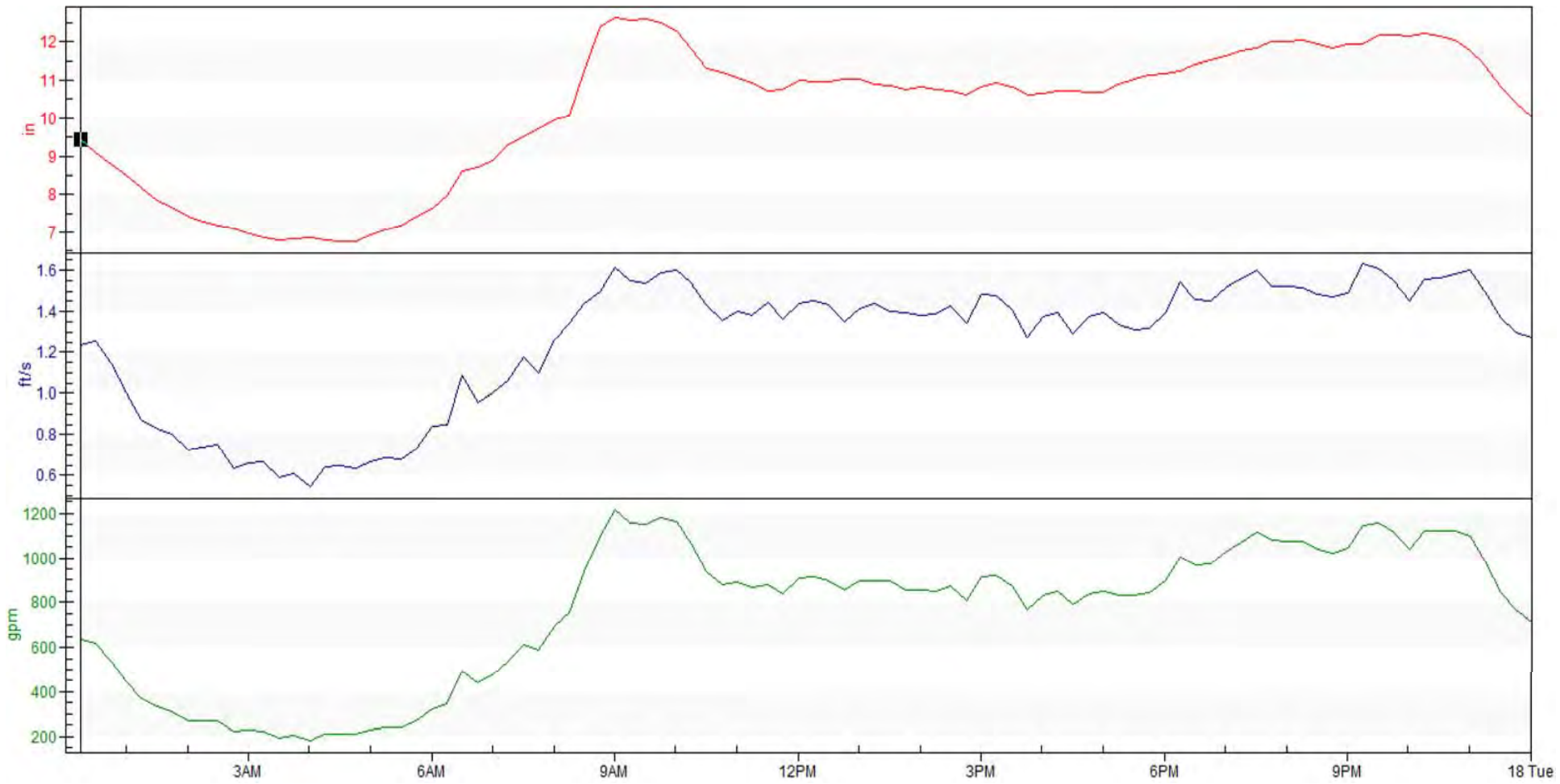
Time	Level	Velocity	Flow
12:00:00 AM	9.81	1.276	691.965
12:15:00 AM	9.515	1.217	633.262
12:30:00 AM	9.363	1.07	544.875
12:45:00 AM	9.07	1.156	563.942
1:00:00 AM	8.862	1.03	487
1:15:00 AM	8.634	1.039	474.455
1:30:00 AM	8.424	0.994	438.731
1:45:00 AM	8.229	0.922	394.253
2:00:00 AM	7.964	0.921	376.634
2:15:00 AM	7.701	0.842	328.923
2:30:00 AM	7.576	0.789	301.25
2:45:00 AM	7.463	0.79	295.325
3:00:00 AM	7.359	0.757	277.625
3:15:00 AM	7.126	0.687	240.841
3:30:00 AM	6.997	0.626	214.11
3:45:00 AM	6.922	0.61	205.374
4:00:00 AM	6.901	0.63	211.406
4:15:00 AM	6.849	0.691	229.383
4:30:00 AM	6.818	0.629	207.535
4:45:00 AM	6.734	0.637	206.42
5:00:00 AM	6.709	0.61	196.573
5:15:00 AM	6.676	0.584	186.873
5:30:00 AM	6.633	0.595	188.976
5:45:00 AM	6.67	0.6	191.782
6:00:00 AM	6.714	0.591	190.608
6:15:00 AM	6.861	0.66	219.683
6:30:00 AM	7.071	0.727	252.144
6:45:00 AM	7.348	0.744	272.144
7:00:00 AM	7.47	0.777	290.805
7:15:00 AM	7.739	0.892	350.454
7:30:00 AM	8.042	0.956	396.271
7:45:00 AM	8.485	0.977	435.573
8:00:00 AM	8.973	1.136	546.545
8:15:00 AM	9.113	1.077	529.101
8:30:00 AM	9.654	1.207	640.408
8:45:00 AM	9.962	1.132	626.209
9:00:00 AM	10.424	1.23	722.475
9:15:00 AM	10.652	1.294	782.042
9:30:00 AM	11.268	1.448	941.771
9:45:00 AM	11.672	1.441	980.554
10:00:00 AM	11.627	1.299	879.749
10:15:00 AM	11.884	1.433	997.991
10:30:00 AM	11.82	1.531	1058.55
10:45:00 AM	12.022	1.665	1176.75
11:00:00 AM	11.893	1.531	1067.23
11:15:00 AM	12.04	1.474	1043.51
11:30:00 AM	12.187	1.544	1110.31
11:45:00 AM	12.16	1.65	1183.12

Sunday - P.M. 7/16/2023

Time	Level	Velocity	Flow
12:00:00 PM	12.008	1.523	1074.47
12:15:00 PM	11.974	1.451	1020.29
12:30:00 PM	12.104	1.451	1034.12
12:45:00 PM	11.99	1.454	1023.71
1:00:00 PM	11.887	1.54	1072.75
1:15:00 PM	11.963	1.493	1048.35
1:30:00 PM	11.813	1.577	1090.01
1:45:00 PM	11.388	1.551	1022.35
2:00:00 PM	11.253	1.331	863.758
2:15:00 PM	11.07	1.374	873.175
2:30:00 PM	11.154	1.438	923.174
2:45:00 PM	11.098	1.474	939.749
3:00:00 PM	11.05	1.433	908.601
3:15:00 PM	10.835	1.319	815.096
3:30:00 PM	10.805	1.363	839.17
3:45:00 PM	10.862	1.475	914.533
4:00:00 PM	10.833	1.239	765.348
4:15:00 PM	10.723	1.429	871.442
4:30:00 PM	10.596	1.42	852.042
4:45:00 PM	10.479	1.366	807.736
5:00:00 PM	10.53	1.308	778.74
5:15:00 PM	10.714	1.311	798.491
5:30:00 PM	10.649	1.36	821.377
5:45:00 PM	10.6	1.346	808.064
6:00:00 PM	10.61	1.365	820.686
6:15:00 PM	10.614	1.399	841.504
6:30:00 PM	10.841	1.433	886.282
6:45:00 PM	10.817	1.339	826.008
7:00:00 PM	10.7	1.406	855.022
7:15:00 PM	10.845	1.321	817.283
7:30:00 PM	10.768	1.389	851.708
7:45:00 PM	10.685	1.304	791.287
8:00:00 PM	10.814	1.347	830.575
8:15:00 PM	11.046	1.387	879.167
8:30:00 PM	11.089	1.454	926.159
8:45:00 PM	11.25	1.468	952.857
9:00:00 PM	11.336	1.491	976.998
9:15:00 PM	11.48	1.469	978.173
9:30:00 PM	11.586	1.544	1040.69
9:45:00 PM	11.541	1.631	1093.99
10:00:00 PM	11.804	1.531	1057.21
10:15:00 PM	11.805	1.466	1012.25
10:30:00 PM	11.685	1.527	1040.69
10:45:00 PM	11.47	1.513	1006.87
11:00:00 PM	11.27	1.475	959.474
11:15:00 PM	11.052	1.491	945.817
11:30:00 PM	10.637	1.261	760.639
11:45:00 PM	10.148	1.254	710.845

	Inches	Feet/Sec	GPM
Daily Avg:	9.964	1.212	714.929
Daily Min:	6.633	0.584	186.873
Daily Max:	12.187	1.665	1183.12
Peak to Avg:			1.65

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/17/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Monday - A.M. 7/17/2023

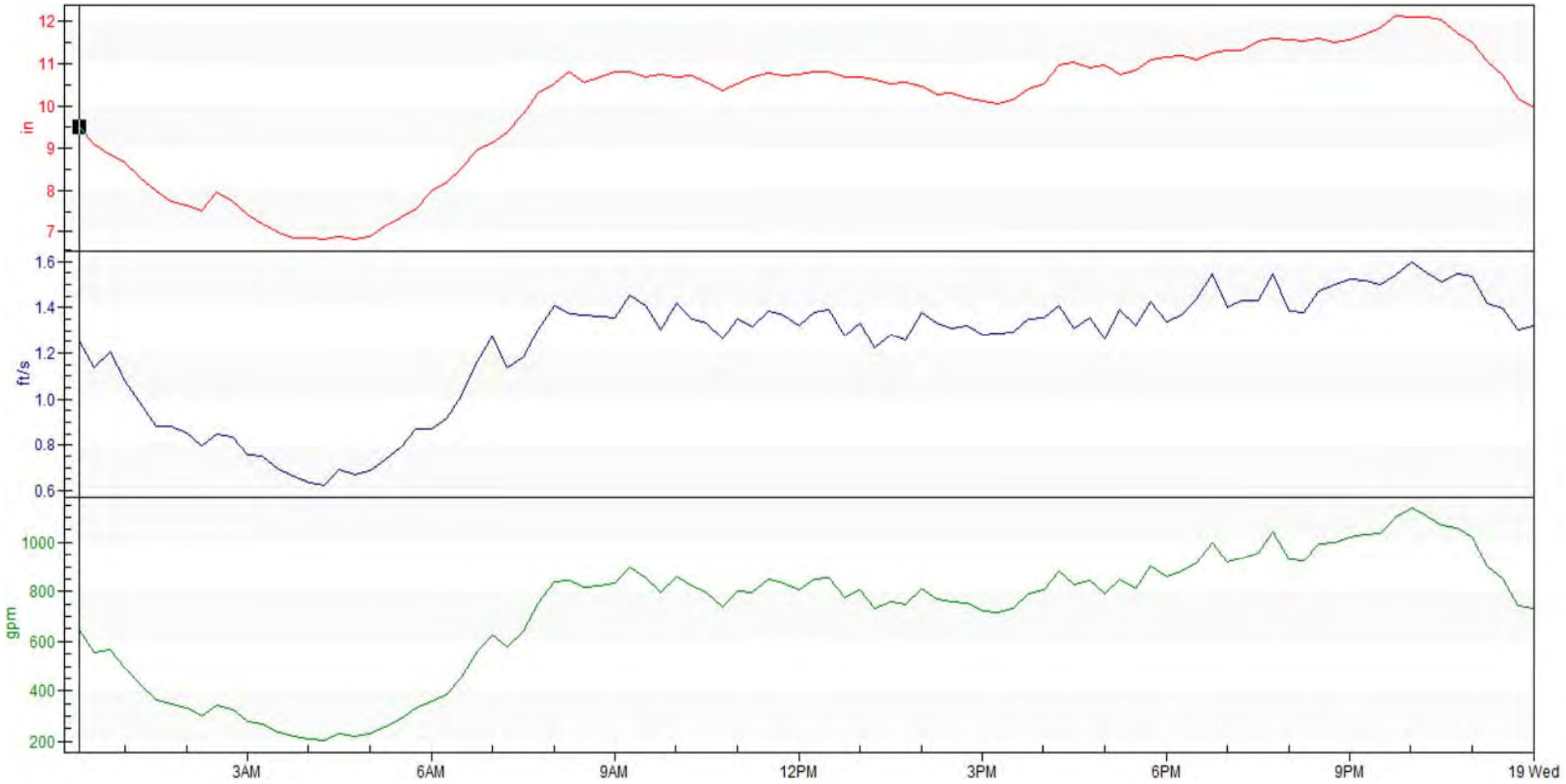
Time	Level	Velocity	Velocity
12:10:00 AM	9.771	1.308	705.196
12:15:00 AM	9.452	1.231	635.24
12:30:00 AM	9.1	1.255	615.211
12:45:00 AM	8.763	1.146	533.939
1:00:00 AM	8.485	1.005	448.205
1:15:00 AM	8.185	0.872	370.232
1:30:00 AM	7.849	0.828	332.022
1:45:00 AM	7.654	0.804	311.181
2:00:00 AM	7.411	0.728	269.439
2:15:00 AM	7.268	0.738	265.822
2:30:00 AM	7.186	0.754	267.496
2:45:00 AM	7.109	0.637	222.554
3:00:00 AM	6.952	0.663	224.51
3:15:00 AM	6.867	0.665	221.508
3:30:00 AM	6.774	0.59	192.874
3:45:00 AM	6.819	0.61	201.16
4:00:00 AM	6.863	0.544	181.182
4:15:00 AM	6.796	0.642	210.752
4:30:00 AM	6.75	0.645	209.737
4:45:00 AM	6.763	0.635	207.075
5:00:00 AM	6.943	0.668	225.778
5:15:00 AM	7.053	0.686	237.071
5:30:00 AM	7.18	0.682	241.826
5:45:00 AM	7.407	0.731	270.309
6:00:00 AM	7.623	0.843	324.486
6:15:00 AM	7.956	0.846	345.437
6:30:00 AM	8.599	1.086	492.968
6:45:00 AM	8.695	0.957	441.147
7:00:00 AM	8.863	1.003	474.487
7:15:00 AM	9.281	1.061	534.09
7:30:00 AM	9.513	1.177	612.489
7:45:00 AM	9.709	1.097	586.739
8:00:00 AM	9.951	1.263	697.799
8:15:00 AM	10.078	1.344	755.241
8:30:00 AM	11.244	1.442	935.265
8:45:00 AM	12.389	1.497	1098.9
9:00:00 AM	12.645	1.613	1215.03
9:15:00 AM	12.557	1.548	1156.03
9:30:00 AM	12.597	1.535	1151.03
9:45:00 AM	12.491	1.589	1178.71
10:00:00 AM	12.305	1.599	1163.97
10:15:00 AM	11.818	1.535	1061.39
10:30:00 AM	11.309	1.433	936.502
10:45:00 AM	11.215	1.356	876.246
11:00:00 AM	11.081	1.403	892.879
11:15:00 AM	10.925	1.385	865.378
11:30:00 AM	10.726	1.445	881.459
11:45:00 AM	10.777	1.366	837.986

Monday - P.M. 7/17/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.006	1.44	908.036
12:15:00 PM	10.976	1.456	915.291
12:30:00 PM	10.968	1.431	898.637
12:45:00 PM	11.036	1.352	855.874
1:00:00 PM	11.04	1.414	895.615
1:15:00 PM	10.893	1.44	896.463
1:30:00 PM	10.881	1.4	895.101
1:45:00 PM	10.756	1.397	855.138
2:00:00 PM	10.829	1.384	854.542
2:15:00 PM	10.749	1.389	849.642
2:30:00 PM	10.717	1.429	870.34
2:45:00 PM	10.617	1.344	808.721
3:00:00 PM	10.817	1.484	915.391
3:15:00 PM	10.92	1.476	921.319
3:30:00 PM	10.835	1.411	871.685
3:45:00 PM	10.634	1.27	765.925
4:00:00 PM	10.658	1.375	831.92
4:15:00 PM	10.734	1.394	851.254
4:30:00 PM	10.733	1.294	789.608
4:45:00 PM	10.7	1.377	837.047
5:00:00 PM	10.69	1.396	847.68
5:15:00 PM	10.886	1.334	829.641
5:30:00 PM	11.034	1.313	830.859
5:45:00 PM	11.143	1.32	845.926
6:00:00 PM	11.168	1.395	896.626
6:15:00 PM	11.248	1.546	1002.92
6:30:00 PM	11.422	1.461	966.545
6:45:00 PM	11.532	1.456	975.425
7:00:00 PM	11.639	1.517	1028.27
7:15:00 PM	11.765	1.556	1069.52
7:30:00 PM	11.848	1.604	1112.88
7:45:00 PM	12.026	1.524	1077.56
8:00:00 PM	12.007	1.522	1074.02
8:15:00 PM	12.045	1.517	1074.93
8:30:00 PM	11.959	1.483	1041.17
8:45:00 PM	11.851	1.474	1023.09
9:00:00 PM	11.936	1.49	1043.1
9:15:00 PM	11.947	1.634	1145.44
9:30:00 PM	12.189	1.605	1154.36
9:45:00 PM	12.198	1.548	1114.48
10:00:00 PM	12.143	1.454	1041
10:15:00 PM	12.221	1.557	1123.67
10:30:00 PM	12.147	1.564	1119.54
10:45:00 PM	12.043	1.584	1121.99
11:00:00 PM	11.774	1.598	1099.71
11:15:00 PM	11.391	1.498	987.839
11:30:00 PM	10.814	1.368	843.039
11:45:00 PM	10.419	1.301	763.901

	Inches	Feet/Sec	GPM
Daily Avg:	10.189	1.250	757.405
Daily Min:	6.75	0.544	181.182
Daily Max:	12.645	1.634	1215.03
Peak to Avg:			1.60

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/18/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Tuesday- A.M. 7/18/2023

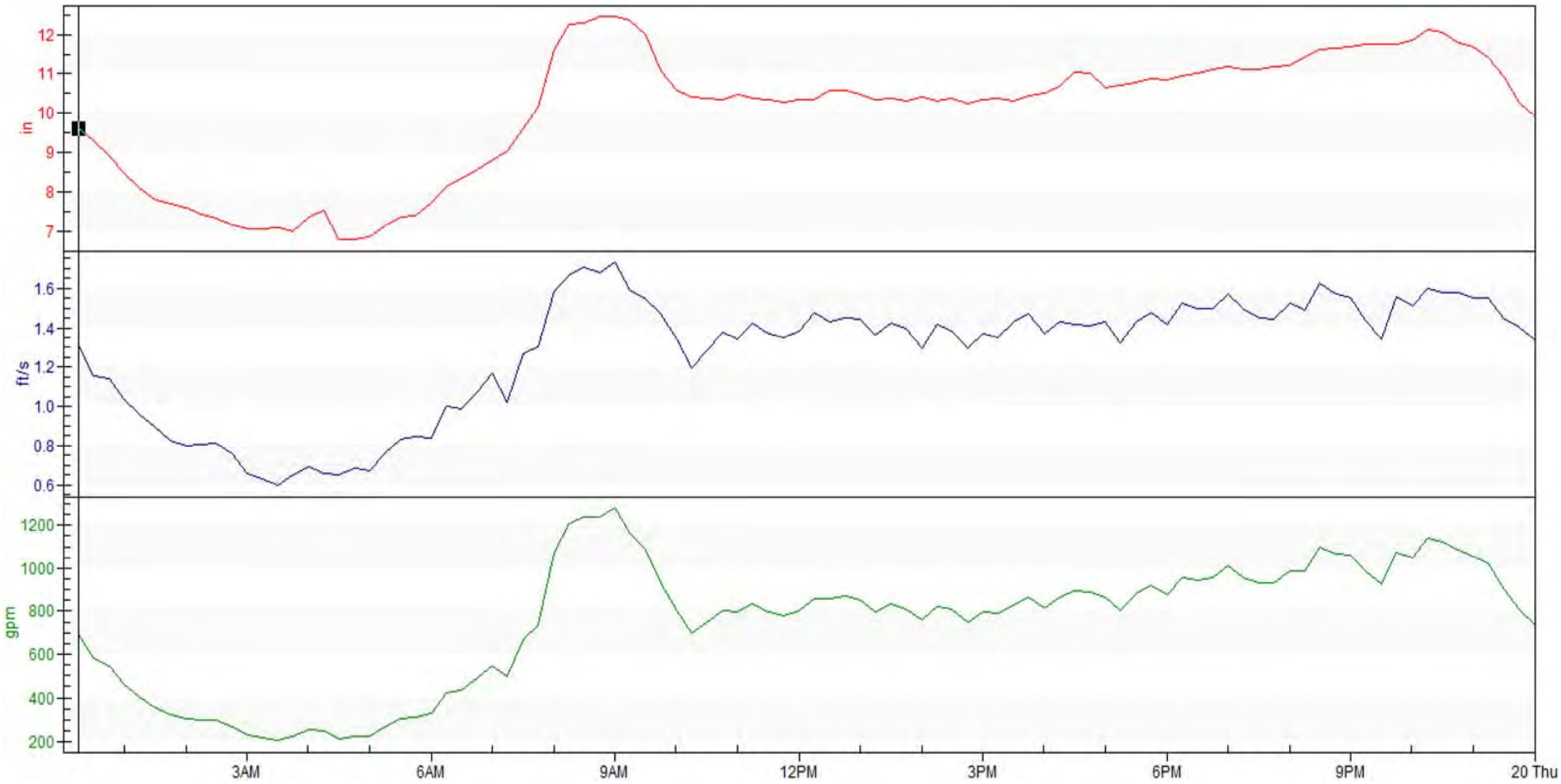
Time	Level	Velocity	Flow
12:00:00 AM	10.037	1.273	711.46
12:15:00 AM	9.495	1.25	648.805
12:30:00 AM	9.077	1.136	555.196
12:45:00 AM	8.838	1.204	567.463
1:00:00 AM	8.63	1.079	492.161
1:15:00 AM	8.313	0.985	427.098
1:30:00 AM	7.976	0.884	362.257
1:45:00 AM	7.736	0.883	346.817
2:00:00 AM	7.635	0.856	330.101
2:15:00 AM	7.529	0.793	300.091
2:30:00 AM	7.944	0.847	345.111
2:45:00 AM	7.746	0.836	329.231
3:00:00 AM	7.43	0.753	279.898
3:15:00 AM	7.201	0.752	267.566
3:30:00 AM	6.97	0.694	235.977
3:45:00 AM	6.869	0.665	221.453
4:00:00 AM	6.846	0.635	210.646
4:15:00 AM	6.827	0.622	205.615
4:30:00 AM	6.879	0.69	230.277
4:45:00 AM	6.826	0.669	221.084
5:00:00 AM	6.905	0.688	231.042
5:15:00 AM	7.146	0.732	257.857
5:30:00 AM	7.352	0.793	290.353
5:45:00 AM	7.532	0.871	329.851
6:00:00 AM	7.984	0.873	358.141
6:15:00 AM	8.165	0.917	387.857
6:30:00 AM	8.528	1.017	456.743
6:45:00 AM	8.97	1.167	561.12
7:00:00 AM	9.124	1.276	627.523
7:15:00 AM	9.366	1.134	577.919
7:30:00 AM	9.811	1.181	640.057
7:45:00 AM	10.303	1.302	753.259
8:00:00 AM	10.531	1.407	837.827
8:15:00 AM	10.789	1.374	844.462
8:30:00 AM	10.563	1.368	818.008
8:45:00 AM	10.663	1.358	822.022
9:00:00 AM	10.792	1.357	834.17
9:15:00 AM	10.8	1.456	896.2
9:30:00 AM	10.679	1.409	854.685
9:45:00 AM	10.732	1.303	795.104
10:00:00 AM	10.673	1.417	858.357
10:15:00 AM	10.714	1.35	822.203
10:30:00 AM	10.561	1.331	795.27
10:45:00 AM	10.356	1.263	735.384
11:00:00 AM	10.518	1.349	801.797
11:15:00 AM	10.677	1.314	796.336
11:30:00 AM	10.767	1.386	849.816
11:45:00 AM	10.71	1.367	831.931

Tuesday- P.M. 7/18/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.741	1.32	806.237
12:15:00 PM	10.812	1.377	848.811
12:30:00 PM	10.792	1.388	853.498
12:45:00 PM	10.687	1.274	773.569
1:00:00 PM	10.674	1.335	808.747
1:15:00 PM	10.615	1.221	734.753
1:30:00 PM	10.517	1.28	760.523
1:45:00 PM	10.555	1.255	749.558
2:00:00 PM	10.464	1.378	813.555
2:15:00 PM	10.272	1.335	769.268
2:30:00 PM	10.301	1.309	756.996
2:45:00 PM	10.185	1.319	751.376
3:00:00 PM	10.115	1.282	724.001
3:15:00 PM	10.045	1.285	718.67
3:30:00 PM	10.143	1.291	731.394
3:45:00 PM	10.397	1.35	790.23
4:00:00 PM	10.513	1.358	806.605
4:15:00 PM	10.957	1.409	883.513
4:30:00 PM	11.027	1.309	827.461
4:45:00 PM	10.88	1.358	843.678
5:00:00 PM	10.959	1.264	792.541
5:15:00 PM	10.724	1.39	847.52
5:30:00 PM	10.836	1.318	814.844
5:45:00 PM	11.071	1.423	904.539
6:00:00 PM	11.153	1.337	858.115
6:15:00 PM	11.182	1.365	879.131
6:30:00 PM	11.074	1.437	913.819
6:45:00 PM	11.229	1.546	1001.1
7:00:00 PM	11.311	1.402	916.463
7:15:00 PM	11.29	1.43	932.471
7:30:00 PM	11.507	1.428	953.963
7:45:00 PM	11.586	1.545	1041.17
8:00:00 PM	11.547	1.385	929.471
8:15:00 PM	11.532	1.377	922.243
8:30:00 PM	11.594	1.471	992.177
8:45:00 PM	11.499	1.5	1001.37
9:00:00 PM	11.541	1.522	1020.75
9:15:00 PM	11.685	1.517	1033.55
9:30:00 PM	11.83	1.499	1037.6
9:45:00 PM	12.117	1.539	1098.19
10:00:00 PM	12.083	1.598	1136.41
10:15:00 PM	12.09	1.55	1103.22
10:30:00 PM	12.03	1.51	1067.98
10:45:00 PM	11.713	1.546	1056.88
11:00:00 PM	11.493	1.532	1022.35
11:15:00 PM	11.062	1.418	900.547
11:30:00 PM	10.708	1.395	848.687
11:45:00 PM	10.178	1.306	743.522

	Inches	Feet/Sec	GPM
Daily Avg:	9.977	1.231	713.318
Daily Min:	6.826	0.622	205.615
Daily Max:	12.117	1.598	1136.41
Peak to Avg:			1.59

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/19/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Wednesday - A.M. 7/19/2023

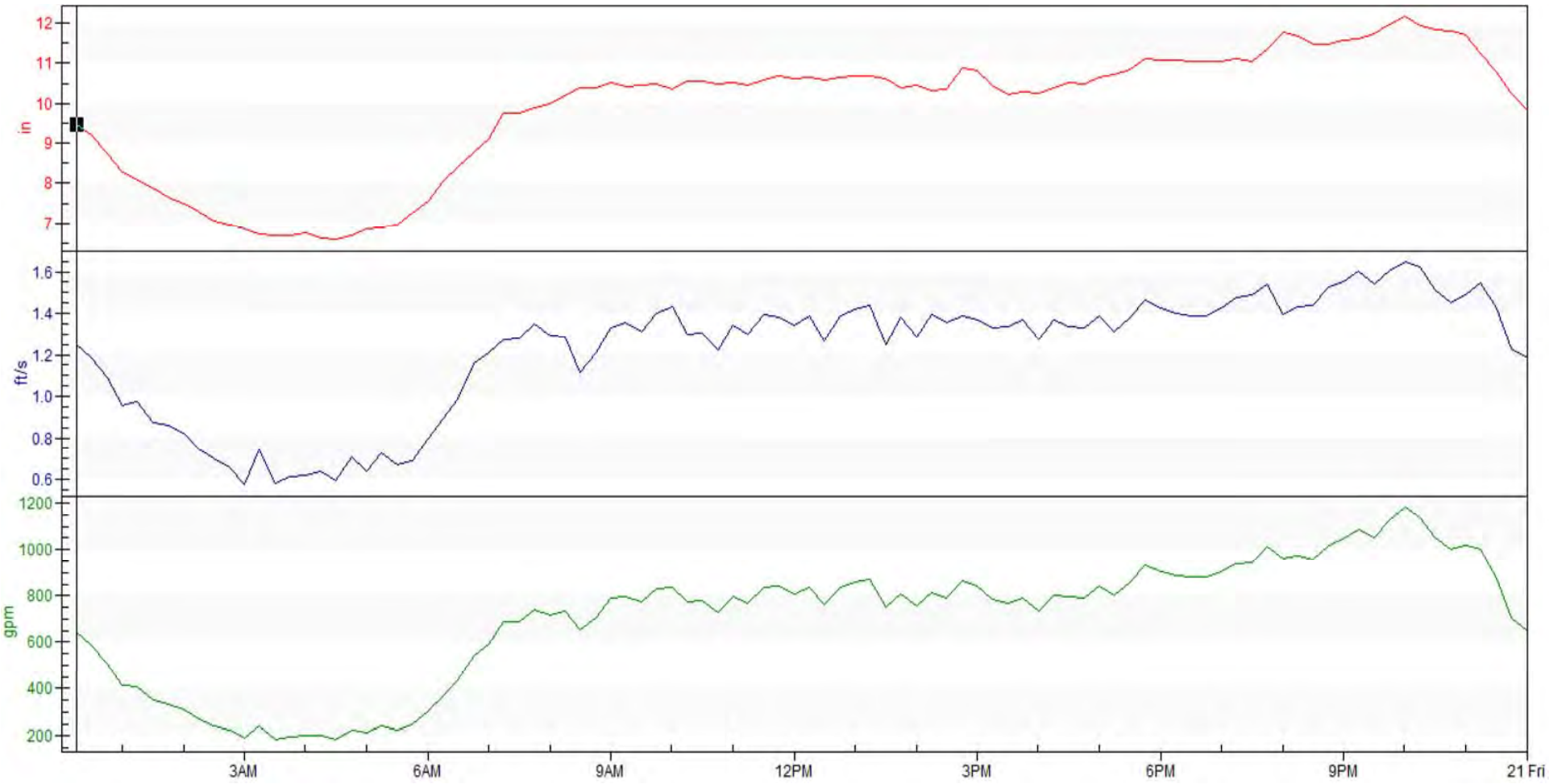
Time	Level	Velocity	Flow
12:00:00 AM	9.944	1.322	729.971
12:15:00 AM	9.614	1.31	691.362
12:30:00 AM	9.313	1.155	584.016
12:45:00 AM	8.897	1.141	542.538
1:00:00 AM	8.465	1.035	460.082
1:15:00 AM	8.088	0.959	400.412
1:30:00 AM	7.813	0.894	356.295
1:45:00 AM	7.692	0.828	322.7
2:00:00 AM	7.594	0.796	305.069
2:15:00 AM	7.435	0.807	300
2:30:00 AM	7.326	0.815	297.072
2:45:00 AM	7.164	0.756	267.184
3:00:00 AM	7.079	0.661	229.584
3:15:00 AM	7.053	0.632	218.567
3:30:00 AM	7.093	0.597	207.994
3:45:00 AM	7.014	0.65	223.136
4:00:00 AM	7.382	0.691	254.432
4:15:00 AM	7.525	0.66	249.517
4:30:00 AM	6.806	0.649	213.508
4:45:00 AM	6.797	0.685	224.995
5:00:00 AM	6.869	0.674	224.708
5:15:00 AM	7.12	0.76	266.213
5:30:00 AM	7.364	0.829	304.462
5:45:00 AM	7.412	0.845	313.137
6:00:00 AM	7.738	0.837	329.117
6:15:00 AM	8.126	0.998	419.711
6:30:00 AM	8.343	0.99	431.436
6:45:00 AM	8.582	1.077	487.643
7:00:00 AM	8.812	1.165	546.99
7:15:00 AM	9.054	1.021	496.862
7:30:00 AM	9.594	1.269	667.707
7:45:00 AM	10.149	1.3	737.075
8:00:00 AM	11.615	1.586	1072.86
8:15:00 AM	12.241	1.667	1205.52
8:30:00 AM	12.294	1.706	1239.99
8:45:00 AM	12.455	1.68	1241.96
9:00:00 AM	12.453	1.733	1280.62
9:15:00 AM	12.364	1.593	1166.37
9:30:00 AM	11.985	1.545	1087.8
9:45:00 AM	11.067	1.471	934.395
10:00:00 AM	10.567	1.346	805.178
10:15:00 AM	10.421	1.193	700.725
10:30:00 AM	10.367	1.282	747.757
10:45:00 AM	10.358	1.374	800.559
11:00:00 AM	10.487	1.343	795.161
11:15:00 AM	10.39	1.426	834.036
11:30:00 AM	10.353	1.369	797.143
11:45:00 AM	10.289	1.348	778.242

Wednesday - P.M. 7/19/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.346	1.381	803.319
12:15:00 PM	10.349	1.477	859.462
12:30:00 PM	10.579	1.433	858.273
12:45:00 PM	10.569	1.452	868.304
1:00:00 PM	10.488	1.441	853.609
1:15:00 PM	10.355	1.364	794.528
1:30:00 PM	10.37	1.424	831.041
1:45:00 PM	10.321	1.394	808.086
2:00:00 PM	10.423	1.297	761.861
2:15:00 PM	10.323	1.416	821.307
2:30:00 PM	10.371	1.383	806.834
2:45:00 PM	10.245	1.297	745.015
3:00:00 PM	10.355	1.367	796.271
3:15:00 PM	10.374	1.353	789.586
3:30:00 PM	10.327	1.428	828.535
3:45:00 PM	10.449	1.471	867.165
4:00:00 PM	10.506	1.372	814.146
4:15:00 PM	10.668	1.43	866.015
4:30:00 PM	11.044	1.416	896.941
4:45:00 PM	11.025	1.408	889.796
5:00:00 PM	10.642	1.433	865.266
5:15:00 PM	10.709	1.324	805.726
5:30:00 PM	10.794	1.433	881.053
5:45:00 PM	10.895	1.48	921.34
6:00:00 PM	10.848	1.419	878.622
6:15:00 PM	10.961	1.527	958.169
6:30:00 PM	11.015	1.499	946.294
6:45:00 PM	11.103	1.495	953.694
7:00:00 PM	11.19	1.573	1014.12
7:15:00 PM	11.125	1.498	958.122
7:30:00 PM	11.13	1.452	928.931
7:45:00 PM	11.194	1.444	930.903
8:00:00 PM	11.231	1.522	985.587
8:15:00 PM	11.406	1.494	986.764
8:30:00 PM	11.622	1.624	1098.97
8:45:00 PM	11.666	1.57	1067.49
9:00:00 PM	11.692	1.552	1058.17
9:15:00 PM	11.765	1.434	986.048
9:30:00 PM	11.761	1.345	924.296
9:45:00 PM	11.745	1.561	1070.47
10:00:00 PM	11.855	1.513	1050.62
10:15:00 PM	12.12	1.597	1140.02
10:30:00 PM	12.056	1.578	1119.2
10:45:00 PM	11.783	1.579	1087.85
11:00:00 PM	11.697	1.548	1056.44
11:15:00 PM	11.423	1.55	1026.15
11:30:00 PM	10.907	1.447	901.772
11:45:00 PM	10.293	1.404	811.044

	Inches	Feet/Sec	GPM
Daily Avg:	10.012	1.274	747.738
Daily Min:	6.797	0.597	207.994
Daily Max:	12.455	1.733	1280.62
Peak to Avg:			1.71

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/20/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Thursday - A.M. 7/20/2023

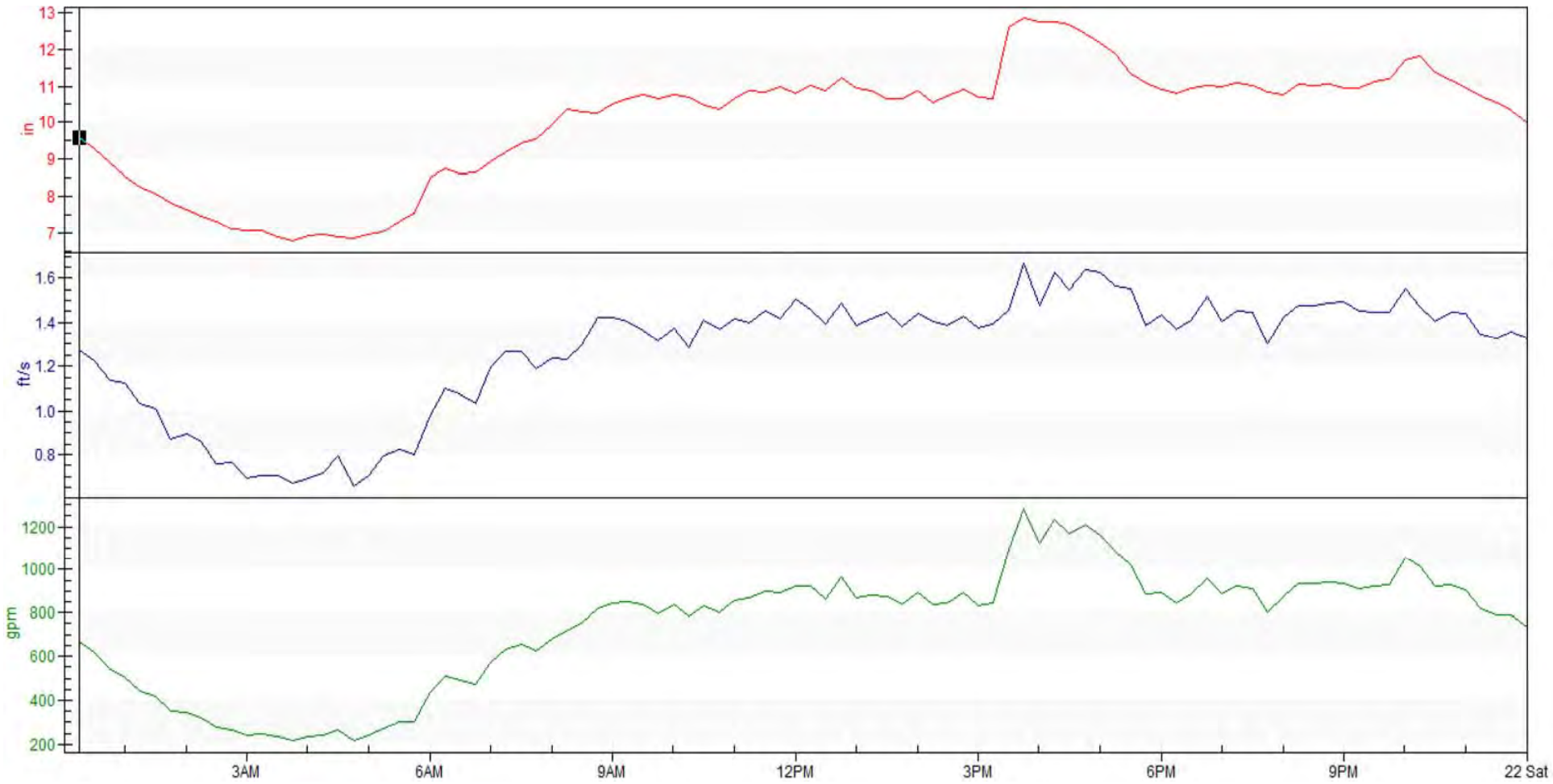
Time	Level	Velocity	Flow
12:00:00 AM	9.919	1.337	735.392
12:15:00 AM	9.475	1.245	644.558
12:30:00 AM	9.196	1.181	587.263
12:45:00 AM	8.753	1.086	505.275
1:00:00 AM	8.276	0.956	412.061
1:15:00 AM	8.067	0.976	406.289
1:30:00 AM	7.889	0.875	353.279
1:45:00 AM	7.642	0.858	331.628
2:00:00 AM	7.485	0.825	309.719
2:15:00 AM	7.28	0.748	270.304
2:30:00 AM	7.071	0.704	244.115
2:45:00 AM	6.952	0.658	223.069
3:00:00 AM	6.869	0.574	191.425
3:15:00 AM	6.725	0.748	241.846
3:30:00 AM	6.688	0.581	186.522
3:45:00 AM	6.701	0.61	196.363
4:00:00 AM	6.755	0.616	200.594
4:15:00 AM	6.631	0.636	201.742
4:30:00 AM	6.595	0.596	187.633
4:45:00 AM	6.707	0.705	227.39
5:00:00 AM	6.845	0.638	211.604
5:15:00 AM	6.909	0.728	244.727
5:30:00 AM	6.975	0.67	227.912
5:45:00 AM	7.265	0.691	248.891
6:00:00 AM	7.548	0.798	302.989
6:15:00 AM	8.05	0.89	369.47
6:30:00 AM	8.408	0.986	434.151
6:45:00 AM	8.757	1.159	539.248
7:00:00 AM	9.098	1.207	591.362
7:15:00 AM	9.771	1.276	688.16
7:30:00 AM	9.768	1.279	689.266
7:45:00 AM	9.908	1.348	740.731
8:00:00 AM	10.001	1.29	717.576
8:15:00 AM	10.185	1.288	733.74
8:30:00 AM	10.398	1.115	653.046
8:45:00 AM	10.391	1.207	706.354
9:00:00 AM	10.515	1.332	791.453
9:15:00 AM	10.411	1.356	795.135
9:30:00 AM	10.445	1.313	773.184
9:45:00 AM	10.5	1.402	831.653
10:00:00 AM	10.362	1.433	835.239
10:15:00 AM	10.548	1.297	774.139
10:30:00 AM	10.542	1.306	778.369
10:45:00 AM	10.491	1.224	725.341
11:00:00 AM	10.516	1.343	798.065
11:15:00 AM	10.443	1.299	765.199
11:30:00 AM	10.591	1.396	837.127
11:45:00 AM	10.686	1.384	839.821

Thursday - P.M. 7/20/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.603	1.346	808.712
12:15:00 PM	10.637	1.385	835.68
12:30:00 PM	10.575	1.269	759.872
12:45:00 PM	10.645	1.386	836.873
1:00:00 PM	10.675	1.418	859.539
1:15:00 PM	10.669	1.438	870.816
1:30:00 PM	10.61	1.247	749.947
1:45:00 PM	10.386	1.378	805.594
2:00:00 PM	10.451	1.285	757.354
2:15:00 PM	10.33	1.396	810.291
2:30:00 PM	10.351	1.358	790.745
2:45:00 PM	10.89	1.388	863.379
3:00:00 PM	10.804	1.369	842.973
3:15:00 PM	10.464	1.332	786.31
3:30:00 PM	10.212	1.337	764.513
3:45:00 PM	10.272	1.368	788.451
4:00:00 PM	10.253	1.276	733.323
4:15:00 PM	10.402	1.369	802.076
4:30:00 PM	10.527	1.337	795.731
4:45:00 PM	10.479	1.333	788.818
5:00:00 PM	10.653	1.391	840.573
5:15:00 PM	10.728	1.31	799.241
5:30:00 PM	10.862	1.384	858.289
5:45:00 PM	11.103	1.467	935.606
6:00:00 PM	11.067	1.426	905.913
6:15:00 PM	11.062	1.398	887.669
6:30:00 PM	11.06	1.387	880.541
6:45:00 PM	11.061	1.388	880.973
7:00:00 PM	11.06	1.423	903.555
7:15:00 PM	11.096	1.474	939.497
7:30:00 PM	11.051	1.489	944.137
7:45:00 PM	11.337	1.541	1010.32
8:00:00 PM	11.76	1.395	958.839
8:15:00 PM	11.673	1.431	973.913
8:30:00 PM	11.488	1.437	958.209
8:45:00 PM	11.47	1.527	1015.92
9:00:00 PM	11.566	1.555	1045.92
9:15:00 PM	11.617	1.603	1084.04
9:30:00 PM	11.739	1.538	1054.47
9:45:00 PM	11.955	1.605	1126.2
10:00:00 PM	12.167	1.648	1182.56
10:15:00 PM	11.928	1.624	1136.42
10:30:00 PM	11.833	1.516	1049.77
10:45:00 PM	11.81	1.451	1002.58
11:00:00 PM	11.713	1.486	1015.95
11:15:00 PM	11.23	1.546	1001.01
11:30:00 PM	10.787	1.423	874.228
11:45:00 PM	10.253	1.229	706.22

	Inches	Feet/Sec	GPM
Daily Avg:	9.851	1.220	701.532
Daily Min:	6.595	0.574	186.522
Daily Max:	12.167	1.648	1182.56
Peak to Avg:			1.69

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/21/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Friday - A.M. 7/21/2023

Time	Level	Velocity	Flow
12:00:00 AM	9.832	1.187	645.357
12:15:00 AM	9.603	1.272	670.266
12:30:00 AM	9.317	1.224	619.334
12:45:00 AM	8.906	1.134	539.809
1:00:00 AM	8.537	1.123	504.798
1:15:00 AM	8.246	1.036	444.099
1:30:00 AM	8.081	1.01	421.145
1:45:00 AM	7.835	0.872	348.5
2:00:00 AM	7.663	0.893	346.382
2:15:00 AM	7.471	0.858	321.473
2:30:00 AM	7.332	0.757	276.181
2:45:00 AM	7.107	0.764	266.816
3:00:00 AM	7.094	0.694	241.82
3:15:00 AM	7.077	0.707	245.701
3:30:00 AM	6.885	0.703	234.889
3:45:00 AM	6.792	0.67	219.855
4:00:00 AM	6.923	0.69	232.527
4:15:00 AM	6.988	0.714	243.652
4:30:00 AM	6.905	0.795	266.891
4:45:00 AM	6.866	0.656	218.606
5:00:00 AM	6.967	0.706	240.045
5:15:00 AM	7.042	0.796	274.654
5:30:00 AM	7.329	0.822	299.859
5:45:00 AM	7.548	0.799	303.541
6:00:00 AM	8.51	0.977	437.347
6:15:00 AM	8.753	1.097	510.035
6:30:00 AM	8.626	1.076	490.73
6:45:00 AM	8.642	1.033	472.083
7:00:00 AM	8.947	1.194	572.06
7:15:00 AM	9.188	1.269	630.338
7:30:00 AM	9.446	1.267	652.878
7:45:00 AM	9.545	1.19	622.149
8:00:00 AM	9.958	1.234	682.476
8:15:00 AM	10.367	1.232	718.756
8:30:00 AM	10.299	1.298	750.568
8:45:00 AM	10.283	1.422	820.46
9:00:00 AM	10.535	1.422	847.282
9:15:00 AM	10.661	1.406	850.631
9:30:00 AM	10.785	1.364	837.578
9:45:00 AM	10.67	1.317	797.991
10:00:00 AM	10.755	1.374	840.685
10:15:00 AM	10.696	1.286	781.631
10:30:00 AM	10.481	1.411	834.799
10:45:00 AM	10.389	1.368	800.132
11:00:00 AM	10.645	1.414	853.929
11:15:00 AM	10.876	1.399	868.751
11:30:00 AM	10.834	1.454	898.454
11:45:00 AM	10.985	1.415	890.368

Friday - P.M. 7/21/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.796	1.504	924.843
12:15:00 PM	11.029	1.458	922.44
12:30:00 PM	10.862	1.392	862.825
12:45:00 PM	11.25	1.487	964.733
1:00:00 PM	10.932	1.386	866.52
1:15:00 PM	10.875	1.415	878.709
1:30:00 PM	10.657	1.444	873.208
1:45:00 PM	10.653	1.382	835.259
2:00:00 PM	10.888	1.441	895.912
2:15:00 PM	10.547	1.402	836.408
2:30:00 PM	10.718	1.386	844.8
2:45:00 PM	10.906	1.43	891.107
3:00:00 PM	10.682	1.373	833.11
3:15:00 PM	10.657	1.392	841.913
3:30:00 PM	12.607	1.459	1094.69
3:45:00 PM	12.847	1.668	1281.36
4:00:00 PM	12.747	1.479	1124.92
4:15:00 PM	12.729	1.628	1236.81
4:30:00 PM	12.652	1.547	1166.33
4:45:00 PM	12.418	1.64	1207.29
5:00:00 PM	12.151	1.623	1162.7
5:15:00 PM	11.861	1.564	1086.63
5:30:00 PM	11.351	1.553	1019.78
5:45:00 PM	11.099	1.387	884.428
6:00:00 PM	10.909	1.432	892.682
6:15:00 PM	10.804	1.368	842.296
6:30:00 PM	10.962	1.412	885.802
6:45:00 PM	11.025	1.521	961.485
7:00:00 PM	10.992	1.405	884.691
7:15:00 PM	11.098	1.452	925.947
7:30:00 PM	11.017	1.445	912.894
7:45:00 PM	10.839	1.301	804.514
8:00:00 PM	10.757	1.425	872.24
8:15:00 PM	11.039	1.479	936.333
8:30:00 PM	11.029	1.477	934.126
8:45:00 PM	11.047	1.486	941.674
9:00:00 PM	10.958	1.493	936.438
9:15:00 PM	10.93	1.453	908.427
9:30:00 PM	11.119	1.448	925.418
9:45:00 PM	11.193	1.444	930.694
10:00:00 PM	11.698	1.554	1060.31
10:15:00 PM	11.789	1.471	1013.78
10:30:00 PM	11.391	1.404	925.616
10:45:00 PM	11.158	1.448	929.657
11:00:00 PM	10.949	1.442	903.379
11:15:00 PM	10.744	1.343	820.917
11:30:00 PM	10.567	1.325	792.151
11:45:00 PM	10.342	1.357	789.027

	Inches	Feet/Sec	GPM
Daily Avg:	10.039	1.268	742.212
Daily Min:	6.792	0.656	218.606
Daily Max:	12.847	1.668	1281.36
Peak to Avg:			1.73

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/22/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Saturday - A.M. 7/22/2023

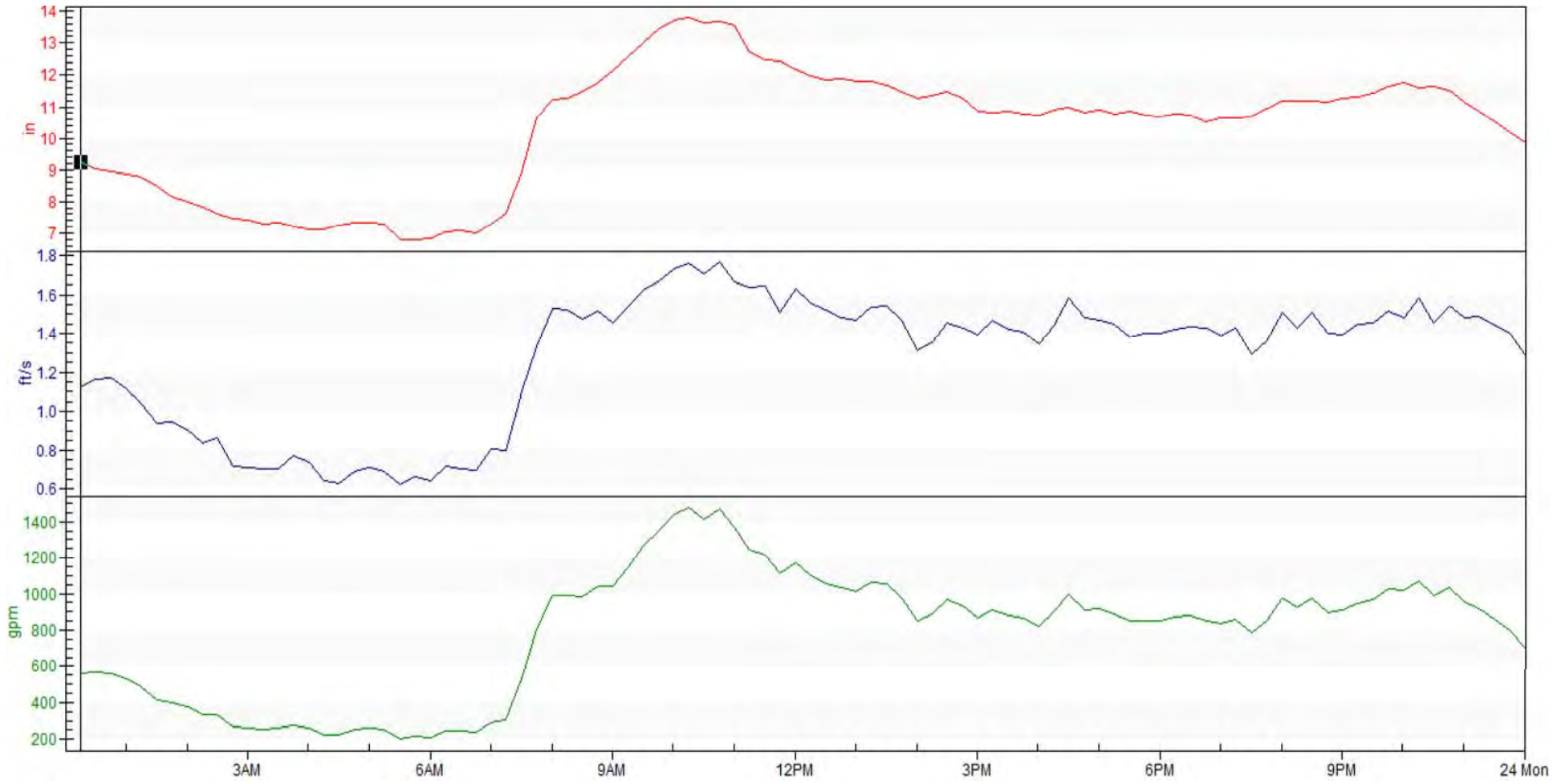
Time	Level	Velocity	Flow
12:00:00 AM	9.965	1.325	733.672
12:15:00 AM	9.684	1.187	632.678
12:30:00 AM	9.247	1.155	578.363
12:45:00 AM	9.023	1.086	526.421
1:00:00 AM	8.691	1.077	496.191
1:15:00 AM	8.388	0.988	433.887
1:30:00 AM	8.209	0.9	383.796
1:45:00 AM	7.981	0.89	365.088
2:00:00 AM	7.839	0.816	326.353
2:15:00 AM	7.557	0.875	333.014
2:30:00 AM	7.453	0.754	281.504
2:45:00 AM	7.324	0.78	284.21
3:00:00 AM	7.16	0.729	257.371
3:15:00 AM	7.017	0.672	230.855
3:30:00 AM	7.073	0.669	232.107
3:45:00 AM	7.15	0.762	268.445
4:00:00 AM	7.118	0.709	248.195
4:15:00 AM	6.94	0.644	217.807
4:30:00 AM	6.907	0.747	250.899
4:45:00 AM	6.852	0.662	219.961
5:00:00 AM	6.971	0.6	204.143
5:15:00 AM	6.997	0.729	249.099
5:30:00 AM	7.157	0.746	263.237
5:45:00 AM	7.264	0.676	243.525
6:00:00 AM	7.281	0.73	263.902
6:15:00 AM	7.686	0.903	351.477
6:30:00 AM	7.923	0.948	384.916
6:45:00 AM	7.872	0.93	374.236
7:00:00 AM	8.081	0.973	405.993
7:15:00 AM	8.402	0.896	394.358
7:30:00 AM	8.756	1.05	488.732
7:45:00 AM	8.896	1.072	509.644
8:00:00 AM	9.401	1.145	586.427
8:15:00 AM	9.649	1.178	624.579
8:30:00 AM	9.849	1.3	708.533
8:45:00 AM	10.338	1.453	844.429
9:00:00 AM	10.702	1.277	776.303
9:15:00 AM	10.867	1.379	855.533
9:30:00 AM	11.077	1.37	871.666
9:45:00 AM	11.217	1.432	926.059
10:00:00 AM	11.597	1.461	985.627
10:15:00 AM	12.098	1.504	1071.32
10:30:00 AM	12.124	1.534	1095.99
10:45:00 AM	11.848	1.441	999.727
11:00:00 AM	11.831	1.526	1056.61
11:15:00 AM	11.737	1.534	1051.6
11:30:00 AM	11.901	1.55	1081.3
11:45:00 AM	11.986	1.544	1086.76

Saturday - P.M. 7/22/2023

Time	Level	Velocity	Flow
12:00:00 PM	12.058	1.462	1037.15
12:15:00 PM	12.033	1.524	1077.92
12:30:00 PM	12.15	1.603	1148.01
12:45:00 PM	12.367	1.552	1137.04
1:00:00 PM	12.427	1.668	1229.58
1:15:00 PM	12.27	1.555	1127.63
1:30:00 PM	11.633	1.499	1015.67
1:45:00 PM	11.779	1.52	1046.68
2:00:00 PM	11.587	1.574	1061.08
2:15:00 PM	11.521	1.581	1058.11
2:30:00 PM	11.406	1.584	1046.22
2:45:00 PM	11.256	1.521	987.487
3:00:00 PM	11.204	1.381	891.218
3:15:00 PM	11.178	1.48	952.465
3:30:00 PM	10.978	1.422	893.762
3:45:00 PM	10.774	1.527	936.955
4:00:00 PM	11.078	1.482	942.935
4:15:00 PM	11.168	1.573	1010.89
4:30:00 PM	10.879	1.439	894.286
4:45:00 PM	10.576	1.362	815.383
5:00:00 PM	10.63	1.29	777.283
5:15:00 PM	10.801	1.389	855.063
5:30:00 PM	10.794	1.433	881.023
5:45:00 PM	10.705	1.406	855.533
6:00:00 PM	10.438	1.147	675.26
6:15:00 PM	10.628	1.459	879.218
6:30:00 PM	10.573	1.372	821.185
6:45:00 PM	10.644	1.381	833.994
7:00:00 PM	10.733	1.554	948.547
7:15:00 PM	10.926	1.468	917.207
7:30:00 PM	11.041	1.41	892.703
7:45:00 PM	10.802	1.352	832.318
8:00:00 PM	10.675	1.324	802.652
8:15:00 PM	10.608	1.393	837.617
8:30:00 PM	10.521	1.246	740.784
8:45:00 PM	10.326	1.442	836.345
9:00:00 PM	10.282	1.425	822.41
9:15:00 PM	10.259	1.393	801.182
9:30:00 PM	10.547	1.392	830.429
9:45:00 PM	10.391	1.323	773.915
10:00:00 PM	10.314	1.332	771.791
10:15:00 PM	10.336	1.377	799.976
10:30:00 PM	10.512	1.382	820.919
10:45:00 PM	10.647	1.428	862.32
11:00:00 PM	10.334	1.378	800.212
11:15:00 PM	10.273	1.354	780.097
11:30:00 PM	10.141	1.33	753.297
11:45:00 PM	9.854	1.332	726.579

	Inches	Feet/Sec	GPM
Daily Avg:	9.939	1.240	721.718
Daily Min:	6.852	0.6	204.143
Daily Max:	12.427	1.668	1229.58
Peak to Avg:			1.70

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/23/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Sunday - A.M. 7/23/2023

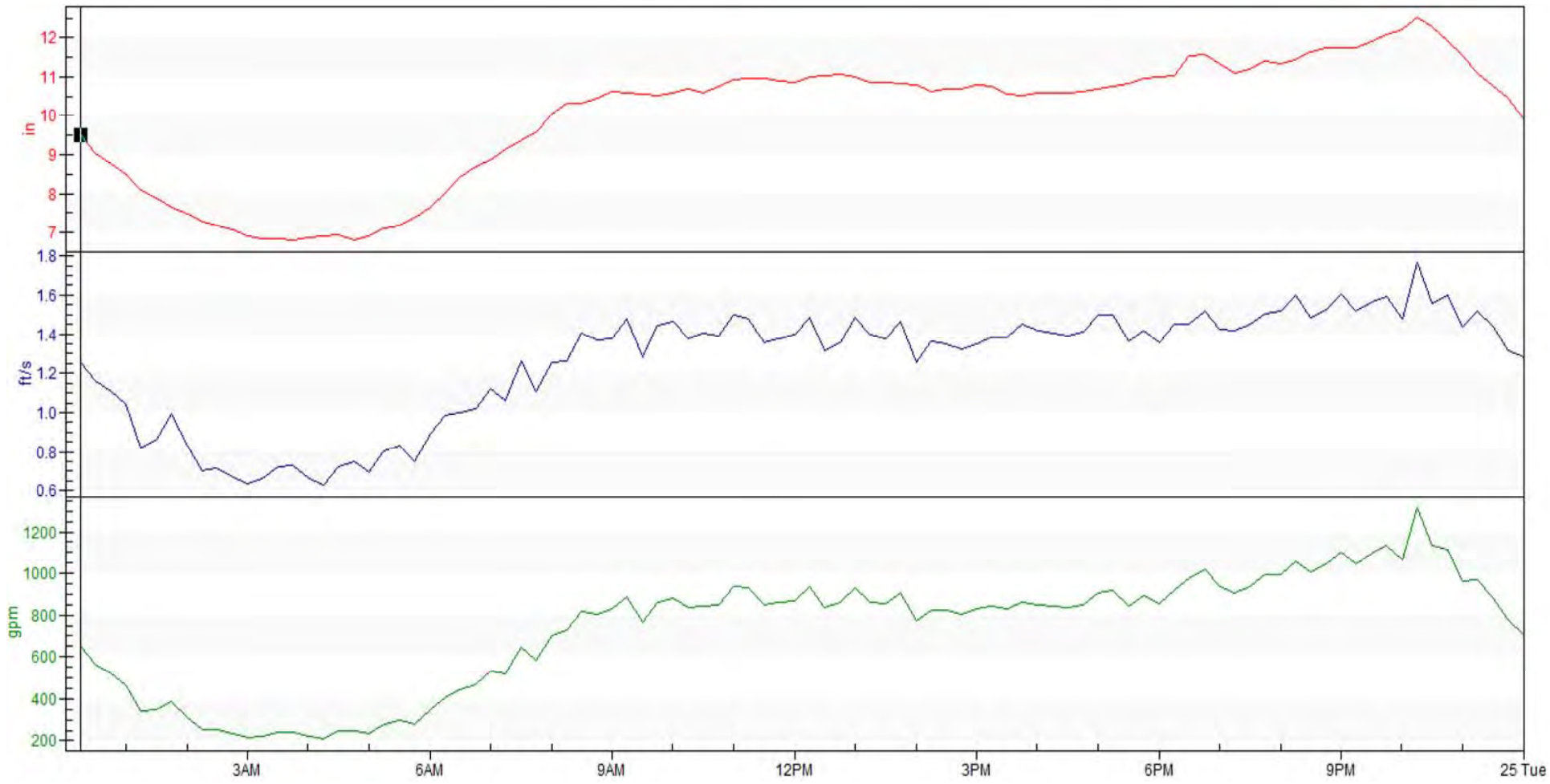
Time	Level	Velocity	Flow
12:00:00 AM	9.596	1.242	653.717
12:15:00 AM	9.226	1.12	559.117
12:30:00 AM	9.042	1.164	565.584
12:45:00 AM	8.957	1.168	560.554
1:00:00 AM	8.858	1.118	528.309
1:15:00 AM	8.778	1.04	485.82
1:30:00 AM	8.47	0.937	416.857
1:45:00 AM	8.169	0.947	401.033
2:00:00 AM	7.993	0.909	373.357
2:15:00 AM	7.822	0.841	335.317
2:30:00 AM	7.616	0.866	333.127
2:45:00 AM	7.464	0.717	267.953
3:00:00 AM	7.407	0.71	262.718
3:15:00 AM	7.305	0.706	256.158
3:30:00 AM	7.32	0.706	256.919
3:45:00 AM	7.212	0.767	273.498
4:00:00 AM	7.116	0.734	256.751
4:15:00 AM	7.139	0.638	224.325
4:30:00 AM	7.251	0.626	224.942
4:45:00 AM	7.322	0.686	249.807
5:00:00 AM	7.325	0.707	257.57
5:15:00 AM	7.305	0.69	250.272
5:30:00 AM	6.788	0.621	203.463
5:45:00 AM	6.796	0.66	216.861
6:00:00 AM	6.813	0.638	210.347
6:15:00 AM	7.04	0.714	246.075
6:30:00 AM	7.063	0.701	242.77
6:45:00 AM	6.994	0.696	237.689
7:00:00 AM	7.305	0.801	290.737
7:15:00 AM	7.635	0.794	306.45
7:30:00 AM	8.951	1.102	528.417
7:45:00 AM	10.655	1.331	804.697
8:00:00 AM	11.236	1.526	989.067
8:15:00 AM	11.279	1.525	993.044
8:30:00 AM	11.489	1.476	984.501
8:45:00 AM	11.759	1.513	1039.5
9:00:00 AM	12.125	1.458	1041.25
9:15:00 AM	12.549	1.536	1145.71
9:30:00 AM	13.017	1.622	1266.9
9:45:00 AM	13.419	1.665	1350.58
10:00:00 AM	13.729	1.733	1445.22
10:15:00 AM	13.802	1.759	1476.69
10:30:00 AM	13.636	1.706	1411.27
10:45:00 AM	13.691	1.767	1468.73
11:00:00 AM	13.532	1.666	1365.34
11:15:00 AM	12.736	1.64	1246.45
11:30:00 AM	12.484	1.642	1217.47
11:45:00 AM	12.445	1.507	1112.75

Sunday - P.M. 7/23/2023

Time	Level	Velocity	Flow
12:00:00 PM	12.187	1.633	1174.42
12:15:00 PM	11.979	1.56	1097.19
12:30:00 PM	11.841	1.524	1056.47
12:45:00 PM	11.911	1.484	1036.06
1:00:00 PM	11.811	1.467	1013.68
1:15:00 PM	11.795	1.538	1060.61
1:30:00 PM	11.693	1.545	1053.98
1:45:00 PM	11.483	1.468	978.09
2:00:00 PM	11.267	1.314	854.257
2:15:00 PM	11.344	1.353	887.703
2:30:00 PM	11.491	1.456	971.018
2:45:00 PM	11.283	1.429	931.17
3:00:00 PM	10.859	1.393	863.285
3:15:00 PM	10.813	1.471	906.404
3:30:00 PM	10.861	1.423	882.245
3:45:00 PM	10.768	1.409	863.703
4:00:00 PM	10.721	1.346	820.341
4:15:00 PM	10.907	1.443	899.417
4:30:00 PM	10.972	1.581	993.315
4:45:00 PM	10.822	1.479	912.873
5:00:00 PM	10.887	1.469	913.382
5:15:00 PM	10.778	1.45	889.797
5:30:00 PM	10.847	1.379	853.589
5:45:00 PM	10.719	1.398	851.636
6:00:00 PM	10.683	1.399	848.708
6:15:00 PM	10.778	1.424	874.141
6:30:00 PM	10.737	1.436	877.107
6:45:00 PM	10.526	1.425	847.696
7:00:00 PM	10.635	1.388	836.997
7:15:00 PM	10.633	1.427	860.427
7:30:00 PM	10.675	1.292	783.213
7:45:00 PM	10.919	1.357	847.435
8:00:00 PM	11.203	1.506	972.315
8:15:00 PM	11.177	1.431	920.791
8:30:00 PM	11.184	1.511	973.332
8:45:00 PM	11.158	1.399	898.088
9:00:00 PM	11.264	1.395	906.547
9:15:00 PM	11.316	1.446	945.336
9:30:00 PM	11.422	1.457	964.475
9:45:00 PM	11.66	1.514	1028.7
10:00:00 PM	11.762	1.48	1016.85
10:15:00 PM	11.607	1.582	1068.58
10:30:00 PM	11.663	1.454	988.41
10:45:00 PM	11.506	1.542	1029.91
11:00:00 PM	11.164	1.481	951.882
11:15:00 PM	10.835	1.487	919.076
11:30:00 PM	10.542	1.443	860.29
11:45:00 PM	10.2	1.404	801.557

	Inches	Feet/Sec	GPM
Daily Avg:	10.309	1.277	789.142
Daily Min:	6.788	0.621	203.463
Daily Max:	13.802	1.767	1476.69
Peak to Avg:			1.87

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/24/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 500 Acacia

Monday - A.M. 7/24/2023

Time	Level	Velocity	Velocity
12:10:00 AM	9.859	1.283	700.097
12:15:00 AM	9.503	1.254	651.536
12:30:00 AM	9.049	1.16	564.577
12:45:00 AM	8.776	1.11	518.026
1:00:00 AM	8.477	1.042	464.145
1:15:00 AM	8.102	0.818	342.601
1:30:00 AM	7.886	0.864	348.541
1:45:00 AM	7.658	0.99	383.465
2:00:00 AM	7.474	0.831	311.278
2:15:00 AM	7.286	0.704	254.769
2:30:00 AM	7.18	0.719	254.996
2:45:00 AM	7.078	0.673	233.731
3:00:00 AM	6.908	0.637	214.082
3:15:00 AM	6.844	0.661	219.194
3:30:00 AM	6.831	0.724	239.375
3:45:00 AM	6.796	0.731	240.017
4:00:00 AM	6.855	0.661	219.765
4:15:00 AM	6.887	0.629	210.293
4:30:00 AM	6.917	0.725	243.967
4:45:00 AM	6.811	0.75	246.928
5:00:00 AM	6.909	0.698	234.589
5:15:00 AM	7.094	0.807	281.142
5:30:00 AM	7.178	0.834	295.439
5:45:00 AM	7.389	0.75	276.598
6:00:00 AM	7.648	0.893	345.481
6:15:00 AM	8.011	0.987	406.988
6:30:00 AM	8.439	1.002	443.333
6:45:00 AM	8.694	1.021	470.657
7:00:00 AM	8.876	1.123	532.34
7:15:00 AM	9.132	1.06	521.917
7:30:00 AM	9.373	1.262	643.942
7:45:00 AM	9.588	1.109	582.908
8:00:00 AM	10.063	1.253	702.524
8:15:00 AM	10.308	1.262	730.3
8:30:00 AM	10.32	1.406	814.941
8:45:00 AM	10.45	1.367	806.004
9:00:00 AM	10.617	1.378	829.037
9:15:00 AM	10.593	1.48	888.299
9:30:00 AM	10.574	1.28	766.164
9:45:00 AM	10.535	1.443	859.593
10:00:00 AM	10.609	1.462	879.026
10:15:00 AM	10.694	1.374	834.504
10:30:00 AM	10.576	1.407	842.51
10:45:00 AM	10.751	1.392	851.57
11:00:00 AM	10.918	1.5	936.492
11:15:00 AM	10.97	1.479	928.597
11:30:00 AM	10.957	1.356	850.217
11:45:00 AM	10.903	1.38	859.509

Monday - P.M. 7/24/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.854	1.399	866.842
12:15:00 PM	10.985	1.487	935.426
12:30:00 PM	11.022	1.318	832.951
12:45:00 PM	11.063	1.354	859.649
1:00:00 PM	10.985	1.484	933.881
1:15:00 PM	10.854	1.394	863.601
1:30:00 PM	10.857	1.378	853.885
1:45:00 PM	10.825	1.462	902.505
2:00:00 PM	10.811	1.258	775.143
2:15:00 PM	10.636	1.364	822.542
2:30:00 PM	10.695	1.351	820.683
2:45:00 PM	10.696	1.322	803.417
3:00:00 PM	10.783	1.349	828.78
3:15:00 PM	10.75	1.381	844.945
3:30:00 PM	10.548	1.385	826.564
3:45:00 PM	10.523	1.452	863.456
4:00:00 PM	10.606	1.415	850.651
4:15:00 PM	10.586	1.405	842.338
4:30:00 PM	10.576	1.391	832.879
4:45:00 PM	10.633	1.412	851.539
5:00:00 PM	10.679	1.498	908.46
5:15:00 PM	10.774	1.496	917.924
5:30:00 PM	10.843	1.365	844.376
5:45:00 PM	10.975	1.419	891.802
6:00:00 PM	10.995	1.358	855.188
6:15:00 PM	11.047	1.45	918.725
6:30:00 PM	11.557	1.451	975.031
6:45:00 PM	11.57	1.52	1022.66
7:00:00 PM	11.331	1.427	934.677
7:15:00 PM	11.092	1.421	905.102
7:30:00 PM	11.194	1.454	937.705
7:45:00 PM	11.42	1.502	993.576
8:00:00 PM	11.324	1.516	992.213
8:15:00 PM	11.426	1.597	1057.47
8:30:00 PM	11.642	1.482	1005.19
8:45:00 PM	11.76	1.523	1046.05
9:00:00 PM	11.735	1.607	1100.82
9:15:00 PM	11.754	1.521	1044.13
9:30:00 PM	11.897	1.568	1093.49
9:45:00 PM	12.075	1.593	1132.29
10:00:00 PM	12.212	1.475	1063.54
10:15:00 PM	12.525	1.768	1315.86
10:30:00 PM	12.297	1.559	1133.94
10:45:00 PM	11.904	1.6	1116.89
11:00:00 PM	11.552	1.435	963.66
11:15:00 PM	11.113	1.516	968.06
11:30:00 PM	10.776	1.438	882.442
11:45:00 PM	10.473	1.318	779.079

	Inches	Feet/Sec	GPM
Daily Avg:	9.965	1.254	730.399
Daily Min:	6.796	0.629	210.293
Daily Max:	12.525	1.768	1315.86
Peak to Avg:			1.80

Sewer Line Flow Study Summary

Project: **City of Santa Paula - Sewer Flow Study**
Location: **500 Acacia, Santa Paula, CA**
Pipe Size: **24” VCP**
Time Period: **7/11/2023, 12:00 a.m. - 7/25/2023, 12:00 a.m.**

Level - Inches

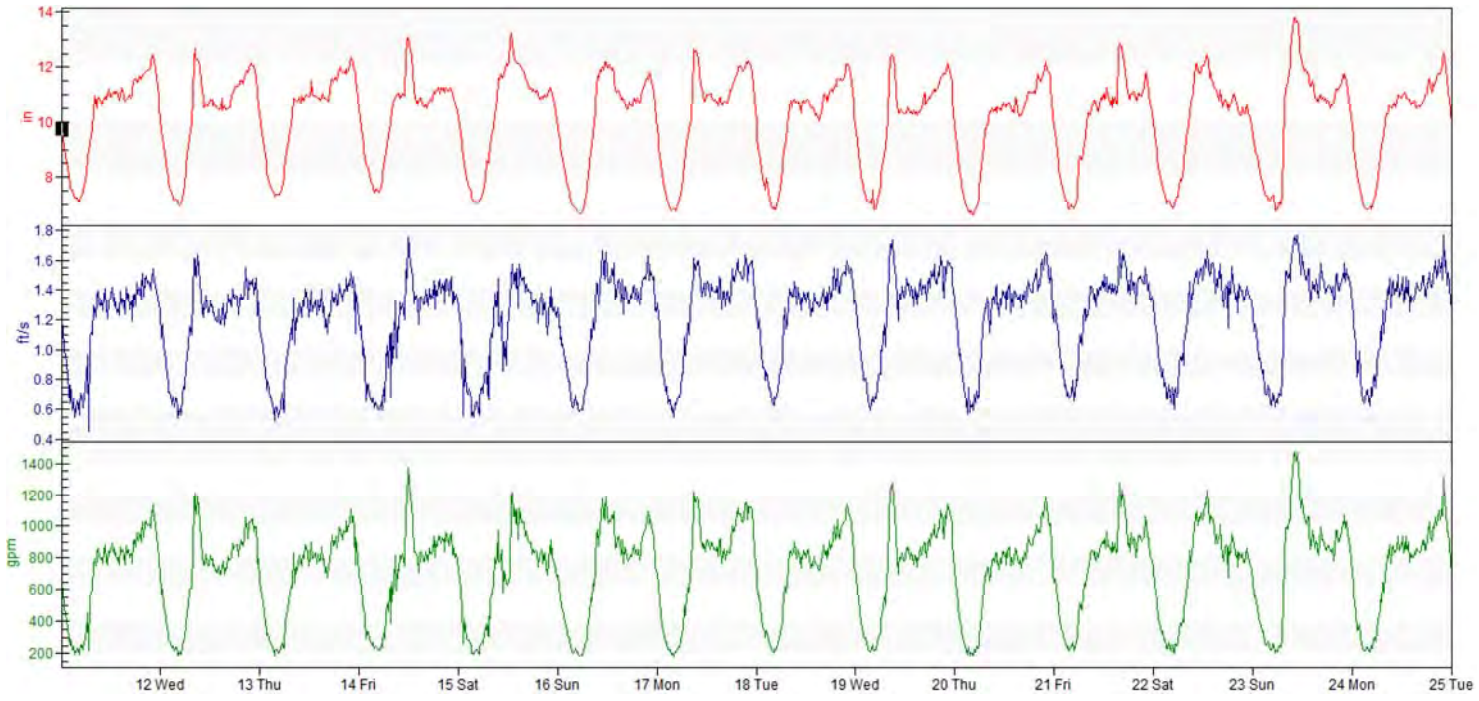
Average:	10.108
Maximum:	13.802
Minimum:	6.595
Max d/D:	57.5%

Velocity - Feet per Second

Average:	1.216
Maximum:	1.768
Minimum:	0.454

Flow Rate - Gallons Per Minute

Average:	721.560
Maximum::	1476.69
Minimum:	181.182
Peak to Average	1.70



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

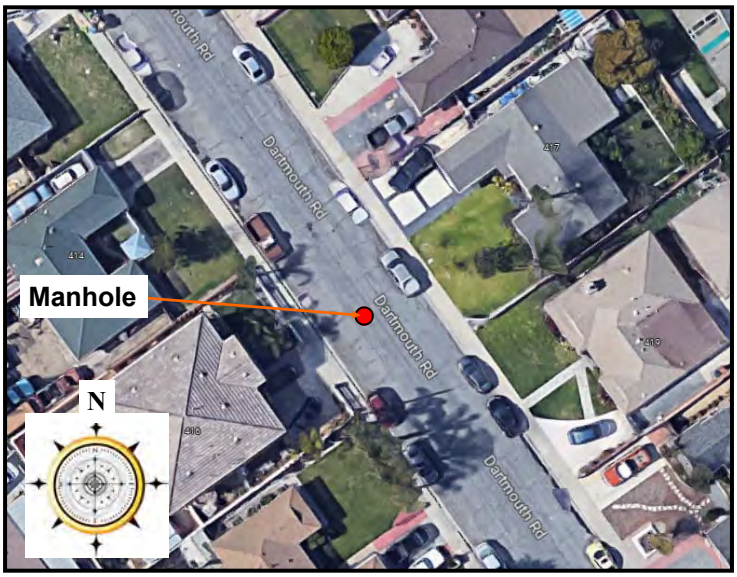
CITY OF SANTA PAULA - SEWER FLOW STUDY

MH Location: **416 Dartmouth**
Santa Paula, CA 93060

Pipe Size: **24" VCP**

Time Period: **7/11/2023 - 12:00 a.m. to**
7/25/2023- 12:00 a.m.

GPS: **34.348436, -119.065191**



Manhole - Layout



- This line has very low velocity possibly from a silt damn downstream.
- The line was cleaned prior to installation of the meter, but after 2.5 weeks of being installed silt was back inside of the channel and on our meter.

Equipment

Teledyne Isco 2150 Area Velocity Flow Meter with 10' measuring range:
Level Measurement:

- Method - Submerged pressure transducer mounted in the flow stream
- Transducer Type - Differential linear integrated circuit pressure transducer
- Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); Maximum Allowable Level 34 ft (10.5 m)
- Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,)
- Long-Term Stability ±0.023 ft/yr (±0.007 m/yr)
- Compensated Range 32° to 122°F (0° to 50°C)

Velocity Measurement:

- Method - Doppler ultrasonic, frequency 500 kHz
- Typical Minimum Depth 0.08 ft (25 mm)
- Range -5 to +20 ft/s (-1.5 to +6.1 m/s)
- Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from— 1.5 to +1.5 m/s)
- ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)

Method Of Insertion:

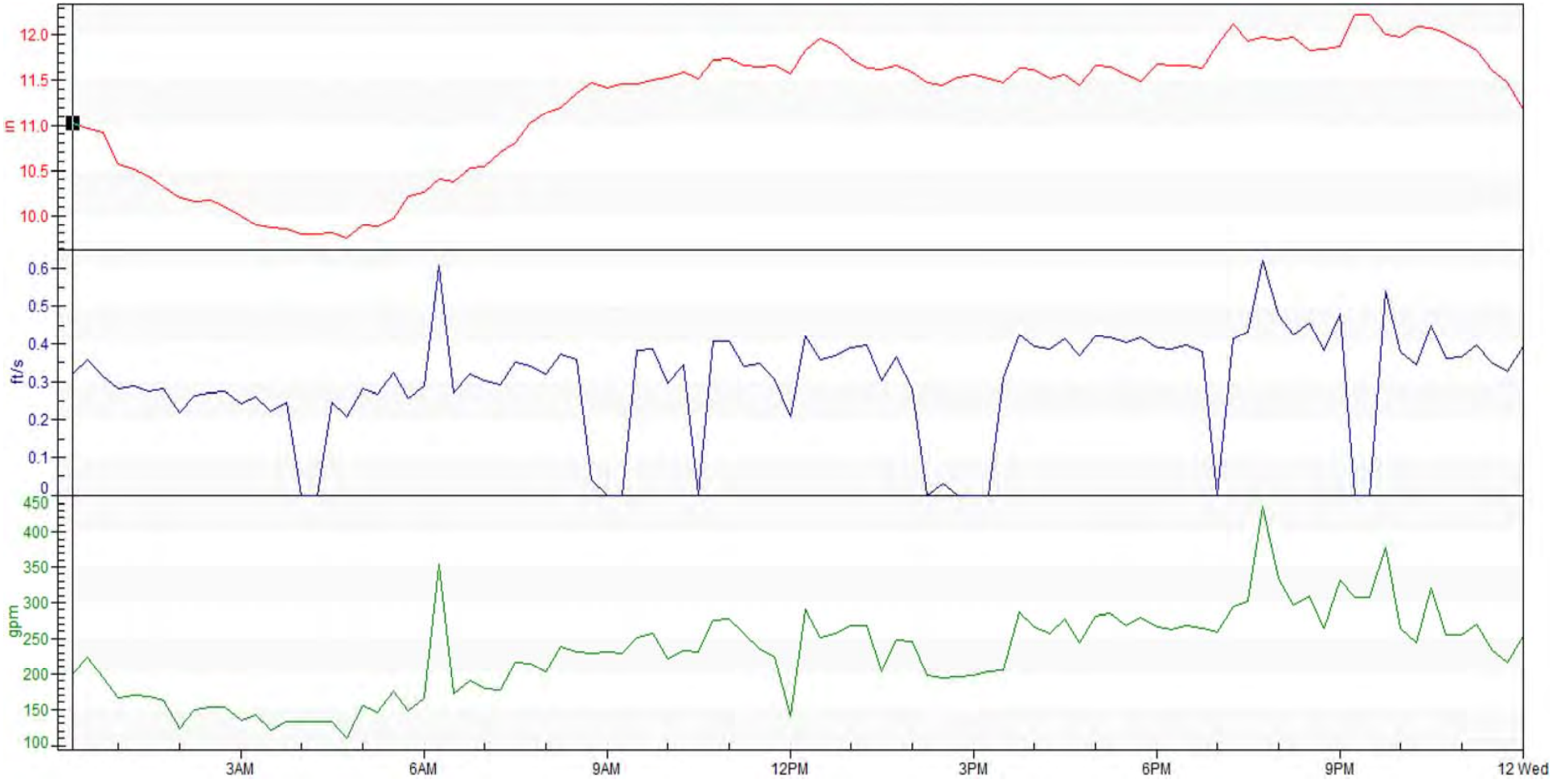
- 24 inch line requires Confined Space Entry.

Gold Coast Environmental

Specializing in process instrumentation and calibration.

1868 Palma Drive, Suite I, Ventura, CA 93003 www.goldcoastenv.com 805.498.3811 ph.

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/11/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Tuesday- A.M. 7/11/2023

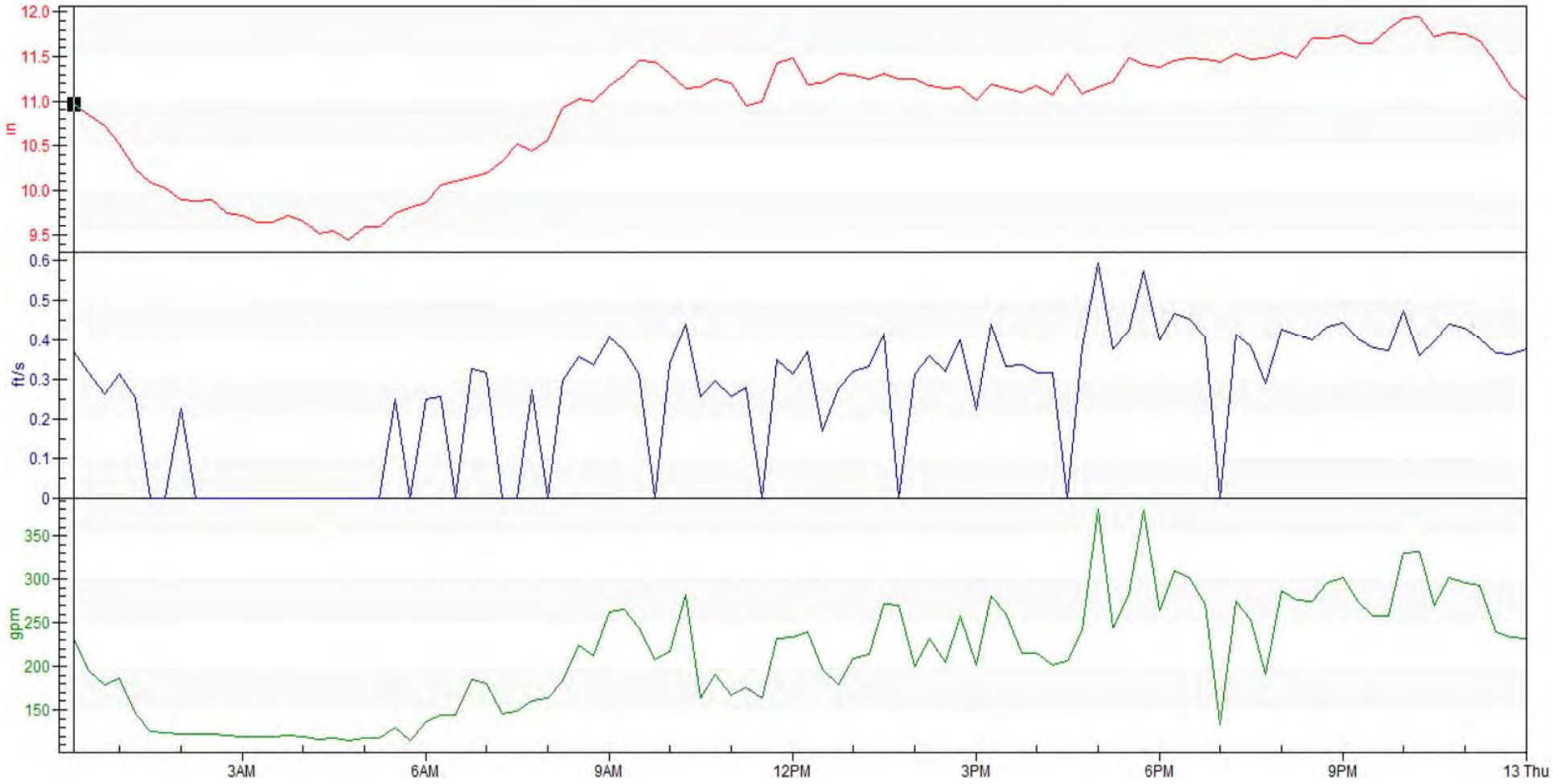
Time	Level	Velocity	Flow
12:15:00 AM	11.017	0.318	200.433
12:30:00 AM	10.958	0.357	223.716
12:45:00 AM	10.927	0.314	193.478
1:00:00 AM	10.571	0.28	166.451
1:15:00 AM	10.512	0.287	170.195
1:30:00 AM	10.432	0.274	168.604
1:45:00 AM	10.322	0.281	163.223
2:00:00 AM	10.195	0.218	124.25
2:15:00 AM	10.161	0.263	149.269
2:30:00 AM	10.167	0.271	153.624
2:45:00 AM	10.098	0.274	153.895
3:00:00 AM	10.001	0.243	135.105
3:15:00 AM	9.898	0.261	142.867
3:30:00 AM	9.861	0.223	121.497
3:45:00 AM	9.842	0.245	133.382
4:00:00 AM	9.789	0	132.427
4:15:00 AM	9.793	0	132.507
4:30:00 AM	9.799	0.246	132.607
4:45:00 AM	9.746	0.206	110.827
5:00:00 AM	9.899	0.282	154.428
5:15:00 AM	9.878	0.268	146.42
5:30:00 AM	9.971	0.323	175.278
5:45:00 AM	10.223	0.257	147.169
6:00:00 AM	10.26	0.289	166.153
6:15:00 AM	10.404	0.606	353.445
6:30:00 AM	10.382	0.272	170.809
6:45:00 AM	10.521	0.32	190.087
7:00:00 AM	10.543	0.302	179.909
7:15:00 AM	10.703	0.29	176.613
7:30:00 AM	10.804	0.352	216.636
7:45:00 AM	11.028	0.34	214.783
8:00:00 AM	11.138	0.319	203.534
8:15:00 AM	11.202	0.373	239.186
8:30:00 AM	11.362	0.356	231.142
8:45:00 AM	11.48	0.039	229.594
9:00:00 AM	11.415	0	231.554
9:15:00 AM	11.456	0	229.802
9:30:00 AM	11.461	0.381	252.104
9:45:00 AM	11.503	0.385	257.038
10:00:00 AM	11.54	0.294	221.091
10:15:00 AM	11.59	0.345	232.273
10:30:00 AM	11.524	0	230.99
10:45:00 AM	11.726	0.405	275.272
11:00:00 AM	11.736	0.407	276.721
11:15:00 AM	11.664	0.341	256.905
11:30:00 AM	11.655	0.347	235.827
11:45:00 AM	11.671	0.306	223.674

Tuesday- P.M. 7/11/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.576	0.209	140.784
12:15:00 PM	11.83	0.42	290.607
12:30:00 PM	11.963	0.359	252.193
12:45:00 PM	11.89	0.37	256.607
1:00:00 PM	11.741	0.391	268.031
1:15:00 PM	11.634	0.397	268.81
1:30:00 PM	11.622	0.302	202.689
1:45:00 PM	11.672	0.365	248.212
2:00:00 PM	11.595	0.282	246.125
2:15:00 PM	11.482	0	198.274
2:30:00 PM	11.441	0.031	194.771
2:45:00 PM	11.529	0	196.523
3:00:00 PM	11.569	0	198.274
3:15:00 PM	11.521	0	203.529
3:30:00 PM	11.475	0.308	205.253
3:45:00 PM	11.635	0.424	287.071
4:00:00 PM	11.627	0.393	265.893
4:15:00 PM	11.514	0.385	257.25
4:30:00 PM	11.56	0.414	278.09
4:45:00 PM	11.451	0.369	243.924
5:00:00 PM	11.666	0.42	281.918
5:15:00 PM	11.655	0.419	284.556
5:30:00 PM	11.57	0.402	268.527
5:45:00 PM	11.493	0.418	278.826
6:00:00 PM	11.686	0.391	266.344
6:15:00 PM	11.674	0.385	261.936
6:30:00 PM	11.661	0.398	268.095
6:45:00 PM	11.635	0.378	264.961
7:00:00 PM	11.893	0	258.402
7:15:00 PM	12.12	0.413	295.038
7:30:00 PM	11.928	0.431	301.196
7:45:00 PM	11.981	0.618	435.178
8:00:00 PM	11.949	0.477	334.175
8:15:00 PM	11.982	0.423	296.382
8:30:00 PM	11.834	0.454	308.777
8:45:00 PM	11.851	0.384	263.941
9:00:00 PM	11.871	0.48	332.156
9:15:00 PM	12.226	0	308.051
9:30:00 PM	12.223	0	307.959
9:45:00 PM	12.004	0.539	377.824
10:00:00 PM	11.977	0.377	265.152
10:15:00 PM	12.089	0.342	243.573
10:30:00 PM	12.08	0.45	319.624
10:45:00 PM	12.019	0.361	255.188
11:00:00 PM	11.917	0.366	255.055
11:15:00 PM	11.83	0.397	269.469
11:30:00 PM	11.604	0.347	233.89
11:45:00 PM	11.47	0.325	216.221

	Inches	Feet/Sec	GPM
Daily Avg:	11.232	0.301	229.285
Daily Min:	9.746	0	110.827
Daily Max:	12.226	0.618	435.178
Peak to Avg:			1.90

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/12/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Wednesday - A.M. 7/12/2023

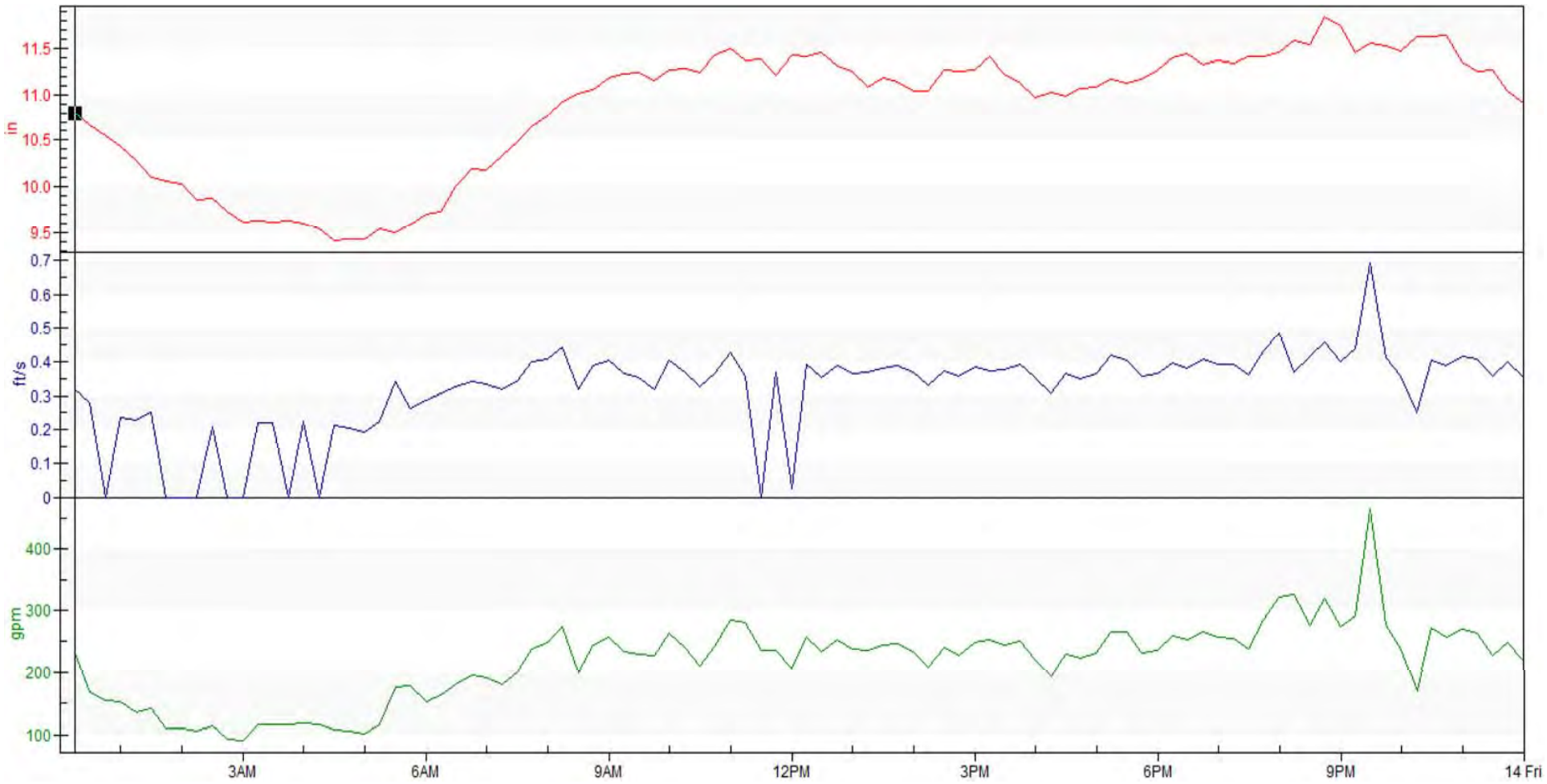
Time	Level	Velocity	Flow
12:00:00 AM	11.188	0.392	252.733
12:15:00 AM	10.973	0.368	230.157
12:30:00 AM	10.842	0.317	196.047
12:45:00 AM	10.727	0.262	179.447
1:00:00 AM	10.523	0.313	185.961
1:15:00 AM	10.242	0.252	144.715
1:30:00 AM	10.097	0	125.786
1:45:00 AM	10.034	0	124.761
2:00:00 AM	9.9	0.225	123.371
2:15:00 AM	9.877	0	123.056
2:30:00 AM	9.896	0	123.371
2:45:00 AM	9.755	0	121.037
3:00:00 AM	9.713	0	120.344
3:15:00 AM	9.648	0	119.271
3:30:00 AM	9.638	0	119.116
3:45:00 AM	9.725	0	120.553
4:00:00 AM	9.661	0	119.486
4:15:00 AM	9.513	0	117.052
4:30:00 AM	9.547	0	117.604
4:45:00 AM	9.437	0	115.793
5:00:00 AM	9.58	0	118.155
5:15:00 AM	9.593	0	118.367
5:30:00 AM	9.744	0.248	130.973
5:45:00 AM	9.808	0	115.449
6:00:00 AM	9.865	0.249	136.239
6:15:00 AM	10.063	0.257	143.859
6:30:00 AM	10.105	0	144.653
6:45:00 AM	10.151	0.326	184.798
7:00:00 AM	10.193	0.316	180.124
7:15:00 AM	10.321	0	145.168
7:30:00 AM	10.524	0	148.934
7:45:00 AM	10.45	0.273	160.933
8:00:00 AM	10.567	0	163.305
8:15:00 AM	10.92	0.295	184.067
8:30:00 AM	11.027	0.356	224.6
8:45:00 AM	10.991	0.337	212.08
9:00:00 AM	11.174	0.408	262.164
9:15:00 AM	11.292	0.372	264.691
9:30:00 AM	11.456	0.313	244.415
9:45:00 AM	11.437	0	207.608
10:00:00 AM	11.303	0.339	217.189
10:15:00 AM	11.151	0.44	282.117
10:30:00 AM	11.156	0.257	164.233
10:45:00 AM	11.242	0.295	191.309
11:00:00 AM	11.209	0.257	166.162
11:15:00 AM	10.954	0.281	175.586
11:30:00 AM	10.992	0	163.391
11:45:00 AM	11.422	0.35	231.737

Wednesday - P.M. 7/12/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.49	0.312	233.534
12:15:00 PM	11.184	0.371	238.961
12:30:00 PM	11.198	0.169	196.427
12:45:00 PM	11.301	0.275	179.298
1:00:00 PM	11.294	0.321	209.227
1:15:00 PM	11.242	0.333	214.065
1:30:00 PM	11.313	0.416	271.759
1:45:00 PM	11.245	0	269.633
2:00:00 PM	11.255	0.312	199.498
2:15:00 PM	11.181	0.36	231.294
2:30:00 PM	11.15	0.319	204.611
2:45:00 PM	11.165	0.4	257.082
3:00:00 PM	11.014	0.222	202.164
3:15:00 PM	11.184	0.439	280.807
3:30:00 PM	11.148	0.334	260.801
3:45:00 PM	11.098	0.336	214.541
4:00:00 PM	11.179	0.316	215.588
4:15:00 PM	11.073	0.317	201.374
4:30:00 PM	11.305	0	206.857
4:45:00 PM	11.086	0.38	240.759
5:00:00 PM	11.158	0.592	380.4
5:15:00 PM	11.215	0.377	243.637
5:30:00 PM	11.492	0.423	282.252
5:45:00 PM	11.412	0.573	378.913
6:00:00 PM	11.376	0.4	263.379
6:15:00 PM	11.462	0.467	309.845
6:30:00 PM	11.486	0.452	301.584
6:45:00 PM	11.475	0.407	270.867
7:00:00 PM	11.434	0	132.976
7:15:00 PM	11.533	0.412	274.591
7:30:00 PM	11.471	0.383	253.446
7:45:00 PM	11.485	0.288	190.789
8:00:00 PM	11.55	0.427	286.463
8:15:00 PM	11.484	0.414	276.182
8:30:00 PM	11.708	0.401	274.096
8:45:00 PM	11.714	0.432	295.645
9:00:00 PM	11.732	0.442	302.45
9:15:00 PM	11.654	0.403	274.665
9:30:00 PM	11.655	0.379	257.752
9:45:00 PM	11.819	0.372	257.121
10:00:00 PM	11.93	0.473	330.985
10:15:00 PM	11.947	0.361	331.575
10:30:00 PM	11.722	0.398	269.839
10:45:00 PM	11.764	0.44	301.983
11:00:00 PM	11.754	0.43	295.507
11:15:00 PM	11.68	0.402	293.118
11:30:00 PM	11.44	0.367	239.205
11:45:00 PM	11.181	0.364	232.871

	Inches	Feet/Sec	GPM
Daily Avg:	10.908	0.262	210.944
Daily Min:	9.437	0	115.449
Daily Max:	11.947	0.592	380.4
Peak to Avg:			1.80

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/13/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Thursday - A.M. 7/13/2023

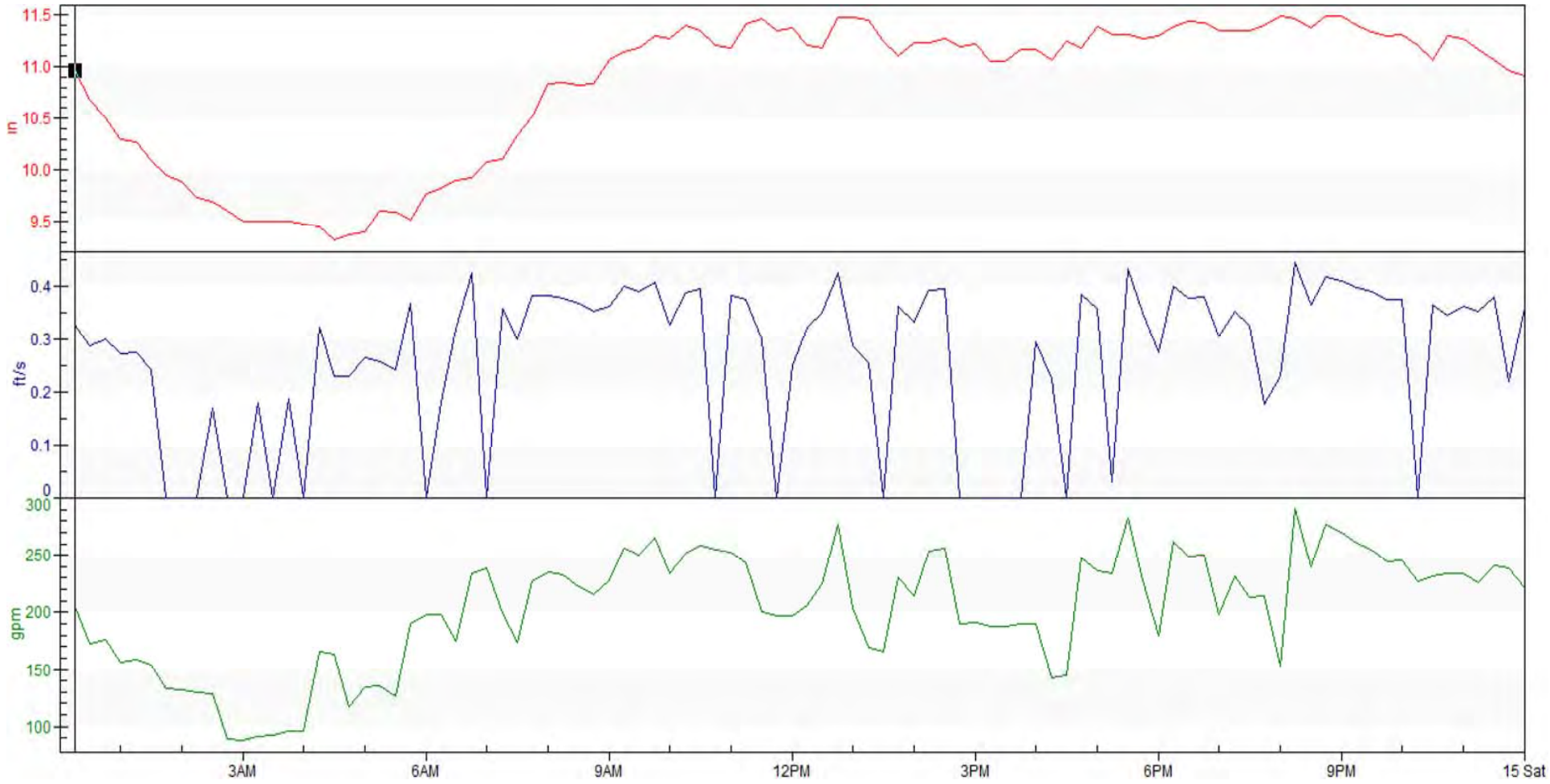
Time	Level	Velocity	Flow
12:00:00 AM	11.004	0.375	231.892
12:15:00 AM	10.79	0.317	230.763
12:30:00 AM	10.662	0.28	168.132
12:45:00 AM	10.545	0	154.368
1:00:00 AM	10.433	0.235	152.232
1:15:00 AM	10.27	0.227	135.633
1:30:00 AM	10.107	0.25	141.168
1:45:00 AM	10.057	0	109.17
2:00:00 AM	10.036	0	108.862
2:15:00 AM	9.854	0	106.244
2:30:00 AM	9.866	0.208	113.1
2:45:00 AM	9.724	0	92.29
3:00:00 AM	9.622	0	90.993
3:15:00 AM	9.634	0.219	116.096
3:30:00 AM	9.608	0.221	116.37
3:45:00 AM	9.629	0	116.712
4:00:00 AM	9.606	0.224	118.066
4:15:00 AM	9.538	0	117.137
4:30:00 AM	9.413	0.212	108.545
4:45:00 AM	9.429	0.205	105.182
5:00:00 AM	9.428	0.195	100.158
5:15:00 AM	9.547	0.224	117.206
5:30:00 AM	9.5	0.342	175.437
5:45:00 AM	9.587	0.262	177.247
6:00:00 AM	9.697	0.287	153.18
6:15:00 AM	9.73	0.305	163.489
6:30:00 AM	10.007	0.325	181.083
6:45:00 AM	10.186	0.342	195.029
7:00:00 AM	10.174	0.335	190.667
7:15:00 AM	10.334	0.316	180.33
7:30:00 AM	10.48	0.34	199.02
7:45:00 AM	10.655	0.4	237.571
8:00:00 AM	10.768	0.408	249.749
8:15:00 AM	10.92	0.443	273.673
8:30:00 AM	11.005	0.316	199.333
8:45:00 AM	11.048	0.388	244.894
9:00:00 AM	11.175	0.403	257.604
9:15:00 AM	11.221	0.365	234.811
9:30:00 AM	11.241	0.355	230.146
9:45:00 AM	11.155	0.317	226.931
10:00:00 AM	11.263	0.405	263.116
10:15:00 AM	11.276	0.37	240.019
10:30:00 AM	11.24	0.324	210.27
10:45:00 AM	11.429	0.366	242.636
11:00:00 AM	11.505	0.427	284.437
11:15:00 AM	11.371	0.357	280.73
11:30:00 AM	11.38	0	235.091
11:45:00 AM	11.206	0.367	236.4

Thursday - P.M. 7/13/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.431	0.024	207.032
12:15:00 PM	11.406	0.391	258.197
12:30:00 PM	11.457	0.354	233.366
12:45:00 PM	11.308	0.389	253.81
1:00:00 PM	11.253	0.366	237.877
1:15:00 PM	11.086	0.371	235.471
1:30:00 PM	11.177	0.379	243.547
1:45:00 PM	11.141	0.389	246.087
2:00:00 PM	11.038	0.368	233.091
2:15:00 PM	11.041	0.331	208.937
2:30:00 PM	11.262	0.372	239.524
2:45:00 PM	11.255	0.357	227.637
3:00:00 PM	11.272	0.383	249.163
3:15:00 PM	11.411	0.371	252.273
3:30:00 PM	11.231	0.376	243.474
3:45:00 PM	11.122	0.394	251.389
4:00:00 PM	10.964	0.351	220.414
4:15:00 PM	11.028	0.306	193.674
4:30:00 PM	10.981	0.367	229.526
4:45:00 PM	11.068	0.35	222.374
5:00:00 PM	11.081	0.366	232.55
5:15:00 PM	11.163	0.42	266.519
5:30:00 PM	11.122	0.405	266.466
5:45:00 PM	11.17	0.359	230.728
6:00:00 PM	11.263	0.363	235.99
6:15:00 PM	11.4	0.395	259.635
6:30:00 PM	11.446	0.381	252.697
6:45:00 PM	11.33	0.408	266.642
7:00:00 PM	11.373	0.39	256.942
7:15:00 PM	11.341	0.391	255.751
7:30:00 PM	11.408	0.361	238.402
7:45:00 PM	11.419	0.43	284.332
8:00:00 PM	11.457	0.485	322.034
8:15:00 PM	11.577	0.368	326.377
8:30:00 PM	11.544	0.414	277.574
8:45:00 PM	11.844	0.46	319.215
9:00:00 PM	11.737	0.4	274.204
9:15:00 PM	11.449	0.44	290.531
9:30:00 PM	11.555	0.691	464.318
9:45:00 PM	11.525	0.412	276.014
10:00:00 PM	11.466	0.357	237.169
10:15:00 PM	11.625	0.25	169.474
10:30:00 PM	11.625	0.404	273.193
10:45:00 PM	11.637	0.388	258.103
11:00:00 PM	11.357	0.415	270.749
11:15:00 PM	11.26	0.408	263.435
11:30:00 PM	11.266	0.358	227.71
11:45:00 PM	11.037	0.4	248.255

	Inches	Feet/Sec	GPM
Daily Avg:	10.850	0.318	216.981
Daily Min:	9.413	0	90.993
Daily Max:	11.844	0.691	464.318
Peak to Avg:			2.14

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/14/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Friday - A.M. 7/14/2023

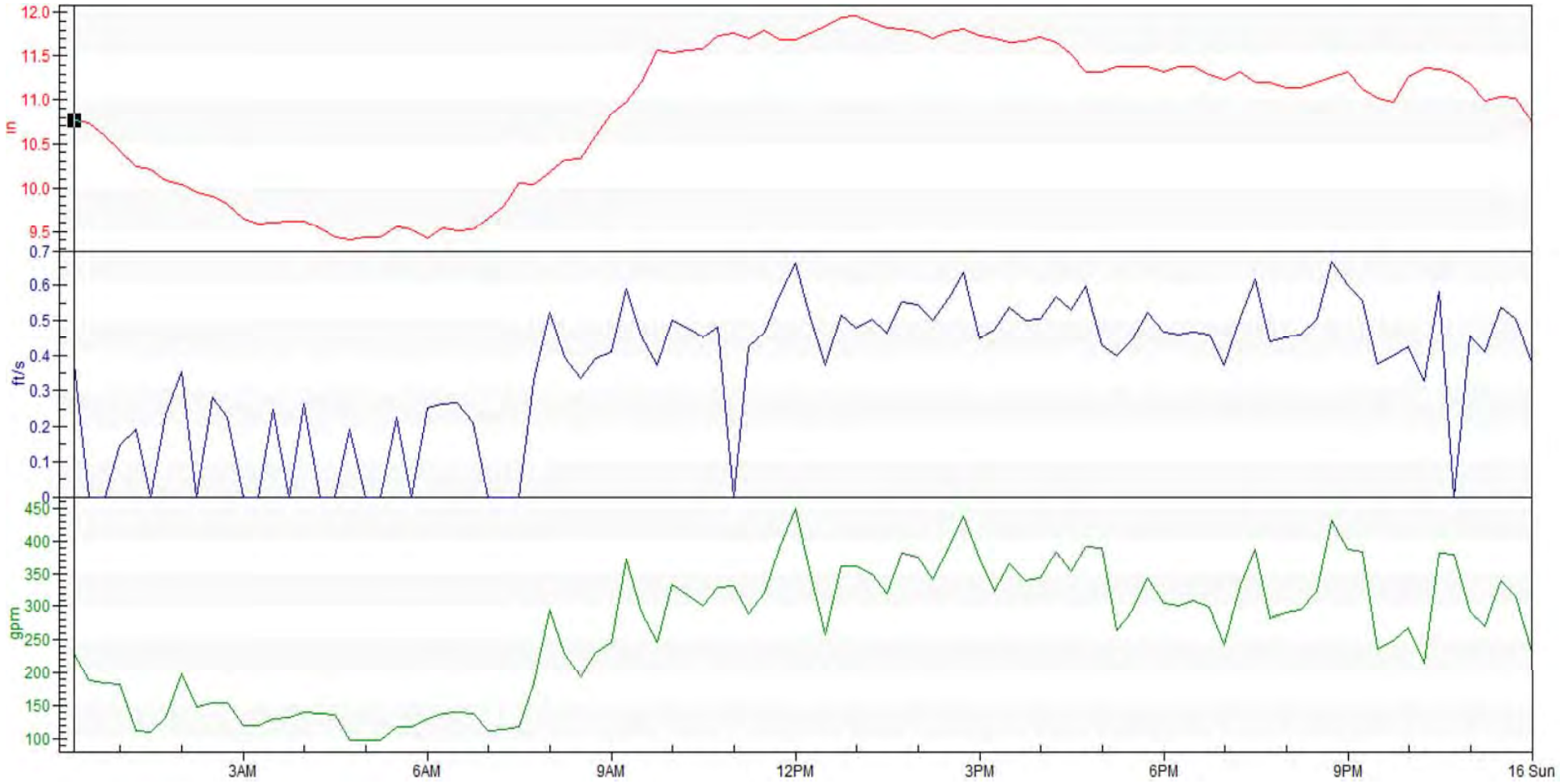
Time	Level	Velocity	Flow
12:00:00 AM	10.911	0.353	219.617
12:15:00 AM	10.955	0.327	205.045
12:30:00 AM	10.674	0.287	172.345
12:45:00 AM	10.499	0.298	176.094
1:00:00 AM	10.302	0.271	156.836
1:15:00 AM	10.271	0.275	158.221
1:30:00 AM	10.093	0.241	154.617
1:45:00 AM	9.951	0	133.364
2:00:00 AM	9.892	0	132.315
2:15:00 AM	9.733	0	129.495
2:30:00 AM	9.691	0.17	128.747
2:45:00 AM	9.61	0	89.704
3:00:00 AM	9.507	0	88.423
3:15:00 AM	9.507	0.178	91.441
3:30:00 AM	9.504	0	92.532
3:45:00 AM	9.502	0.186	96.352
4:00:00 AM	9.476	0	96.252
4:15:00 AM	9.456	0.322	166.079
4:30:00 AM	9.325	0.23	163.335
4:45:00 AM	9.377	0.23	117.221
5:00:00 AM	9.4	0.263	134.789
5:15:00 AM	9.606	0.256	135.216
5:30:00 AM	9.591	0.242	126.765
5:45:00 AM	9.514	0.366	190.345
6:00:00 AM	9.777	0	197.569
6:15:00 AM	9.818	0.179	198.653
6:30:00 AM	9.896	0.319	174.685
6:45:00 AM	9.928	0.425	234.168
7:00:00 AM	10.076	0	238.817
7:15:00 AM	10.11	0.356	199.067
7:30:00 AM	10.336	0.299	173.976
7:45:00 AM	10.518	0.381	226.579
8:00:00 AM	10.836	0.381	235.709
8:15:00 AM	10.844	0.375	232.311
8:30:00 AM	10.822	0.366	222.853
8:45:00 AM	10.829	0.352	215.825
9:00:00 AM	11.066	0.363	228.107
9:15:00 AM	11.141	0.4	256.162
9:30:00 AM	11.176	0.389	250.119
9:45:00 AM	11.299	0.406	264.686
10:00:00 AM	11.27	0.326	233.406
10:15:00 AM	11.394	0.385	250.904
10:30:00 AM	11.343	0.395	258.831
10:45:00 AM	11.202	0	254.678
11:00:00 AM	11.178	0.382	252.774
11:15:00 AM	11.407	0.375	242.969
11:30:00 AM	11.457	0.299	200.357
11:45:00 AM	11.345	0	196.422

Friday - P.M. 7/14/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.365	0.25	196.874
12:15:00 PM	11.198	0.321	205.912
12:30:00 PM	11.178	0.349	224.517
12:45:00 PM	11.474	0.424	276.868
1:00:00 PM	11.475	0.285	203.707
1:15:00 PM	11.441	0.255	168.948
1:30:00 PM	11.241	0	165.158
1:45:00 PM	11.099	0.361	230.423
2:00:00 PM	11.223	0.332	214.571
2:15:00 PM	11.223	0.392	253.332
2:30:00 PM	11.269	0.394	256.416
2:45:00 PM	11.192	0	190.363
3:00:00 PM	11.215	0	190.867
3:15:00 PM	11.056	0	187.353
3:30:00 PM	11.055	0	187.344
3:45:00 PM	11.169	0	189.847
4:00:00 PM	11.159	0.294	189.629
4:15:00 PM	11.062	0.224	142.021
4:30:00 PM	11.243	0	145.044
4:45:00 PM	11.176	0.385	247.823
5:00:00 PM	11.388	0.358	235.745
5:15:00 PM	11.301	0.03	233.405
5:30:00 PM	11.302	0.433	282.43
5:45:00 PM	11.27	0.35	227.676
6:00:00 PM	11.29	0.275	179.28
6:15:00 PM	11.38	0.398	262.238
6:30:00 PM	11.431	0.377	248.621
6:45:00 PM	11.42	0.378	250.203
7:00:00 PM	11.338	0.304	198.606
7:15:00 PM	11.346	0.352	231.281
7:30:00 PM	11.341	0.324	212.6
7:45:00 PM	11.397	0.177	213.961
8:00:00 PM	11.48	0.229	152.845
8:15:00 PM	11.453	0.443	290.424
8:30:00 PM	11.374	0.364	239.628
8:45:00 PM	11.485	0.416	277.054
9:00:00 PM	11.479	0.408	269.844
9:15:00 PM	11.396	0.397	261.167
9:30:00 PM	11.336	0.389	254.707
9:45:00 PM	11.298	0.375	244.153
10:00:00 PM	11.311	0.375	244.975
10:15:00 PM	11.209	0	226.502
10:30:00 PM	11.067	0.365	231.996
10:45:00 PM	11.294	0.344	233.684
11:00:00 PM	11.27	0.36	234.288
11:15:00 PM	11.169	0.351	225.766
11:30:00 PM	11.065	0.38	240.441
11:45:00 PM	10.963	0.219	238.413

	Inches	Feet/Sec	GPM
Daily Avg:	10.799	0.260	202.991
Daily Min:	9.325	0	88.423
Daily Max:	11.485	0.443	290.424
Peak to Avg:			1.43

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/15/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Saturday - A.M. 7/15/2023

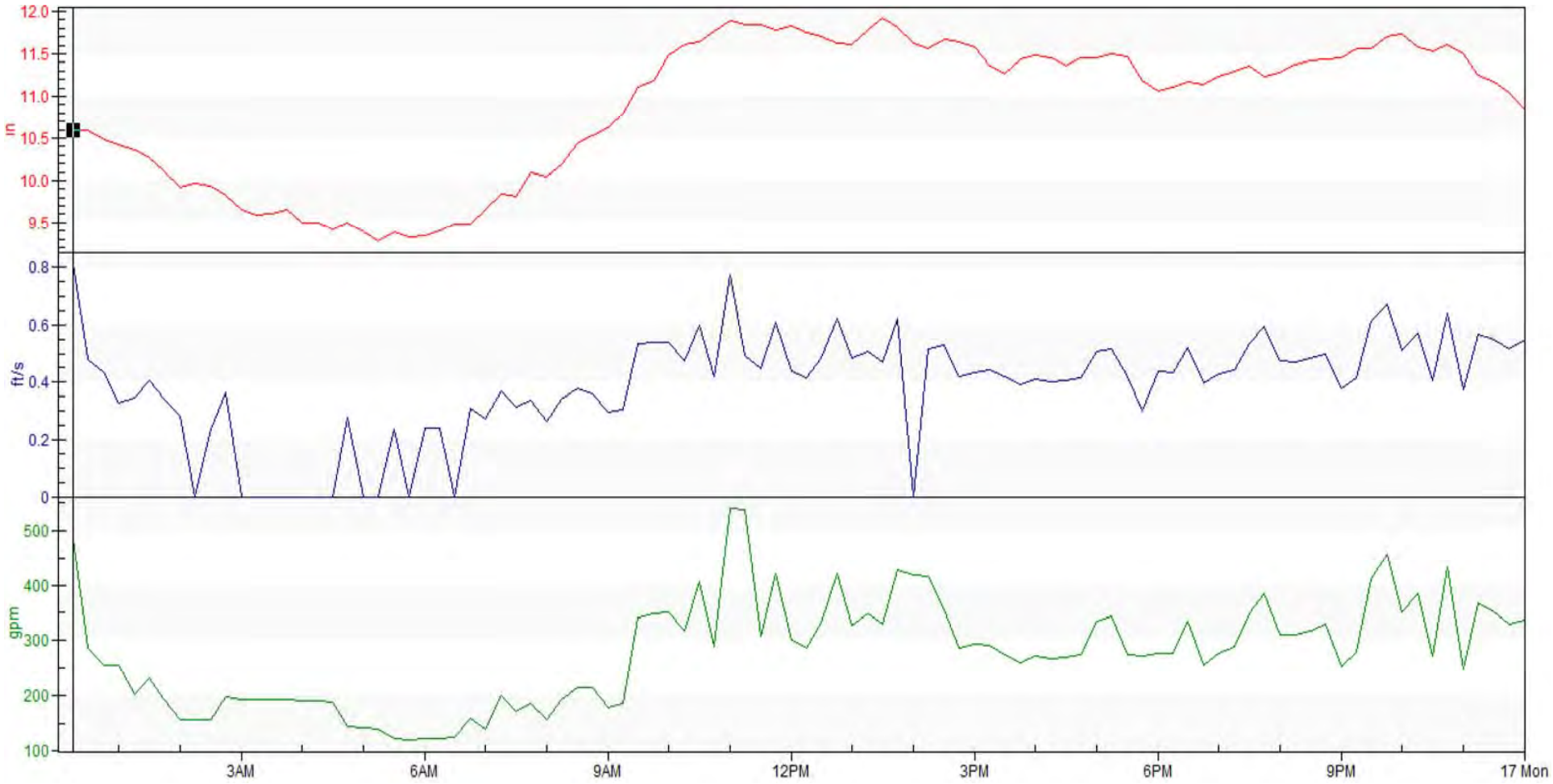
Time	Level	Velocity	Flow
12:00:00 AM	10.909	0.358	221.001
12:15:00 AM	10.762	0.376	228.583
12:30:00 AM	10.734	0	188.613
12:45:00 AM	10.585	0	185.192
1:00:00 AM	10.42	0.149	181.416
1:15:00 AM	10.242	0.193	111.014
1:30:00 AM	10.212	0	110.583
1:45:00 AM	10.085	0.234	131.068
2:00:00 AM	10.035	0.354	197.614
2:15:00 AM	9.942	0	148.686
2:30:00 AM	9.908	0.284	154.346
2:45:00 AM	9.818	0.228	153.884
3:00:00 AM	9.648	0	120.986
3:15:00 AM	9.589	0	119.994
3:30:00 AM	9.599	0.248	130.86
3:45:00 AM	9.614	0	131.13
4:00:00 AM	9.618	0.264	139.255
4:15:00 AM	9.538	0	137.716
4:30:00 AM	9.438	0	135.777
4:45:00 AM	9.402	0.192	98.33
5:00:00 AM	9.427	0	98.687
5:15:00 AM	9.433	0	98.775
5:30:00 AM	9.552	0.225	117.722
5:45:00 AM	9.524	0	117.252
6:00:00 AM	9.416	0.255	130.804
6:15:00 AM	9.537	0.263	137.301
6:30:00 AM	9.513	0.269	140.085
6:45:00 AM	9.522	0.211	138.957
7:00:00 AM	9.638	0	111.949
7:15:00 AM	9.796	0	114.402
7:30:00 AM	10.052	0	118.386
7:45:00 AM	10.042	0.329	183.611
8:00:00 AM	10.175	0.524	295.258
8:15:00 AM	10.313	0.396	229.571
8:30:00 AM	10.324	0.336	193.748
8:45:00 AM	10.591	0.393	230.544
9:00:00 AM	10.847	0.411	246.74
9:15:00 AM	10.975	0.592	370.711
9:30:00 AM	11.201	0.455	293.602
9:45:00 AM	11.566	0.374	245.995
10:00:00 AM	11.542	0.5	332.878
10:15:00 AM	11.562	0.477	317.844
10:30:00 AM	11.578	0.451	301.394
10:45:00 AM	11.741	0.482	328.436
11:00:00 AM	11.763	0	331.241
11:15:00 AM	11.709	0.425	289.87
11:30:00 AM	11.792	0.466	321.561
11:45:00 AM	11.695	0.573	389.483

Saturday - P.M. 7/15/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.696	0.661	449.317
12:15:00 PM	11.77	0.508	349.285
12:30:00 PM	11.84	0.374	259.048
12:45:00 PM	11.95	0.516	360.984
1:00:00 PM	11.962	0.477	361.42
1:15:00 PM	11.879	0.505	349.506
1:30:00 PM	11.824	0.461	318.379
1:45:00 PM	11.809	0.552	381.308
2:00:00 PM	11.785	0.545	374.48
2:15:00 PM	11.697	0.501	340.986
2:30:00 PM	11.775	0.565	389.126
2:45:00 PM	11.804	0.634	437.674
3:00:00 PM	11.732	0.446	373.705
3:15:00 PM	11.699	0.475	324.094
3:30:00 PM	11.662	0.538	365.53
3:45:00 PM	11.668	0.5	340.145
4:00:00 PM	11.723	0.504	343.528
4:15:00 PM	11.652	0.567	382.931
4:30:00 PM	11.519	0.529	354.238
4:45:00 PM	11.331	0.596	390.6
5:00:00 PM	11.326	0.43	390.364
5:15:00 PM	11.393	0.401	264.382
5:30:00 PM	11.387	0.448	295.09
5:45:00 PM	11.383	0.521	343.515
6:00:00 PM	11.327	0.469	305.904
6:15:00 PM	11.385	0.457	301.388
6:30:00 PM	11.393	0.468	308.403
6:45:00 PM	11.297	0.46	299.64
7:00:00 PM	11.236	0.374	242.174
7:15:00 PM	11.323	0.506	331.406
7:30:00 PM	11.203	0.617	388.405
7:45:00 PM	11.2	0.439	282.406
8:00:00 PM	11.143	0.453	290.548
8:15:00 PM	11.148	0.458	293.947
8:30:00 PM	11.201	0.503	323.646
8:45:00 PM	11.271	0.664	430.739
9:00:00 PM	11.323	0.6	388.396
9:15:00 PM	11.122	0.556	383.898
9:30:00 PM	11.025	0.376	237.508
9:45:00 PM	10.974	0.398	249.184
10:00:00 PM	11.264	0.424	268.423
10:15:00 PM	11.378	0.327	215.247
10:30:00 PM	11.362	0.581	380.552
10:45:00 PM	11.306	0	379.592
11:00:00 PM	11.193	0.454	292.946
11:15:00 PM	10.992	0.412	271.602
11:30:00 PM	11.033	0.538	339.645
11:45:00 PM	11.024	0.505	315.834

	Inches	Feet/Sec	GPM
Daily Avg:	10.878	0.360	264.136
Daily Min:	9.402	0	98.33
Daily Max:	11.962	0.664	449.317
Peak to Avg:			1.70

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/16/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Sunday - A.M. 7/16/2023

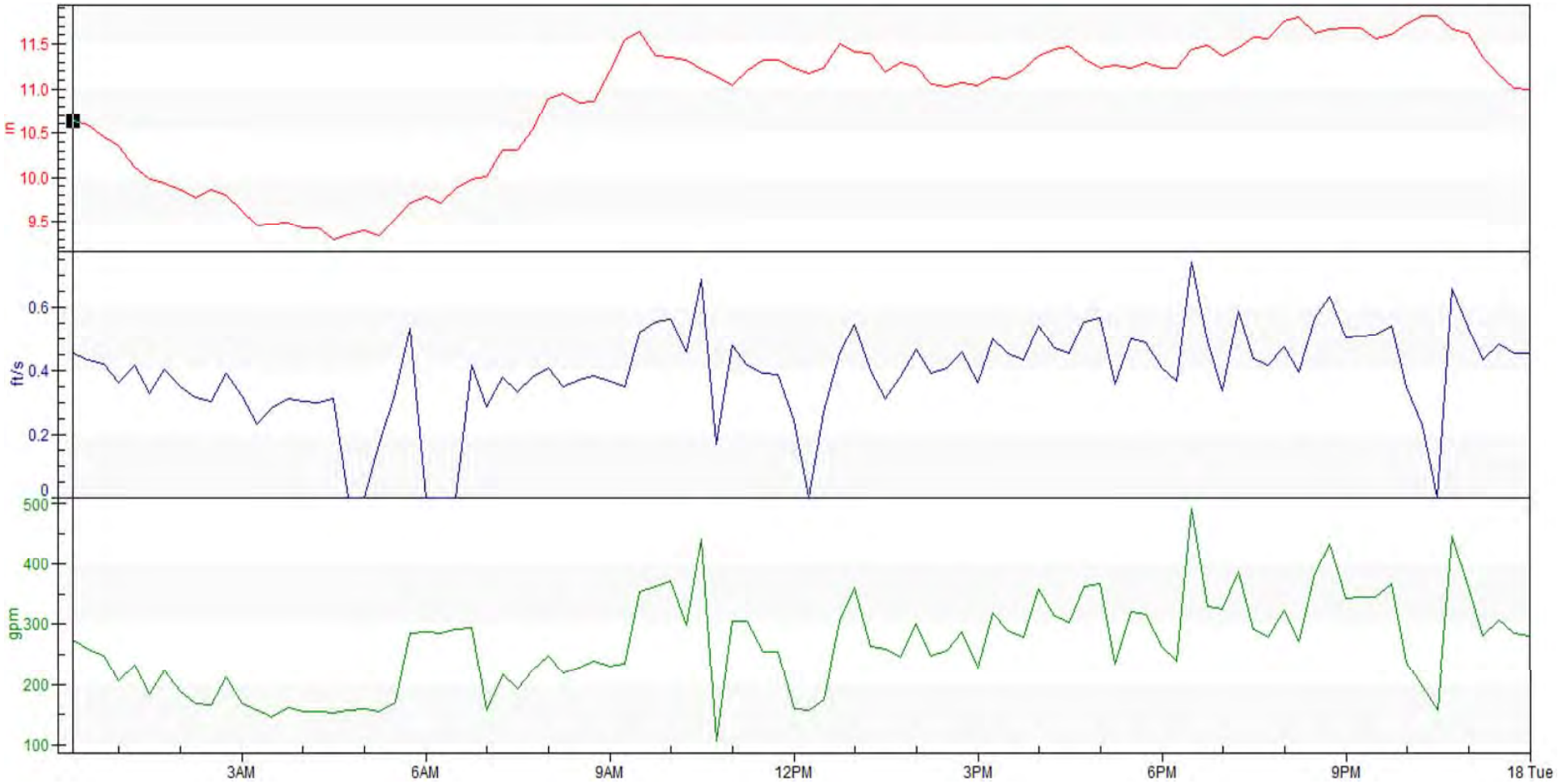
Time	Level	Velocity	Flow
12:00:00 AM	10.754	0.382	232.604
12:15:00 AM	10.589	0.813	485.304
12:30:00 AM	10.59	0.481	287.362
12:45:00 AM	10.481	0.436	255.478
1:00:00 AM	10.422	0.329	254.888
1:15:00 AM	10.364	0.347	202.253
1:30:00 AM	10.27	0.406	230.526
1:45:00 AM	10.105	0.341	192.183
2:00:00 AM	9.913	0.283	155.47
2:15:00 AM	9.965	0	156.552
2:30:00 AM	9.931	0.238	155.844
2:45:00 AM	9.831	0.364	196.851
3:00:00 AM	9.653	0	193.151
3:15:00 AM	9.597	0	191.648
3:30:00 AM	9.607	0	191.929
3:45:00 AM	9.648	0	192.998
4:00:00 AM	9.498	0	189.021
4:15:00 AM	9.498	0	189.019
4:30:00 AM	9.413	0	186.749
4:45:00 AM	9.493	0.278	144.316
5:00:00 AM	9.384	0	142.097
5:15:00 AM	9.279	0	139.964
5:30:00 AM	9.392	0.239	122.098
5:45:00 AM	9.326	0	120.955
6:00:00 AM	9.345	0.24	122.161
6:15:00 AM	9.406	0.24	122.884
6:30:00 AM	9.478	0	124.15
6:45:00 AM	9.481	0.308	159.448
7:00:00 AM	9.66	0.272	140.085
7:15:00 AM	9.84	0.371	200.858
7:30:00 AM	9.806	0.314	169.718
7:45:00 AM	10.093	0.335	184.956
8:00:00 AM	10.049	0.264	156.782
8:15:00 AM	10.181	0.341	192.309
8:30:00 AM	10.443	0.377	215.082
8:45:00 AM	10.531	0.358	213.272
9:00:00 AM	10.626	0.297	178.62
9:15:00 AM	10.789	0.303	186.288
9:30:00 AM	11.102	0.536	342.072
9:45:00 AM	11.185	0.542	348.148
10:00:00 AM	11.486	0.54	351.047
10:15:00 AM	11.603	0.474	317.759
10:30:00 AM	11.636	0.6	405.313
10:45:00 AM	11.762	0.421	289.313
11:00:00 AM	11.895	0.775	540.432
11:15:00 AM	11.844	0.492	537.409
11:30:00 AM	11.839	0.447	308.873
11:45:00 AM	11.784	0.61	419.903

Sunday - P.M. 7/16/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.828	0.437	300.74
12:15:00 PM	11.748	0.417	286.412
12:30:00 PM	11.709	0.484	330.754
12:45:00 PM	11.628	0.623	421.863
1:00:00 PM	11.615	0.483	326.692
1:15:00 PM	11.775	0.508	349.645
1:30:00 PM	11.922	0.47	328.972
1:45:00 PM	11.807	0.62	428.128
2:00:00 PM	11.618	0	419.361
2:15:00 PM	11.565	0.515	416.895
2:30:00 PM	11.668	0.532	356.269
2:45:00 PM	11.635	0.421	285.592
3:00:00 PM	11.575	0.436	293.349
3:15:00 PM	11.359	0.443	290.98
3:30:00 PM	11.267	0.422	274.59
3:45:00 PM	11.436	0.391	259.005
4:00:00 PM	11.486	0.409	270.991
4:15:00 PM	11.446	0.402	266.551
4:30:00 PM	11.357	0.409	268.423
4:45:00 PM	11.455	0.416	275.099
5:00:00 PM	11.445	0.509	335.351
5:15:00 PM	11.496	0.518	344.367
5:30:00 PM	11.471	0.42	274.721
5:45:00 PM	11.193	0.303	270.924
6:00:00 PM	11.063	0.437	277.544
6:15:00 PM	11.102	0.434	275.906
6:30:00 PM	11.166	0.521	333.311
6:45:00 PM	11.139	0.397	254.147
7:00:00 PM	11.233	0.428	277.125
7:15:00 PM	11.302	0.445	289.522
7:30:00 PM	11.359	0.536	348.083
7:45:00 PM	11.241	0.595	385.264
8:00:00 PM	11.276	0.476	309.904
8:15:00 PM	11.373	0.472	309.394
8:30:00 PM	11.419	0.482	318.044
8:45:00 PM	11.429	0.497	329.146
9:00:00 PM	11.46	0.381	253.081
9:15:00 PM	11.558	0.414	278.232
9:30:00 PM	11.559	0.611	410.025
9:45:00 PM	11.699	0.671	457.882
10:00:00 PM	11.738	0.512	350.798
10:15:00 PM	11.572	0.571	384.499
10:30:00 PM	11.534	0.408	272.462
10:45:00 PM	11.61	0.642	433.712
11:00:00 PM	11.5	0.372	248.602
11:15:00 PM	11.243	0.568	367.196
11:30:00 PM	11.178	0.548	351.052
11:45:00 PM	11.039	0.518	328.301

	Inches	Feet/Sec	GPM
Daily Avg:	10.867	0.385	277.078
Daily Min:	9.279	0	120.955
Daily Max:	11.922	0.813	540.432
Peak to Avg:			1.95

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/17/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Monday - A.M. 7/17/2023

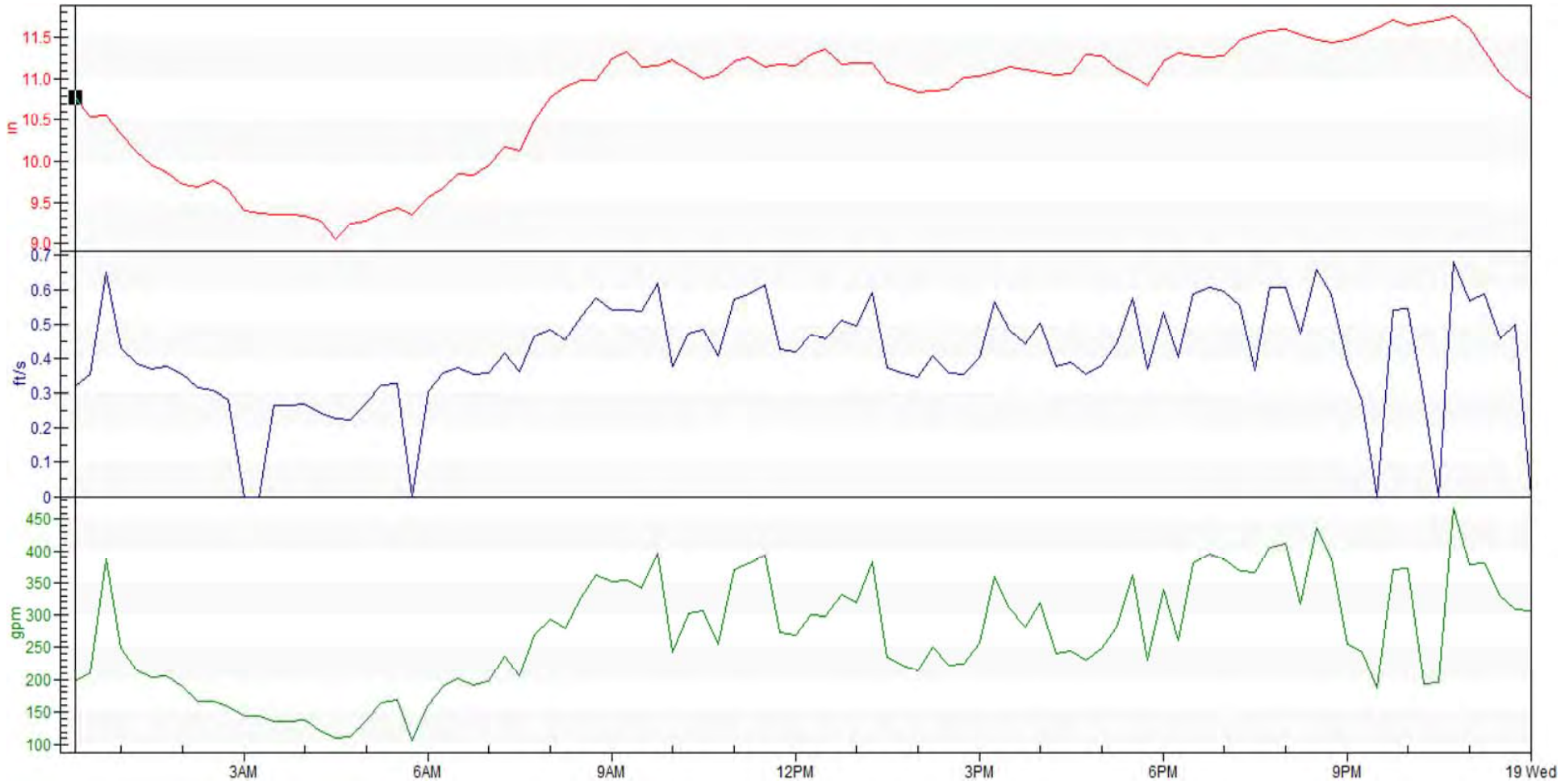
Time	Level	Velocity	Velocity
12:10:00 AM	10.846	0.548	337.004
12:15:00 AM	10.632	0.456	273.097
12:30:00 AM	10.594	0.435	257.864
12:45:00 AM	10.463	0.42	247.71
1:00:00 AM	10.353	0.362	206.835
1:15:00 AM	10.113	0.415	232.693
1:30:00 AM	9.985	0.331	183.51
1:45:00 AM	9.939	0.404	222.608
2:00:00 AM	9.858	0.348	188.961
2:15:00 AM	9.772	0.316	169.336
2:30:00 AM	9.862	0.305	166.245
2:45:00 AM	9.808	0.392	212.19
3:00:00 AM	9.62	0.32	168.873
3:15:00 AM	9.465	0.234	157.584
3:30:00 AM	9.478	0.281	145.669
3:45:00 AM	9.485	0.312	160.908
4:00:00 AM	9.426	0.303	154.921
4:15:00 AM	9.433	0.3	154.335
4:30:00 AM	9.294	0.31	153.911
4:45:00 AM	9.357	0	157.972
5:00:00 AM	9.396	0	158.854
5:15:00 AM	9.341	0.168	156.091
5:30:00 AM	9.535	0.327	170.127
5:45:00 AM	9.718	0.532	284.624
6:00:00 AM	9.787	0	287.309
6:15:00 AM	9.706	0	284.149
6:30:00 AM	9.881	0	290.98
6:45:00 AM	9.984	0.417	295.011
7:00:00 AM	10.006	0.287	158.106
7:15:00 AM	10.307	0.379	217.79
7:30:00 AM	10.313	0.335	193.515
7:45:00 AM	10.539	0.379	222.888
8:00:00 AM	10.884	0.407	246.901
8:15:00 AM	10.946	0.351	219.828
8:30:00 AM	10.848	0.369	228.281
8:45:00 AM	10.864	0.384	238.092
9:00:00 AM	11.207	0.367	229.374
9:15:00 AM	11.551	0.35	234.123
9:30:00 AM	11.64	0.521	353.137
9:45:00 AM	11.369	0.554	361.557
10:00:00 AM	11.357	0.564	370.4
10:15:00 AM	11.318	0.46	299.268
10:30:00 AM	11.217	0.687	442.366
10:45:00 AM	11.142	0.168	107.476
11:00:00 AM	11.039	0.481	304.716
11:15:00 AM	11.198	0.416	305.903
11:30:00 AM	11.323	0.391	255.41
11:45:00 AM	11.329	0.388	253.431

Monday - P.M. 7/17/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.229	0.246	159.491
12:15:00 PM	11.177	0	158.529
12:30:00 PM	11.237	0.27	174.67
12:45:00 PM	11.504	0.456	304.61
1:00:00 PM	11.413	0.544	359.838
1:15:00 PM	11.391	0.4	264.007
1:30:00 PM	11.184	0.313	257.8
1:45:00 PM	11.293	0.378	246.539
2:00:00 PM	11.242	0.468	300.946
2:15:00 PM	11.054	0.392	248.19
2:30:00 PM	11.017	0.408	257.244
2:45:00 PM	11.067	0.456	287.992
3:00:00 PM	11.033	0.363	228.449
3:15:00 PM	11.131	0.5	318.26
3:30:00 PM	11.108	0.456	289.898
3:45:00 PM	11.218	0.432	279.17
4:00:00 PM	11.374	0.544	357.895
4:15:00 PM	11.444	0.472	312.833
4:30:00 PM	11.469	0.455	302.743
4:45:00 PM	11.339	0.553	362.275
5:00:00 PM	11.238	0.568	365.901
5:15:00 PM	11.264	0.358	234.408
5:30:00 PM	11.228	0.501	319.32
5:45:00 PM	11.296	0.488	315.491
6:00:00 PM	11.235	0.408	264.217
6:15:00 PM	11.24	0.367	238.034
6:30:00 PM	11.436	0.741	491.486
6:45:00 PM	11.486	0.493	328.508
7:00:00 PM	11.374	0.339	324.4
7:15:00 PM	11.462	0.589	387.427
7:30:00 PM	11.578	0.437	292.056
7:45:00 PM	11.559	0.415	277.966
8:00:00 PM	11.753	0.475	321.525
8:15:00 PM	11.801	0.396	273.019
8:30:00 PM	11.625	0.568	384.644
8:45:00 PM	11.669	0.634	431.532
9:00:00 PM	11.684	0.503	342.512
9:15:00 PM	11.68	0.508	345.361
9:30:00 PM	11.56	0.513	343.965
9:45:00 PM	11.609	0.543	366.727
10:00:00 PM	11.721	0.349	237.861
10:15:00 PM	11.808	0.228	195.229
10:30:00 PM	11.815	0	157.805
10:45:00 PM	11.671	0.657	445.772
11:00:00 PM	11.625	0.536	361.149
11:15:00 PM	11.353	0.432	280.524
11:30:00 PM	11.162	0.485	307.19
11:45:00 PM	11.008	0.452	285.299

	Inches	Feet/Sec	GPM
Daily Avg:	10.858	0.390	265.007
Daily Min:	9.294	0	107.476
Daily Max:	11.815	0.741	491.486
Peak to Avg:			1.85

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/18/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Tuesday- A.M. 7/18/2023

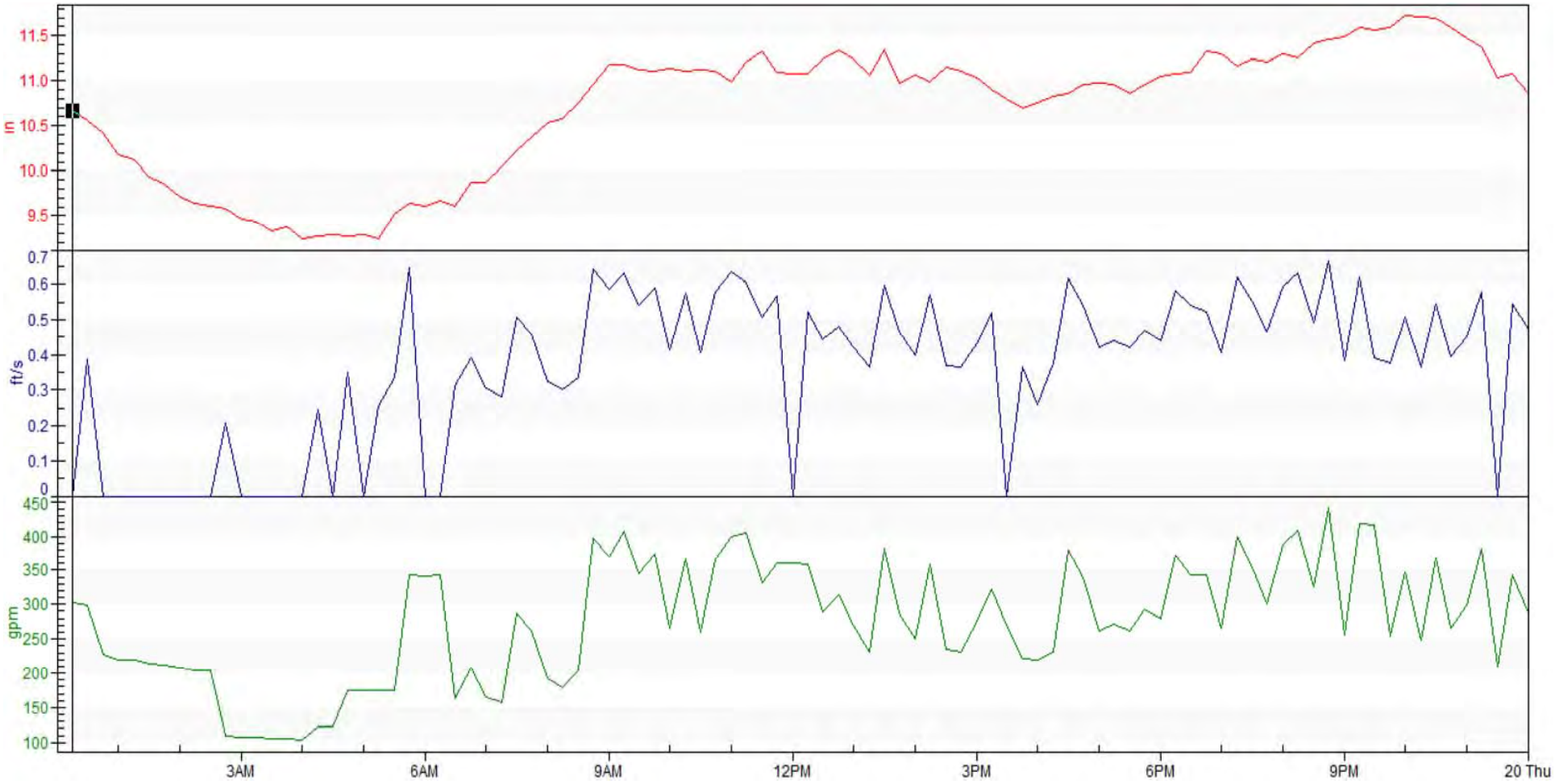
Time	Level	Velocity	Flow
12:00:00 AM	10.99	0.453	280.813
12:15:00 AM	10.785	0.321	197.034
12:30:00 AM	10.535	0.355	210.128
12:45:00 AM	10.549	0.649	386.837
1:00:00 AM	10.324	0.433	248.033
1:15:00 AM	10.1	0.385	214.809
1:30:00 AM	9.953	0.371	204.324
1:45:00 AM	9.87	0.379	206.125
2:00:00 AM	9.725	0.355	188.953
2:15:00 AM	9.687	0.315	166.437
2:30:00 AM	9.769	0.311	167.477
2:45:00 AM	9.665	0.281	158.979
3:00:00 AM	9.399	0	143.777
3:15:00 AM	9.366	0	143.094
3:30:00 AM	9.349	0.267	134.579
3:45:00 AM	9.348	0.265	134.94
4:00:00 AM	9.341	0.271	137.226
4:15:00 AM	9.279	0.242	120.285
4:30:00 AM	9.049	0.228	110.009
4:45:00 AM	9.249	0.224	112.448
5:00:00 AM	9.28	0.274	137.923
5:15:00 AM	9.372	0.322	164.401
5:30:00 AM	9.432	0.329	169.172
5:45:00 AM	9.36	0	107.19
6:00:00 AM	9.562	0.307	160.606
6:15:00 AM	9.668	0.357	189.736
6:30:00 AM	9.845	0.373	202.51
6:45:00 AM	9.827	0.354	191.488
7:00:00 AM	9.954	0.357	197.319
7:15:00 AM	10.17	0.415	235.975
7:30:00 AM	10.127	0.363	205.355
7:45:00 AM	10.486	0.466	270.201
8:00:00 AM	10.781	0.485	294.62
8:15:00 AM	10.9	0.455	279.899
8:30:00 AM	10.993	0.523	328.082
8:45:00 AM	10.991	0.578	362.155
9:00:00 AM	11.24	0.542	351.642
9:15:00 AM	11.325	0.543	354.112
9:30:00 AM	11.144	0.538	340.908
9:45:00 AM	11.156	0.618	396.683
10:00:00 AM	11.227	0.377	243.209
10:15:00 AM	11.113	0.475	303.18
10:30:00 AM	10.998	0.486	305.994
10:45:00 AM	11.056	0.408	255.166
11:00:00 AM	11.218	0.573	370.675
11:15:00 AM	11.258	0.588	381.567
11:30:00 AM	11.151	0.615	393.827
11:45:00 AM	11.173	0.429	274.189

Tuesday- P.M. 7/18/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.157	0.422	270.205
12:15:00 PM	11.297	0.468	300.893
12:30:00 PM	11.354	0.459	298.275
12:45:00 PM	11.183	0.513	330.518
1:00:00 PM	11.198	0.498	319.734
1:15:00 PM	11.202	0.592	382.042
1:30:00 PM	10.95	0.375	234.073
1:45:00 PM	10.904	0.359	222.787
2:00:00 PM	10.851	0.348	214.669
2:15:00 PM	10.857	0.407	251.653
2:30:00 PM	10.878	0.358	221.373
2:45:00 PM	11.023	0.354	223.721
3:00:00 PM	11.033	0.406	256.725
3:15:00 PM	11.09	0.564	359.226
3:30:00 PM	11.145	0.484	310.109
3:45:00 PM	11.11	0.442	282.454
4:00:00 PM	11.089	0.503	319.585
4:15:00 PM	11.059	0.378	239.727
4:30:00 PM	11.064	0.388	245.379
4:45:00 PM	11.298	0.353	230.441
5:00:00 PM	11.277	0.382	248.954
5:15:00 PM	11.137	0.441	282.619
5:30:00 PM	11.039	0.576	361.669
5:45:00 PM	10.927	0.369	230.838
6:00:00 PM	11.205	0.534	340.388
6:15:00 PM	11.31	0.406	261.582
6:30:00 PM	11.27	0.588	380.885
6:45:00 PM	11.259	0.607	394.434
7:00:00 PM	11.283	0.595	387.801
7:15:00 PM	11.466	0.554	368.35
7:30:00 PM	11.525	0.368	367.073
7:45:00 PM	11.588	0.606	406.431
8:00:00 PM	11.598	0.61	411.487
8:15:00 PM	11.537	0.475	315.868
8:30:00 PM	11.466	0.659	435.441
8:45:00 PM	11.435	0.588	389.848
9:00:00 PM	11.462	0.384	254.585
9:15:00 PM	11.54	0.277	241.919
9:30:00 PM	11.61	0	187.493
9:45:00 PM	11.715	0.544	370.482
10:00:00 PM	11.649	0.548	372.31
10:15:00 PM	11.677	0.285	193.967
10:30:00 PM	11.715	0	194.769
10:45:00 PM	11.758	0.68	466.787
11:00:00 PM	11.615	0.571	378.281
11:15:00 PM	11.346	0.589	381.163
11:30:00 PM	11.071	0.459	329.887
11:45:00 PM	10.889	0.5	308.35

	Inches	Feet/Sec	GPM
Daily Avg:	10.750	0.418	269.795
Daily Min:	9.049	0	107.19
Daily Max:	11.758	0.68	466.787
Peak to Avg:			1.73

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/19/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Wednesday - A.M. 7/19/2023

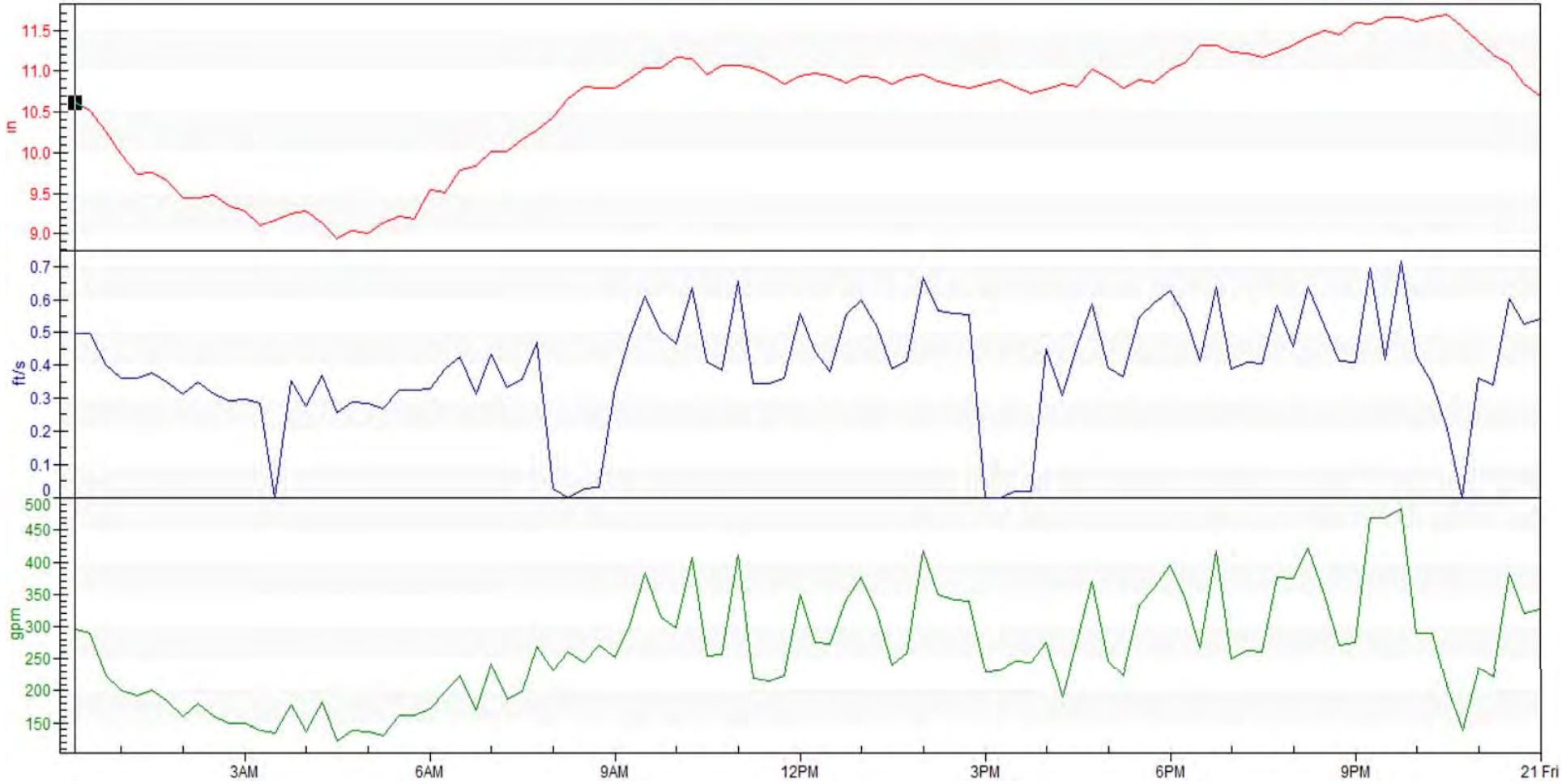
Time	Level	Velocity	Flow
12:00:00 AM	10.756	0	305.887
12:15:00 AM	10.661	0	302.345
12:30:00 AM	10.563	0.387	298.71
12:45:00 AM	10.423	0	227.243
1:00:00 AM	10.183	0	220.363
1:15:00 AM	10.12	0	218.568
1:30:00 AM	9.936	0	213.334
1:45:00 AM	9.852	0	210.924
2:00:00 AM	9.71	0	206.878
2:15:00 AM	9.631	0	204.643
2:30:00 AM	9.613	0	204.144
2:45:00 AM	9.574	0.207	108.872
3:00:00 AM	9.465	0	107.212
3:15:00 AM	9.43	0	106.682
3:30:00 AM	9.324	0	105.076
3:45:00 AM	9.371	0	105.785
4:00:00 AM	9.246	0	103.901
4:15:00 AM	9.277	0.246	123.616
4:30:00 AM	9.281	0	123.69
4:45:00 AM	9.274	0.349	175.473
5:00:00 AM	9.289	0	175.876
5:15:00 AM	9.24	0.258	174.388
5:30:00 AM	9.525	0.335	174.623
5:45:00 AM	9.633	0.647	342.136
6:00:00 AM	9.608	0	340.919
6:15:00 AM	9.668	0	343.769
6:30:00 AM	9.609	0.312	163.53
6:45:00 AM	9.868	0.391	208.158
7:00:00 AM	9.876	0.306	165.967
7:15:00 AM	10.043	0.282	157.629
7:30:00 AM	10.222	0.507	287.309
7:45:00 AM	10.379	0.459	262.828
8:00:00 AM	10.538	0.325	192.937
8:15:00 AM	10.574	0.303	179.536
8:30:00 AM	10.751	0.334	204.415
8:45:00 AM	10.956	0.644	397.46
9:00:00 AM	11.176	0.585	369.264
9:15:00 AM	11.179	0.631	406.442
9:30:00 AM	11.124	0.54	345.179
9:45:00 AM	11.112	0.59	374.907
10:00:00 AM	11.139	0.414	265.138
10:15:00 AM	11.114	0.574	365.584
10:30:00 AM	11.12	0.407	260.33
10:45:00 AM	11.106	0.577	366.267
11:00:00 AM	10.995	0.635	399.776
11:15:00 AM	11.212	0.603	403.986
11:30:00 AM	11.323	0.506	330.993
11:45:00 AM	11.091	0.567	361.227

Wednesday - P.M. 7/19/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.085	0	360.97
12:15:00 PM	11.074	0.523	357.786
12:30:00 PM	11.238	0.445	288.451
12:45:00 PM	11.341	0.481	314.287
1:00:00 PM	11.24	0.42	269.658
1:15:00 PM	11.062	0.366	230.542
1:30:00 PM	11.347	0.596	381.458
1:45:00 PM	10.977	0.465	287.857
2:00:00 PM	11.058	0.399	250.781
2:15:00 PM	10.989	0.572	358.271
2:30:00 PM	11.144	0.368	234.948
2:45:00 PM	11.108	0.363	230.237
3:00:00 PM	11.03	0.434	274.548
3:15:00 PM	10.897	0.518	321.125
3:30:00 PM	10.804	0	269.989
3:45:00 PM	10.702	0.366	222.018
4:00:00 PM	10.751	0.259	220.123
4:15:00 PM	10.825	0.375	231.577
4:30:00 PM	10.859	0.615	379.376
4:45:00 PM	10.959	0.543	338.399
5:00:00 PM	10.979	0.42	262.528
5:15:00 PM	10.963	0.44	272.346
5:30:00 PM	10.858	0.423	261.988
5:45:00 PM	10.953	0.469	293.116
6:00:00 PM	11.043	0.441	279.088
6:15:00 PM	11.077	0.584	371.639
6:30:00 PM	11.095	0.54	343.782
6:45:00 PM	11.326	0.524	342.954
7:00:00 PM	11.303	0.406	265.18
7:15:00 PM	11.161	0.621	398.424
7:30:00 PM	11.24	0.552	354.569
7:45:00 PM	11.208	0.467	301.274
8:00:00 PM	11.296	0.594	387.361
8:15:00 PM	11.252	0.63	408.775
8:30:00 PM	11.413	0.492	325.173
8:45:00 PM	11.463	0.664	441.173
9:00:00 PM	11.493	0.385	256.221
9:15:00 PM	11.593	0.62	418.512
9:30:00 PM	11.556	0.393	416.791
9:45:00 PM	11.593	0.377	254.223
10:00:00 PM	11.725	0.508	347.572
10:15:00 PM	11.706	0.365	248.438
10:30:00 PM	11.699	0.543	367.343
10:45:00 PM	11.596	0.393	265.469
11:00:00 PM	11.477	0.451	298.832
11:15:00 PM	11.379	0.578	380.807
11:30:00 PM	11.029	0	208.912
11:45:00 PM	11.072	0.546	342.511

	Inches	Feet/Sec	GPM
Daily Avg:	10.689	0.363	277.110
Daily Min:	9.24	0	103.901
Daily Max:	11.725	0.664	441.173
Peak to Avg:			1.59

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/20/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Thursday - A.M. 7/20/2023

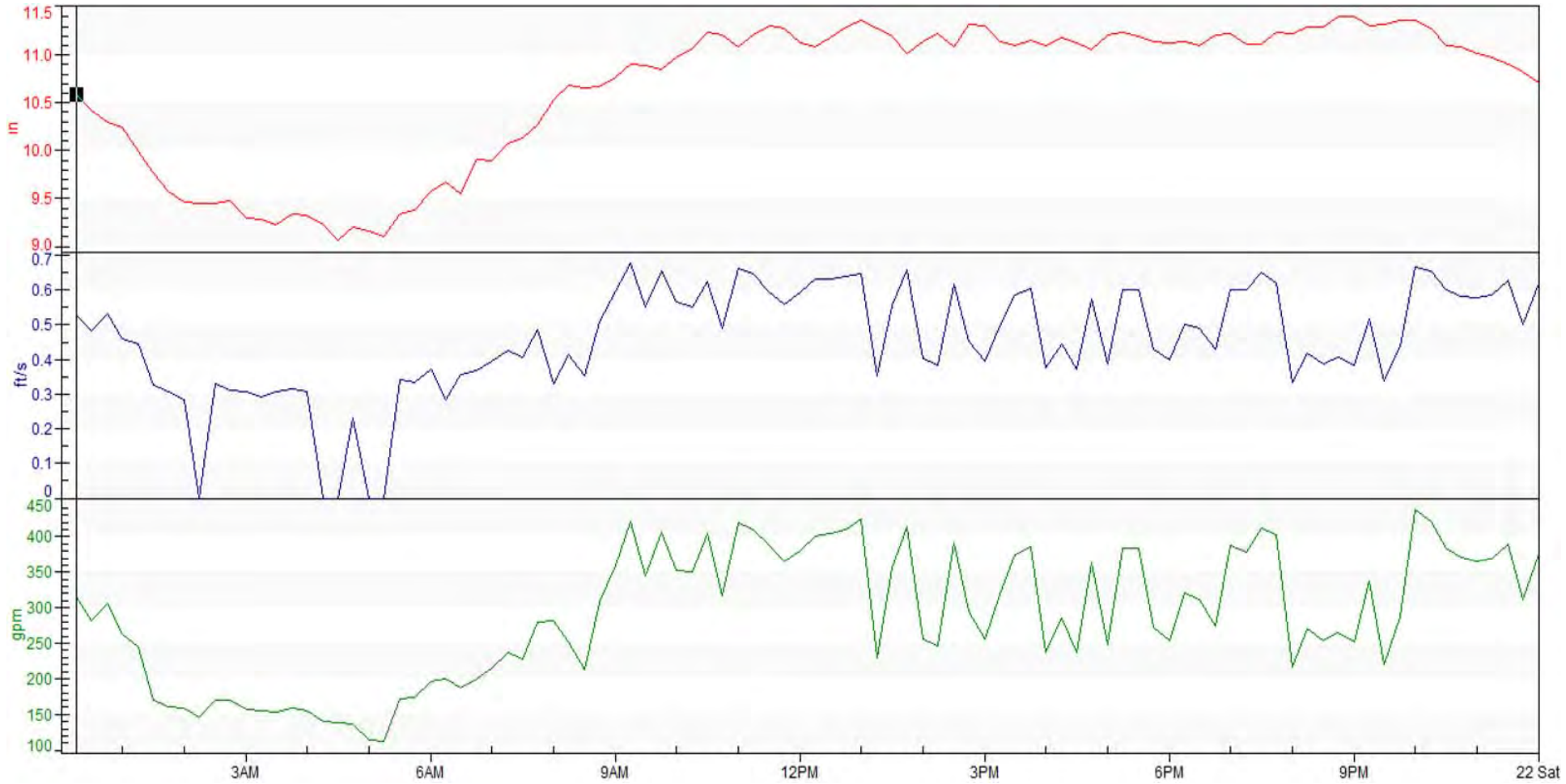
Time	Level	Velocity	Flow
12:00:00 AM	10.856	0.473	287.896
12:15:00 AM	10.62	0.496	295.316
12:30:00 AM	10.516	0.497	289.271
12:45:00 AM	10.251	0.4	224.497
1:00:00 AM	9.981	0.362	200.568
1:15:00 AM	9.744	0.362	193.264
1:30:00 AM	9.76	0.376	201.633
1:45:00 AM	9.663	0.348	183.489
2:00:00 AM	9.45	0.312	160.598
2:15:00 AM	9.443	0.35	180.187
2:30:00 AM	9.48	0.311	160.194
2:45:00 AM	9.352	0.292	148.666
3:00:00 AM	9.277	0.296	148.819
3:15:00 AM	9.104	0.284	137.99
3:30:00 AM	9.161	0	135.427
3:45:00 AM	9.242	0.354	177.173
4:00:00 AM	9.278	0.275	137.761
4:15:00 AM	9.133	0.368	181.371
4:30:00 AM	8.94	0.257	122.912
4:45:00 AM	9.038	0.287	139.345
5:00:00 AM	9.01	0.282	136.458
5:15:00 AM	9.132	0.267	129.831
5:30:00 AM	9.215	0.323	160.694
5:45:00 AM	9.191	0.324	160.881
6:00:00 AM	9.539	0.328	171.242
6:15:00 AM	9.514	0.388	198.976
6:30:00 AM	9.791	0.426	222.915
6:45:00 AM	9.841	0.311	169.321
7:00:00 AM	10.01	0.434	241.456
7:15:00 AM	10.016	0.333	185.648
7:30:00 AM	10.167	0.355	199.346
7:45:00 AM	10.276	0.468	269.887
8:00:00 AM	10.441	0.025	231.21
8:15:00 AM	10.669	0	260.871
8:30:00 AM	10.815	0.027	245.169
8:45:00 AM	10.787	0.032	271.34
9:00:00 AM	10.801	0.332	252.148
9:15:00 AM	10.903	0.488	303.935
9:30:00 AM	11.031	0.61	381.691
9:45:00 AM	11.031	0.504	314.903
10:00:00 AM	11.173	0.467	297.622
10:15:00 AM	11.15	0.634	406.486
10:30:00 AM	10.961	0.41	254.681
10:45:00 AM	11.071	0.386	256.302
11:00:00 AM	11.068	0.655	411.585
11:15:00 AM	11.038	0.346	219.064
11:30:00 AM	10.951	0.343	214.488
11:45:00 AM	10.849	0.362	223.781

Thursday - P.M. 7/20/2023

Time	Level	Velocity	Flow
12:00:00 PM	10.933	0.56	350.273
12:15:00 PM	10.973	0.44	274.849
12:30:00 PM	10.946	0.379	273.723
12:45:00 PM	10.853	0.555	341.842
1:00:00 PM	10.946	0.6	375.27
1:15:00 PM	10.92	0.518	321.107
1:30:00 PM	10.846	0.389	239.621
1:45:00 PM	10.922	0.414	258.591
2:00:00 PM	10.949	0.668	418.247
2:15:00 PM	10.869	0.564	350.257
2:30:00 PM	10.819	0.56	340.639
2:45:00 PM	10.802	0.553	340.146
3:00:00 PM	10.846	0	229.848
3:15:00 PM	10.892	0	231.13
3:30:00 PM	10.806	0.018	246.913
3:45:00 PM	10.734	0.018	245.169
4:00:00 PM	10.784	0.448	275.024
4:15:00 PM	10.844	0.309	190.596
4:30:00 PM	10.817	0.457	276.67
4:45:00 PM	11.029	0.585	369.692
5:00:00 PM	10.923	0.394	246.348
5:15:00 PM	10.79	0.363	223.34
5:30:00 PM	10.888	0.547	332.938
5:45:00 PM	10.867	0.59	360.007
6:00:00 PM	11.017	0.625	394.801
6:15:00 PM	11.106	0.551	344.014
6:30:00 PM	11.314	0.413	267.678
6:45:00 PM	11.313	0.639	417.678
7:00:00 PM	11.233	0.388	251.18
7:15:00 PM	11.212	0.408	263.525
7:30:00 PM	11.163	0.404	259.759
7:45:00 PM	11.237	0.584	376.314
8:00:00 PM	11.316	0.456	374.922
8:15:00 PM	11.404	0.639	421.043
8:30:00 PM	11.497	0.523	349.129
8:45:00 PM	11.447	0.411	271.01
9:00:00 PM	11.584	0.408	274.629
9:15:00 PM	11.573	0.697	468.567
9:30:00 PM	11.65	0.418	468.708
9:45:00 PM	11.651	0.714	483.119
10:00:00 PM	11.609	0.429	289.946
10:15:00 PM	11.649	0.346	289.348
10:30:00 PM	11.689	0.206	203.294
10:45:00 PM	11.543	0	138.329
11:00:00 PM	11.359	0.359	235.894
11:15:00 PM	11.195	0.342	220.701
11:30:00 PM	11.079	0.602	382.778
11:45:00 PM	10.835	0.525	319.984

	Inches	Feet/Sec	GPM
Daily Avg:	10.584	0.389	263.763
Daily Min:	8.94	0	122.912
Daily Max:	11.689	0.714	483.119
Peak to Avg:			1.83

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/21/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Friday - A.M. 7/21/2023

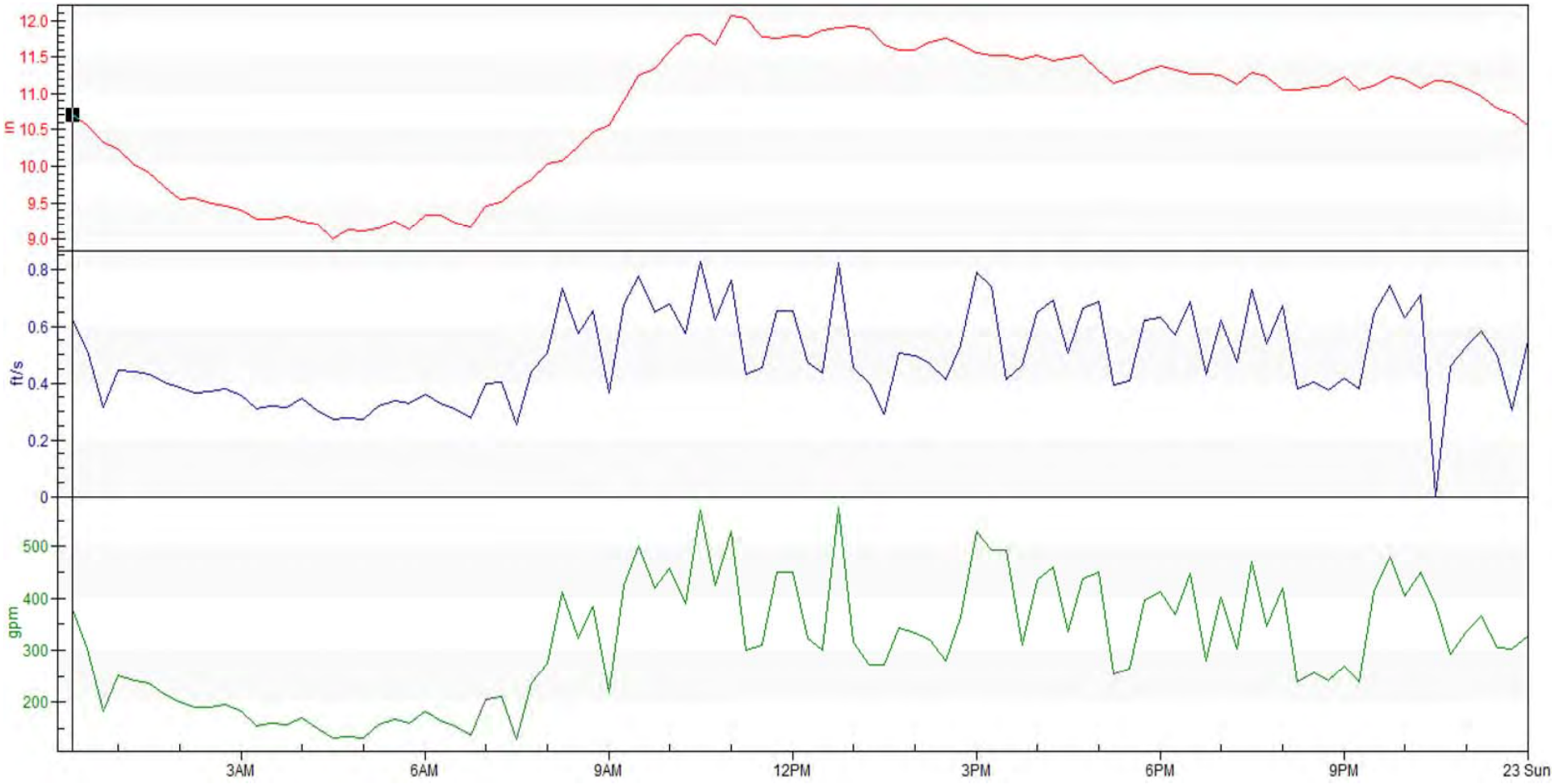
Time	Level	Velocity	Flow
12:00:00 AM	10.699	0.541	327.061
12:15:00 AM	10.583	0.527	315.311
12:30:00 AM	10.424	0.485	280.77
12:45:00 AM	10.298	0.531	305.641
1:00:00 AM	10.234	0.46	263.673
1:15:00 AM	9.997	0.446	245.362
1:30:00 AM	9.77	0.325	169.977
1:45:00 AM	9.578	0.307	161.329
2:00:00 AM	9.465	0.283	158.791
2:15:00 AM	9.449	0	145.944
2:30:00 AM	9.455	0.329	169.916
2:45:00 AM	9.48	0.313	170.524
3:00:00 AM	9.298	0.307	157.73
3:15:00 AM	9.281	0.291	154.332
3:30:00 AM	9.222	0.306	152.586
3:45:00 AM	9.34	0.314	159.191
4:00:00 AM	9.33	0.307	155.415
4:15:00 AM	9.233	0	141.077
4:30:00 AM	9.062	0	137.57
4:45:00 AM	9.2	0.23	136.589
5:00:00 AM	9.163	0	113.758
5:15:00 AM	9.11	0	112.867
5:30:00 AM	9.342	0.34	172.815
5:45:00 AM	9.375	0.335	173.345
6:00:00 AM	9.571	0.374	196.045
6:15:00 AM	9.676	0.283	198.927
6:30:00 AM	9.55	0.356	186.087
6:45:00 AM	9.901	0.369	200.38
7:00:00 AM	9.896	0.395	214.721
7:15:00 AM	10.081	0.427	236.167
7:30:00 AM	10.124	0.407	228.469
7:45:00 AM	10.262	0.486	279.914
8:00:00 AM	10.533	0.329	282.143
8:15:00 AM	10.681	0.416	252.313
8:30:00 AM	10.651	0.351	212.286
8:45:00 AM	10.668	0.51	307.206
9:00:00 AM	10.766	0.596	359.034
9:15:00 AM	10.902	0.676	421.087
9:30:00 AM	10.887	0.553	344.006
9:45:00 AM	10.854	0.655	405.828
10:00:00 AM	10.976	0.566	352.687
10:15:00 AM	11.075	0.55	349.694
10:30:00 AM	11.24	0.624	404.619
10:45:00 AM	11.216	0.489	316.336
11:00:00 AM	11.08	0.661	418.948
11:15:00 AM	11.213	0.646	410.548
11:30:00 AM	11.304	0.593	387.498
11:45:00 AM	11.281	0.56	364.485

Friday - P.M. 7/21/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.132	0.595	380.133
12:15:00 PM	11.081	0.631	401.615
12:30:00 PM	11.176	0.63	405.196
12:45:00 PM	11.298	0.64	410.405
1:00:00 PM	11.359	0.648	425.767
1:15:00 PM	11.28	0.352	228.943
1:30:00 PM	11.194	0.557	356.481
1:45:00 PM	11.012	0.657	414.625
2:00:00 PM	11.14	0.404	255.6
2:15:00 PM	11.219	0.384	246.761
2:30:00 PM	11.085	0.616	391.937
2:45:00 PM	11.316	0.45	294.498
3:00:00 PM	11.31	0.396	255.303
3:15:00 PM	11.138	0.5	319.592
3:30:00 PM	11.106	0.586	373.917
3:45:00 PM	11.155	0.603	385.179
4:00:00 PM	11.105	0.377	237.77
4:15:00 PM	11.181	0.443	285.1
4:30:00 PM	11.127	0.372	237.744
4:45:00 PM	11.055	0.575	363.832
5:00:00 PM	11.207	0.388	248.522
5:15:00 PM	11.239	0.6	383.396
5:30:00 PM	11.202	0.603	384.432
5:45:00 PM	11.146	0.43	272.544
6:00:00 PM	11.135	0.398	253.524
6:15:00 PM	11.135	0.503	321.08
6:30:00 PM	11.104	0.49	312.272
6:45:00 PM	11.208	0.429	274.683
7:00:00 PM	11.22	0.601	388.549
7:15:00 PM	11.117	0.602	379.057
7:30:00 PM	11.114	0.649	412.62
7:45:00 PM	11.237	0.622	403.017
8:00:00 PM	11.223	0.334	215.986
8:15:00 PM	11.288	0.418	271.247
8:30:00 PM	11.296	0.388	253.007
8:45:00 PM	11.405	0.405	265.341
9:00:00 PM	11.403	0.382	252.021
9:15:00 PM	11.307	0.517	337.073
9:30:00 PM	11.315	0.339	220.776
9:45:00 PM	11.369	0.437	286.429
10:00:00 PM	11.361	0.666	437.486
10:15:00 PM	11.28	0.653	420.775
10:30:00 PM	11.105	0.601	383.328
10:45:00 PM	11.088	0.583	371.225
11:00:00 PM	11.02	0.578	365.427
11:15:00 PM	10.975	0.586	368.29
11:30:00 PM	10.903	0.626	390.232
11:45:00 PM	10.827	0.503	310.744

	Inches	Feet/Sec	GPM
Daily Avg:	10.640	0.453	287.762
Daily Min:	9.062	0	112.867
Daily Max:	11.405	0.676	437.486
Peak to Avg:			1.52

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/22/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Saturday - A.M. 7/22/2023

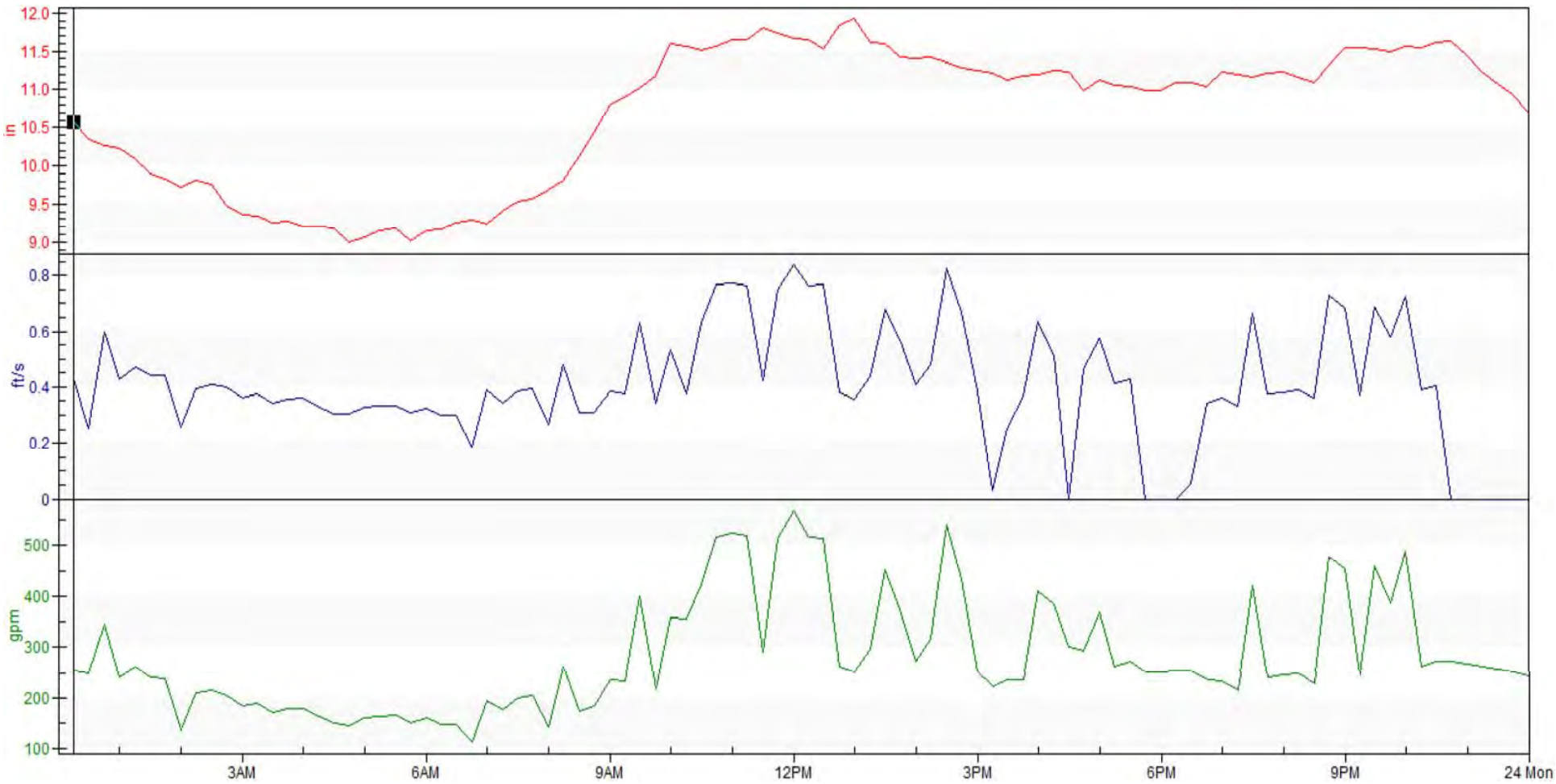
Time	Level	Velocity	Flow
12:00:00 AM	10.707	0.619	376.859
12:15:00 AM	10.705	0.623	378.83
12:30:00 AM	10.566	0.514	303.691
12:45:00 AM	10.329	0.316	183.664
1:00:00 AM	10.234	0.446	251.172
1:15:00 AM	10.02	0.438	240.771
1:30:00 AM	9.908	0.433	236.06
1:45:00 AM	9.73	0.404	215.303
2:00:00 AM	9.554	0.384	201.139
2:15:00 AM	9.561	0.364	190.079
2:30:00 AM	9.488	0.37	191.707
2:45:00 AM	9.453	0.379	195.387
3:00:00 AM	9.409	0.358	183.47
3:15:00 AM	9.283	0.309	155.375
3:30:00 AM	9.278	0.319	160.759
3:45:00 AM	9.306	0.315	158.774
4:00:00 AM	9.236	0.345	171.614
4:15:00 AM	9.203	0.301	149.804
4:30:00 AM	9.005	0.275	132.818
4:45:00 AM	9.13	0.276	135.675
5:00:00 AM	9.114	0.271	132.473
5:15:00 AM	9.151	0.318	157.229
5:30:00 AM	9.237	0.338	167.771
5:45:00 AM	9.133	0.328	161.44
6:00:00 AM	9.336	0.363	183.965
6:15:00 AM	9.339	0.326	164.474
6:30:00 AM	9.218	0.31	154.604
6:45:00 AM	9.172	0.277	136.705
7:00:00 AM	9.449	0.398	205.185
7:15:00 AM	9.518	0.404	210.198
7:30:00 AM	9.694	0.252	130.419
7:45:00 AM	9.826	0.438	236.443
8:00:00 AM	10.033	0.505	275.265
8:15:00 AM	10.072	0.735	412.745
8:30:00 AM	10.278	0.576	323.318
8:45:00 AM	10.47	0.655	384.073
9:00:00 AM	10.569	0.367	219.581
9:15:00 AM	10.915	0.68	424.251
9:30:00 AM	11.242	0.775	501.167
9:45:00 AM	11.347	0.65	420.454
10:00:00 AM	11.569	0.68	457.353
10:15:00 AM	11.796	0.574	388.426
10:30:00 AM	11.815	0.825	570.345
10:45:00 AM	11.676	0.623	424.427
11:00:00 AM	12.066	0.762	527.772
11:15:00 AM	12.033	0.431	299.252
11:30:00 AM	11.775	0.456	311.266
11:45:00 AM	11.756	0.655	448.876

Saturday - P.M. 7/22/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.802	0.653	450.64
12:15:00 PM	11.771	0.472	323.713
12:30:00 PM	11.867	0.434	300.368
12:45:00 PM	11.91	0.823	573.74
1:00:00 PM	11.922	0.452	316.114
1:15:00 PM	11.89	0.398	272.455
1:30:00 PM	11.666	0.293	270.936
1:45:00 PM	11.593	0.507	341.943
2:00:00 PM	11.59	0.494	332.884
2:15:00 PM	11.708	0.467	319.397
2:30:00 PM	11.759	0.411	280.231
2:45:00 PM	11.669	0.535	363.836
3:00:00 PM	11.56	0.789	529.511
3:15:00 PM	11.517	0.738	493.945
3:30:00 PM	11.517	0.411	493.962
3:45:00 PM	11.476	0.465	309.374
4:00:00 PM	11.515	0.65	433.944
4:15:00 PM	11.456	0.693	460.045
4:30:00 PM	11.49	0.507	335.216
4:45:00 PM	11.522	0.662	436.134
5:00:00 PM	11.305	0.688	449.219
5:15:00 PM	11.136	0.395	253.252
5:30:00 PM	11.214	0.408	263.545
5:45:00 PM	11.299	0.621	397.572
6:00:00 PM	11.386	0.631	411.829
6:15:00 PM	11.32	0.57	367.614
6:30:00 PM	11.267	0.689	446.799
6:45:00 PM	11.277	0.431	280.261
7:00:00 PM	11.249	0.62	402.337
7:15:00 PM	11.123	0.474	303.062
7:30:00 PM	11.285	0.73	470.032
7:45:00 PM	11.229	0.539	345.056
8:00:00 PM	11.043	0.672	419.319
8:15:00 PM	11.058	0.379	240.006
8:30:00 PM	11.084	0.402	255.71
8:45:00 PM	11.112	0.377	240.425
9:00:00 PM	11.24	0.417	269.479
9:15:00 PM	11.044	0.382	239.314
9:30:00 PM	11.108	0.644	411.42
9:45:00 PM	11.228	0.741	479.334
10:00:00 PM	11.195	0.631	404.698
10:15:00 PM	11.068	0.709	450.5
10:30:00 PM	11.175	0	385.39
10:45:00 PM	11.156	0.457	293.27
11:00:00 PM	11.077	0.527	334.896
11:15:00 PM	10.952	0.584	366.107
11:30:00 PM	10.791	0.496	304.227
11:45:00 PM	10.72	0.303	302.156

	Inches	Feet/Sec	GPM
Daily Avg:	10.740	0.490	312.535
Daily Min:	9.005	0	130.419
Daily Max:	12.066	0.825	573.74
Peak to Avg:			1.84

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/23/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Sunday - A.M. 7/23/2023

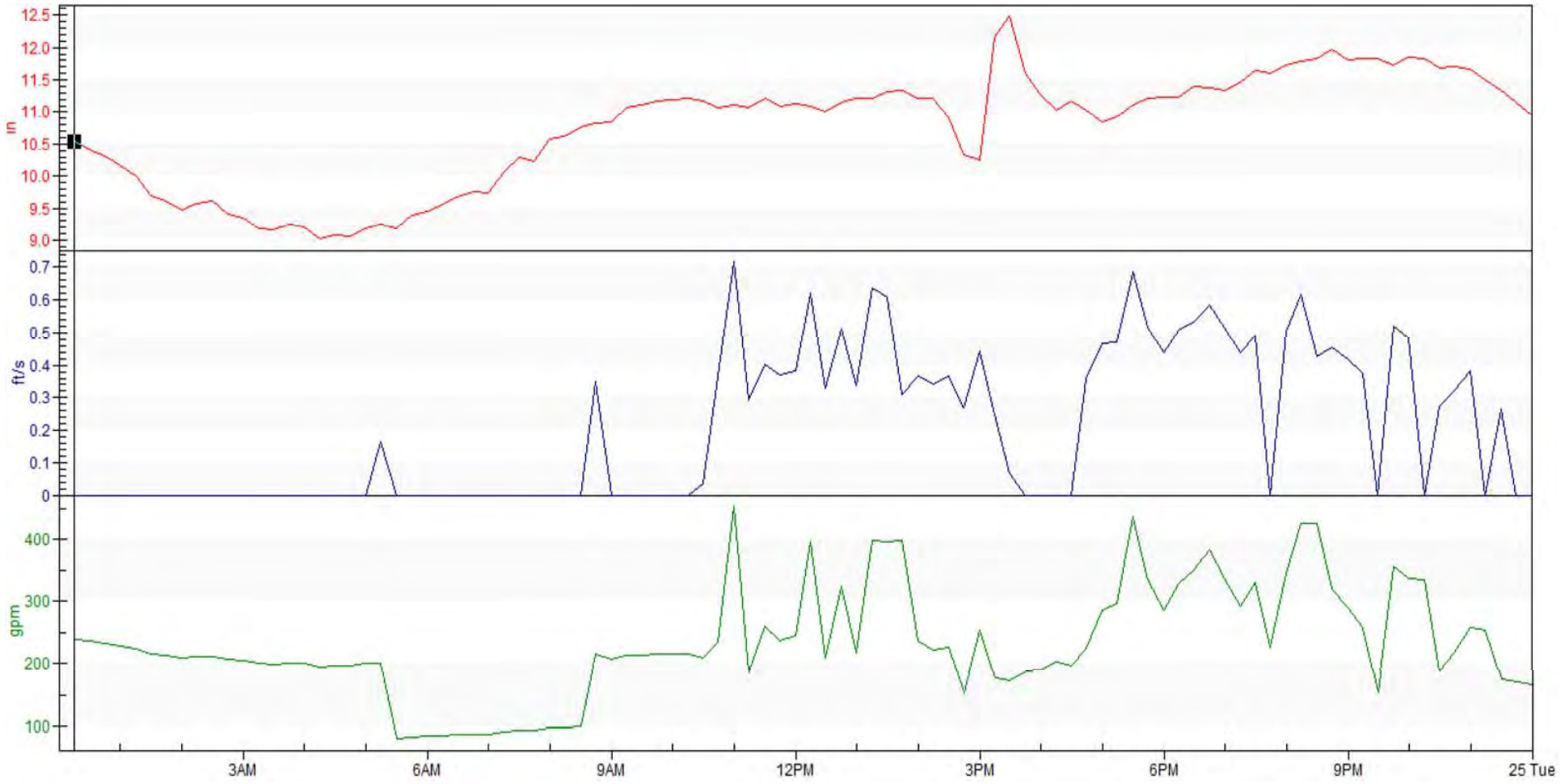
Time	Level	Velocity	Flow
12:00:00 AM	10.568	0.548	327.576
12:15:00 AM	10.568	0.429	254.559
12:30:00 AM	10.347	0.253	249.379
12:45:00 AM	10.269	0.6	345.507
1:00:00 AM	10.231	0.426	242.282
1:15:00 AM	10.089	0.472	261.903
1:30:00 AM	9.903	0.441	241.982
1:45:00 AM	9.821	0.442	239.386
2:00:00 AM	9.724	0.255	136.573
2:15:00 AM	9.811	0.395	211.2
2:30:00 AM	9.759	0.408	216.179
2:45:00 AM	9.473	0.398	204.938
3:00:00 AM	9.352	0.361	183.269
3:15:00 AM	9.351	0.374	188.754
3:30:00 AM	9.264	0.342	171.931
3:45:00 AM	9.281	0.359	178.871
4:00:00 AM	9.204	0.361	179.605
4:15:00 AM	9.209	0.329	164.087
4:30:00 AM	9.189	0.304	149.748
4:45:00 AM	8.995	0.305	146.332
5:00:00 AM	9.069	0.329	160.134
5:15:00 AM	9.149	0.333	164.512
5:30:00 AM	9.18	0.334	165.268
5:45:00 AM	9.01	0.311	149.944
6:00:00 AM	9.15	0.324	159.956
6:15:00 AM	9.169	0.302	148.074
6:30:00 AM	9.253	0.301	146.699
6:45:00 AM	9.286	0.188	114.499
7:00:00 AM	9.239	0.389	194.562
7:15:00 AM	9.405	0.344	176.144
7:30:00 AM	9.53	0.388	200.596
7:45:00 AM	9.56	0.393	206.066
8:00:00 AM	9.693	0.265	141.394
8:15:00 AM	9.814	0.482	261.589
8:30:00 AM	10.123	0.31	173.398
8:45:00 AM	10.442	0.31	182.766
9:00:00 AM	10.793	0.385	236.705
9:15:00 AM	10.908	0.374	232.847
9:30:00 AM	11.023	0.631	398.58
9:45:00 AM	11.176	0.342	217.976
10:00:00 AM	11.591	0.53	357.397
10:15:00 AM	11.563	0.378	356.288
10:30:00 AM	11.507	0.633	423.179
10:45:00 AM	11.569	0.769	517.298
11:00:00 AM	11.655	0.772	524.537
11:15:00 AM	11.657	0.765	519.318
11:30:00 AM	11.811	0.424	290.629
11:45:00 AM	11.745	0.747	512.572

Sunday - P.M. 7/23/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.67	0.838	567.821
12:15:00 PM	11.656	0.765	517.351
12:30:00 PM	11.535	0.768	514.977
12:45:00 PM	11.848	0.378	261.641
1:00:00 PM	11.929	0.359	251.328
1:15:00 PM	11.617	0.435	294.497
1:30:00 PM	11.604	0.677	451.163
1:45:00 PM	11.416	0.568	374.245
2:00:00 PM	11.415	0.411	271.9
2:15:00 PM	11.429	0.48	317.636
2:30:00 PM	11.361	0.827	539.333
2:45:00 PM	11.293	0.668	433.4
3:00:00 PM	11.26	0.387	251.659
3:15:00 PM	11.214	0.029	223.869
3:30:00 PM	11.126	0.251	235.422
3:45:00 PM	11.175	0.366	235.209
4:00:00 PM	11.199	0.636	410.646
4:15:00 PM	11.249	0.512	383.144
4:30:00 PM	11.234	0	301.893
4:45:00 PM	10.994	0.466	293.252
5:00:00 PM	11.128	0.576	368.769
5:15:00 PM	11.056	0.413	262.258
5:30:00 PM	11.04	0.429	271.22
5:45:00 PM	10.993	0	251.43
6:00:00 PM	10.987	0	251.245
6:15:00 PM	11.095	0	254.465
6:30:00 PM	11.095	0.053	254.303
6:45:00 PM	11.036	0.343	235.422
7:00:00 PM	11.233	0.362	233.149
7:15:00 PM	11.201	0.335	214.802
7:30:00 PM	11.17	0.663	421.186
7:45:00 PM	11.221	0.376	242.365
8:00:00 PM	11.231	0.382	247.355
8:15:00 PM	11.165	0.389	247.731
8:30:00 PM	11.088	0.36	229.157
8:45:00 PM	11.323	0.731	478.106
9:00:00 PM	11.545	0.681	453.628
9:15:00 PM	11.547	0.37	247.154
9:30:00 PM	11.527	0.688	458.041
9:45:00 PM	11.492	0.58	386.023
10:00:00 PM	11.566	0.728	488.191
10:15:00 PM	11.542	0.392	263.202
10:30:00 PM	11.608	0.403	272.048
10:45:00 PM	11.627	0	272.617
11:00:00 PM	11.448	0	267.231
11:15:00 PM	11.235	0	260.836
11:30:00 PM	11.083	0	256.266
11:45:00 PM	10.938	0	251.908

	Inches	Feet/Sec	GPM
Daily Avg:	10.688	0.404	281.788
Daily Min:	8.995	0	114.499
Daily Max:	11.929	0.838	567.821
Peak to Avg:			2.02

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/24/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 416 Dartmouth

Monday - A.M. 7/24/2023

Time	Level	Velocity	Velocity
12:10:00 AM	10.697	0	244.707
12:15:00 AM	10.53	0	239.71
12:30:00 AM	10.424	0	236.543
12:45:00 AM	10.304	0	232.94
1:00:00 AM	10.174	0	229.066
1:15:00 AM	10.003	0	223.99
1:30:00 AM	9.689	0	214.691
1:45:00 AM	9.619	0	212.617
2:00:00 AM	9.465	0	208.078
2:15:00 AM	9.566	0	211.072
2:30:00 AM	9.604	0	212.176
2:45:00 AM	9.413	0	206.544
3:00:00 AM	9.344	0	204.519
3:15:00 AM	9.183	0	199.803
3:30:00 AM	9.166	0	199.307
3:45:00 AM	9.237	0	201.387
4:00:00 AM	9.197	0	200.219
4:15:00 AM	9.018	0	194.98
4:30:00 AM	9.077	0	196.702
4:45:00 AM	9.06	0	196.22
5:00:00 AM	9.173	0	199.517
5:15:00 AM	9.237	0.164	201.399
5:30:00 AM	9.187	0	81.59
5:45:00 AM	9.387	0	83.981
6:00:00 AM	9.459	0	84.853
6:15:00 AM	9.544	0	85.869
6:30:00 AM	9.674	0	87.437
6:45:00 AM	9.761	0	88.482
7:00:00 AM	9.74	0	88.226
7:15:00 AM	10.066	0	92.173
7:30:00 AM	10.288	0	94.877
7:45:00 AM	10.234	0	94.216
8:00:00 AM	10.572	0	98.338
8:15:00 AM	10.612	0	98.827
8:30:00 AM	10.765	0	100.696
8:45:00 AM	10.817	0.35	215.917
9:00:00 AM	10.848	0	207.029
9:15:00 AM	11.079	0	212.804
9:30:00 AM	11.115	0	213.694
9:45:00 AM	11.176	0	215.225
10:00:00 AM	11.185	0	215.437
10:15:00 AM	11.207	0	215.982
10:30:00 AM	11.169	0.034	208.474
10:45:00 AM	11.069	0.368	233.876
11:00:00 AM	11.106	0.717	453.845
11:15:00 AM	11.073	0.294	185.051
11:30:00 AM	11.22	0.402	260.141
11:45:00 AM	11.089	0.372	236.901

Monday - P.M. 7/24/2023

Time	Level	Velocity	Flow
12:00:00 PM	11.138	0.384	245.678
12:15:00 PM	11.09	0.622	396.127
12:30:00 PM	11.01	0.331	208.776
12:45:00 PM	11.159	0.51	324.131
1:00:00 PM	11.216	0.337	216.732
1:15:00 PM	11.21	0.639	399.944
1:30:00 PM	11.313	0.607	396.873
1:45:00 PM	11.342	0.309	398.159
2:00:00 PM	11.217	0.366	236.354
2:15:00 PM	11.209	0.344	221.441
2:30:00 PM	10.907	0.364	227.046
2:45:00 PM	10.33	0.27	154.547
3:00:00 PM	10.241	0.443	253.854
3:15:00 PM	12.156	0.248	177.557
3:30:00 PM	12.487	0.066	172.544
3:45:00 PM	11.611	0	188.712
4:00:00 PM	11.276	0	190.509
4:15:00 PM	11.024	0	203.084
4:30:00 PM	11.172	0	195.898
4:45:00 PM	11.038	0.357	223.727
5:00:00 PM	10.845	0.466	286.089
5:15:00 PM	10.933	0.473	295.572
5:30:00 PM	11.118	0.685	437.05
5:45:00 PM	11.217	0.517	334.524
6:00:00 PM	11.229	0.44	284.976
6:15:00 PM	11.226	0.508	328.332
6:30:00 PM	11.397	0.532	350.753
6:45:00 PM	11.381	0.586	384.797
7:00:00 PM	11.335	0.518	336.344
7:15:00 PM	11.47	0.438	291.576
7:30:00 PM	11.654	0.491	331.287
7:45:00 PM	11.602	0	226.122
8:00:00 PM	11.725	0.505	345.375
8:15:00 PM	11.786	0.618	425.848
8:30:00 PM	11.824	0.427	427.564
8:45:00 PM	11.966	0.455	319.237
9:00:00 PM	11.808	0.42	289.76
9:15:00 PM	11.827	0.375	257.88
9:30:00 PM	11.824	0	154.073
9:45:00 PM	11.723	0.522	357.073
10:00:00 PM	11.859	0.484	335.972
10:15:00 PM	11.833	0	335.034
10:30:00 PM	11.689	0.274	186.743
10:45:00 PM	11.704	0.321	218.296
11:00:00 PM	11.667	0.381	257.696
11:15:00 PM	11.512	0	253.027
11:30:00 PM	11.343	0.265	173.904
11:45:00 PM	11.146	0	170.02

	Inches	Feet/Sec	GPM
Daily Avg:	10.744	0.206	232.653
Daily Min:	9.018	0	81.59
Daily Max:	12.487	0.717	453.845
Peak to Avg:			1.95

Sewer Line Flow Study Summary

Project: **City of Santa Paula - Sewer Flow Study**
Location: **416 Dartmouth, Santa Paula, CA**
Pipe Size: **24" VCP**
Time Period: **7/11/2023, 12:00 a.m. - 7/25/2023, 12:00 a.m.**

Level - Inches

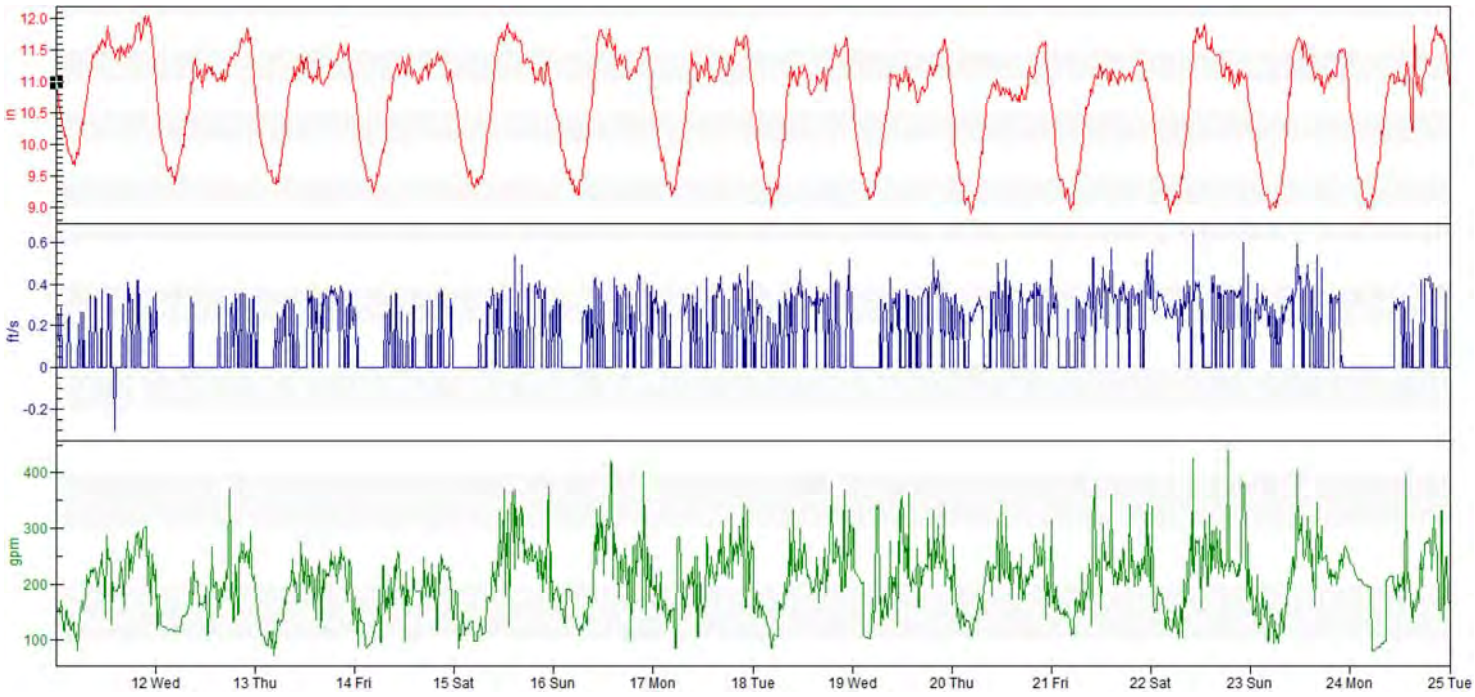
Average:	10.757
Maximum:	12.487
Minimum:	8.904
Max d/D:	52.0%

Velocity - Feet per Second

Average:	0.258
Maximum:	0.838
Minimum:	0.194

Flow Rate - Gallons Per Minute

Average:	228.388
Maximum::	573.740
Minimum:	73.413
Peak to Average	1.70



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

CITY OF SANTA PAULA - SEWER FLOW STUDY

MH Location: **224 S. Palm Ave.**
Santa Paula, CA 93060

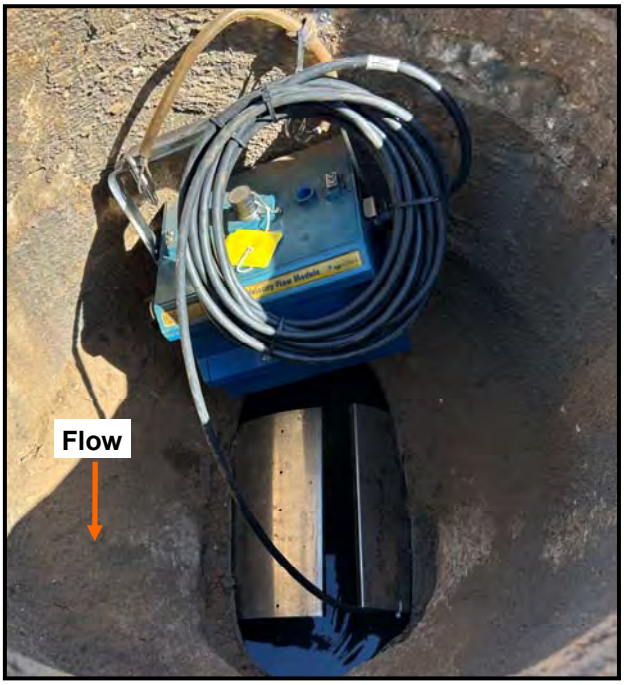
Pipe Size: **15" VCP**

Time Period: **7/11/2023 - 12:00 a.m. to**
7/25/2023- 12:00 a.m.

GPS: **34.347765, -119.070200**



Manhole - Layout



- This is a very shallow manhole, top of the VCP line is not fully opened, a special spring ring was required to install the meter inside of this line.

Equipment

Teledyne Isco 2150 Area Velocity Flow Meter with 10' measuring range:
Level Measurement:

- Method - Submerged pressure transducer mounted in the flow stream
- Transducer Type - Differential linear integrated circuit pressure transducer
- Range (standard) 0.033 to 10 ft (0.010 to 3.05 m); Maximum Allowable Level 34 ft (10.5 m)
- Accuracy ±0.01 ft from 0.033 to 10 ft, (±0.003 m from 0.01 to 3.05 m,)
- Long-Term Stability ±0.023 ft/yr (±0.007 m/yr)
- Compensated Range 32° to 122°F (0° to 50°C)

Velocity Measurement:

- Method - Doppler ultrasonic, frequency 500 kHz
- Typical Minimum Depth 0.08 ft (25 mm)
- Range -5 to +20 ft/s (-1.5 to +6.1 m/s)
- Accuracy (in water with uniform velocity profile, speed of sound = 4850 ft/s, for indicated velocity range) ±0.1 ft/s from -5 to 5 ft/s (±0.03 m/s from— 1.5 to +1.5 m/s)
- ±2% of reading from 5 to 20 ft/s (1.5 to 6.1 m/s)

Method Of Insertion:

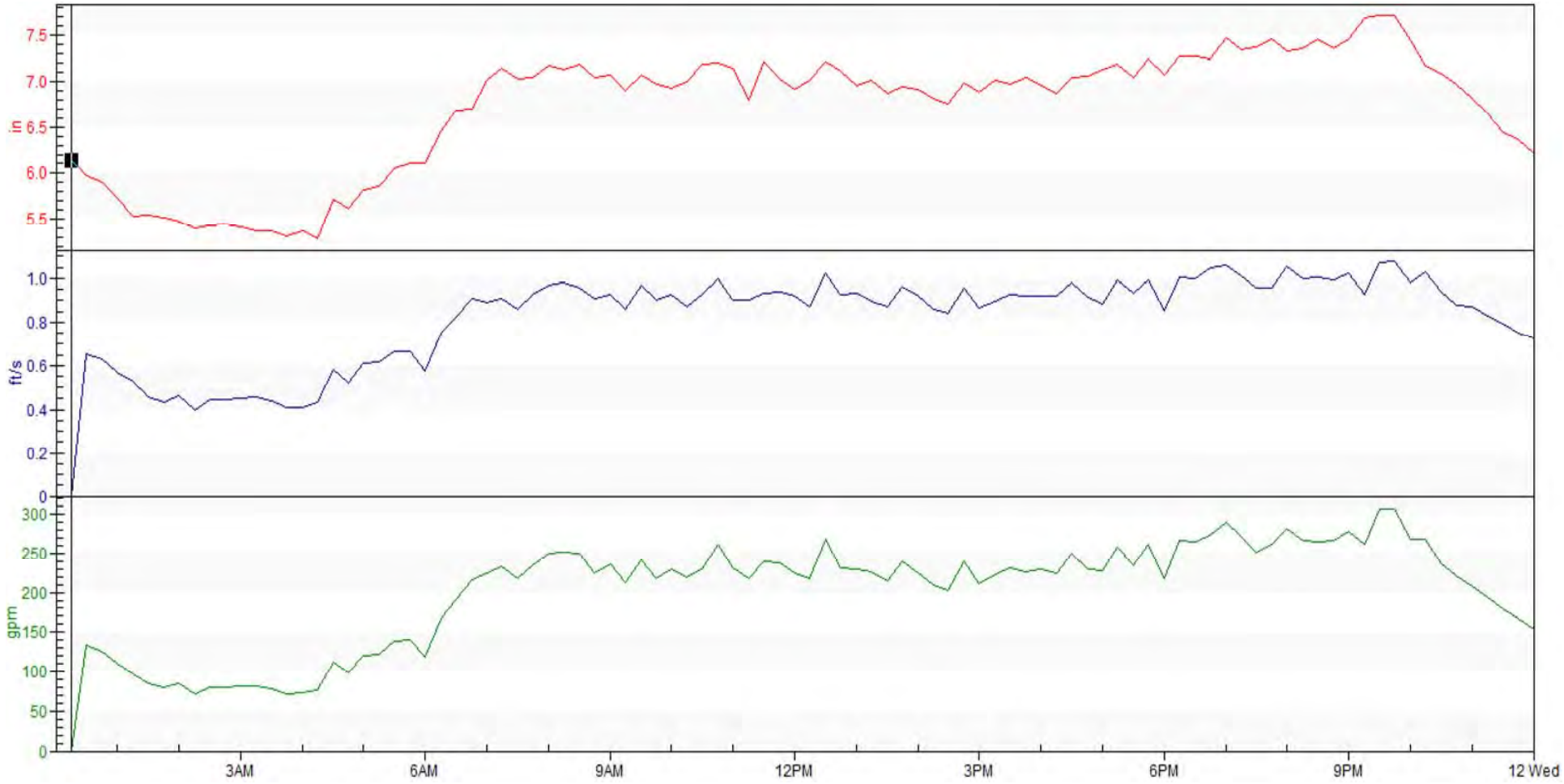
- 15 inch line did not require Confined Space Entry.

Gold Coast Environmental

Specializing in process instrumentation and calibration.

1868 Palma Drive, Suite I, Ventura, CA 93003 www.goldcoastenv.com 805.498.3811 ph.

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/11/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Tuesday- A.M. 7/11/2023

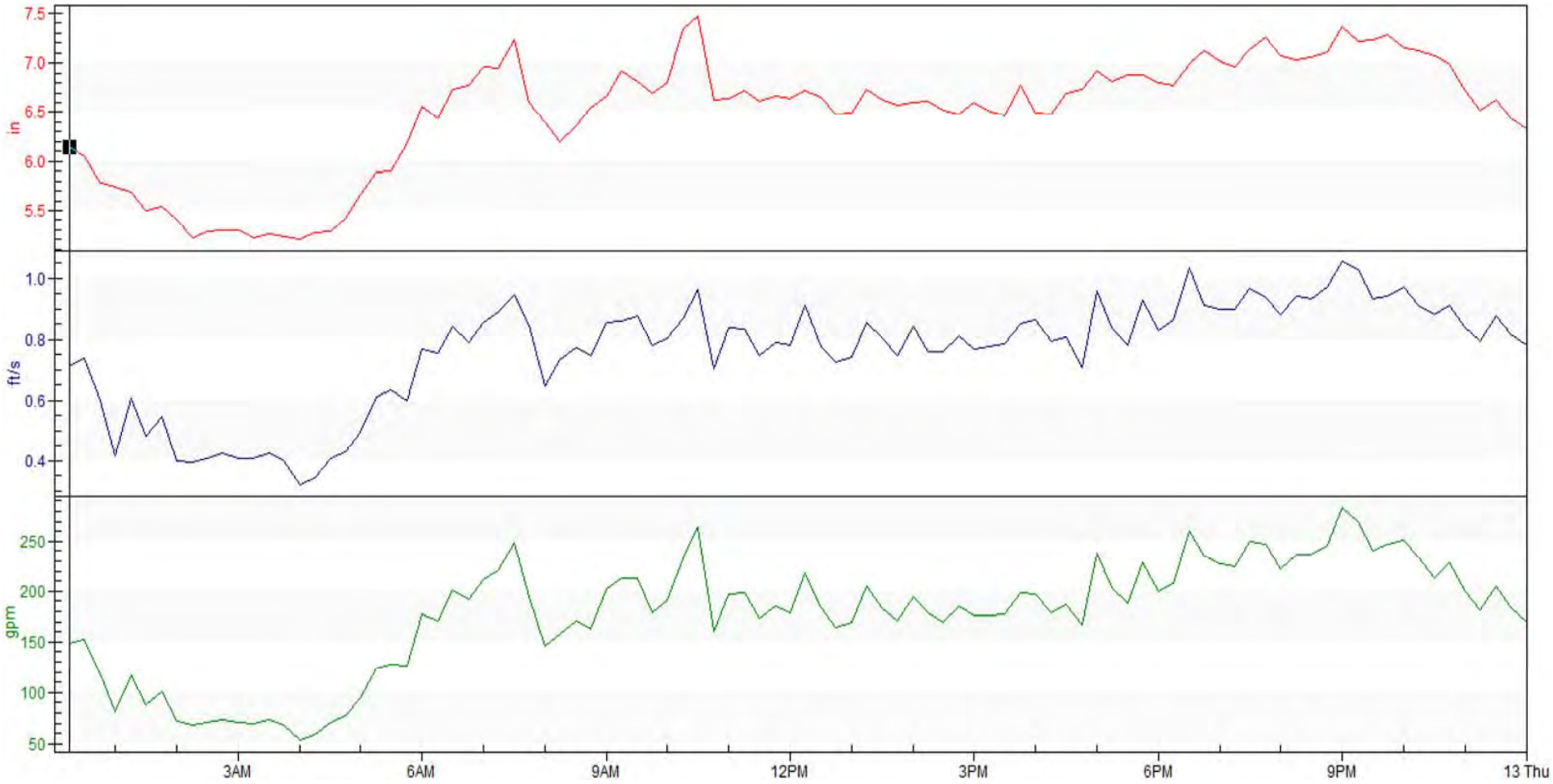
Time	Level	Velocity	Flow
12:15:00 AM	6.129	0	0
12:30:00 AM	5.972	0.654	133.776
12:45:00 AM	5.902	0.627	126.011
1:00:00 AM	5.736	0.569	110.265
1:15:00 AM	5.533	0.525	96.839
1:30:00 AM	5.551	0.46	85.299
1:45:00 AM	5.518	0.433	79.378
2:00:00 AM	5.473	0.464	84.43
2:15:00 AM	5.398	0.4	71.144
2:30:00 AM	5.426	0.449	80.336
2:45:00 AM	5.448	0.448	80.332
3:00:00 AM	5.412	0.455	81.402
3:15:00 AM	5.376	0.458	81.242
3:30:00 AM	5.374	0.438	77.732
3:45:00 AM	5.308	0.412	71.675
4:00:00 AM	5.374	0.41	72.758
4:15:00 AM	5.285	0.437	75.718
4:30:00 AM	5.725	0.579	111.905
4:45:00 AM	5.624	0.517	97.557
5:00:00 AM	5.821	0.609	120.274
5:15:00 AM	5.857	0.615	122.047
5:30:00 AM	6.054	0.664	138.335
5:45:00 AM	6.114	0.666	140.414
6:00:00 AM	6.105	0.572	119.231
6:15:00 AM	6.46	0.749	166.732
6:30:00 AM	6.685	0.826	190.249
6:45:00 AM	6.702	0.906	215.71
7:00:00 AM	7.008	0.888	224.237
7:15:00 AM	7.147	0.906	232.467
7:30:00 AM	7.028	0.861	218.19
7:45:00 AM	7.045	0.927	234.658
8:00:00 AM	7.172	0.97	249.226
8:15:00 AM	7.127	0.981	251.751
8:30:00 AM	7.188	0.954	248.92
8:45:00 AM	7.039	0.905	224.595
9:00:00 AM	7.067	0.925	236.087
9:15:00 AM	6.898	0.861	213.012
9:30:00 AM	7.071	0.969	241.544
9:45:00 AM	6.975	0.9	217.589
10:00:00 AM	6.933	0.925	230.365
10:15:00 AM	7.007	0.871	219.704
10:30:00 AM	7.192	0.925	229.825
10:45:00 AM	7.203	1	261.612
11:00:00 AM	7.141	0.903	231.434
11:15:00 AM	6.801	0.903	218.507
11:30:00 AM	7.223	0.935	239.633
11:45:00 AM	7.03	0.941	238.623

Tuesday- P.M. 7/11/2023

Time	Level	Velocity	Flow
12:00:00 PM	6.912	0.918	223.882
12:15:00 PM	7.016	0.87	217.385
12:30:00 PM	7.217	1.024	268.509
12:45:00 PM	7.111	0.925	230.476
1:00:00 PM	6.964	0.936	228.964
1:15:00 PM	7.013	0.893	225.676
1:30:00 PM	6.87	0.873	214.799
1:45:00 PM	6.94	0.961	239.509
2:00:00 PM	6.919	0.923	225.227
2:15:00 PM	6.806	0.859	208.814
2:30:00 PM	6.757	0.843	202.249
2:45:00 PM	6.982	0.954	239.733
3:00:00 PM	6.881	0.866	210.973
3:15:00 PM	7.013	0.899	222.758
3:30:00 PM	6.978	0.928	230.863
3:45:00 PM	7.04	0.922	226.783
4:00:00 PM	6.955	0.919	229.609
4:15:00 PM	6.877	0.918	225.108
4:30:00 PM	7.049	0.981	249.531
4:45:00 PM	7.057	0.917	229.938
5:00:00 PM	7.129	0.884	228.185
5:15:00 PM	7.194	0.991	258.857
5:30:00 PM	7.037	0.932	234.978
5:45:00 PM	7.25	0.994	261.801
6:00:00 PM	7.07	0.855	218.135
6:15:00 PM	7.271	1.007	266.313
6:30:00 PM	7.281	1	265.151
6:45:00 PM	7.245	1.05	272.794
7:00:00 PM	7.475	1.06	290.696
7:15:00 PM	7.348	1.014	272.067
7:30:00 PM	7.37	0.955	252.058
7:45:00 PM	7.46	0.956	261.477
8:00:00 PM	7.329	1.056	281.756
8:15:00 PM	7.363	0.997	265.869
8:30:00 PM	7.461	1.005	265.666
8:45:00 PM	7.363	0.995	266.421
9:00:00 PM	7.464	1.025	278.616
9:15:00 PM	7.685	0.926	260.758
9:30:00 PM	7.72	1.074	306.682
9:45:00 PM	7.721	1.076	307.546
10:00:00 PM	7.453	0.984	267.989
10:15:00 PM	7.168	1.03	267.694
10:30:00 PM	7.086	0.936	236.752
10:45:00 PM	6.975	0.878	220.356
11:00:00 PM	6.813	0.873	207.581
11:15:00 PM	6.653	0.827	194.995
11:30:00 PM	6.441	0.795	179.633
11:45:00 PM	6.368	0.751	167.312

	Inches	Feet/Sec	GPM
Daily Avg:	6.718	0.822	201.070
Daily Min:	5.285	0	0
Daily Max:	7.721	1.076	307.546
Peak to Avg:			1.53

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/12/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Wednesday - A.M. 7/12/2023

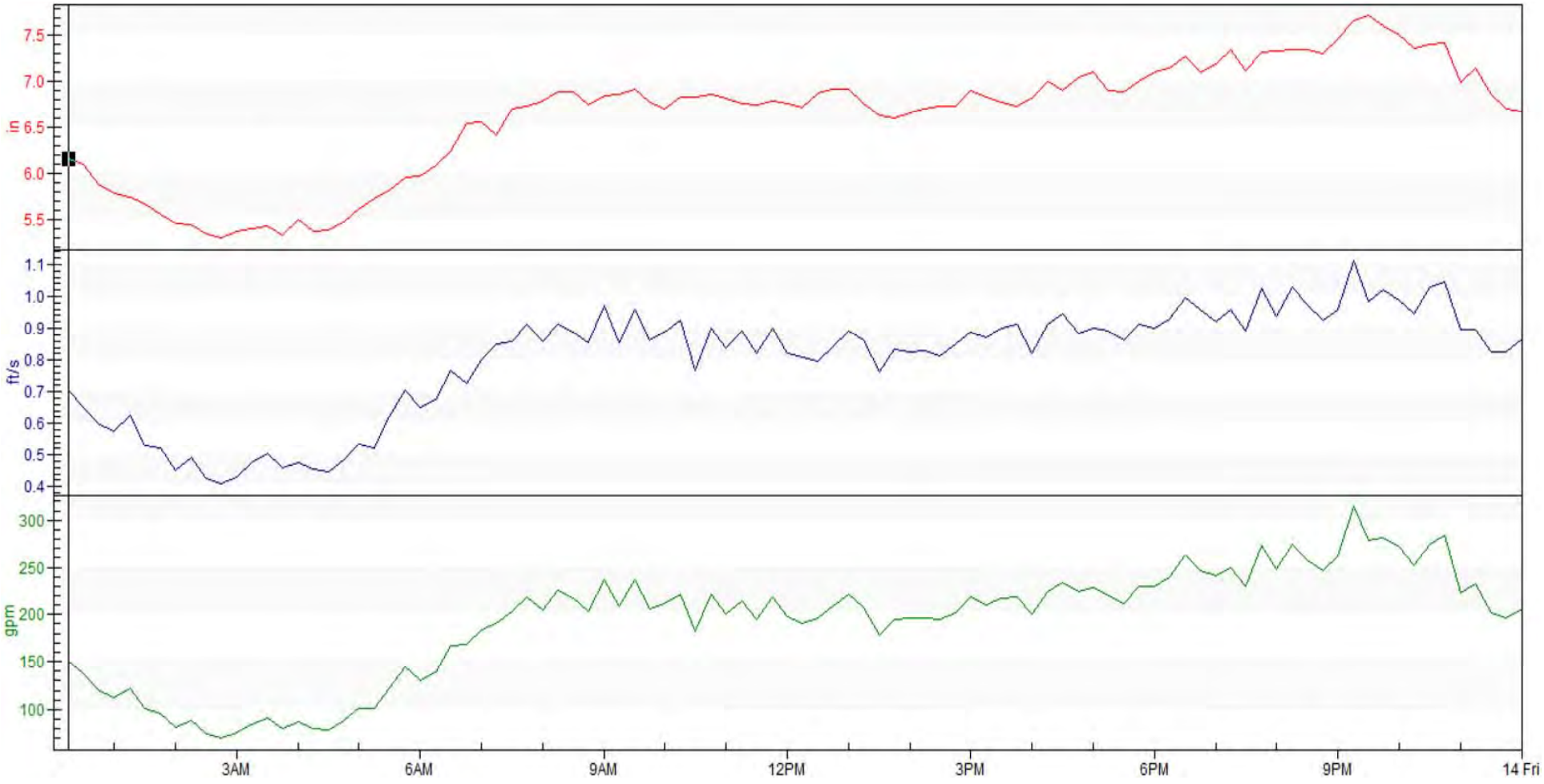
Time	Level	Velocity	Flow
12:00:00 AM	6.201	0.724	153.448
12:15:00 AM	6.14	0.712	149.048
12:30:00 AM	6.043	0.736	152.973
12:45:00 AM	5.787	0.6	117.546
1:00:00 AM	5.738	0.417	80.737
1:15:00 AM	5.687	0.607	116.151
1:30:00 AM	5.504	0.482	87.292
1:45:00 AM	5.535	0.547	101.051
2:00:00 AM	5.412	0.4	71.655
2:15:00 AM	5.219	0.397	67.656
2:30:00 AM	5.28	0.41	70.956
2:45:00 AM	5.302	0.426	73.419
3:00:00 AM	5.298	0.408	70.965
3:15:00 AM	5.222	0.407	69.449
3:30:00 AM	5.263	0.425	72.922
3:45:00 AM	5.237	0.401	68.06
4:00:00 AM	5.204	0.321	53.885
4:15:00 AM	5.275	0.344	59.362
4:30:00 AM	5.291	0.407	70.691
4:45:00 AM	5.424	0.43	77.227
5:00:00 AM	5.663	0.494	94.141
5:15:00 AM	5.887	0.614	123.092
5:30:00 AM	5.898	0.634	127.401
5:45:00 AM	6.182	0.6	125.935
6:00:00 AM	6.563	0.769	177.434
6:15:00 AM	6.438	0.755	170.475
6:30:00 AM	6.731	0.843	201.108
6:45:00 AM	6.78	0.792	191.426
7:00:00 AM	6.959	0.855	211.363
7:15:00 AM	6.95	0.888	220.603
7:30:00 AM	7.236	0.945	248.607
7:45:00 AM	6.596	0.848	194.717
8:00:00 AM	6.401	0.649	145.454
8:15:00 AM	6.198	0.733	157.427
8:30:00 AM	6.356	0.771	171.267
8:45:00 AM	6.546	0.745	162.888
9:00:00 AM	6.666	0.855	202.083
9:15:00 AM	6.92	0.859	213.373
9:30:00 AM	6.812	0.877	213.362
9:45:00 AM	6.694	0.783	178.437
10:00:00 AM	6.805	0.802	191.08
10:15:00 AM	7.342	0.868	232.563
10:30:00 AM	7.473	0.963	264.026
10:45:00 AM	6.624	0.703	160.723
11:00:00 AM	6.642	0.838	197.256
11:15:00 AM	6.723	0.835	198.306
11:30:00 AM	6.619	0.747	173.973
11:45:00 AM	6.661	0.788	185.673

Wednesday - P.M. 7/12/2023

Time	Level	Velocity	Flow
12:00:00 PM	6.638	0.783	178.56
12:15:00 PM	6.717	0.913	217.571
12:30:00 PM	6.653	0.778	183.382
12:45:00 PM	6.475	0.725	164.208
1:00:00 PM	6.488	0.741	169.077
1:15:00 PM	6.73	0.854	204.556
1:30:00 PM	6.631	0.801	182.976
1:45:00 PM	6.568	0.747	171.13
2:00:00 PM	6.596	0.843	194.916
2:15:00 PM	6.619	0.761	178.354
2:30:00 PM	6.521	0.758	169.743
2:45:00 PM	6.485	0.814	185.599
3:00:00 PM	6.596	0.769	175.444
3:15:00 PM	6.51	0.775	176.371
3:30:00 PM	6.468	0.787	176.716
3:45:00 PM	6.771	0.852	198.218
4:00:00 PM	6.492	0.863	197.038
4:15:00 PM	6.475	0.796	178.353
4:30:00 PM	6.689	0.808	187.203
4:45:00 PM	6.734	0.709	166.941
5:00:00 PM	6.921	0.961	238.564
5:15:00 PM	6.817	0.837	203.779
5:30:00 PM	6.881	0.783	188.012
5:45:00 PM	6.88	0.93	229.106
6:00:00 PM	6.799	0.83	200.057
6:15:00 PM	6.781	0.865	207.122
6:30:00 PM	6.99	1.032	259.715
6:45:00 PM	7.126	0.913	235.415
7:00:00 PM	7.019	0.898	227.075
7:15:00 PM	6.961	0.9	225.138
7:30:00 PM	7.135	0.969	250.334
7:45:00 PM	7.251	0.939	247.769
8:00:00 PM	7.076	0.882	221.891
8:15:00 PM	7.033	0.942	236.848
8:30:00 PM	7.056	0.931	237.104
8:45:00 PM	7.116	0.971	246.043
9:00:00 PM	7.363	1.055	283.725
9:15:00 PM	7.224	1.029	269.394
9:30:00 PM	7.236	0.933	241.017
9:45:00 PM	7.285	0.94	247.551
10:00:00 PM	7.147	0.971	251.295
10:15:00 PM	7.122	0.91	234.498
10:30:00 PM	7.069	0.879	213.072
10:45:00 PM	6.983	0.91	228.531
11:00:00 PM	6.726	0.838	200.401
11:15:00 PM	6.515	0.793	181.852
11:30:00 PM	6.63	0.875	205.425
11:45:00 PM	6.438	0.818	183.61

	Inches	Feet/Sec	GPM
Daily Avg:	6.491	0.759	177.010
Daily Min:	5.204	0.321	53.885
Daily Max:	7.473	1.055	283.725
Peak to Avg:			1.60

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/13/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Thursday - A.M. 7/13/2023

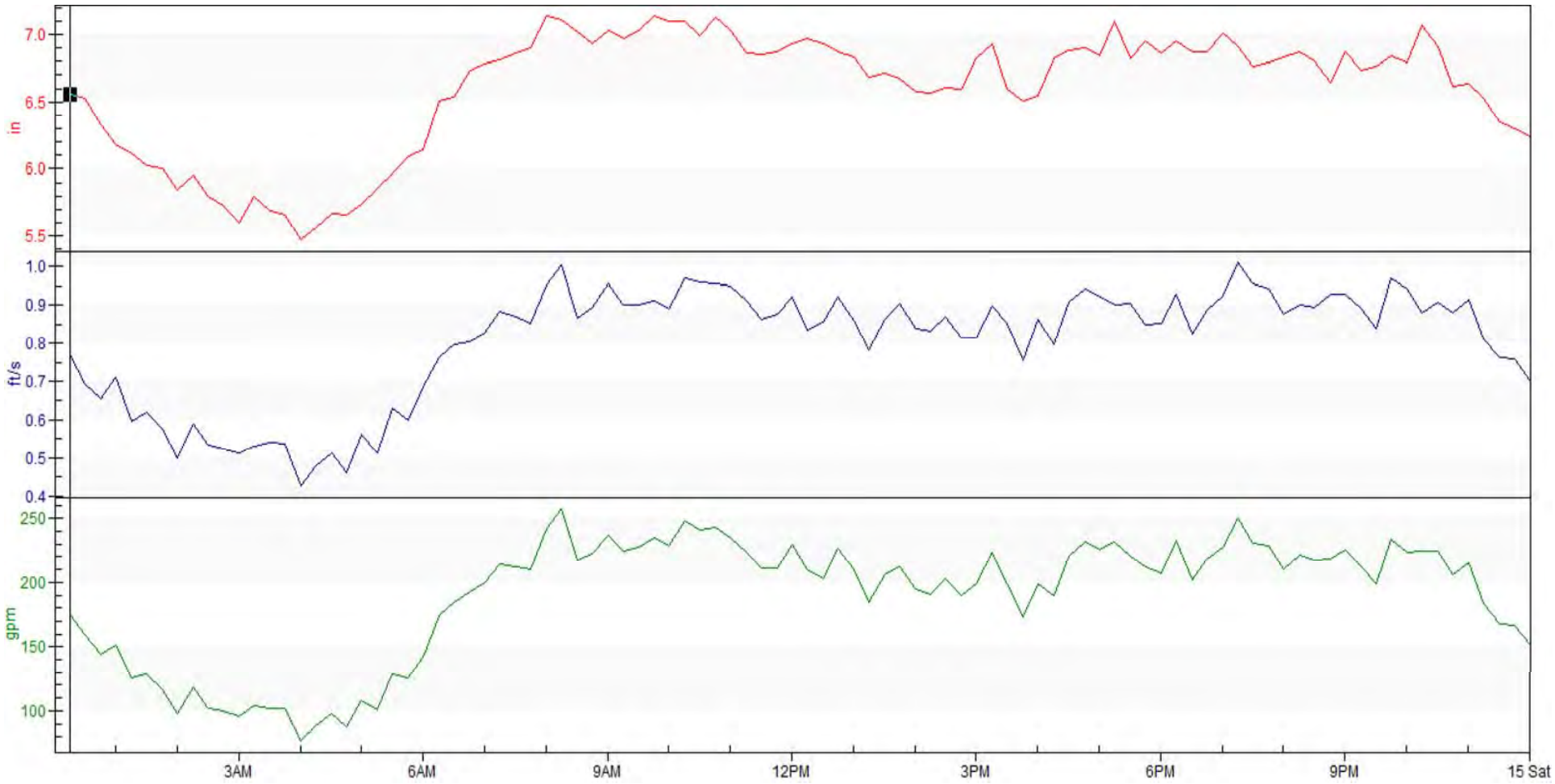
Time	Level	Velocity	Flow
12:00:00 AM	6.326	0.781	169.149
12:15:00 AM	6.161	0.703	149.807
12:30:00 AM	6.099	0.652	137.209
12:45:00 AM	5.873	0.596	118.661
1:00:00 AM	5.786	0.576	112.03
1:15:00 AM	5.745	0.626	121.472
1:30:00 AM	5.666	0.53	101.012
1:45:00 AM	5.549	0.522	96.251
2:00:00 AM	5.45	0.45	81.254
2:15:00 AM	5.44	0.493	88.675
2:30:00 AM	5.333	0.425	74.604
2:45:00 AM	5.295	0.409	70.732
3:00:00 AM	5.365	0.432	76.39
3:15:00 AM	5.396	0.477	84.396
3:30:00 AM	5.429	0.505	90.882
3:45:00 AM	5.32	0.46	80.445
4:00:00 AM	5.498	0.478	87.373
4:15:00 AM	5.367	0.453	80.286
4:30:00 AM	5.38	0.446	79.167
4:45:00 AM	5.464	0.486	88.119
5:00:00 AM	5.61	0.535	100.505
5:15:00 AM	5.724	0.52	100.511
5:30:00 AM	5.807	0.621	122.334
5:45:00 AM	5.954	0.707	143.948
6:00:00 AM	5.97	0.652	130.53
6:15:00 AM	6.092	0.676	138.483
6:30:00 AM	6.238	0.768	166.507
6:45:00 AM	6.551	0.728	168.205
7:00:00 AM	6.565	0.801	183.53
7:15:00 AM	6.414	0.849	190.782
7:30:00 AM	6.699	0.858	203.396
7:45:00 AM	6.73	0.913	218.672
8:00:00 AM	6.788	0.861	204.739
8:15:00 AM	6.89	0.912	225.285
8:30:00 AM	6.891	0.889	217.24
8:45:00 AM	6.75	0.855	202.595
9:00:00 AM	6.844	0.97	237.442
9:15:00 AM	6.858	0.856	208.565
9:30:00 AM	6.913	0.957	236.532
9:45:00 AM	6.779	0.862	205.611
10:00:00 AM	6.704	0.886	211.006
10:15:00 AM	6.832	0.927	220.859
10:30:00 AM	6.831	0.768	182.661
10:45:00 AM	6.856	0.9	220.705
11:00:00 AM	6.816	0.837	199.856
11:15:00 AM	6.759	0.892	214.755
11:30:00 AM	6.75	0.822	195.234
11:45:00 AM	6.79	0.901	218.193

Thursday - P.M. 7/13/2023

Time	Level	Velocity	Flow
12:00:00 PM	6.759	0.823	198.174
12:15:00 PM	6.719	0.811	191.121
12:30:00 PM	6.873	0.797	195.522
12:45:00 PM	6.911	0.844	209.271
1:00:00 PM	6.918	0.893	221.7
1:15:00 PM	6.753	0.861	207.211
1:30:00 PM	6.626	0.761	177.354
1:45:00 PM	6.605	0.832	194.501
2:00:00 PM	6.662	0.828	195.544
2:15:00 PM	6.699	0.831	196.077
2:30:00 PM	6.729	0.815	195.033
2:45:00 PM	6.729	0.852	202.232
3:00:00 PM	6.909	0.89	218.277
3:15:00 PM	6.833	0.872	210.337
3:30:00 PM	6.767	0.902	216.979
3:45:00 PM	6.737	0.914	219.121
4:00:00 PM	6.821	0.823	200.51
4:15:00 PM	6.999	0.914	224.589
4:30:00 PM	6.908	0.945	234.103
4:45:00 PM	7.049	0.884	224.473
5:00:00 PM	7.101	0.9	228.312
5:15:00 PM	6.91	0.89	219.798
5:30:00 PM	6.889	0.861	211.838
5:45:00 PM	7.001	0.914	230.278
6:00:00 PM	7.099	0.9	229.797
6:15:00 PM	7.152	0.93	239.162
6:30:00 PM	7.277	0.996	263.91
6:45:00 PM	7.108	0.961	246.36
7:00:00 PM	7.197	0.92	240.362
7:15:00 PM	7.351	0.96	250.014
7:30:00 PM	7.119	0.893	229.897
7:45:00 PM	7.326	1.024	273.501
8:00:00 PM	7.334	0.937	248.154
8:15:00 PM	7.353	1.03	274.889
8:30:00 PM	7.351	0.976	257.081
8:45:00 PM	7.311	0.926	246.93
9:00:00 PM	7.462	0.958	262.19
9:15:00 PM	7.659	1.113	314.718
9:30:00 PM	7.722	0.984	278.427
9:45:00 PM	7.604	1.021	281.535
10:00:00 PM	7.502	0.988	272.291
10:15:00 PM	7.356	0.945	251.856
10:30:00 PM	7.402	1.028	274.952
10:45:00 PM	7.419	1.048	284.643
11:00:00 PM	6.986	0.898	222.373
11:15:00 PM	7.146	0.898	232.483
11:30:00 PM	6.862	0.826	201.946
11:45:00 PM	6.707	0.826	195.659

	Inches	Feet/Sec	GPM
Daily Avg:	6.608	0.801	191.399
Daily Min:	5.295	0.409	70.732
Daily Max:	7.722	1.113	314.718
Peak to Avg:			1.64

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/14/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Friday - A.M. 7/14/2023

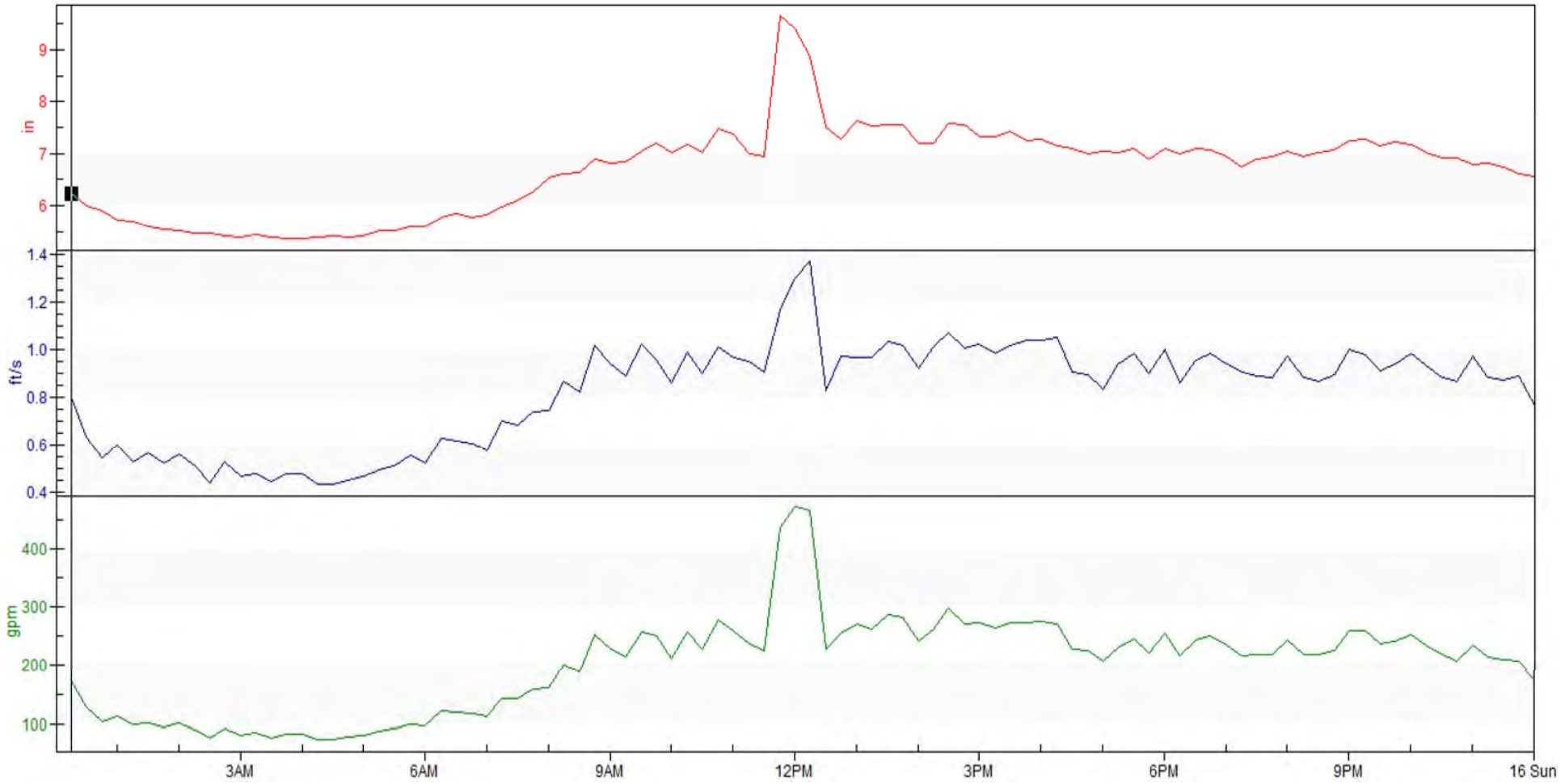
Time	Level	Velocity	Flow
12:00:00 AM	6.677	0.867	205.407
12:15:00 AM	6.554	0.77	175.321
12:30:00 AM	6.522	0.694	159.566
12:45:00 AM	6.329	0.654	144.536
1:00:00 AM	6.18	0.71	151.542
1:15:00 AM	6.11	0.597	125.846
1:30:00 AM	6.024	0.62	128.289
1:45:00 AM	6.003	0.577	116.151
2:00:00 AM	5.851	0.499	97.556
2:15:00 AM	5.952	0.589	118.907
2:30:00 AM	5.799	0.534	102.426
2:45:00 AM	5.73	0.524	100.234
3:00:00 AM	5.6	0.513	95.42
3:15:00 AM	5.798	0.531	104.284
3:30:00 AM	5.689	0.539	101.484
3:45:00 AM	5.656	0.536	101.607
4:00:00 AM	5.472	0.426	77.462
4:15:00 AM	5.562	0.479	89.026
4:30:00 AM	5.671	0.515	97.559
4:45:00 AM	5.662	0.46	87.47
5:00:00 AM	5.737	0.56	108.547
5:15:00 AM	5.853	0.514	100.607
5:30:00 AM	5.97	0.629	128.622
5:45:00 AM	6.097	0.6	126.141
6:00:00 AM	6.141	0.686	142.428
6:15:00 AM	6.507	0.763	174.05
6:30:00 AM	6.534	0.798	183.904
6:45:00 AM	6.734	0.803	192.52
7:00:00 AM	6.783	0.827	200.125
7:15:00 AM	6.81	0.883	214.715
7:30:00 AM	6.859	0.869	212.374
7:45:00 AM	6.896	0.852	210.509
8:00:00 AM	7.138	0.953	242.397
8:15:00 AM	7.106	1.004	257.351
8:30:00 AM	7.02	0.866	217.014
8:45:00 AM	6.929	0.894	222.239
9:00:00 AM	7.031	0.955	237.094
9:15:00 AM	6.967	0.901	224.249
9:30:00 AM	7.027	0.9	227.909
9:45:00 AM	7.137	0.91	235.186
10:00:00 AM	7.101	0.89	228.545
10:15:00 AM	7.096	0.97	248.774
10:30:00 AM	6.991	0.96	241.492
10:45:00 AM	7.131	0.956	243.087
11:00:00 AM	7.027	0.948	234.473
11:15:00 AM	6.866	0.911	223.955
11:30:00 AM	6.847	0.864	211.608
11:45:00 AM	6.868	0.877	211.089

Friday - P.M. 7/14/2023

Time	Level	Velocity	Flow
12:00:00 PM	6.932	0.923	229.721
12:15:00 PM	6.973	0.837	209.84
12:30:00 PM	6.931	0.855	203.255
12:45:00 PM	6.87	0.921	226.292
1:00:00 PM	6.837	0.86	210.227
1:15:00 PM	6.685	0.782	184.138
1:30:00 PM	6.714	0.862	205.79
1:45:00 PM	6.674	0.905	211.778
2:00:00 PM	6.578	0.84	195.224
2:15:00 PM	6.566	0.832	190.418
2:30:00 PM	6.601	0.869	202.545
2:45:00 PM	6.597	0.815	190.058
3:00:00 PM	6.827	0.813	198.465
3:15:00 PM	6.933	0.898	223.585
3:30:00 PM	6.6	0.851	198.733
3:45:00 PM	6.508	0.756	173.156
4:00:00 PM	6.546	0.862	198.95
4:15:00 PM	6.818	0.797	190.026
4:30:00 PM	6.883	0.907	220.509
4:45:00 PM	6.899	0.942	231.677
5:00:00 PM	6.841	0.921	225.219
5:15:00 PM	7.098	0.903	231.361
5:30:00 PM	6.824	0.905	220.56
5:45:00 PM	6.952	0.849	212.034
6:00:00 PM	6.862	0.851	206.956
6:15:00 PM	6.955	0.93	232.39
6:30:00 PM	6.87	0.825	202.355
6:45:00 PM	6.875	0.887	218.316
7:00:00 PM	7.014	0.926	227.203
7:15:00 PM	6.91	1.012	250.817
7:30:00 PM	6.765	0.957	230.641
7:45:00 PM	6.789	0.944	228.656
8:00:00 PM	6.831	0.876	210.065
8:15:00 PM	6.876	0.899	221.43
8:30:00 PM	6.805	0.895	217.444
8:45:00 PM	6.645	0.928	218.533
9:00:00 PM	6.873	0.928	225.3
9:15:00 PM	6.733	0.889	212.134
9:30:00 PM	6.767	0.839	198.975
9:45:00 PM	6.842	0.97	234.164
10:00:00 PM	6.794	0.942	223.4
10:15:00 PM	7.072	0.88	224.83
10:30:00 PM	6.909	0.908	225.092
10:45:00 PM	6.615	0.88	205.945
11:00:00 PM	6.635	0.916	215.228
11:15:00 PM	6.53	0.81	183.121
11:30:00 PM	6.353	0.761	167.792
11:45:00 PM	6.299	0.758	166.425

	Inches	Feet/Sec	GPM
Daily Avg:	6.597	0.804	189.542
Daily Min:	5.472	0.426	77.462
Daily Max:	7.138	1.012	257.351
Peak to Avg:			1.36

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/15/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Saturday - A.M. 7/15/2023

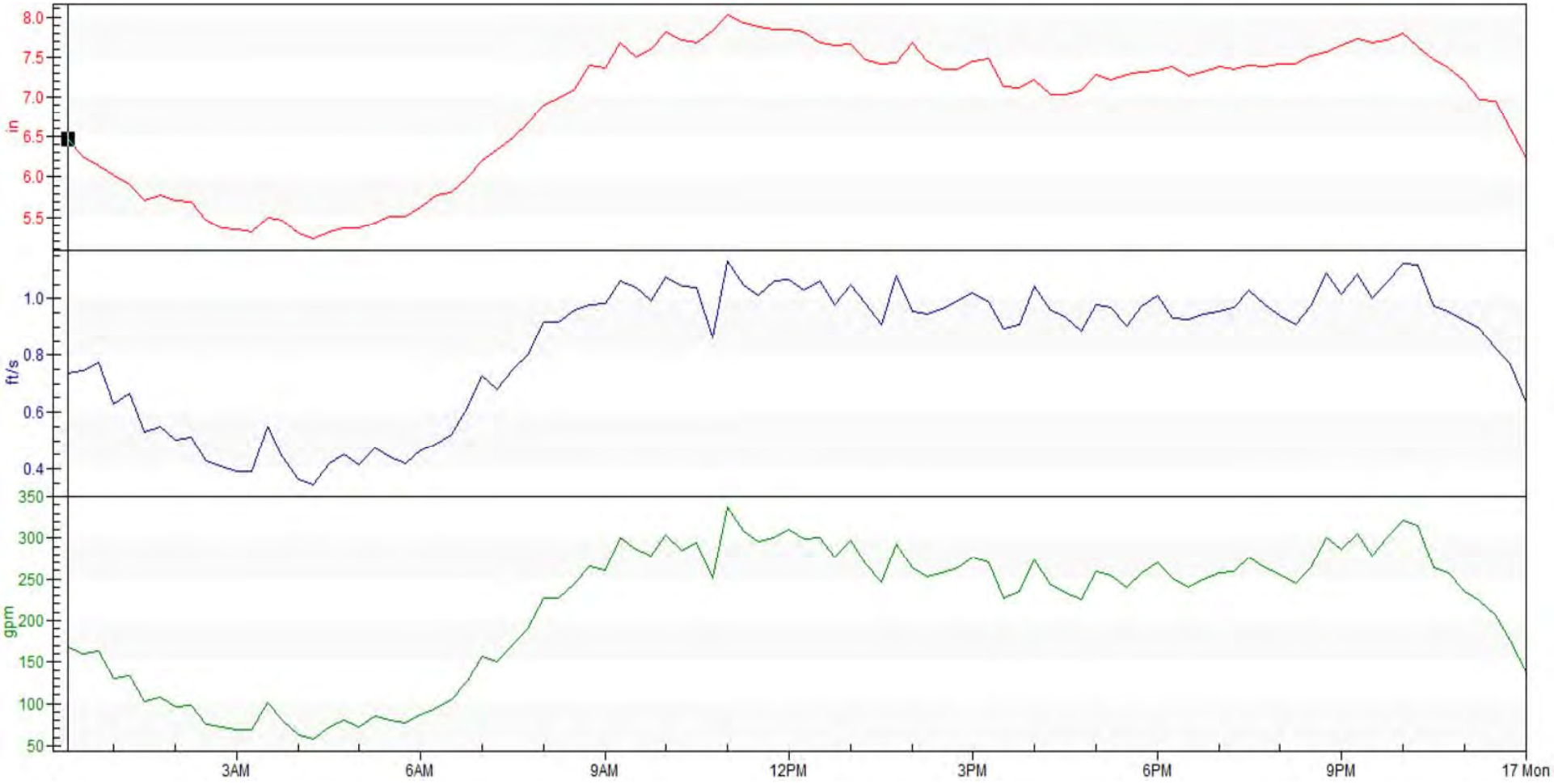
Time	Level	Velocity	Flow
12:00:00 AM	6.24	0.699	151.565
12:15:00 AM	6.233	0.797	172.425
12:30:00 AM	6.006	0.632	130.182
12:45:00 AM	5.895	0.544	105.238
1:00:00 AM	5.72	0.598	114.874
1:15:00 AM	5.691	0.527	100.92
1:30:00 AM	5.587	0.562	104.02
1:45:00 AM	5.546	0.52	96.262
2:00:00 AM	5.532	0.557	102.78
2:15:00 AM	5.464	0.509	92.352
2:30:00 AM	5.479	0.437	78.061
2:45:00 AM	5.41	0.524	93.224
3:00:00 AM	5.394	0.466	82.816
3:15:00 AM	5.447	0.477	86.177
3:30:00 AM	5.391	0.441	78.558
3:45:00 AM	5.368	0.477	84.545
4:00:00 AM	5.377	0.474	84.061
4:15:00 AM	5.399	0.431	76.401
4:30:00 AM	5.409	0.431	76.606
4:45:00 AM	5.385	0.447	79.437
5:00:00 AM	5.431	0.465	82.652
5:15:00 AM	5.51	0.49	89.851
5:30:00 AM	5.534	0.506	93.37
5:45:00 AM	5.592	0.553	101.901
6:00:00 AM	5.596	0.521	97.615
6:15:00 AM	5.778	0.627	122.585
6:30:00 AM	5.852	0.616	120.943
6:45:00 AM	5.778	0.603	117.949
7:00:00 AM	5.822	0.578	114.177
7:15:00 AM	5.967	0.7	142.9
7:30:00 AM	6.111	0.679	143.209
7:45:00 AM	6.265	0.738	160.46
8:00:00 AM	6.542	0.744	160.989
8:15:00 AM	6.612	0.867	199.783
8:30:00 AM	6.64	0.819	189.04
8:45:00 AM	6.9	1.016	251.452
9:00:00 AM	6.808	0.938	228.132
9:15:00 AM	6.837	0.885	213.187
9:30:00 AM	7.033	1.019	257.702
9:45:00 AM	7.197	0.956	249.626
10:00:00 AM	7.016	0.862	212.781
10:15:00 AM	7.182	0.985	256.738
10:30:00 AM	7.018	0.895	226.424
10:45:00 AM	7.467	1.01	276.361
11:00:00 AM	7.364	0.966	259.897
11:15:00 AM	6.991	0.947	236.838
11:30:00 AM	6.941	0.903	224.334
11:45:00 AM	9.657	1.165	436.863

Saturday - P.M. 7/15/2023

Time	Level	Velocity	Flow
12:00:00 PM	9.396	1.298	471.466
12:15:00 PM	8.863	1.371	464.305
12:30:00 PM	7.509	0.825	227.643
12:45:00 PM	7.272	0.968	254.357
1:00:00 PM	7.637	0.964	270.347
1:15:00 PM	7.516	0.965	262.594
1:30:00 PM	7.55	1.032	286.73
1:45:00 PM	7.548	1.017	282.403
2:00:00 PM	7.201	0.919	240.193
2:15:00 PM	7.186	1.006	261.913
2:30:00 PM	7.564	1.071	298.135
2:45:00 PM	7.557	1.005	270.325
3:00:00 PM	7.329	1.018	272.017
3:15:00 PM	7.335	0.983	263.177
3:30:00 PM	7.418	1.015	272.95
3:45:00 PM	7.245	1.038	273.57
4:00:00 PM	7.277	1.037	274.649
4:15:00 PM	7.146	1.047	269.573
4:30:00 PM	7.086	0.903	227.525
4:45:00 PM	6.991	0.893	224.828
5:00:00 PM	7.041	0.828	207.763
5:15:00 PM	7.006	0.936	230.272
5:30:00 PM	7.092	0.979	245.917
5:45:00 PM	6.881	0.896	220.897
6:00:00 PM	7.093	1	255.107
6:15:00 PM	6.982	0.86	215.731
6:30:00 PM	7.093	0.956	243.559
6:45:00 PM	7.071	0.982	250.657
7:00:00 PM	6.938	0.937	233.457
7:15:00 PM	6.732	0.905	216.736
7:30:00 PM	6.89	0.888	219.007
7:45:00 PM	6.943	0.879	219.136
8:00:00 PM	7.041	0.971	242.972
8:15:00 PM	6.955	0.879	218.373
8:30:00 PM	7.024	0.865	218.95
8:45:00 PM	7.064	0.89	225.492
9:00:00 PM	7.236	0.998	260.2
9:15:00 PM	7.27	0.977	258.496
9:30:00 PM	7.156	0.911	236.245
9:45:00 PM	7.216	0.937	242.225
10:00:00 PM	7.158	0.983	253.022
10:15:00 PM	7.011	0.934	234.554
10:30:00 PM	6.915	0.879	217.351
10:45:00 PM	6.909	0.862	206.58
11:00:00 PM	6.792	0.969	234.706
11:15:00 PM	6.803	0.881	213.842
11:30:00 PM	6.743	0.872	209.382
11:45:00 PM	6.615	0.886	207.333

	Inches	Feet/Sec	GPM
Daily Avg:	6.689	0.821	202.246
Daily Min:	5.368	0.431	76.401
Daily Max:	9.657	1.371	471.466
Peak to Avg:			2.33

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/16/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Sunday - A.M. 7/16/2023

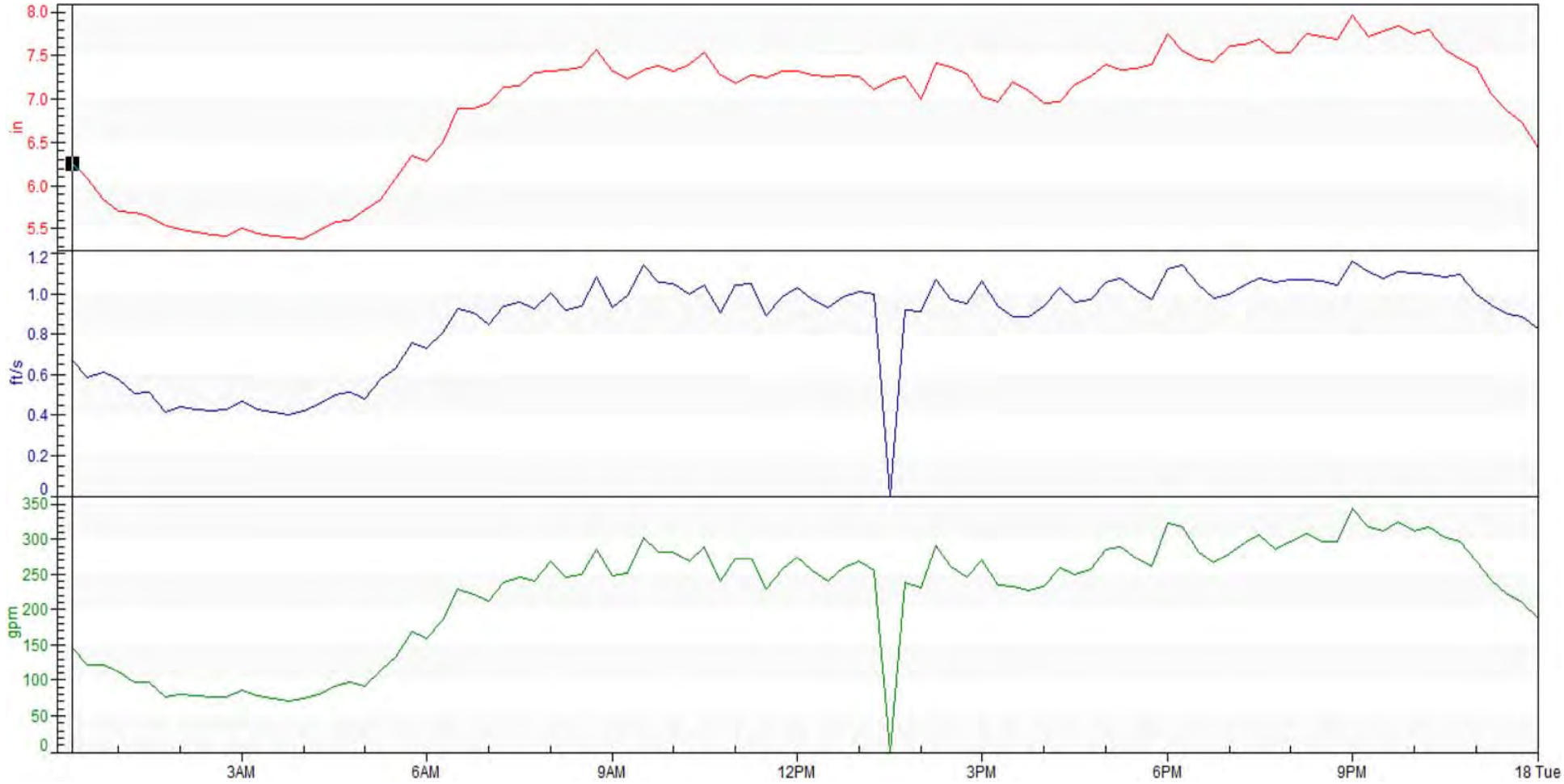
Time	Level	Velocity	Flow
12:00:00 AM	6.558	0.763	176.515
12:15:00 AM	6.467	0.736	167.343
12:30:00 AM	6.258	0.744	160.279
12:45:00 AM	6.143	0.772	163.834
1:00:00 AM	6.027	0.63	128.944
1:15:00 AM	5.909	0.665	133.615
1:30:00 AM	5.708	0.531	102.198
1:45:00 AM	5.773	0.548	107.058
2:00:00 AM	5.702	0.502	96.535
2:15:00 AM	5.695	0.514	97.81
2:30:00 AM	5.466	0.428	75.17
2:45:00 AM	5.367	0.41	72.57
3:00:00 AM	5.353	0.392	69.191
3:15:00 AM	5.311	0.393	68.548
3:30:00 AM	5.488	0.549	100.108
3:45:00 AM	5.462	0.44	79.811
4:00:00 AM	5.294	0.363	63.16
4:15:00 AM	5.23	0.344	58.126
4:30:00 AM	5.306	0.419	72.693
4:45:00 AM	5.371	0.453	79.693
5:00:00 AM	5.361	0.416	72.834
5:15:00 AM	5.428	0.473	85.072
5:30:00 AM	5.518	0.44	79.495
5:45:00 AM	5.518	0.42	76.936
6:00:00 AM	5.629	0.465	86.356
6:15:00 AM	5.774	0.489	94.523
6:30:00 AM	5.814	0.524	103.314
6:45:00 AM	5.986	0.613	125.746
7:00:00 AM	6.206	0.725	156.05
7:15:00 AM	6.335	0.679	149.639
7:30:00 AM	6.488	0.75	171.254
7:45:00 AM	6.674	0.804	190.349
8:00:00 AM	6.907	0.918	227.303
8:15:00 AM	6.987	0.917	227.374
8:30:00 AM	7.099	0.959	245.127
8:45:00 AM	7.398	0.978	264.741
9:00:00 AM	7.37	0.983	261.401
9:15:00 AM	7.682	1.061	301.284
9:30:00 AM	7.498	1.041	286.545
9:45:00 AM	7.601	0.991	277.532
10:00:00 AM	7.805	1.075	304.46
10:15:00 AM	7.704	1.046	284.47
10:30:00 AM	7.679	1.039	294.807
10:45:00 AM	7.832	0.863	251.112
11:00:00 AM	8.026	1.133	336.989
11:15:00 AM	7.925	1.046	308.056
11:30:00 AM	7.871	1.013	296.525
11:45:00 AM	7.839	1.061	300.76

Sunday - P.M. 7/16/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.838	1.069	309.653
12:15:00 PM	7.811	1.031	298.86
12:30:00 PM	7.678	1.061	300.683
12:45:00 PM	7.648	0.981	276.906
1:00:00 PM	7.667	1.049	296.987
1:15:00 PM	7.465	0.981	268.699
1:30:00 PM	7.406	0.91	246.546
1:45:00 PM	7.423	1.082	292.385
2:00:00 PM	7.679	0.958	263.137
2:15:00 PM	7.441	0.945	253.105
2:30:00 PM	7.343	0.966	257.921
2:45:00 PM	7.353	0.991	264.097
3:00:00 PM	7.447	1.02	276.846
3:15:00 PM	7.48	0.986	270.632
3:30:00 PM	7.129	0.895	226.501
3:45:00 PM	7.119	0.911	234.669
4:00:00 PM	7.213	1.043	273.31
4:15:00 PM	7.039	0.961	243.689
4:30:00 PM	7.028	0.936	233.964
4:45:00 PM	7.08	0.885	225.991
5:00:00 PM	7.275	0.98	259.645
5:15:00 PM	7.223	0.97	254.618
5:30:00 PM	7.282	0.905	240.118
5:45:00 PM	7.307	0.975	257.054
6:00:00 PM	7.326	1.013	270.077
6:15:00 PM	7.383	0.932	251.569
6:30:00 PM	7.26	0.926	240.304
6:45:00 PM	7.307	0.944	249.913
7:00:00 PM	7.382	0.954	257.45
7:15:00 PM	7.348	0.969	259.246
7:30:00 PM	7.4	1.03	277.345
7:45:00 PM	7.383	0.978	264.083
8:00:00 PM	7.422	0.944	256.389
8:15:00 PM	7.409	0.911	245.07
8:30:00 PM	7.511	0.973	263.667
8:45:00 PM	7.568	1.093	299.849
9:00:00 PM	7.652	1.015	286.816
9:15:00 PM	7.727	1.084	305.143
9:30:00 PM	7.686	1.003	278.082
9:45:00 PM	7.706	1.06	299.954
10:00:00 PM	7.786	1.125	321.224
10:15:00 PM	7.636	1.118	314.966
10:30:00 PM	7.469	0.973	263.674
10:45:00 PM	7.371	0.954	257.063
11:00:00 PM	7.201	0.921	235.595
11:15:00 PM	6.96	0.897	223.863
11:30:00 PM	6.946	0.826	205.97
11:45:00 PM	6.6	0.771	176.301

	Inches	Feet/Sec	GPM
Daily Avg:	6.885	0.839	214.593
Daily Min:	5.23	0.344	58.126
Daily Max:	8.026	1.133	336.989
Peak to Avg:			1.57

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/17/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Monday - A.M. 7/17/2023

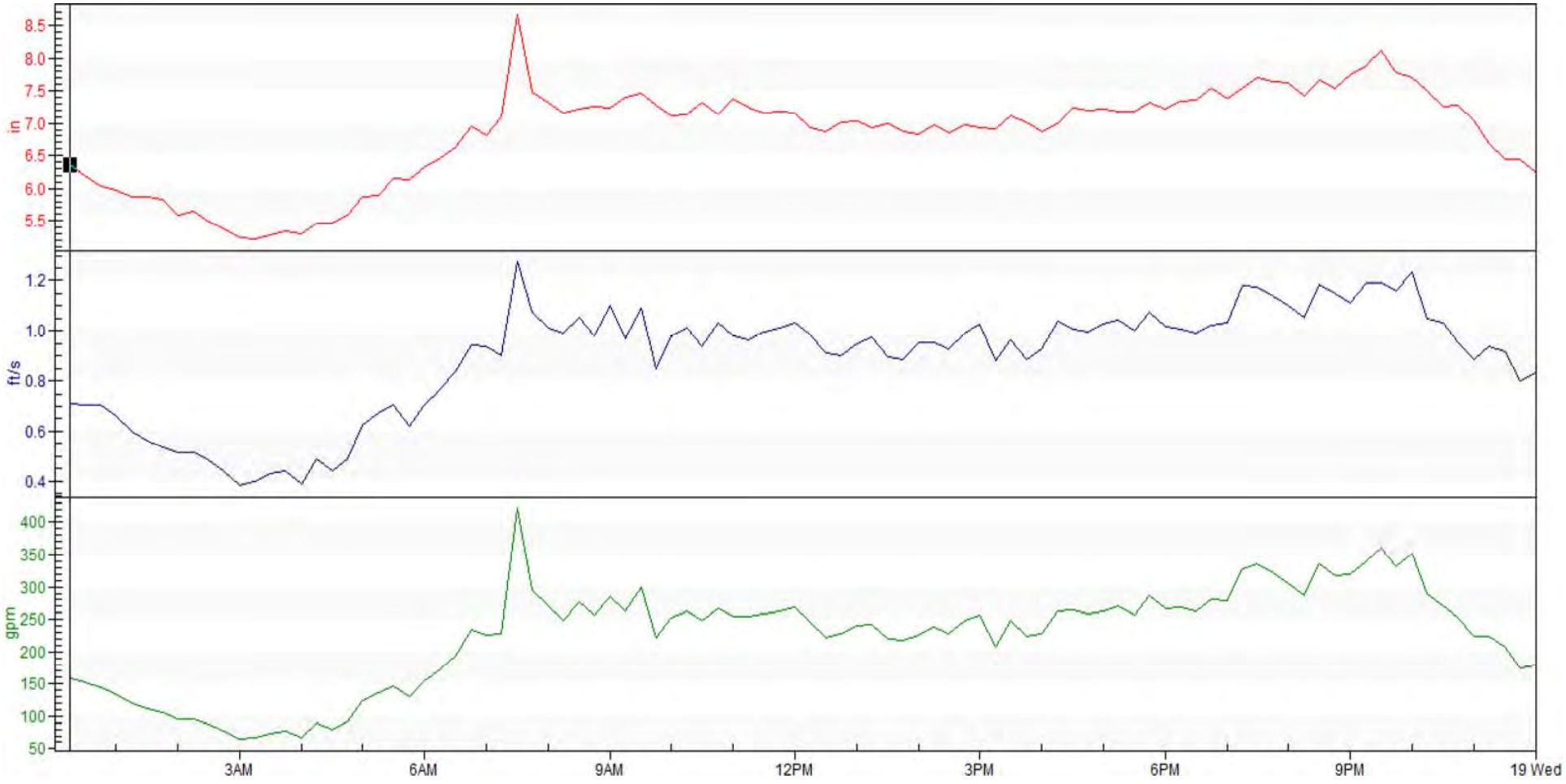
Time	Level	Velocity	Velocity
12:10:00 AM	6.233	0.632	136.879
12:15:00 AM	6.256	0.67	145.813
12:30:00 AM	6.091	0.587	120.64
12:45:00 AM	5.846	0.614	122.051
1:00:00 AM	5.71	0.58	111.725
1:15:00 AM	5.695	0.51	97.809
1:30:00 AM	5.647	0.515	97.737
1:45:00 AM	5.533	0.417	75.695
2:00:00 AM	5.486	0.44	80.272
2:15:00 AM	5.462	0.429	77.702
2:30:00 AM	5.435	0.424	75.813
2:45:00 AM	5.419	0.429	76.874
3:00:00 AM	5.513	0.47	86.371
3:15:00 AM	5.448	0.43	77.742
3:30:00 AM	5.408	0.417	74.563
3:45:00 AM	5.393	0.4	71.198
4:00:00 AM	5.384	0.424	75.306
4:15:00 AM	5.475	0.453	80.878
4:30:00 AM	5.582	0.502	90.978
4:45:00 AM	5.592	0.515	96.365
5:00:00 AM	5.728	0.482	91.228
5:15:00 AM	5.849	0.577	114.711
5:30:00 AM	6.092	0.632	132.761
5:45:00 AM	6.352	0.758	168.15
6:00:00 AM	6.288	0.731	159.608
6:15:00 AM	6.506	0.808	184.979
6:30:00 AM	6.903	0.928	229.737
6:45:00 AM	6.9	0.907	221.691
7:00:00 AM	6.954	0.848	211.88
7:15:00 AM	7.137	0.937	237.758
7:30:00 AM	7.162	0.957	245.021
7:45:00 AM	7.314	0.923	240.757
8:00:00 AM	7.327	1.004	268.39
8:15:00 AM	7.332	0.917	245.37
8:30:00 AM	7.371	0.941	250.122
8:45:00 AM	7.561	1.08	284.907
9:00:00 AM	7.328	0.931	247.823
9:15:00 AM	7.239	0.989	251.054
9:30:00 AM	7.338	1.14	302.011
9:45:00 AM	7.39	1.058	282.188
10:00:00 AM	7.327	1.053	281.485
10:15:00 AM	7.397	0.999	268.293
10:30:00 AM	7.536	1.045	289.64
10:45:00 AM	7.283	0.904	239.927
11:00:00 AM	7.185	1.042	271.658
11:15:00 AM	7.282	1.053	273.197
11:30:00 AM	7.246	0.896	229.801
11:45:00 AM	7.329	0.984	258.002

Monday - P.M. 7/17/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.319	1.029	274.561
12:15:00 PM	7.273	0.972	254.845
12:30:00 PM	7.264	0.933	241.134
12:45:00 PM	7.272	0.982	259.965
1:00:00 PM	7.268	1.013	267.694
1:15:00 PM	7.103	0.998	255.691
1:30:00 PM	7.224	0	0
1:45:00 PM	7.266	0.917	238.318
2:00:00 PM	6.995	0.916	230.161
2:15:00 PM	7.413	1.07	290.223
2:30:00 PM	7.364	0.969	260.781
2:45:00 PM	7.289	0.953	246.109
3:00:00 PM	7.039	1.064	270.216
3:15:00 PM	6.976	0.941	235.401
3:30:00 PM	7.201	0.89	232.584
3:45:00 PM	7.094	0.888	227.652
4:00:00 PM	6.952	0.942	231.839
4:15:00 PM	6.976	1.03	258.355
4:30:00 PM	7.174	0.96	249.795
4:45:00 PM	7.27	0.975	257.877
5:00:00 PM	7.393	1.055	285.173
5:15:00 PM	7.346	1.079	289.306
5:30:00 PM	7.354	1.015	271.483
5:45:00 PM	7.406	0.97	261.037
6:00:00 PM	7.75	1.123	322.295
6:15:00 PM	7.548	1.14	316.584
6:30:00 PM	7.463	1.043	280.813
6:45:00 PM	7.424	0.98	266.29
7:00:00 PM	7.607	0.995	279.04
7:15:00 PM	7.635	1.044	294.034
7:30:00 PM	7.686	1.076	305.79
7:45:00 PM	7.537	1.056	285.157
8:00:00 PM	7.541	1.069	296.523
8:15:00 PM	7.747	1.071	307.21
8:30:00 PM	7.717	1.061	296.746
8:45:00 PM	7.691	1.044	296.77
9:00:00 PM	7.965	1.16	344.566
9:15:00 PM	7.721	1.112	316.75
9:30:00 PM	7.783	1.079	311.493
9:45:00 PM	7.841	1.113	324.197
10:00:00 PM	7.749	1.1	312.755
10:15:00 PM	7.801	1.096	317.157
10:30:00 PM	7.567	1.083	301.601
10:45:00 PM	7.468	1.095	297.152
11:00:00 PM	7.362	0.996	267.77
11:15:00 PM	7.06	0.949	241.59
11:30:00 PM	6.864	0.899	221.006
11:45:00 PM	6.729	0.889	210.242

	Inches	Feet/Sec	GPM
Daily Avg:	6.921	0.869	222.331
Daily Min:	5.384	0	0
Daily Max:	7.965	1.16	344.566
Peak to Avg:			1.55

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/18/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Tuesday- A.M. 7/18/2023

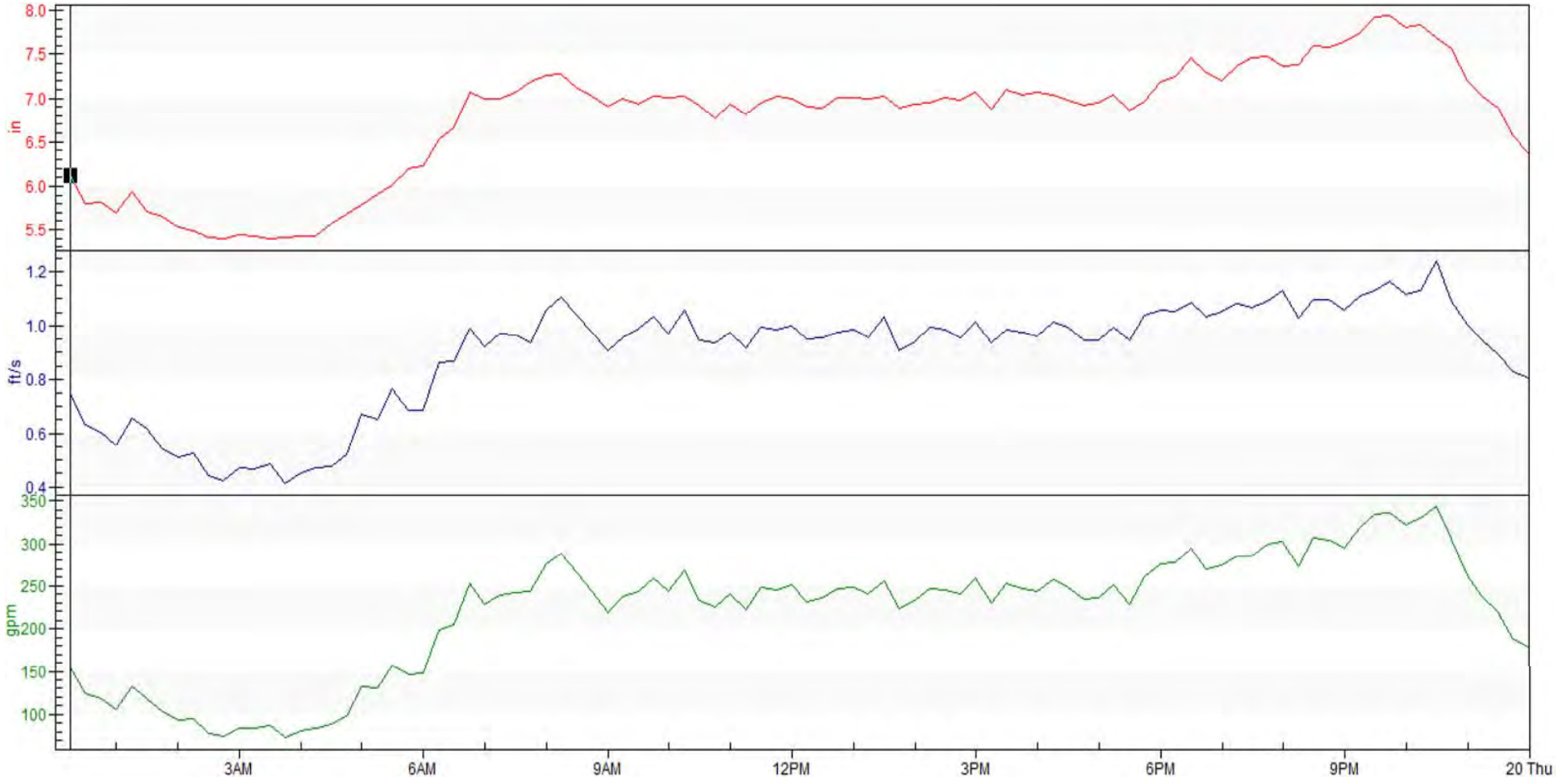
Time	Level	Velocity	Flow
12:00:00 AM	6.436	0.831	187.73
12:15:00 AM	6.355	0.712	158.124
12:30:00 AM	6.203	0.708	152.168
12:45:00 AM	6.024	0.704	144.569
1:00:00 AM	5.972	0.663	133.712
1:15:00 AM	5.878	0.599	119.983
1:30:00 AM	5.879	0.561	111.425
1:45:00 AM	5.822	0.533	105.393
2:00:00 AM	5.58	0.516	94.727
2:15:00 AM	5.644	0.514	96.338
2:30:00 AM	5.48	0.481	87.616
2:45:00 AM	5.383	0.438	77.893
3:00:00 AM	5.242	0.382	65.539
3:15:00 AM	5.218	0.398	67.329
3:30:00 AM	5.281	0.432	73.272
3:45:00 AM	5.34	0.441	77.461
4:00:00 AM	5.301	0.389	67.799
4:15:00 AM	5.463	0.488	88.585
4:30:00 AM	5.454	0.443	79.844
4:45:00 AM	5.593	0.49	91.642
5:00:00 AM	5.869	0.623	124.525
5:15:00 AM	5.896	0.675	135.687
5:30:00 AM	6.153	0.703	146.568
5:45:00 AM	6.138	0.622	130.211
6:00:00 AM	6.319	0.704	155.204
6:15:00 AM	6.462	0.769	172.269
6:30:00 AM	6.625	0.835	194.211
6:45:00 AM	6.943	0.942	234.734
7:00:00 AM	6.808	0.939	226.131
7:15:00 AM	7.1	0.902	228.495
7:30:00 AM	8.666	1.277	420.868
7:45:00 AM	7.484	1.074	295.008
8:00:00 AM	7.314	1.013	270.263
8:15:00 AM	7.163	0.99	248.241
8:30:00 AM	7.226	1.052	276.346
8:45:00 AM	7.255	0.981	255.96
9:00:00 AM	7.242	1.099	284.995
9:15:00 AM	7.402	0.971	262.42
9:30:00 AM	7.472	1.093	299.62
9:45:00 AM	7.287	0.848	222.609
10:00:00 AM	7.114	0.981	252.364
10:15:00 AM	7.138	1.013	261.831
10:30:00 AM	7.329	0.938	248.492
10:45:00 AM	7.138	1.035	267.561
11:00:00 AM	7.37	0.981	253.551
11:15:00 AM	7.24	0.965	254.1
11:30:00 AM	7.162	0.995	257.543
11:45:00 AM	7.176	1.011	262.876

Tuesday- P.M. 7/18/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.166	1.034	268.514
12:15:00 PM	6.929	0.988	245.661
12:30:00 PM	6.87	0.911	222.197
12:45:00 PM	7.018	0.902	228.109
1:00:00 PM	7.043	0.947	240.62
1:15:00 PM	6.941	0.976	242.962
1:30:00 PM	6.99	0.896	219.847
1:45:00 PM	6.865	0.886	217.727
2:00:00 PM	6.838	0.951	226.511
2:15:00 PM	6.976	0.955	237.793
2:30:00 PM	6.846	0.929	227.583
2:45:00 PM	6.971	0.991	248.373
3:00:00 PM	6.939	1.03	256.748
3:15:00 PM	6.917	0.878	207.813
3:30:00 PM	7.113	0.962	247.492
3:45:00 PM	7.004	0.885	223.139
4:00:00 PM	6.864	0.929	228.368
4:15:00 PM	6.992	1.04	261.753
4:30:00 PM	7.239	1.008	265.383
4:45:00 PM	7.192	0.997	257.967
5:00:00 PM	7.223	1.025	263.278
5:15:00 PM	7.168	1.041	270.525
5:30:00 PM	7.171	1	256.151
5:45:00 PM	7.328	1.073	286.893
6:00:00 PM	7.213	1.017	266.512
6:15:00 PM	7.331	1.007	268.028
6:30:00 PM	7.364	0.99	262.392
6:45:00 PM	7.549	1.021	281.155
7:00:00 PM	7.38	1.036	279.022
7:15:00 PM	7.552	1.18	327.805
7:30:00 PM	7.711	1.176	335.405
7:45:00 PM	7.649	1.139	321.522
8:00:00 PM	7.616	1.104	305.369
8:15:00 PM	7.429	1.055	287.131
8:30:00 PM	7.664	1.188	334.984
8:45:00 PM	7.534	1.148	317.959
9:00:00 PM	7.743	1.113	319.172
9:15:00 PM	7.883	1.191	339.052
9:30:00 PM	8.115	1.192	361.064
9:45:00 PM	7.78	1.159	332.731
10:00:00 PM	7.703	1.236	352.053
10:15:00 PM	7.508	1.05	289.596
10:30:00 PM	7.267	1.036	270.027
10:45:00 PM	7.277	0.956	253.341
11:00:00 PM	7.039	0.882	224.02
11:15:00 PM	6.694	0.939	223.18
11:30:00 PM	6.434	0.918	207.152
11:45:00 PM	6.442	0.801	174.59

	Inches	Feet/Sec	GPM
Daily Avg:	6.843	0.891	224.429
Daily Min:	5.218	0.382	65.539
Daily Max:	8.666	1.277	420.868
Peak to Avg:			1.88

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/19/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Wednesday - A.M. 7/19/2023

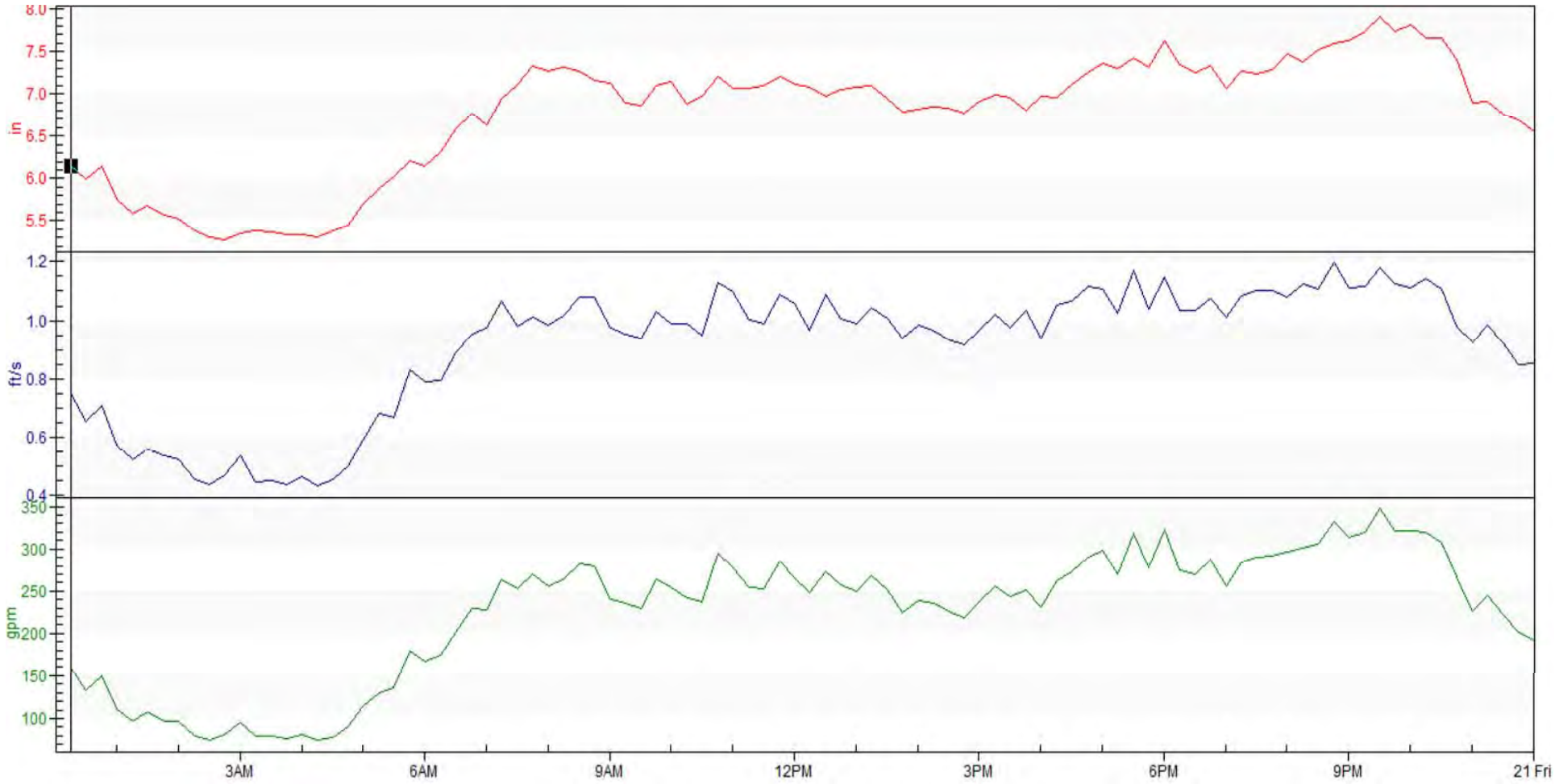
Time	Level	Velocity	Flow
12:00:00 AM	6.237	0.831	180.038
12:15:00 AM	6.121	0.746	153.35
12:30:00 AM	5.804	0.631	124.168
12:45:00 AM	5.812	0.602	118.697
1:00:00 AM	5.697	0.556	106.623
1:15:00 AM	5.94	0.655	132.951
1:30:00 AM	5.706	0.618	118.953
1:45:00 AM	5.651	0.539	102.284
2:00:00 AM	5.532	0.51	93.335
2:15:00 AM	5.491	0.525	95.948
2:30:00 AM	5.413	0.443	77.572
2:45:00 AM	5.397	0.425	74.992
3:00:00 AM	5.443	0.469	83.85
3:15:00 AM	5.432	0.466	83.859
3:30:00 AM	5.394	0.488	86.998
3:45:00 AM	5.414	0.413	73.923
4:00:00 AM	5.43	0.45	80.892
4:15:00 AM	5.431	0.47	84.649
4:30:00 AM	5.574	0.479	89.196
4:45:00 AM	5.688	0.522	98.129
5:00:00 AM	5.783	0.673	131.839
5:15:00 AM	5.903	0.654	130.775
5:30:00 AM	6.016	0.764	157.711
5:45:00 AM	6.192	0.684	146.855
6:00:00 AM	6.229	0.688	148.261
6:15:00 AM	6.527	0.864	198.646
6:30:00 AM	6.668	0.869	205.605
6:45:00 AM	7.067	0.99	252.551
7:00:00 AM	6.992	0.919	228.477
7:15:00 AM	6.996	0.968	238.277
7:30:00 AM	7.074	0.964	241.347
7:45:00 AM	7.189	0.934	243.655
8:00:00 AM	7.269	1.059	276.431
8:15:00 AM	7.277	1.108	288.957
8:30:00 AM	7.113	1.039	264.811
8:45:00 AM	7.023	0.974	243.826
9:00:00 AM	6.908	0.908	218.987
9:15:00 AM	6.988	0.957	236.991
9:30:00 AM	6.937	0.989	243.414
9:45:00 AM	7.026	1.035	259.231
10:00:00 AM	7.003	0.969	244.305
10:15:00 AM	7.019	1.06	267.858
10:30:00 AM	6.926	0.945	233.404
10:45:00 AM	6.769	0.935	224.424
11:00:00 AM	6.931	0.977	240.408
11:15:00 AM	6.807	0.914	222.136
11:30:00 AM	6.942	0.996	248.339
11:45:00 AM	7.021	0.985	245.514

Wednesday - P.M. 7/19/2023

Time	Level	Velocity	Flow
12:00:00 PM	6.997	0.999	251.739
12:15:00 PM	6.904	0.951	231.554
12:30:00 PM	6.881	0.956	235.629
12:45:00 PM	7.006	0.977	246.594
1:00:00 PM	7.003	0.985	248.381
1:15:00 PM	6.989	0.956	240.359
1:30:00 PM	7.019	1.034	255.474
1:45:00 PM	6.884	0.907	223.77
2:00:00 PM	6.94	0.942	232.874
2:15:00 PM	6.944	0.993	246.52
2:30:00 PM	7.003	0.985	244.554
2:45:00 PM	6.98	0.956	240.036
3:00:00 PM	7.069	1.015	259.03
3:15:00 PM	6.874	0.934	230.016
3:30:00 PM	7.102	0.983	252.43
3:45:00 PM	7.045	0.974	247.418
4:00:00 PM	7.076	0.96	244.211
4:15:00 PM	7.038	1.012	256.787
4:30:00 PM	6.982	0.993	248.991
4:45:00 PM	6.925	0.946	234.854
5:00:00 PM	6.954	0.946	236.331
5:15:00 PM	7.046	0.993	251.524
5:30:00 PM	6.851	0.945	228.756
5:45:00 PM	6.96	1.04	260.162
6:00:00 PM	7.183	1.059	276.024
6:15:00 PM	7.255	1.054	278.208
6:30:00 PM	7.455	1.087	293.875
6:45:00 PM	7.293	1.033	269.574
7:00:00 PM	7.202	1.055	275.078
7:15:00 PM	7.37	1.081	284.797
7:30:00 PM	7.461	1.067	284.716
7:45:00 PM	7.472	1.09	298.861
8:00:00 PM	7.368	1.129	303.105
8:15:00 PM	7.379	1.028	272.874
8:30:00 PM	7.591	1.099	307.293
8:45:00 PM	7.581	1.097	303.897
9:00:00 PM	7.637	1.059	294.715
9:15:00 PM	7.749	1.113	319.342
9:30:00 PM	7.935	1.132	334.137
9:45:00 PM	7.945	1.166	336.256
10:00:00 PM	7.806	1.115	323.036
10:15:00 PM	7.841	1.131	329.522
10:30:00 PM	7.684	1.239	343.754
10:45:00 PM	7.57	1.093	304.701
11:00:00 PM	7.212	1.003	262.816
11:15:00 PM	7.03	0.947	237.472
11:30:00 PM	6.89	0.89	219.648
11:45:00 PM	6.575	0.828	187.262

	Inches	Feet/Sec	GPM
Daily Avg:	6.768	0.893	220.551
Daily Min:	5.394	0.413	73.923
Daily Max:	7.945	1.239	343.754
Peak to Avg:			1.56

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/20/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Thursday - A.M. 7/20/2023

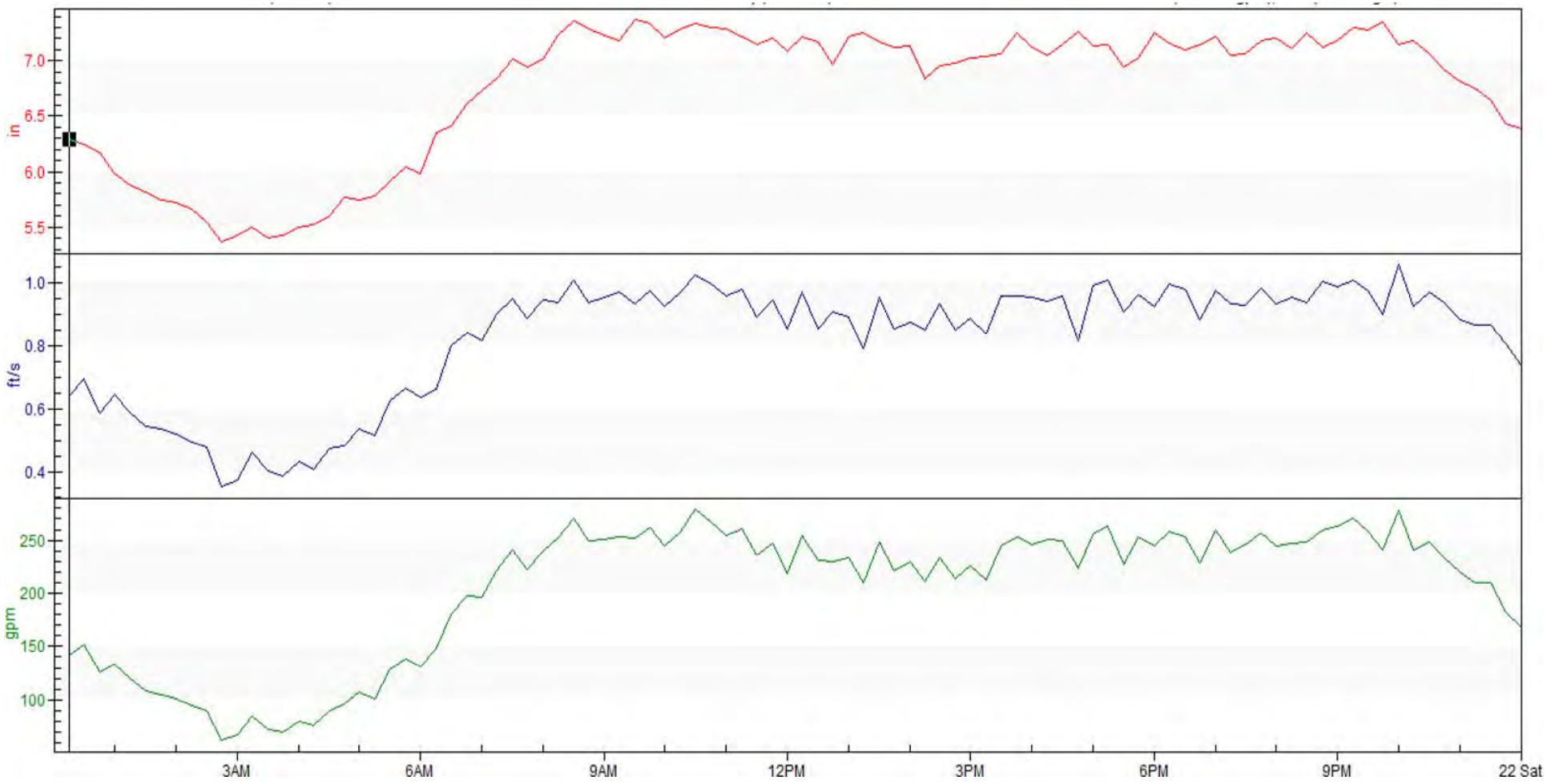
Time	Level	Velocity	Flow
12:00:00 AM	6.361	0.804	178.766
12:15:00 AM	6.14	0.751	159.216
12:30:00 AM	5.989	0.654	132.689
12:45:00 AM	6.14	0.708	150.257
1:00:00 AM	5.748	0.575	111.304
1:15:00 AM	5.584	0.523	97.336
1:30:00 AM	5.675	0.56	106.975
1:45:00 AM	5.572	0.537	96.664
2:00:00 AM	5.52	0.526	96.205
2:15:00 AM	5.377	0.455	80.251
2:30:00 AM	5.298	0.438	75.525
2:45:00 AM	5.271	0.471	81.009
3:00:00 AM	5.352	0.538	94.862
3:15:00 AM	5.38	0.445	79.043
3:30:00 AM	5.368	0.453	80.248
3:45:00 AM	5.334	0.436	76.337
4:00:00 AM	5.334	0.467	81.646
4:15:00 AM	5.296	0.433	75.333
4:30:00 AM	5.381	0.454	78.69
4:45:00 AM	5.438	0.501	90.382
5:00:00 AM	5.694	0.593	113.811
5:15:00 AM	5.884	0.681	129.839
5:30:00 AM	6.016	0.667	135.908
5:45:00 AM	6.206	0.831	178.907
6:00:00 AM	6.153	0.789	166.525
6:15:00 AM	6.317	0.794	174.811
6:30:00 AM	6.587	0.888	201.03
6:45:00 AM	6.763	0.952	229.384
7:00:00 AM	6.623	0.976	227.859
7:15:00 AM	6.948	1.067	262.936
7:30:00 AM	7.111	0.982	252.49
7:45:00 AM	7.325	1.011	269.277
8:00:00 AM	7.267	0.987	255.735
8:15:00 AM	7.313	1.019	264.162
8:30:00 AM	7.268	1.078	282.516
8:45:00 AM	7.162	1.078	279.84
9:00:00 AM	7.132	0.976	239.853
9:15:00 AM	6.899	0.953	235.707
9:30:00 AM	6.87	0.938	229.923
9:45:00 AM	7.091	1.028	263.388
10:00:00 AM	7.15	0.987	253.952
10:15:00 AM	6.88	0.991	242.308
10:30:00 AM	6.966	0.948	237.325
10:45:00 AM	7.205	1.128	295.081
11:00:00 AM	7.07	1.096	278.083
11:15:00 AM	7.06	1.003	254.047
11:30:00 AM	7.101	0.991	252.803
11:45:00 AM	7.211	1.09	285.406

Thursday - P.M. 7/20/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.115	1.056	265.161
12:15:00 PM	7.086	0.967	247.568
12:30:00 PM	6.976	1.09	273.454
12:45:00 PM	7.058	1.009	257.122
1:00:00 PM	7.08	0.989	250.068
1:15:00 PM	7.104	1.044	268.081
1:30:00 PM	6.946	1.008	251.513
1:45:00 PM	6.78	0.939	224.211
2:00:00 PM	6.811	0.984	239.392
2:15:00 PM	6.842	0.968	235.827
2:30:00 PM	6.834	0.937	226.976
2:45:00 PM	6.77	0.918	218.521
3:00:00 PM	6.913	0.967	237.385
3:15:00 PM	6.981	1.021	255.721
3:30:00 PM	6.951	0.974	242.974
3:45:00 PM	6.806	1.036	251.821
4:00:00 PM	6.977	0.938	231.072
4:15:00 PM	6.958	1.051	262.849
4:30:00 PM	7.114	1.068	273.365
4:45:00 PM	7.248	1.117	289.59
5:00:00 PM	7.369	1.107	298.195
5:15:00 PM	7.297	1.024	269.329
5:30:00 PM	7.43	1.171	318.791
5:45:00 PM	7.319	1.04	277.683
6:00:00 PM	7.626	1.147	322.596
6:15:00 PM	7.342	1.036	274.293
6:30:00 PM	7.259	1.037	270.628
6:45:00 PM	7.327	1.075	287.289
7:00:00 PM	7.068	1.013	255.22
7:15:00 PM	7.271	1.085	283.675
7:30:00 PM	7.233	1.104	290.181
7:45:00 PM	7.278	1.103	291.728
8:00:00 PM	7.475	1.079	295.896
8:15:00 PM	7.386	1.126	301.621
8:30:00 PM	7.523	1.109	306.529
8:45:00 PM	7.59	1.197	331.801
9:00:00 PM	7.635	1.112	313.392
9:15:00 PM	7.737	1.116	319.766
9:30:00 PM	7.909	1.18	347.513
9:45:00 PM	7.735	1.123	321.537
10:00:00 PM	7.81	1.111	322.024
10:15:00 PM	7.66	1.143	319.435
10:30:00 PM	7.652	1.106	306.915
10:45:00 PM	7.41	0.982	266.225
11:00:00 PM	6.9	0.925	226.501
11:15:00 PM	6.917	0.985	244.336
11:30:00 PM	6.751	0.923	221.993
11:45:00 PM	6.692	0.848	200.6

	Inches	Feet/Sec	GPM
Daily Avg:	6.769	0.913	226.234
Daily Min:	5.271	0.433	75.333
Daily Max:	7.909	1.197	347.513
Peak to Avg:			1.54

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/21/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Friday - A.M. 7/21/2023

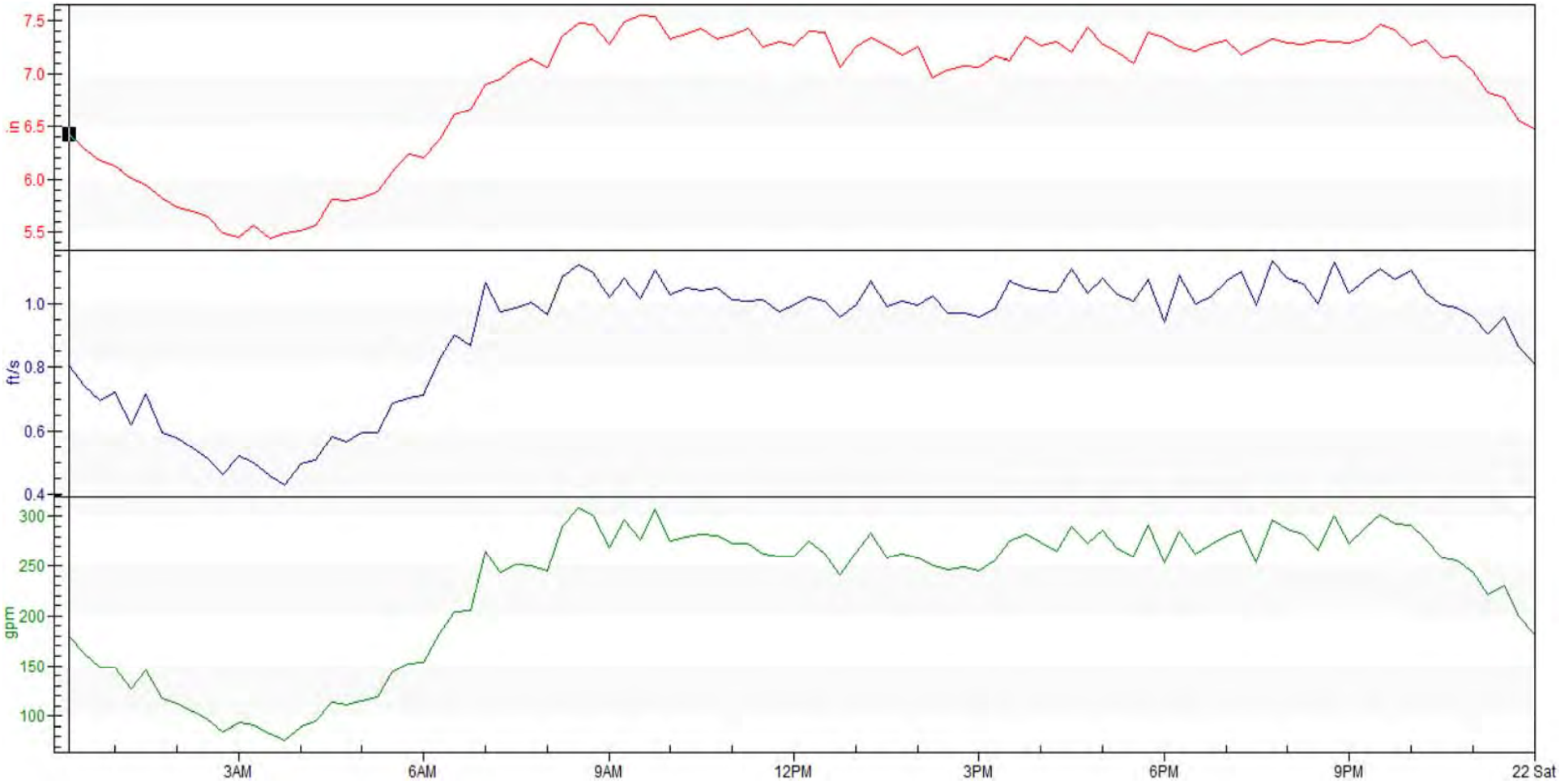
Time	Level	Velocity	Flow
12:00:00 AM	6.549	0.854	191.468
12:15:00 AM	6.428	0.805	179.563
12:30:00 AM	6.29	0.741	162.414
12:45:00 AM	6.177	0.696	148.635
1:00:00 AM	6.122	0.72	147.641
1:15:00 AM	6.017	0.618	126.154
1:30:00 AM	5.946	0.717	145.836
1:45:00 AM	5.828	0.595	117.722
2:00:00 AM	5.738	0.58	112.406
2:15:00 AM	5.697	0.544	104.407
2:30:00 AM	5.652	0.51	96.92
2:45:00 AM	5.49	0.459	83.872
3:00:00 AM	5.453	0.52	94.044
3:15:00 AM	5.564	0.5	91.422
3:30:00 AM	5.436	0.457	82.399
3:45:00 AM	5.481	0.427	76.682
4:00:00 AM	5.514	0.493	90.11
4:15:00 AM	5.565	0.508	94.364
4:30:00 AM	5.814	0.583	113.216
4:45:00 AM	5.802	0.565	111.046
5:00:00 AM	5.82	0.594	115.415
5:15:00 AM	5.886	0.595	119.307
5:30:00 AM	6.076	0.688	144.039
5:45:00 AM	6.234	0.702	152.085
6:00:00 AM	6.201	0.714	153.459
6:15:00 AM	6.38	0.825	183.177
6:30:00 AM	6.61	0.901	204.147
6:45:00 AM	6.664	0.869	204.932
7:00:00 AM	6.905	1.067	264.192
7:15:00 AM	6.954	0.977	244.212
7:30:00 AM	7.078	0.987	251.561
7:45:00 AM	7.14	1.005	250.762
8:00:00 AM	7.058	0.968	245.047
8:15:00 AM	7.346	1.084	290.263
8:30:00 AM	7.476	1.124	308.259
8:45:00 AM	7.461	1.098	300.468
9:00:00 AM	7.27	1.022	269.412
9:15:00 AM	7.485	1.079	296.287
9:30:00 AM	7.552	1.019	276.971
9:45:00 AM	7.543	1.108	307.224
10:00:00 AM	7.321	1.03	274.936
10:15:00 AM	7.374	1.05	279.702
10:30:00 AM	7.423	1.044	281.587
10:45:00 AM	7.325	1.053	280.122
11:00:00 AM	7.367	1.013	272.597
11:15:00 AM	7.429	1.007	272.816
11:30:00 AM	7.251	1.014	262.361
11:45:00 AM	7.296	0.975	259.321

Friday - P.M. 7/21/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.264	0.998	259.31
12:15:00 PM	7.395	1.02	275.832
12:30:00 PM	7.388	1.01	262.681
12:45:00 PM	7.066	0.96	240.322
1:00:00 PM	7.257	0.997	263.313
1:15:00 PM	7.336	1.073	283.344
1:30:00 PM	7.264	0.991	258.121
1:45:00 PM	7.17	1.009	262.294
2:00:00 PM	7.248	0.998	257.996
2:15:00 PM	6.968	1.024	250.504
2:30:00 PM	7.038	0.972	246.665
2:45:00 PM	7.073	0.973	248.644
3:00:00 PM	7.068	0.96	244.491
3:15:00 PM	7.16	0.985	255.512
3:30:00 PM	7.13	1.071	275.282
3:45:00 PM	7.355	1.049	281.873
4:00:00 PM	7.269	1.044	273.884
4:15:00 PM	7.295	1.04	264.803
4:30:00 PM	7.202	1.111	290.359
4:45:00 PM	7.443	1.033	273.103
5:00:00 PM	7.276	1.081	286.421
5:15:00 PM	7.202	1.032	266.963
5:30:00 PM	7.097	1.009	258.995
5:45:00 PM	7.393	1.076	290.966
6:00:00 PM	7.338	0.942	252.353
6:15:00 PM	7.253	1.088	284.309
6:30:00 PM	7.215	0.999	261.752
6:45:00 PM	7.28	1.022	270.96
7:00:00 PM	7.308	1.07	280.391
7:15:00 PM	7.179	1.101	286.659
7:30:00 PM	7.251	0.995	253.911
7:45:00 PM	7.328	1.135	296.482
8:00:00 PM	7.293	1.079	286.748
8:15:00 PM	7.278	1.063	281.627
8:30:00 PM	7.315	1	266.68
8:45:00 PM	7.301	1.131	300.903
9:00:00 PM	7.285	1.035	272.735
9:15:00 PM	7.34	1.077	288.477
9:30:00 PM	7.47	1.109	301.71
9:45:00 PM	7.418	1.077	292.482
10:00:00 PM	7.268	1.107	291.104
10:15:00 PM	7.319	1.034	276.064
10:30:00 PM	7.153	0.999	258.785
10:45:00 PM	7.164	0.988	255.834
11:00:00 PM	7.02	0.961	243.042
11:15:00 PM	6.825	0.906	221.045
11:30:00 PM	6.781	0.957	230.79
11:45:00 PM	6.549	0.862	199.15

	Inches	Feet/Sec	GPM
Daily Avg:	6.866	0.915	229.149
Daily Min:	5.436	0.427	76.682
Daily Max:	7.552	1.135	308.259
Peak to Avg:			1.35

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/22/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Saturday - A.M. 7/22/2023

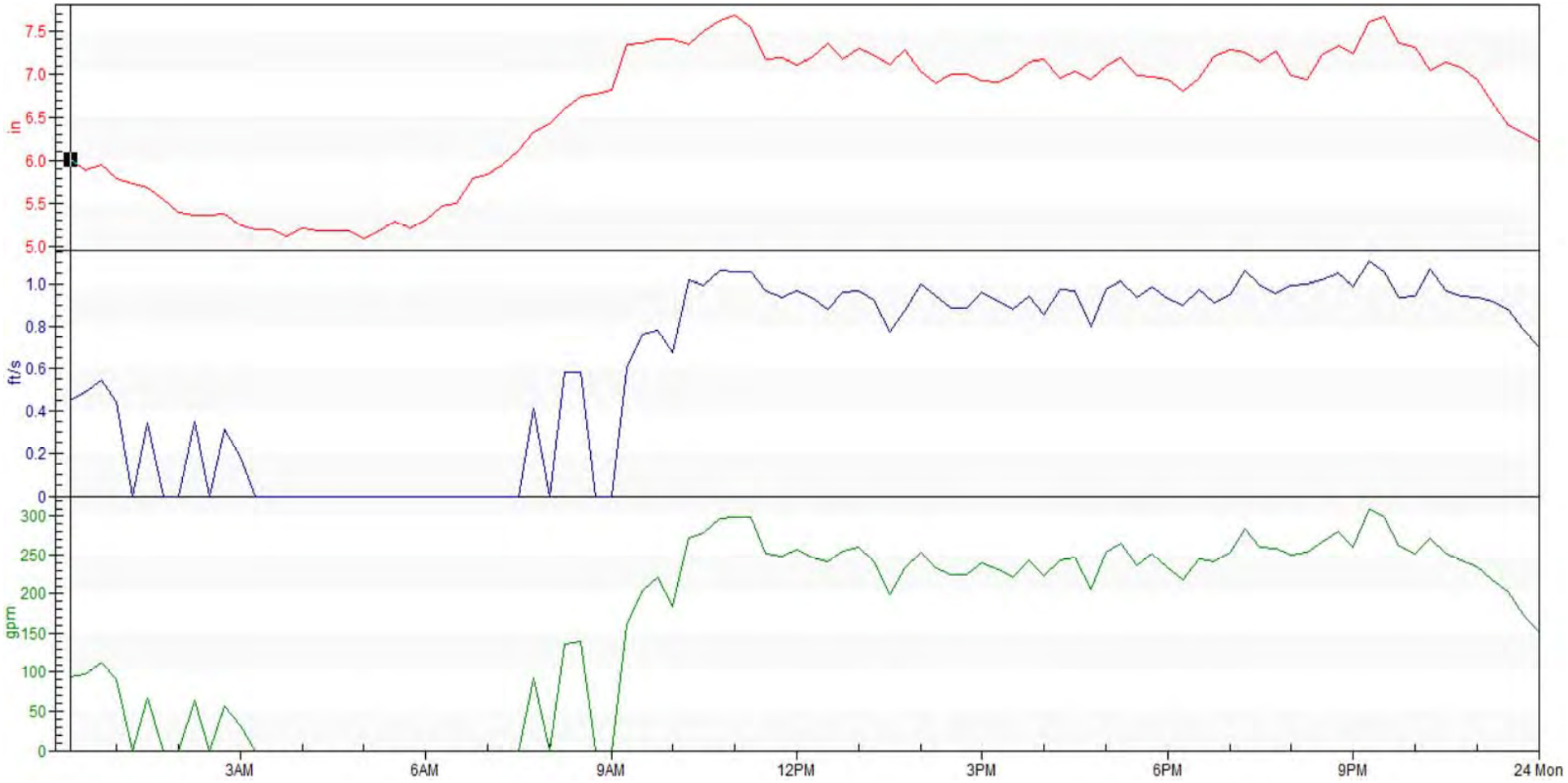
Time	Level	Velocity	Flow
12:00:00 AM	6.47	0.808	180.59
12:15:00 AM	6.38	0.829	184.992
12:30:00 AM	6.293	0.806	174.207
12:45:00 AM	6.15	0.727	153.528
1:00:00 AM	6.039	0.684	141.909
1:15:00 AM	6.049	0.672	138.716
1:30:00 AM	5.99	0.671	136.001
1:45:00 AM	5.984	0.526	107.919
2:00:00 AM	5.883	0.457	88.252
2:15:00 AM	5.698	0.415	79.161
2:30:00 AM	5.685	0.441	84.417
2:45:00 AM	5.75	0.44	85.569
3:00:00 AM	5.699	0.537	102.887
3:15:00 AM	5.677	0.441	83.619
3:30:00 AM	5.608	0.408	76.614
3:45:00 AM	5.541	0.373	68.997
4:00:00 AM	5.499	0.402	73.439
4:15:00 AM	5.541	0.444	81.838
4:30:00 AM	5.668	0.42	80.038
4:45:00 AM	5.763	0.46	87.602
5:00:00 AM	5.648	0.558	105.772
5:15:00 AM	5.659	0.497	94.548
5:30:00 AM	5.779	0.574	110.786
5:45:00 AM	5.784	0.619	120.143
6:00:00 AM	5.974	0.595	121.688
6:15:00 AM	5.908	0.577	116.247
6:30:00 AM	5.931	0.573	116.193
6:45:00 AM	6.102	0.654	133.611
7:00:00 AM	6.131	0.634	134.148
7:15:00 AM	6.562	0.825	189.492
7:30:00 AM	6.683	0.939	219.023
7:45:00 AM	6.796	0.892	214.865
8:00:00 AM	7.162	1.019	264.626
8:15:00 AM	7.096	1.026	256.999
8:30:00 AM	7.198	1.049	274.06
8:45:00 AM	7.474	1.11	304.34
9:00:00 AM	7.747	1.116	320.112
9:15:00 AM	7.6	1.138	318.734
9:30:00 AM	7.804	1.19	344.49
9:45:00 AM	7.809	1.155	334.864
10:00:00 AM	7.894	1.17	338.352
10:15:00 AM	7.768	1.185	341.035
10:30:00 AM	7.491	1.007	276.776
10:45:00 AM	7.46	1.108	293.65
11:00:00 AM	7.523	1.186	327.976
11:15:00 AM	7.693	1.107	306.054
11:30:00 AM	7.742	1.081	310.04
11:45:00 AM	7.6	1.123	311.582

Saturday - P.M. 7/22/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.427	1.149	312.411
12:15:00 PM	7.581	1.101	307.458
12:30:00 PM	7.69	1.137	323.331
12:45:00 PM	7.542	1.09	302.445
1:00:00 PM	7.267	1.117	290.88
1:15:00 PM	7.391	1.115	301.292
1:30:00 PM	7.517	1.093	301.918
1:45:00 PM	7.635	1.068	294.068
2:00:00 PM	7.357	1.048	276.028
2:15:00 PM	7.308	1.092	290.974
2:30:00 PM	7.391	1.047	280.814
2:45:00 PM	7.331	1.069	285.924
3:00:00 PM	7.212	1.093	286.268
3:15:00 PM	7.295	1.037	271.8
3:30:00 PM	7.067	1.106	282.144
3:45:00 PM	7.137	0.997	253.24
4:00:00 PM	7.12	1.084	279.231
4:15:00 PM	7.269	1.046	276.552
4:30:00 PM	7.143	1.068	276.351
4:45:00 PM	7.105	1.119	287.541
5:00:00 PM	6.983	1.001	251.415
5:15:00 PM	7.103	0.967	248.169
5:30:00 PM	7.122	1.013	260.988
5:45:00 PM	7	1.091	275.043
6:00:00 PM	7.08	1.03	258.429
6:15:00 PM	6.921	0.925	225.362
6:30:00 PM	6.948	0.96	237.76
6:45:00 PM	6.924	0.941	233.78
7:00:00 PM	6.714	0.934	219.433
7:15:00 PM	7.008	1.053	265.762
7:30:00 PM	6.916	1.025	251.189
7:45:00 PM	6.877	0.913	222.926
8:00:00 PM	7.063	0.972	247.782
8:15:00 PM	6.933	1.02	253.889
8:30:00 PM	6.974	0.991	246.793
8:45:00 PM	7.074	1.003	246.355
9:00:00 PM	7.161	1.031	262.78
9:15:00 PM	7.058	0.982	250.049
9:30:00 PM	7.067	0.994	251.045
9:45:00 PM	7.154	1.032	267.528
10:00:00 PM	7.079	0.998	253.586
10:15:00 PM	7.035	0.986	250.013
10:30:00 PM	6.928	1.013	251.627
10:45:00 PM	6.751	0.94	222.614
11:00:00 PM	6.703	0.895	208.999
11:15:00 PM	6.597	0.919	214.422
11:30:00 PM	6.662	0.865	202.14
11:45:00 PM	6.304	0.777	169.756

	Inches	Feet/Sec	GPM
Daily Avg:	6.798	0.893	222.739
Daily Min:	5.499	0.373	68.997
Daily Max:	7.894	1.19	344.49
Peak to Avg:			1.55

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/23/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Sunday - A.M. 7/23/2023

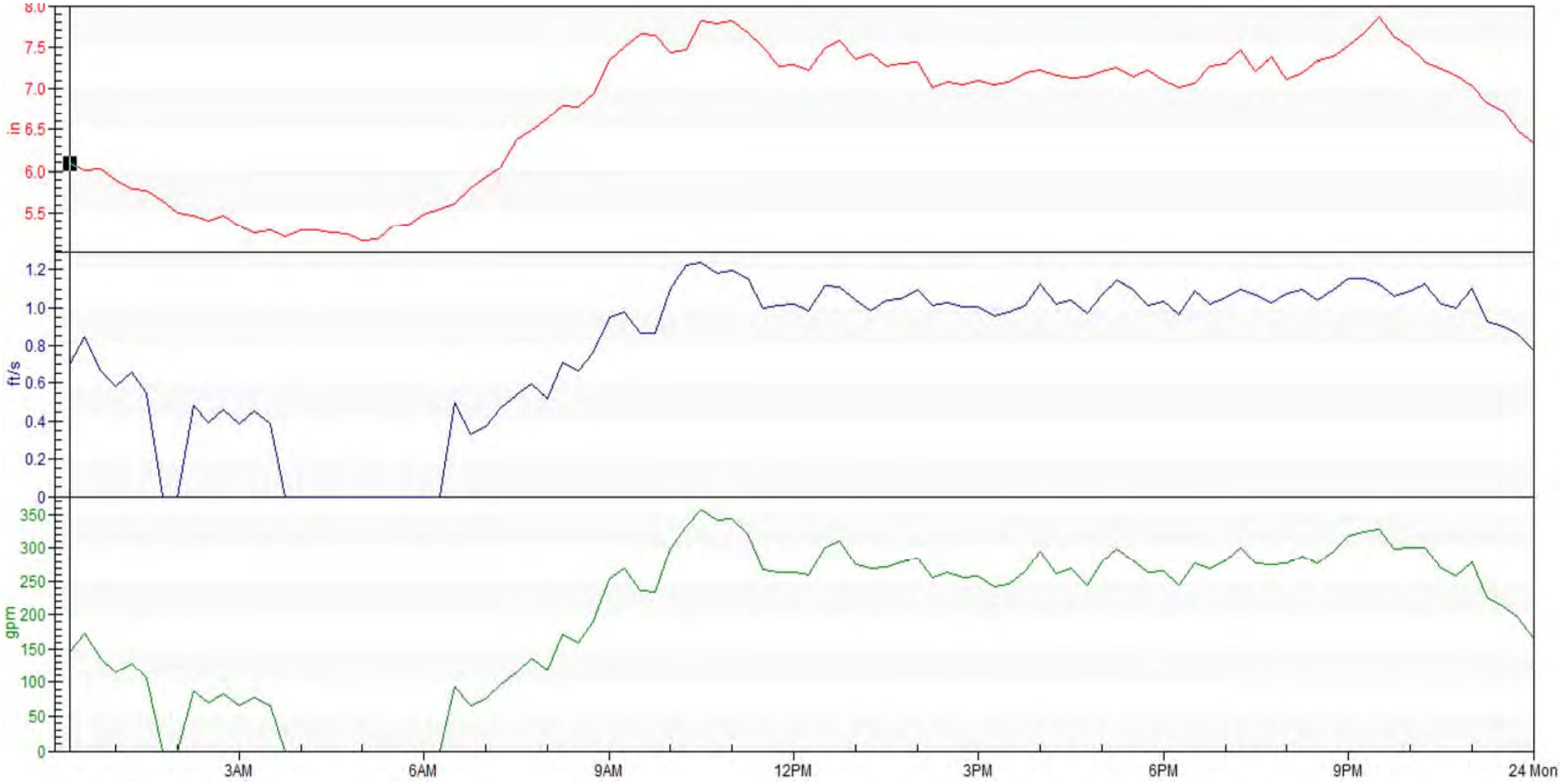
Time	Level	Velocity	Flow
12:00:00 AM	6.291	0.791	169.053
12:15:00 AM	6.084	0.697	146.175
12:30:00 AM	6.003	0.845	173.993
12:45:00 AM	6.023	0.669	135.863
1:00:00 AM	5.899	0.579	115.319
1:15:00 AM	5.79	0.66	127.835
1:30:00 AM	5.769	0.544	106.058
1:45:00 AM	5.648	0	0
2:00:00 AM	5.505	0	0
2:15:00 AM	5.468	0.483	86.966
2:30:00 AM	5.403	0.391	69.67
2:45:00 AM	5.469	0.462	83.959
3:00:00 AM	5.338	0.387	66.391
3:15:00 AM	5.253	0.457	78.128
3:30:00 AM	5.286	0.388	65.914
3:45:00 AM	5.216	0	0
4:00:00 AM	5.286	0	0
4:15:00 AM	5.288	0	0
4:30:00 AM	5.252	0	0
4:45:00 AM	5.238	0	0
5:00:00 AM	5.161	0	0
5:15:00 AM	5.182	0	0
5:30:00 AM	5.344	0	0
5:45:00 AM	5.358	0	0
6:00:00 AM	5.488	0	0
6:15:00 AM	5.54	0	0
6:30:00 AM	5.603	0.498	92.456
6:45:00 AM	5.797	0.33	64.788
7:00:00 AM	5.932	0.371	74.533
7:15:00 AM	6.046	0.467	97.015
7:30:00 AM	6.377	0.541	114.088
7:45:00 AM	6.491	0.597	136.293
8:00:00 AM	6.632	0.52	117.725
8:15:00 AM	6.787	0.71	171.962
8:30:00 AM	6.781	0.663	160.238
8:45:00 AM	6.934	0.766	190.704
9:00:00 AM	7.338	0.948	253.79
9:15:00 AM	7.493	0.981	269.82
9:30:00 AM	7.661	0.867	236.112
9:45:00 AM	7.643	0.864	234.083
10:00:00 AM	7.423	1.099	298.605
10:15:00 AM	7.464	1.22	331.823
10:30:00 AM	7.817	1.234	358.139
10:45:00 AM	7.784	1.182	341.238
11:00:00 AM	7.809	1.194	343.669
11:15:00 AM	7.669	1.153	319.97
11:30:00 AM	7.495	0.998	267.649
11:45:00 AM	7.275	1.013	263.945

Sunday - P.M. 7/23/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.283	1.018	263.539
12:15:00 PM	7.224	0.986	258.621
12:30:00 PM	7.473	1.115	300.549
12:45:00 PM	7.58	1.109	309.633
1:00:00 PM	7.353	1.039	275.98
1:15:00 PM	7.418	0.989	268.508
1:30:00 PM	7.267	1.042	270.911
1:45:00 PM	7.304	1.051	278.984
2:00:00 PM	7.322	1.1	284.405
2:15:00 PM	7.019	1.014	254.833
2:30:00 PM	7.075	1.028	262.611
2:45:00 PM	7.05	1.007	256.227
3:00:00 PM	7.087	1.009	258.525
3:15:00 PM	7.048	0.96	241.953
3:30:00 PM	7.081	0.98	246.16
3:45:00 PM	7.191	1.017	265.406
4:00:00 PM	7.216	1.122	294.073
4:15:00 PM	7.159	1.02	262.355
4:30:00 PM	7.134	1.041	268.998
4:45:00 PM	7.142	0.971	244.344
5:00:00 PM	7.204	1.068	279.295
5:15:00 PM	7.259	1.148	299.36
5:30:00 PM	7.142	1.099	281.367
5:45:00 PM	7.218	1.016	262.616
6:00:00 PM	7.097	1.035	265.42
6:15:00 PM	7.013	0.967	244.218
6:30:00 PM	7.069	1.087	277.58
6:45:00 PM	7.265	1.024	268.898
7:00:00 PM	7.301	1.057	280.16
7:15:00 PM	7.458	1.098	300.193
7:30:00 PM	7.211	1.069	276.367
7:45:00 PM	7.376	1.029	275.611
8:00:00 PM	7.111	1.08	277.726
8:15:00 PM	7.188	1.099	286.568
8:30:00 PM	7.337	1.042	276.931
8:45:00 PM	7.377	1.1	294.449
9:00:00 PM	7.506	1.154	318.18
9:15:00 PM	7.671	1.154	324.99
9:30:00 PM	7.862	1.124	328.558
9:45:00 PM	7.614	1.064	298.582
10:00:00 PM	7.489	1.093	300.583
10:15:00 PM	7.323	1.124	300.193
10:30:00 PM	7.237	1.023	269.25
10:45:00 PM	7.156	0.999	258.493
11:00:00 PM	7.033	1.101	279.228
11:15:00 PM	6.824	0.932	227.156
11:30:00 PM	6.721	0.904	212.342
11:45:00 PM	6.494	0.864	197.352

	Inches	Feet/Sec	GPM
Daily Avg:	6.721	0.789	201.297
Daily Min:	5.161	0	0
Daily Max:	7.862	1.234	358.139
Peak to Avg:			1.78

MAXIMUM DAILY FLOW DATA



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 S. Palm, Santa Paula, CA**
Flow Meter: **Teledyne Isco 2150 Area Velocity w/ Pressure Transducer**
Time Period: **7/24/2023, 12:00 a.m. - 12:00 p.m.**

Project: City of Santa Paula - Sewer Flow Study
Manhole Location: 224 S. Palm

Monday - A.M. 7/24/2023

Time	Level	Velocity	Velocity
12:10:00 AM	6.327	0.769	165.914
12:15:00 AM	6.265	0.82	178.626
12:30:00 AM	5.956	0.651	125.797
12:45:00 AM	6	0.749	154.044
1:00:00 AM	5.924	0.619	125.203
1:15:00 AM	5.738	0.593	113.569
1:30:00 AM	5.628	0.571	107.896
1:45:00 AM	5.632	0.475	87.068
2:00:00 AM	5.65	0.581	110.239
2:15:00 AM	5.632	0.538	101.631
2:30:00 AM	5.433	0.43	76.119
2:45:00 AM	5.325	0.437	76.252
3:00:00 AM	5.378	0.479	84.995
3:15:00 AM	5.357	0.518	89.023
3:30:00 AM	5.384	0.523	91.596
3:45:00 AM	5.273	0.529	91.492
4:00:00 AM	5.294	0.434	74.443
4:15:00 AM	5.293	0.47	81.326
4:30:00 AM	5.414	0.473	84.676
4:45:00 AM	5.516	0.568	104.365
5:00:00 AM	5.65	0.63	118.33
5:15:00 AM	5.789	0.66	129.423
5:30:00 AM	5.963	0.666	134.334
5:45:00 AM	6.033	0.819	169.785
6:00:00 AM	6.12	0.86	181.49
6:15:00 AM	6.284	0.802	174.909
6:30:00 AM	6.515	0.913	208.795
6:45:00 AM	6.71	0.956	227.962
7:00:00 AM	6.738	0.941	224.86
7:15:00 AM	6.892	0.956	228.679
7:30:00 AM	6.932	0.985	243.035
7:45:00 AM	7.03	1.091	272.32
8:00:00 AM	7.011	1.065	266.739
8:15:00 AM	6.968	1.06	264.585
8:30:00 AM	7.002	1.108	279.348
8:45:00 AM	7.161	1.057	269.283
9:00:00 AM	7.041	0.992	251.893
9:15:00 AM	7.006	1.076	271.33
9:30:00 AM	7.104	1.043	264.416
9:45:00 AM	7.139	1.061	268.97
10:00:00 AM	7.504	1.119	303.799
10:15:00 AM	7.378	0.968	259.272
10:30:00 AM	7.574	1.103	302.61
10:45:00 AM	7.358	1.078	289.722
11:00:00 AM	7.406	1	269.628
11:15:00 AM	7.368	1.066	279.352
11:30:00 AM	7.098	0.96	245.048
11:45:00 AM	7.24	1.109	290.235

Monday - P.M. 7/24/2023

Time	Level	Velocity	Flow
12:00:00 PM	7.031	0.998	251.241
12:15:00 PM	7.143	1.007	258.079
12:30:00 PM	7.111	0.986	253.766
12:45:00 PM	7.267	1.05	272.694
1:00:00 PM	7.168	1.054	272.796
1:15:00 PM	7.155	0.995	258.086
1:30:00 PM	7.067	0.982	244.061
1:45:00 PM	6.988	0.975	245.187
2:00:00 PM	6.989	0.984	247.219
2:15:00 PM	7.057	0.933	237.295
2:30:00 PM	7.146	0.969	250.935
2:45:00 PM	7.093	1.025	262.786
3:00:00 PM	6.925	1.043	259.211
3:15:00 PM	6.956	1.031	254.407
3:30:00 PM	7.037	0.914	231.561
3:45:00 PM	7.078	1.082	271.098
4:00:00 PM	7.189	1.023	261.89
4:15:00 PM	7.234	1.071	281.663
4:30:00 PM	7.235	1.013	266.498
4:45:00 PM	7.121	1.108	285.417
5:00:00 PM	7.179	1.059	273.171
5:15:00 PM	7.237	1.053	277.066
5:30:00 PM	7.294	1.185	314.897
5:45:00 PM	7.303	1.032	268.419
6:00:00 PM	7.439	1.189	319.855
6:15:00 PM	7.275	1.102	291.953
6:30:00 PM	7.005	0.953	237.253
6:45:00 PM	7.069	1.023	261.018
7:00:00 PM	7.124	1.036	259.749
7:15:00 PM	7.137	0.996	256.392
7:30:00 PM	7.209	0.971	237.576
7:45:00 PM	7.577	1.066	290.174
8:00:00 PM	7.554	1.113	307.942
8:15:00 PM	7.435	1.136	306.764
8:30:00 PM	7.442	1.041	281.421
8:45:00 PM	7.869	1.156	338.458
9:00:00 PM	7.628	1.132	318.581
9:15:00 PM	7.78	1.182	334.407
9:30:00 PM	7.546	0.989	269.859
9:45:00 PM	7.668	1.137	322.209
10:00:00 PM	7.695	1.145	325.631
10:15:00 PM	7.435	1.159	312.493
10:30:00 PM	7.398	1.045	281.942
10:45:00 PM	7.323	1.057	277.852
11:00:00 PM	7.066	0.995	253.753
11:15:00 PM	6.767	0.959	223.243
11:30:00 PM	6.489	0.909	207.253
11:45:00 PM	6.292	0.791	171.735

	Inches	Feet/Sec	GPM
Daily Avg:	6.782	0.921	227.742
Daily Min:	5.273	0.43	74.443
Daily Max:	7.869	1.189	338.458
Peak to Avg:			1.49

Sewer Line Flow Study Summary

Project: **City of Santa Paula - Sewer Flow Study**
Location: **224 Palm, Santa Paula, CA**
Pipe Size: **15” VCP**
Time Period: **7/11/2023, 12:00 a.m. - 7/25/2023, 12:00 a.m.**

Level - Inches

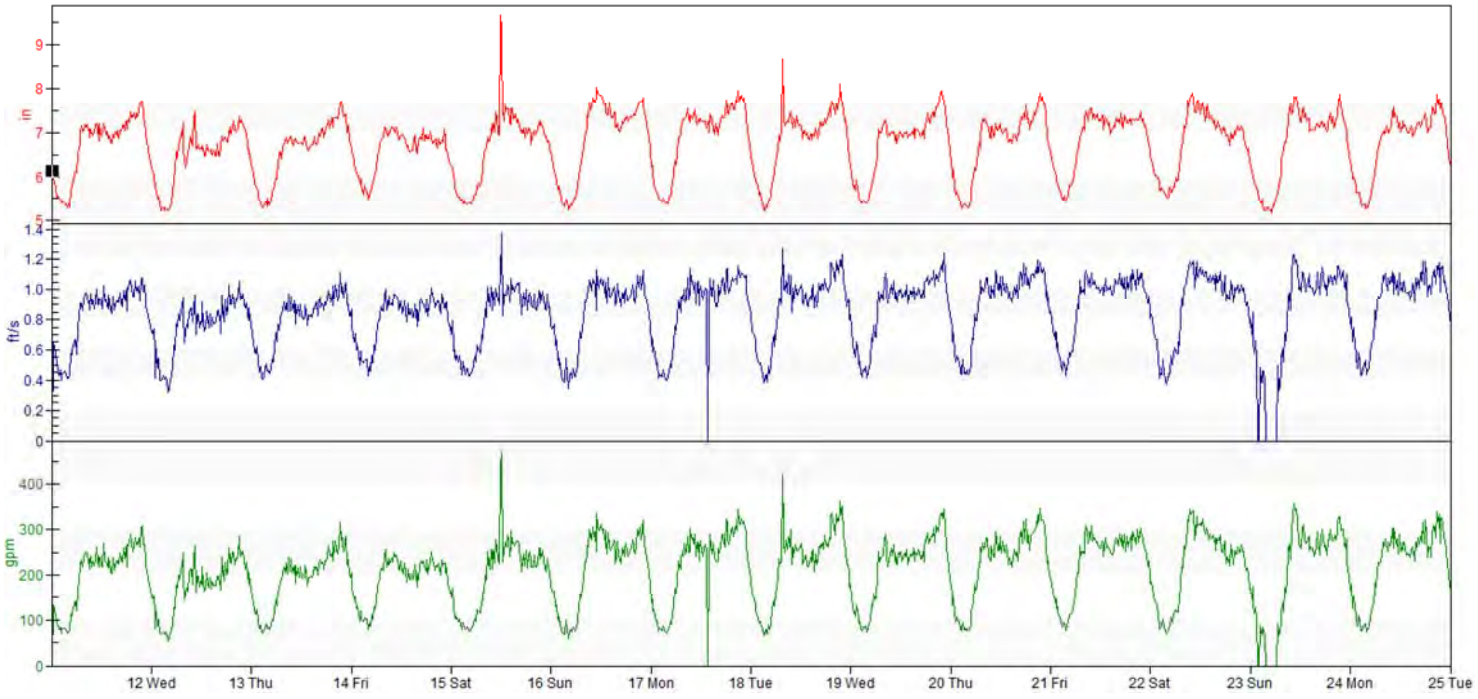
Average:	6.675
Maximum:	9.657
Minimum:	5.088
Max d/D:	64.4%

Velocity - Feet per Second

Average:	0.800
Maximum:	0.363
Minimum:	0.408

Flow Rate - Gallons Per Minute

Average:	196.456
Maximum::	471.466
Minimum:	55.449
Peak to Average	2.33



Maximum Level **Maximum Velocity** **Maximum Flow Rate**

Appendix B – Detailed Flow Verification

Appendix B - Flow Verification

During the flow monitoring study, the average day water demand was 2.72 MGD and the average day flow to the WRF was 2.02 MGD, resulting in an average return factor of 74%, which is slightly lower than the average return factor of 86% from 2020 to 2022. For validating the preliminary return factors, MKN reduced the return factors for all land uses proportionally by 12%. **Table 1** provides the preliminary wastewater return factors adjusted proportionally for validation with the flow monitoring study.

Table 1: Flow Monitoring Wastewater Return Factors

Land Use	Number of Parcels	Acreage	Average Day Demand (MGD)[1]	Average Day Demand (GPM)[1]	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	3,405	829	1.19	827	68%	0.74	512
Multi-Family Residential	1,890	278	0.81	562	78%	0.57	398
Mobile Homes	6	57	0.14	99	73%	0.09	66
General Commercial	499	266	0.43	300	83%	0.33	226
Commercial Office	178	40	0.07	52	83%	0.06	39
General Industrial	99	130	0.11	80	83%	0.09	60
Public Facilities	23	114	0.12	81	68%	0.07	50
Airport	9	47	0.01	5	73%	0.00	3
Specific Plan	12	124	0.11	74	73%	0.07	49
Total	**6,121**	**1,885**	**2.99**	**2,078**	**74%**	**2.02**	**1,403**
					WRF ADF[2]	**2.02**	**1,403**

Notes:
1. Potable water usage was calculated using a three-year average from 2020 to 2022 water billing data. Water usage that did not result in return wastewater flows was not included in this average (ex: hydrant testing, landscaping-specific meters, water losses, etc.)
2. Actual existing average daily flow calculated from influent WRF data from 2020 to 2022

Table 2 through **Table 5** provide a summary of the estimated average day water demand and average day flow within the FM01, FM02, FM03, and FM04 sewersheds during the flow monitoring study.

Table 2: Estimated FM01 Results with Adjusted Preliminary Wastewater Return Factors							
Land Use	Number of Sewered Parcels	Sewered Acres	Average Day Demand (MGD)	Average Day Demand (GPM)	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	282	45	0.07	48	68%	0.05	32
Multi-Family Residential	58	13	0.04	27	78%	0.03	21
Mobile Homes	3	36	0.08	54	73%	0.06	39
General Commercial	89	52	0.09	64	83%	0.08	53
Commercial Office	1	1	0.00	0	83%	0.00	0
General Industrial	82	77	0.05	37	83%	0.04	31
Public Facilities	1	0	0.00	0	68%	0.00	0
Airport	9	47	0.01	4	73%	0.00	3
Specific Plan	10	92	0.09	64	73%	0.07	47
Total	**535**	**363**	**0.43**	**299**	**76%**	**0.33**	**228**
					Estimated ADF	**0.33**	**228**
					Flow Monitoring ADF	**0.37**	**256**
					Percent Difference	**11%**	

Table 3: Estimated FM02 Results with Adjusted Preliminary Wastewater Return Factors							
Land Use	Number of Sewered Parcels	Sewered Acres	Average Day Demand (MGD)	Average Day Demand (GPM)	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	3084	852	1.00	696	68%	0.68	474
Multi-Family Residential	1593	234	0.63	438	78%	0.49	341
Mobile Homes	1	13	0.01	6	73%	0.01	5
General Commercial	378	178	0.27	189	83%	0.23	157
Commercial Office	177	40	0.07	46	83%	0.06	39
General Industrial	9	16	0.03	23	83%	0.03	19
Public Facilities	21	103	0.10	72	68%	0.07	49
Airport	0	0	0.00	0	73%	0.00	0
Specific Plan	0	0	0.00	0	73%	0.00	0
Total	**5,263**	**1,435**	**2**	**1,471**	**74%**	**1.56**	**1,083**
					Estimated ADF	**1.56**	**1,083**
					Flow Monitoring ADF	**1.04**	**722**
					Percent Difference	**50%**	

Table 4: Estimated FM03 Results with Adjusted Preliminary Wastewater Return Factors							
Land Use	Number of Sewered Parcels	Sewered Acres	Average Day Demand (MGD)	Average Day Demand (GPM)	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	1498	437	0.49	339	68%	0.33	230
Multi-Family Residential	667	106	0.28	197	78%	0.22	154
Mobile Homes	1	13	0.01	6	73%	0.01	5
General Commercial	230	99	0.14	100	83%	0.12	83
Commercial Office	128	21	0.04	25	83%	0.03	21
General Industrial	4	4	0.00	1	83%	0.00	1
Public Facilities	15	41	0.06	42	68%	0.04	29
Airport	0	0	0.00	0	73%	0.00	0
Specific Plan	0	0	0.00	0	73%	0.00	0
Total	**6,121**	**1,885**	**2.72**	**1887**	**73%**	**0.75**	**522**
					Estimated ADF	**0.75**	**522**
					Flow Monitoring ADF	**0.52**	**361**
					Percent Difference	**45%**	

Table 5: Estimated FM04 Results with Adjusted Preliminary Wastewater Return Factors							
Land Use	Number of Sewered Parcels	Sewered Acres	Average Day Demand (MGD)	Average Day Demand (GPM)	Return Factor %	Estimated ADF (MGD)	Estimated ADF (GPM)
Single-Family Residential	649	170	0.24	168	68%	0.16	114
Multi-Family Residential	346	64	0.16	110	78%	0.12	86
Mobile Homes	0	0	0.00	0	73%	0.00	0
General Commercial	67	22	0.03	22	83%	0.03	18
Commercial Office	24	10	0.01	10	83%	0.01	8
General Industrial	3	10	0.01	4	83%	0.00	3
Public Facilities	1	11	0.01	7	68%	0.01	5
Airport	0	0	0.00	0	73%	0.00	0
Specific Plan	0	0	0.00	0	73%	0.00	0
Total	**6,121**	**1,885**	**2.72**	**1887**	**73%**	**0.34**	**235**
					Estimated ADF	**0.34**	**235**
					Flow Monitoring ADF	**0.31**	**213**
					Percent Difference	**10%**	

Estimated ADF for flow meter basins FM01 and FM04 were within approximately 11% of the measured flows, which are within an acceptable range for validation purposes. However, FM02 and FM03 had large discrepancies at approximately 50% and 45%, respectively. Possible explanations could include discrepancies with the flow meter at the WRF or pipeline connections throughout the collection system that may be directing flow to other portions of the collection system not measured by the flow meters.

Appendix C – Waste Discharge Requirements and Cease and Desist Order

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

320 West 4th Street, Suite 200, Los Angeles, California 90013
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ORDER NO. R4-2018-0022, AS AMENDED BY ORDER NO. R4-2018-0022-A01 FILE NO. 06-189 CI-9259

WASTE DISCHARGE REQUIREMENTS ISSUED TO CITY OF SANTA PAULA (SANTA PAULA WATER RECYCLING FACILITY)

The California Regional Water Quality Control Board, Los Angeles Region (Regional Water Board) finds:

PURPOSE OF ORDER

1. The City of Santa Paula (City or Discharger) is the owner of the Santa Paula Water Recycling Facility (SPWRF), a Publicly-Owned Treatment Works (POTW), located at 920 Corporation Street in Santa Paula, California (Figure 1). The SPWRF, currently operated by Ventura Regional Sanitation District, discharges tertiary-treated wastewater to groundwater via three percolation ponds adjacent to the facility.

2. The City was previously regulated under Waste Discharge Requirements (WDRs) contained in Order No. R4-2007-0028, adopted by this Regional Board on May 3, 2007. The Regional Board amended Order No. R4-2007-0028 three times as follows:

   A. Order No. R4-2010-0074, adopted by this Regional Board on May 6, 2010, required that effluent discharged to percolations ponds shall not exceed 2.6 million gallons per day (MGD).

   B. Order No. R4-2007-0028-R02, adopted by this Regional Board on February 2, 2012, incorporated pretreatment program requirements and corresponding monitoring requirements.

   C. Order No. R4-2007-0028-R03, adopted by this Regional Board on April 6, 2017, extended the expiration date of Order No. R4-2007-0028 from May 3, 2010 to December 15, 2017 or upon future issuance of new or revised WDRs.

   D. Order No. R4-2007-0028-R04, adopted by this Regional Board on December 21, 2017, extended the expiration date of Order No. R4-2007-0028 from December 15, 2017 to March 31, 2018 or upon future issuance of new or revised WDRs.

Adopted: February 8, 2018
Amended: May 12, 2022

3. On October 1, 2015, the Regional Board directed the City to submit a Report of Waste Discharge (ROWD) for application of renewal of the City's WDRs to discharge treated wastewater from the SPWRF to the percolation pond. On December 5, 2015, the City filed its ROWD for the SPWRF.

4. To verify the information provided in the ROWD, Regional Board staff conducted inspections of the SPWRF on December 8, 2015 and December 28, 2016, including the wastewater treatment processes, percolation ponds, and groundwater monitoring wells.

5. The purpose of this Order is to renew WDRs for the City's SPWRF. This Order includes updates to effluent limitations, groundwater limitations, and Monitoring and Reporting Program (MRP) CI No. 9259 to ensure that the City's discharge of waste complies with water quality objectives set forth in the *Water Quality Control Plan for the Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties* (Basin Plan) and is protective of beneficial uses.

BACKGROUND

6. Before 2010, the City's wastewater was treated at the Santa Paula Wastewater Reclamation Plant (Plant), which discharged the treated wastewater to the Santa Clara River. That discharge was regulated by a National Pollutant Discharge Elimination System (NPDES) permit. Due to the age of the Plant, which was built in 1939, the City was unable to comply with the effluent limitations for biological oxygen demand (BOD), total suspended solids (TSS), turbidity, bacteria, residual chlorine, nitrate-nitrite, sulfate, and toxicity, as set forth in its NPDES permit. More than 3,000 violations at the Plant lead the Regional Board to engage in settlement discussions with the City, resulting in a Stipulated Consent Judgment and Final Order in 2007. The City chose to build a new treatment plant, the SPWRF, to discharge to groundwater through percolation ponds. The City was required to complete construction of the new SPWRF by September 15, 2010 and be in full compliance with WDRs set forth in Order No. R4-2007-0028 by December 15, 2010.

7. Construction of the SPWRF began in July 2008 and was completed in December 2009. The SPWRF began accepting partial flow in April 2010 and then accepted all flow from the City in May 2010. The Plant built in 1939 was thereafter decommissioned.

8. According to the United States Census Bureau, approximately 19% of the population in the City have income levels below the poverty line, and approximately 25% of area in the City is categorized as a disadvantage community (less than 80% of the State's median household income) or a severely disadvantaged community (less than 60% of the State's median household income). The average sewer fee assessed for a single family was about $88, based on the City's *2014 Water and Sewer Rate Study Results*.

9. Drinking water supplied to the City is produced from deep wells including Well 1-B, Well 11, Well 12, Well 13, and Well 14, which are owned and operated by the Water Division of the City and produce up to 10.6 MGD. Water produced at all five wells between 2010 and 2020 complied with all primary state and federal drinking water standards. Table 1 summarizes drinking water test results for total dissolved solids (TDS), sulfate, chloride, and boron from the City's 2010-2020Annual Water Quality Reports, as compared to the groundwater quality objectives (GQOs) set forth in the Basin Plan.

Table 1. Drinking Water Quality (milligrams per liter, mg/L)

Period	TDS	Sulfate	Chloride	Boron
2010	941	440	43	0.53
2011	918	428	41	0.54
2012	964	442	42	0.52
2013	693	208	47	0.52
2014	975	420	42	0.54
2015	941	405	44	0.47
2016	981	440	48	0.55
2017	924.2	393.6	47.8	0.4482
2018	924.2[1]	450.5	48	0.525
2019	1.036.7	477.7	48	0.4833
2020	1,060	446	49	0.6
GQOs	2,000	800	110	1.0

Table note: [1] Result sampled in 2017.

CURRENT FACILITY AND TREATMENT PROCESS DESCRIPTION

10. SPWRF and Vicinity

    A. The SPWRF (34º 19' 56.3" N, 119º 04' 57.2" W) is sited on a 50-acre parcel along Calpipe Road and Todd Lane in Santa Paula, California (Figure 1). The SPWRF is approximately 1,200 feet southeast of Highway 126, approximately 1,000 southwest of Shell Road, and approximately 1,300 feet northwest of the Santa Clara River.

    B. The SPWRF is located over the Santa Clara-Santa Paula Groundwater Basin (DWR Basin No. 4-4) (Figure 2).

11. SPWRF Treatment

A. The SPWRF treats wastewater generated within the City and is designed for a flow of 4.2 MGD. Based on the discharge records between July 2010 and June 2017, the monthly average effluent discharged from the SPWRF ranged between 1.36 and 2.44 MGD, with an average of 1.86 MGD. The monthly average effluent discharge flow rates between February 2018 and December 2021 ranged from 1.03 to 3.4 MGD, with an average of 1.86 MGD.

B. The wastewater treatment process at the SPWRF (See Figure 3 for process flow schematic) consists of preliminary treatment (coarse and fine mechanical screening and grit removal at the Influent Lift Station), flow equalization (two flow equalization tanks), secondary treatment (three aeration tanks with nitrification and denitrification activated sludge), tertiary treatment (six membrane bioreactors, providing further carbonaceous oxidation, nitrification/denitrification and solids removal to meet the limits of the WDRs), and disinfection (UV). Treated and disinfected effluent is discharged to three percolation ponds (Figure 5). The returned activated sludge is treated at two of three aerobic digesters (one aerobic digester is for backup) after being thickened at two thickeners. The solids generated at the aerobic digesters receive final dewatering at the screw dewatering press. Final solids are hauled by Synargro to their South Kern Compost Manufacturing Facility where they are composted to the United States Environmental Protection Agency (USEPA) Class A reuse standards for agricultural reuse.

C. To address levels of chloride in the effluent, an advanced treatment system, consisting of reverse osmosis (RO), will be constructed at the SPWRF, which will be designed to reduce the chloride concentration in the effluent to 110 milligrams per liter (mg/L) or less. The RO system will consist of nanofiltration and RO units to reduce effluent chloride concentrations followed by a RO brine concentrator (Figure 4).

D. The City owns and operates the sewer collection system, which conveys domestic, commercial, and industrial wastewater to the SPWRF. Two industrial users within the City are Aurora Casting (metal foundry) and Saticoy Lemon (lemon packing house). The City is required to implement a Pretreatment Program and to comply with requirements for operation and maintenance of the sewer collection system. The City has been implementing an industrial wastewater Pretreatment Program for the SPWRF, which has been approved by the USEPA and the Regional Board.

E. Percolation Ponds

i. The three percolation ponds were built on approximately 34 acres of agriculture land (Figure 5) and are located along Todd Lane in the Santa Clara-Santa Paula Groundwater Basin area.

ii. The Regional Board classified the discharge to the percolation pond as a discharge of treated wastewater to land that is subject to WDRs.

iii. A hydrologic model completed by the City in 2008 indicated that the percolation pond have a maximum discharge capacity of 2.6 MGD during wet years. Therefore, the allowable discharge of the SPWRF was reduced from 8 MGD to 2.6 MGD in Order No. R4-2010-0074 (amending Order No. R4-2007-0028).

12. Depth to groundwater within the shallow aquifer at the site ranges from approximately 15 to 49 feet below ground surface. Groundwater gradients generally appear to parallel the ground surface, gently sloping downward to the southwest. During wet years, groundwater may rise to within 10 to 11 feet below ground surface in the area along the Santa Clara River.

13. On August 23, 2018, the Regional Water Board approved the City's modified groundwater monitoring network dated May 1, 2018 to expand the groundwater monitoring network by including agricultural water supply wells. Subsequently, on April 22, 2019, the Regional Water Board approved the Groundwater Chloride Investigation and Well Production Workplan dated December 2018, which proposed installing one additional off-site groundwater monitoring well, MW-9.

    The City owns and currently samples nine (9) groundwater monitoring wells, including MW-1, MW-2a, MW-3, MW-4, MW-5, MW-6, MW-7a, MW-8, and MW-9 (shown on Figure 5).

COMPLIANCE HISTORY

14. Based on data collected from July 2010 to June 2017, the City had the following number of exceedances recorded in the effluent and groundwater at the SPWRF, which are identified in Table 2.

Table 2. Number of Exceedances Recorded in Effluent and Groundwater

Pollutants	Effluent	Groundwater
Chloride	84	174
Di(2-ethyl)phthalate	1	
Dioxin	1	
Total nitrogen	1	
Nitrate plus nitrite		1
Sulfate		1
Chromium		5
Aluminum		10
Nickel		1

Pollutants	Effluent	Groundwater
Boron		1

Multiple effluent and groundwater limitations were exceeded during the period between the 2nd quarter of 2010 and the 3rd quarter of 2011. Beginning with the 4th quarter of 2011, the City had met all effluent limitations except for chloride. As previously noted, the SPWRF was not designed to remove chloride. The monthly effluent chloride concentration ranged from 125 to 166 mg/L and continuously exceeded the effluent chloride monthly average of 110 mg/L. Table 3 summarizes the annual average chloride concentrations in the SPWRF effluent.

Table 3. Annual Average Chloride Concentrations[1] (mg/L) in SPWRF Effluent

Period	Concentration
2010	156
2011	153
2012	149
2013	155
2014	145
2015	134
2016	137
2017	131
2018	121
2019	120
2020	118.88
2021	112
Range[2]	135.99 ± 15.61

Table Notes:
[1] All data collected from grab samples.
[2] Data range is based on one standard deviation.

15. Table 4 summarizes the groundwater annual average chloride concentration before and after the SPWRF began discharging via the percolation pond. The annual average chloride groundwater concentration was 108 mg/L at the downgradient water supply Well AW03 prior to initiation of discharge at the percolation pond in 2010. After the SPWRF began discharging to the percolation pond, the annual average chloride groundwater concentration increased to 135 mg/L at Well AW03.

Monitoring data from the upgradient groundwater monitoring Well MW-3 indicates an annual average chloride groundwater concentration of 100 mg/L. This information suggests that the background groundwater chloride concentration was around 100 mg/L. Groundwater chloride concentrations at the downgradient groundwater monitoring Well MW-5 have been recorded between 135 and 155 mg/L, with an average of 142 mg/L. This data closely aligns with the SPWRF's effluent chloride concentration of approximately 136 mg/L (Table 3). The groundwater and effluent data indicate that the chloride discharges from the SPWRF have impacted, and continue to impact, the receiving groundwater quality in the vicinity of the SPWRF.

Table 4. Annual Average Chloride Concentration[1] in Groundwater (mg/L)

Prior to Discharge from SPWRF			
Period	**Downgradient MW-5[2]**	**Downgradient 03N21W21G03S[3]**	**Upgradient MW-3[4]**
2003		113	
2004		111	
2005	115	117	92
2006	114	112	88
2007	108	110	85
2008	87	100	78
2009	74	92	96
Range[5]	99.6 ± 16.3	107.9 ± 8.6	87.8 ± 6.1
After Discharge from SPWRF			
2010 (Jul – Dec)	145	138	93
2011	145	146	112
2012	153	135	87
2013	155	136	103
2014	135	129	115
2015	136	129	108
2016	135	134	103
2017	121	131	105
2018	128.2	126.6	123.6
2019	128.8	129.4	163.1

2020	129.5	127.4	126.3
2021	130.2	129.8	114.3
Range[5]	136.8 ± 10.5	132.6 ± 5.5	112.8 ± 19.5

Table Notes:

[1] All data collected from grab samples.

[2] Data were averaged from samples collected at the City-owned groundwater monitoring Well MW-5 with screen intervals of 42 to 62 feet, located approximately 50 feet downgradient from Percolation Pond 3.

[3] Water supply Well AW03 is owned and operated by a private entity. This well is located approximately 300 feet southwest of Well MW-5. The screen intervals of Well AW03 are from 80 to 120 below surface grade. Water produced at this well is used for agricultural irrigation only.

[4] Data were averaged from samples collected at the City-owned groundwater monitoring Well MW-3 with screen intervals of 25 to 45 feet, located approximately 1,800 feet upgradient from Percolation Pond 1.

[5] Data range is based on one standard deviation.

16. The Regional Board issued three Notices of Violation (NOVs) to the City, dated November 3, 2011, December 30, 2014, and March 20, 2017, for exceedances of the chloride effluent and groundwater limitations in Order No. R4-2007-0028. These NOVs required the City to implement corrective and preventative actions to bring the City's discharge to full compliance with the chloride effluent limitation and receiving water requirements specified in Order No. R4-2007-0028.

PLAN FOR CHLORIDE COMPLIANCE

17. The City's efforts to reduce the chloride concentration in the influent to the SPWRF are summarized below:

    A. The City identified that the influent to the SPWRF contains brine with elevated chloride concentration from Self-Regenerating Water Softeners (SRWS). There are approximately 1,250 residential SRWS used in the City.

    B. On September 5, 2006, the City established Ordinance No. 1160 prohibiting the installation or replacement of residential SRWS.

    C. On June 22, 2015, the City adopted Resolution No. 6918 approving a SRWS Buyback and Incentive Program. This program offers a financial incentive to residents to voluntarily remove SRWS. A Kick-Off SRWS Buyback event was held on September 19, 2015. The removal of SRWS under this program began in October 2015. Three hundred (300) of the approximately 1,250 SRWS have been removed from October 2015 through February 2022. Decreasing chloride concentrations in the effluent have been observed, but they still cannot meet the chloride discharge limitation set forth in the WDRs.

18. To address the City's chloride exceedances in the effluent and groundwater, the Regional Board required the City to submit a Chloride Reduction Workplan. Board staff also met with the City on several occasions to discuss the City's chloride exceedances. A summary of these events are as follows:

    A. On December 19, 2013 and May 11, 2015, the Regional Board met with the City to discuss its Chloride Reduction Workplan. The City's Chloride Reduction Workplan includes the following tasks:

        i. Prohibit SRWS installations or replacements;

        ii. Implement a SRWS Buyback Program;

        iii. Implement a Recycled Water Program to reduce effluent discharged to the three percolation ponds; and

        iv. Implement Supplemental Strategies, if needed, including advanced treatment (e.g. reverse osmosis) and disposal of brine.

    B. On January 28, 2016, Regional Board staff discussed with the City the necessary actions to reduce the chloride concentration in the effluent, which included the SRWS Buyback Program. The City also proposed to explore application of recycled water at locations other than identified groundwater hot spots and to conduct groundwater impact investigation and remediation activities. The City was notified that detailed schedules and milestones were required for all actions.

    C. On March 8, 2016 and September 14, 2016, the City met with Regional Board staff to provide an update of its SRWS Buyback Program efforts. The City noted that five City employees were deployed to conduct door-to-door visits to encourage participation in the SRWS Buyback Program among 7,500 dwellings within the City.

    D. On October 31, 2016, the City met with Regional Board staff to provide an update on the following topics:

        i. Status of implementing the chloride compliance strategy and potential for reduction of effluent discharged to the three percolation ponds via the City's Recycled Water Program;

        ii. Assimilative capacities for chloride at different groundwater locations beneath the City based on the Salt and Nutrient Management Plan for the Lower Santa Clara River Basin; and

        iii. Groundwater hot spots (i.e., chloride-impaired areas with no assimilative capacity for recycled water applications) in the City.

19. On July 9, 2015, the Regional Board adopted Resolution No. R15-007, an amendment to the Basin Plan that incorporated stakeholder-developed groundwater quality management plan for salts and nutrients in the Lower Santa Clara River groundwater basins. Groundwater quality management measures were developed by stakeholders as part of the Salt and Nutrient Management Plan (SNMP) for the Lower Santa Clara River Basins in Ventura County. Such plans are a requirement of the State Water Resources Control Board's (State Water Board) Recycled Water Policy and are intended to maintain high quality waters and to protect the beneficial uses of groundwater while promoting recycled water use throughout the state. The SNMP utilized a groundwater quality model that characterized the water quality in the Santa Paula Basin and examined the degree of impairment to water quality in the Basin. The model shows there is available assimilative capacity for salts and nutrients, including chloride, in most areas of the Santa Paula Basin to allow for recycled water projects consistent with the Recycled Water Policy. As described below, the City is planning to recycle effluent that is currently discharged to the percolation pond.

20. The City developed and utilized a simple spreadsheet mixing model, the Groundwater Chloride Transportation Model (Chloride Model), to analyze the effect of future effluent discharges on groundwater over time at various distances from the percolation pond. The City's modelling assumed some degradation of groundwater with respect to chloride within a limited range of mixing zone radius below and adjacent to the SPWRF, measured from the boundaries of the percolation pond. This distance is the maximum allowable distance where SPWRF effluent disposed to the percolation pond can mix with groundwater and result in receiving water chloride concentrations of 110 mg/L or less in order to provide protection to groundwater beneficial uses at the first encountered water supply wells which are at 150 feet away from the percolation ponds. Groundwater within the mixing zone will exceed the chloride GQO of 110 mg/L. Mass-volume balance calculations along with Darcy's Law are used to account for travel in porous media. The Chloride Model simulates instantaneous and complete mixing of ambient groundwater with effluent seepage reaching the water table from the percolation pond using SPWRF data for flow and chloride effluent concentrations. It was conservatively assumed that any effluent discharge to the percolation pond would infiltrate into the underlying aquifer and not be diverted for other uses. Groundwater parameters within the spreadsheet model were selected based on recent monitoring reports in order to be representative of average conditions within the vicinity of the SPWRF. The Chloride Model assumes an initial volume of groundwater underlying the ponds possessing background chloride concentrations of 136 mg/L. The volume of the existing groundwater body is calculated as the product of the radius of interest (150-1200 feet), an assumed saturated thickness of potentially impacted groundwater (50 feet), and the porosity of the underlying sediments (assumed to be 0.2) based on the low end of published literature values for a sand and gravel mixture. Based on the regional groundwater quality data documented in the SNMP, regional groundwater inflow is assumed to have a chloride concentration of 91 mg/L.

On December 14, 2016, Regional Board staff met with the City to discuss the results of the Chloride Model, which evaluated compliance with the groundwater quality objectives beneath and adjacent to the three percolation ponds, for various discharge scenarios. Based on Regional Board staff's comments, the City implemented additional discharge scenarios in the Chloride Model, which was discussed in meetings held on February 8, 2017, February 17, 2017, July 24, 2017, and August 7, 2017.

21. The Chloride Model simulated chloride concentrations in the receiving groundwater resulting from chloride mass loading reduction in the three percolation ponds. The Model predicted GQOs being achieved at 150 feet away from the percolation pond when the total mass of chloride in the effluent is significantly reduced. The initial mass of chloride is calculated based on the average chloride effluent concentration of 135 mg/L and the discharge rate of 2.2 MGD [95 percentile of monthly average effluent flows, resulting from data recorded between October 2015 (beginning of the SRWS Buyback Program) and June 2017], which results in 2,479 pounds total mass of chloride discharged per day. The reduction of chloride mass discharged to the percolation pond can be achieved by improving the effluent chloride concentration (e.g., source control or treatment), or diverting a significant amount of flow for recycled water uses, or a combination of both in order to protect water supply Wells AW01, AW02, and, AW03, approximately 150, 150, and 300 feet, respectively, away from percolation ponds. Water produced from these wells is primarily for agricultural irrigation use.

    To achieve the chloride GQO of 110 mg/L in groundwater at least 150 feet away from the percolation pond, the City provided various effluent chloride concentration and allowable flow combinations (Table 5). Based on the hydrology and hydrogeologic condition at the SPWRF percolation ponds area, the higher the concentration of chloride in the effluent, the less volume and mass can be discharged to percolation ponds to comply with the chloride GQO in the Basin Plan. For example, if the chloride concentration in the effluent is 135 mg/L, only 0.07 MGD, which is equivalent to 79 pounds of chloride per day, could be discharged to the percolation pond to achieve the chloride GQO of 110 mg/L at 150 feet away from the percolation pond. If the chloride concentration in the effluent is reduced to 120 mg/L, then more flow (0.2 MGD) can be discharged to the percolation pond and achieve the chloride GQO 150 feet away from the percolation pond.

Table 5. Groundwater Chloride Transportation Model – Continuous Discharge

Chloride Effluent Concentration (mg/L)	Flow to Percolation Ponds (MGD) (% of 2.2 MGD)	Daily Allowable Effluent Mass Load to Groundwater (lbs)	Chloride Groundwater Concentration at 150 feet (mg/L)
135	0.07 (3.2%)	79	110
130	0.1 (4.5%)	108	110

Chloride Effluent Concentration (mg/L)	Flow to Percolation Ponds (MGD) (% of 2.2 MGD)	Daily Allowable Effluent Mass Load to Groundwater (lbs)	Chloride Groundwater Concentration at 150 feet (mg/L)
125	0.13 (5.9%)	135	110
120	0.2 (9.1%)	200	110
115	0.4 (18.2%)	384	110

22. To achieve compliance with the chloride GQO in this Order and to conserve potable water, the City plans to reduce the volume of effluent, and thus a reduction of the chloride mass discharged to the percolation pond by providing recycled water for various local uses. The Regional Board has evaluated the planned recycle projects and has determined that they will be consistent with the State Water Board's Recycled Water Policy and will still preserve available assimilative capacity within the Santa Paula Basin consistent with the SNMP. The mass-based effluent limitation for chloride in this Order reflects the City's chosen compliance option. The groundwater limitations are based on the GQOs in the Basin Plan.

23. On December 22, 2015, the City submitted the Recycled Water Program Technical Report and Notice of Intent with the Title 22 Engineering Report to the State Water Board's Division of Drinking Water (DDW) for approval. DDW conditionally approved the Title 22 Engineering Report on August 19, 2016. On June 14, 2017, the Regional Board enrolled the City's recycled water program under separate Water Reclamation Requirements for Recycled Water Use, Order WQ 2016-0068-DDW, issued by the State Water Board on June 7, 2016.

24. In the City's report, Chloride Load Reduction Milestones, submitted to the Regional Board on March 14, 2017, the City included the construction of RO treatment at the SPWRF as an option (under Supplemental Strategies), if needed, in order to comply with the chloride groundwater quality objective (GQO) of 110 mg/L. The City will continue its source control efforts to remove SRWSs and will first focus on recycling most of its effluent in order to bring the groundwater back into compliance with GQOs. Progress with these efforts was assessed at Year 2020 and determination was made to pursue advanced treatment to meet the chloride GQO at Year 2027.

    On April 15, 2020, the City notified the Regional Water Board of its modified approach to install an advanced wastewater treatment system with RO at SPWRF in lieu of the originally proposed recycled water project to meet the effluent limitations in this Order.

25. Due to the following reasons, the City cannot immediately comply with the chloride effluent and groundwater limitations prescribed in this Order: (1) elevated chloride concentrations in the influent, (2) the wastewater treatment process not currently designed to remove chloride out of the waste stream, and (3) time needed to

construct the advanced wastewater treatment system with RO. In addition, the current progress of the City's SRWS Buyback Program does not reliably ensure that the SPWRF will comply with the chloride effluent and groundwater limitations. Therefore, the Regional Board has determined that issuance of an accompanying CDO is appropriate and necessary to put the City on the path towards compliance with the effluent and groundwater limitations for chloride set forth in this Order. The CDO requires the City to comply with interim chloride effluent and groundwater limitations and implement actions pursuant to a prescribed time schedule.

During the pendency of the CDO schedule, there will be permitted degradation of groundwater with respect to chloride within a limited mixing zone radius downgradient and adjacent to the SPWRF percolation ponds, measured from the boundaries of the percolation pond to 150 feet. This distance is the shortest distance where SPWRF effluent disposed to the percolation pond can mix with groundwater and result in receiving water chloride concentrations of 110 mg/L or less. Groundwater within the 150-foot mixing zone will exceed the chloride GQO of 110 mg/L for the duration of the CDO schedule. Based on the available data, there are no water supply wells within the 150-foot mixing zone. The City can arrange for alternative water supplies for any well owners in the mixing zone, if any are discovered. At the end of the CDO schedule, the mixing zone is no longer allowed, and compliance with chloride limitations of 110 mg/L at monitoring wells adjacent and downgradient to the boundaries of the percolation ponds is required. global warming and climate change

26. The observed century-scale rise in the average temperature of the Earth's surface, oceans, and atmosphere, commonly recognized as the Global Warming, has resulted in extreme climate change, such as the extreme drought and extremely heavy rainfall. In Southern California, the predicted impacts of climate change are numerous. Annual average temperatures are expected to increase, coupled with a higher frequency of extreme heat days. A likely consequence of this warmer climate will be more severe drought periods, leading to an increase in the amount and intensity of fires and a longer fire season. In addition, precipitation patterns are likely to be modified. A decrease in snowfall, combined with warmer temperatures, will induce a decrease in the amount and duration of snowpack, an essential source of freshwater to the region. The increasing occurrence of extreme precipitation events will amplify the risk of flooding, which recently happened in Southern California.

    These impacts will affect water quality in multiple ways, including changes in stream flow, aquatic habitats, surface water temperature, pollutant levels, sedimentation, algal growth, and salinity levels and acidification in coastal areas. For permitted facilities such as Publically Owned Treatment Works (POTWs), specific impacts could include, but are not limited to, an increase in the concentration of pollutants entering the facility, an increase in the temperature of effluents and receiving waters, an increase in storm water inflow and infiltration, increase in flooding/inundation of facilities, sewer overflows, power outages, pump maintenance issues, and onsite or nearby hillside destabilization.

Executive Order B-30-15, issued on April 29, 2015, recognizing the challenges posed by climate change, directed state agencies to take climate change into account in their planning decisions, guided by the following principles: Priority should be given to actions that both build climate preparedness and reduce greenhouse gas emissions; where possible, flexible and adaptive approaches should be taken to prepare for uncertain climate impacts; actions should protect the state's most vulnerable populations; and natural infrastructure solutions should be prioritized.

On February 7, 2019, the City submitted a Climate Change Plan. The Climate Change Plan indicated the SPWRF is outside of the 100-year floodplain of the Santa Clara River. This Order requires the City to periodically review and submit a revised Climate Change Plan when conditions at the facility change that may impact water quality. In addition, this Order contains provisions to require planning and actions to address climate-related impacts that can cause or contribute to violations of this Order and/or degradation of waters of the state.

27. The SPWRF was designed to include protection from a 100-year storm event in the Santa Clara River. The SPWRF buildings and percolation ponds are located behind a dike that has an elevation above the elevation anticipated as the result of a 100-year storm event. The design documents and potential flood flow assessment is contained in files in the City's Building & Safety Department. The elevation of the dike at the SPWRF is 23 feet higher than the Santa Clara River located at approximately 1,300 feet southeast. This elevation separation provides additional protection from a possible flood overflow from the Santa Clara River caused by the climate change. It should also be noted that the SPWRF is located outside of the Santa Clara River floodway defined by the Federal Emergency Management Agency and the Ventura County Watershed Protection District. Lastly, the SPWRF is equipped with a backup generator that is capable of operating the SPWRF through power outages and other emergencies.

    Climate change may also increase drought and related impacts such as reduced potable water supply and/or changing water supplies, which may be of less quality.

APPLICABLE LAWS, PLANS, POLICIES, AND REGULATIONS

28. This Order serves as WDRs pursuant to Division 7, Chapter 4, Article 4 of the California Water Code (commencing with section 13260). WDRs have been established because discharges from the SPWRF have the potential to affect the quality of the waters of the State, to impact the beneficial uses of those waters, and/or to cause a nuisance. The Regional Board developed the requirements of this Order based on information submitted as part of the application, through monitoring and reporting programs, and other available information.

29. Water Quality Control Plan for the Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (Basin Plan) - On June 13, 1994, the Regional Board adopted a comprehensive revision to the Basin Plan. The Basin

Plan: (i) designates beneficial uses for surface and groundwater, (ii) establishes narrative and numeric water quality objectives that must be attained or maintained to protect the designated beneficial uses, and (iii) sets forth implementation programs to achieve those objectives for all waters addressed through the Basin Plan. The Basin Plan also incorporates State Water Board Resolution No. 68-16 (see finding below for detail). In addition, the Basin Plan incorporates applicable State and Regional Board plans and policies and other pertinent water quality policies and regulations. The Basin Plan has been amended occasionally since 1994, including recent administrative updates. The requirements in this Order implement the Basin Plan.

30. Beneficial Uses - The SPWRF overlies the Santa Clara-Santa Paula Groundwater Basin (DWR Basin No. 4-4). The Basin Plan identifies beneficial uses for regional waters, including those based on State Water Board Resolution No. 88-63 ("Sources of Drinking Water Policy"), which established state policy that all surface and ground waters of the State, with certain exceptions, are considered suitable or potentially suitable for municipal or domestic water supply. Beneficial uses applicable to the receiving groundwater are as follows:

Table 6. Basin Plan Beneficial Uses of Groundwater

Receiving Water	Beneficial Use(s)
Santa Clara-Santa Paula Groundwater (DWR Basin No. 4-4)	Existing: Municipal and domestic supply (MUN), industrial service supply (IND), industrial process supply (PROC), and agricultural supply (AGR)

31. Title 22, California Code of Regulations (CCR) - To protect sources of drinking water, the Basin Plan (Chapter 3) incorporates the primary and secondary maximum contaminant levels (MCLs) for inorganic, organic, and radioactive contaminants in drinking water as water quality objectives. These MCLs are codified in CCR, Title 22, Division 4. This incorporation by reference is prospective including future changes to the incorporated provisions as the changes take effect. The primary MCLs (see Attachments A-1 to A-6) are applicable water quality objectives for a receiving water to protect beneficial uses when that receiving water is designated as municipal and domestic supply. The Basin Plan also specifies that "Ground waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses." Therefore, the secondary MCLs, which are limits based on aesthetic, organoleptic standards, are applicable water quality objectives for a receiving water to protect beneficial uses when that receiving water is designated as municipal and domestic supply. These water quality objectives are implemented in this Order to protect the designated beneficial uses.

32. Domestic Water Quality – In compliance with California Water Code section 106.3, it is the policy of the State of California that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking,

and sanitary purposes. This Order promotes that policy by requiring discharges to meet MCLs implemented by the Basin Plan that are designed to protect human health and ensure that water is safe for domestic use.

33. Impaired Water Bodies on Clean Water Act Section 303(d) List/Total Maximum Daily Loads (TMDLs) – The Santa Clara River is listed on the Clean Water Act Section 303(d) List as impaired by ammonia in Reach 3 and by nitrate plus nitrite in Reach 7. To address this impairment, the Regional Board established the Santa Clara River Nitrogen Compounds TMDL on August 7, 2003 by Regional Board Resolution No. 2003-011. The State Water Board approved the TMDL on November 19, 2003 (Resolution No. 2003-0073) and OAL approved it on February 27, 2004. The TMDL became effective upon approval of the U.S. Environmental Protection Agency on March 18, 2004. Concentration-based loads for nitrogen compounds are allocated for nonpoint sources. The Discharger is subject to the following assigned load allocation for nonpoint sources:

Table 7. Nonpoint Source Load Allocation for Santa Clara River Nitrogen Compounds TMDL

Nitrogen Compounds TMDL	Monthly Average (mg/L)
Combined ammonia (NH_3-N), nitrite (NO_2-N), nitrate (NO_3-N) loads as nitrogen	10

34. California Water Code section 13263 requires that the Regional Board, when prescribing waste discharge requirements, take into consideration the factors in section 13241. The Regional Board has considered those factors in establishing the WDRs in this Order.

35. State Water Board Resolution No. 68-16, Antidegradation Policy – State Water Board Resolution No. 68-16 “Statement of Policy with Respect to Maintaining High Quality of Waters in California” (also called the “Antidegradation Policy”) requires the Regional Board, in regulating the discharges of waste, to maintain high quality waters of the state unless it is demonstrated that any change in quality is consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in the State Water Board’s policies (e.g., quality that exceeds water quality objectives). Further, any activity that produces waste must meet waste discharge requirements that will result in the best practicable treatment or control (BPTC) of the discharge necessary to assure that (a) pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

Excepting chloride (discussed below), the SPWRF's discharge is high quality, tertiary-treated effluent meeting groundwater quality objectives in the Basin Plan and MCLs for drinking water. The Regional Board finds that the discharge, as allowed in

this Order, is consistent with Resolution No. 68-16 since this Order: (1) requires compliance with the requirements set forth in this Order, including the use of best practicable treatment and control of the discharges, (2) requires implementation of a Monitoring and Reporting Program (MRP); and (3) requires that the discharges comply with effluent limits to meet water quality objectives. This Order establishes limitations and requirements that will not unreasonably threaten present and anticipated beneficial uses or result in receiving ground water quality that exceeds water quality objectives set forth in the Basin Plan. Limitations for each waste constituent are based on the most stringent applicable water quality objectives to protect the most sensitive beneficial use of the receiving waterbody; thus, all beneficial uses are protected. To ensure such protection, a vigorous monitoring plan is also adopted with this Order. This Order contains requirements for implementing Best Practicable Technology and Control (BPTC). Accordingly, the discharge is consistent with the antidegradation provisions of Resolution 68-16. Based on the results of wastewater treatment and monitoring of effluent and groundwater quality, the Regional Water Board may open this Order to reconsider groundwater limitations and other requirements to comply with Resolution 68-16, if necessary.

Untreated discharges of chloride over the last 10 years have resulted in elevated concentrations of chloride in the effluent and groundwater. The groundwater quality objective for chloride is 110 mg/L and the average effluent chloride concentration in 2016 was 137 mg/L. To comply with the chloride groundwater limitations in this Order, which are based on the chloride groundwater quality objective, the City intends to upgrade the SPWRF with reverse osmosis (RO) in lieu of the recycled water projects to reduce the chloride concentration in the effluent prior to discharge into the percolation pond. This will, in time, restore the impaired groundwater zone adjacent and downgradient to the percolation pond. However, implementation of the RO system will take time to fully implement, which will result in continued localized degradation in the immediate vicinity of the SPWRF percolation ponds. Construction and optimization of the RO system is due to be completed by March 30, 2025, at which time, a chloride concentration in the effluent from the SPWRF of 110 mg/L is required. However, a lag in groundwater quality improvement is expected following the improved quality of the discharge. While groundwater within the 150-foot mixing zone adjacent to the percolation ponds will temporarily exceed the chloride groundwater quality objective, this Order imposes limits on flow and chloride mass loading in the effluent to ensure receiving groundwater beneficial uses will be maintained and supported. Beneficial uses will be maintained as all wells utilized for crop irrigation are located outside the mixing zone. By the final CDO compliance date of February 8, 2028, the mixing zone is no longer allowed and compliance with chloride limitations of 110 mg/L at monitoring wells adjacent and downgradient to the boundaries of the percolation ponds is required.

The Regional Board recognizes that reducing chloride concentrations in the effluent or in the groundwater by using RO can be costly. The current estimated cost for the City to install a RO system is $26.6 million with annual operating and maintenance costs of $1.6 million, including brine waste disposal. These costs would be passed on to the ratepayers, who already pay one of the highest sewer rates in the State.

The City is also a small low-income community. The costs of RO treatment depend on the volume of effluent or groundwater to be treated in order to meet the groundwater quality objectives specified in the Basin Plan. To defray the costs of the upgrade, the City has submitted a State Water Board Clean Water State Revolving Fund application with the State Water Board Division of Financial Assistance. The City plans to complete construction of the RO system within two years of receiving the Final Funding Agreement but no later than December 2024.

Incorporating an RO system to reduce chloride and other salts from the SPWRF effluent prior to discharge into the percolation pond will benefit water quality locally and effectively reduce the contribution of chloride and other salts to the Santa Clara-Santa Paula groundwater basin. This Order establishes limitations and requirements protective of the present and anticipated beneficial uses or result in receiving ground water quality that meets or exceeds water quality objectives set forth in the Basin Plan and is therefore, consistent with State Water Board Resolution No. 68-16.

36. California Water Code section 13267 authorizes the Regional Water Board to require the City to submit monitoring and technical reports as necessary to investigate the impact of a waste discharge on waters of the state. The monitoring and reporting requirements established in this Order are necessary to characterize the discharge, evaluate compliance with this Order, and evaluate groundwater quality and the extent of degradation, if any, caused by the discharge.

37. Publicly Owned Treatment Works (POTW) – The term POTW means a treatment works as defined by section 212 of the federal Clean Water Act, which is owned by a State or municipality (as defined by section 502(4) of the Act). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW treatment facility. The term also means the municipality as defined in section 502(4) of the Clean Water Act, which has jurisdiction over the indirect discharges to and the discharges from such treatment works. (40 C.F.R. section 403.3(q)). The SPWRF meets all of the above criteria and therefore is considered a POTW.

38. Pretreatment – The City is required to implement a Pretreatment Program and to comply with requirements for operation and maintenance of its sewer collection system. Pursuant to CCR, Title 23, section 2233 and Title 40, Code of Federal Regulations (C.F.R.), Part 403, the City has been implementing an approved industrial wastewater Pretreatment Program for the SPWRF since February 2012. The Regional Board finds it appropriate to require the City to continue to implement its approved Pretreatment Program.

39. Endangered Species Act Requirements - This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code, §§ 2050 to 2097) or the Federal Endangered Species Act (16 U.S.C. §§ 1531 to 1544). This Order requires

compliance with effluent limits, groundwater quality objectives, and other requirements to protect the beneficial uses of waters of the state. The Discharger is responsible for meeting all requirements of the applicable Endangered Species Act.

40. California Environmental Quality Act - This Order involves the renewal of WDRs for an existing facility. Therefore, this action to prescribe WDRs is exempt from the provisions of CEQA (Public Resources Code section 21000 et seq.) in accordance with California Code of Regulations, Title 14, section 15301.

41. Pursuant to CWC section 13263, the requirements of this Order take into consideration the provisions of CWC section 13241, including the following factors.

    A. Past, present, and probable future beneficial uses of water;

    The receiving water for discharges from the SPWRF is the Santa Clara Valley River Groundwater Basin-Santa Paula subbasin-West of Peck Road. The receiving water limitations in this Order are specified to maintain the beneficial uses of this basin: municipal and domestic water supply (MUN), industrial service supply (IND), industrial process supply (PROC), and agricultural supply (AGR). This Order also specifies effluent limitations protective of the beneficial uses and includes effluent and receiving water monitoring and reporting requirements to verify that discharges will not adversely affect the beneficial uses of groundwater.

    B. Environmental characteristics of the hydrographic unit under consideration, including the quality of the water available thereto;

    This Order incorporates the site-specific water quality objectives for groundwater in the Basin Plan considering geology, hydrogeology, and hydrology. Based on recent and historical data, the regional groundwater basin currently has high quality water, but is experiencing increases in salt and nitrogen loading from natural and anthropogenic sources. The SPWRF will produce effluent quality that is better than or equivalent to the groundwater quality objectives and will comply with the state's Antidegradation Policy (Resolution No. 68-16). The project will therefore limit further groundwater degradation.

    C. Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area;

    The water quality conditions that can be reasonably achieved are those consistent with the site-specific water quality objectives necessary to protect the beneficial uses of the groundwater basin identified in A, above. through the coordinated control of all factors that affect water quality in the area. The City's plans to upgrade the SPWRF with an advanced treatment system, including RO, is part of the coordinated control of all factors that affect water quality in the areas.

D. Economic considerations;

The City of Santa Paula is identified as a disadvantaged community as defined in CWC section 79505.5. A “disadvantaged community means a community with an annual median household income that is less than 80 percent of the statewide annual median household income.” According to the United States Census Bureau, the 2019 California median household income is $80,440 and the City of Santa Paula median household income is $60,468.

Based on the City’s *Water and Sewer Rate Study* dated September 2019, the monthly wastewater user rate at monthly water use of 8.1 hundred cubic feet is $98.55 per single family residence in the fiscal year 2021-2022.

Therefore, the implementation of the RO system may cause significant economic impact to the community. The City continuously investigates solutions to minimize economic impact, including submittal of an application to the State Revolving Fund to defray costs to the community.

E. The need for developing housing within the region;

According to the United States Census Bureau, the total population in the City of Santa Paula is 30,657 in 2019. The SPWRF is designed to treat 4.2 MGD of wastewater and currently discharges approximately 2 MGD. The SPWRF has sufficient capacity to treat additional wastewater generated from newly developed residential, commercial, and industrial districts.

F. The need to develop and use recycled water;

The State Water Board adopted the *Water Quality Control Policy for Recycled Water* (Recycled Water Policy) in 2018 and encourages the increased use of recycled water in California: 714,000 acre-feet per year (AFY) in 2015 to 1.5 million AFY by 2020 and to 2.5 million AFY by 2030. The Recycled Water Policy categorizes recycled water use as agricultural irrigation, landscape irrigation, golf course irrigation, commercial application, industrial application, geothermal energy production, non-potable uses, groundwater recharge, seawater intrusion barrier, reservoir water augmentation, raw water augmentation, and potable uses.

On June 14, 2017, the City enrolled under State Water Board Water Reclamation Requirements for Recycled Water Use Order No. WQ 2016-0068-DDW. The City may distribute the disinfected tertiary-treated wastewater for recycled water applications, as appropriate, consistent with the Recycled Water Policy when the RO system is implemented at the SPWRF. This will help offset the need for potable water.

NOTIFICATION

42. The Regional Board has notified the Discharger and interested agencies and persons of its intent to prescribe WDRs for the discharge and has provided them with an opportunity to submit their written comments and recommendations.

43. The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge.

44. Any person aggrieved by this action of the Regional Board may petition the State Water Board to review the action in accordance with California Water Code section 13320 and California Code of Regulations, title 23, section 2050 and following. The State Water Board must receive the petition by 5:00 p.m., 30 days after the Regional Board's action, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions will be provided upon request or may be found on the Internet at: http://www.waterboards.ca.gov/public_notices/petitions/water_quality

IT IS HEREBY ORDERED that, in order to meet the provisions contained in Division 7 of the California Water Code (commencing with section 13000) and regulations adopted thereunder, the City of Santa Paula shall comply with the following requirements, including all attachments, in all operations and activities at the SPWRF:

I. INFLUENT LIMITATIONS AND REQUIREMENTS

Influent wastewater shall be limited to wastewater generated within the jurisdiction of the City.

II. EFFLUENT LIMITATIONS

A. Discharges from the SPWRF shall not exceed the maximum effluent volume of 4.2 MGD and the quarterly average effluent volume of 2.6 MGD.

B. Tertiary-treated effluent shall not exceed the effluent limitations in Table 8 below.

Table 8. Effluent Limits

Constituents	Units	Monthly Average	Daily Maximum
Oil and grease	mg/L	10[1]	15[1]
Total suspended solids	mg/L	10[1]	15[1]
	%removal	≥85[2]	None

Constituents	Units	Monthly Average	Daily Maximum
$BOD_{5@20°C}$	mg/L	10[1]	15[1]
	%removal	≥85[2]	None
Ammonia as nitrogen + nitrate as nitrogen + nitrite as nitrogen	mg/L	10[3]	None
Nitrite as nitrogen	mg/L	1	None
Total dissolved solids	mg/L	2,000[4]	None
Sulfate	mg/L	800[4]	None
Boron	mg/L	1.0[4]	None
Chloride	mg/L	110[4]	None

Table Notes:

[1] Limit is based on best professional judgment. Limits adopted by this Regional Board exist in the permits for tertiary-treated wastewater treatment plants.

[2] Limit is based on secondary treatment requirements, 40 C.F.R. section 133.102.

[3] Limit is based on the Load Allocations for nonpoint sources set forth in the Santa Clara River Nitrogen Compounds TMDL, Resolution No. 2003-011.

[4] Limit based on Basin Plan Groundwater Quality Objective.

C. The pH of effluent discharged shall at all times be within the range of 6.5 to 8.5. Excursion from this range shall not be considered a violation provided the duration is not more than 10 minutes in a 24-hour period, and pH shall at all times be within 6 to 9.

D. Effluent shall, at all times, be adequately disinfected and oxidized and shall meet the following effluent limitations:

1. the median concentration of total coliform bacteria shall not exceed a most probable number (MPN) of 23 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed; and

2. the number of total coliform bacteria shall not exceed an MPN of 240 per 100 milliliters in more than one sample in any 30 day period.

Samples shall be collected at a time when wastewater flow and characteristics are most demanding (e.g., during peak flows) on treatment facilities and disinfection processes.

E. A filtered wastewater shall be an oxidized wastewater that has been passed through a membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

1. An average of 2 Nephelometric Turbidity Units (NTU) within a 24-hour period;

2. 5 NTU more than 5 percent of the time within a 24-hour period; and

3. 10 NTU at any time.

F. Maximum Contaminant Levels: The effluent shall not contain trace, toxic and other constituents in concentrations that exceed the applicable maximum contaminant levels for drinking water established by the State Water Board's Division of Drinking Water (DDW) in sections 64431, 64442, 64443, 64444, 64449, and 64533 of CCR, Title 22, Division 4, or subsequent revisions, or at levels that adversely affect the beneficial uses of receiving groundwater. The effluent shall, at all times, not exceed the following MCLs (Attachment A). In the event of a violation of any primary or secondary MCL, the City shall notify and submit a report in accordance with Provision VI.F. of this Order.

1. Primary MCLs specified in CCR, Title 22, Division 4, Chapter 15 (Domestic Water Quality and Monitoring Regulations):

i. Inorganic chemicals in CCR, Title 22, Division 4, Chapter 15, Section 64431, Table 64431-A, except for nitrogen compounds (Attachment A-1 of this Order);

ii.. Radionuclides in CCR, Title 22, Division 4, Chapter 15, Section 64442, Table 64442 (Attachment A-2 of this Order) and Section 64443, Table 64443 (Attachment A-3 of this Order); and

iii. Organic chemicals in CCR, Title 22, Division 4, Chapter 15, Section 64444, Table 64444-A (Attachment A-4 of this Order).

2. Secondary MCLs specified in CCR, Title 22, Division 4, Chapter 15 (Domestic Water Quality and Monitoring Regulations), Section 64449, Table 64449-A (Attachment A-5 of this Order).

3. Primary MCLs for disinfection byproducts specified in CCR, Title 22, Division 4, Chapter 15.5 (Disinfectant Residuals, Disinfection Byproducts, and Disinfection Byproduct Precursors) Article 2, Section 64533, Table 64533-A (Attachment A-6 of this Order).

III. GROUNDWATER LIMITATIONS

A. The City is prohibited from negatively altering the quality or elevation of the underlying groundwater.

B. The discharge of treated wastewater from the SPWRF shall not cause an exceedance of the following groundwater limitations in Table 9 below. Except for chloride, compliance with the groundwater limitations will be determined by the groundwater samples collected from monitoring wells located within or on the boundary of the percolation pond. Compliance with the chloride groundwater limitation will be determined by the groundwater samples collected from monitoring wells located 150 feet away from the percolation pond. The specific monitoring well locations will be determined through the Monitoring and Reporting Program (MRP) (Attachment E). Per Section IV.C.3 of the MRP, the City is required to submit a work plan proposing a modified groundwater monitoring network by May 1, 2018.

Table 9. Groundwater Limitations

Constituents	Units	Monthly Average
Nitrate as nitrogen + nitrite as nitrogen	mg/L	10[1]
Nitrite as nitrogen	mg/L	1[1]
Total dissolved solids	mg/L	2,000[1]
Sulfate	mg/L	800[1]
Chloride	mg/L	110[1]
Boron	mg/L	1.0[1]
Total coliform	MPN/100mL	1.1[1]
Fecal coliform	MPN/100mL	1.1[1]

Table Note:
[1] Limit based on Basin Plan Groundwater Quality Objective.

C. Groundwater shall not exceed the MCLs specified in Attachments A-1 to A-6.

E. The minimum vertical separation between the bottom of the percolation pond and groundwater table shall be five feet.

IV. GENERAL REQUIREMENTS

A. The SPWRF and areas where any potential pollutants are stored shall be adequately protected from inundation and damage by storm flows and runoff.

B. Adequate facilities shall be provided to protect the SPWRF, treatment system devices, sewer collection system and recycling/disposal facilities from damage by storm flows and run-off or run-on generated by a 100-year return storm/24 hour duration.

C. The SPWRF and the collection system that is a part of the treatment and disposal system shall be maintained in such a manner that prevents sewage from surfacing or overflowing at any location.

D. A minimum of two feet of freeboard shall be maintained in the percolation/evaporation ponds at all time to ensure that direct rainfall will not cause overtopping.

E. No disposal areas with treated wastewater shall be located within 600 feet of any domestic water supply well unless all of the following conditions have been met:

1. A geological investigation demonstrates that an aquitard exists at the well between the uppermost aquifer being drawn from and the ground surface;

2. The well contains an annular seal that extends from the surface into the aquitard;

3. The well is housed to prevent any treated wastewater spray from coming into contact with the wellhead facilities;

4. The ground surface immediately around the wellhead is contoured to allow surface water to drain away from the well; and

5. The owner of the well approves of the elimination of the buffer zone requirement.

F. There shall be no storage or impoundment of treated wastewater within 600 feet of any domestic water supply well.

G. No disposal of sludge, waste, and treated wastewater shall take place within 600 feet of any reservoir or stream used as a source of domestic water.

H. Any wastes that do not meet the foregoing requirements shall be held in impervious containers and discharged at a legal point of disposal.

I. Percolation ponds shall be maintained to ensure that percolation rate at the pond bottom shall not decrease over time.

J. The Discharger shall notify well owners within 500 feet radius from the boundary of percolation ponds when there is any exceedance on the effluent limitations and/or groundwater limitations.

K. The City shall, at all times, properly operate and maintain all treatment facilities and control systems (and related appurtenances), which are installed or used by the City to achieve compliance with the conditions of this Order. Proper operation and maintenance include effective performance, adequate funding,

adequate operator staffing and training, and adequate laboratory and process controls (including appropriate quality assurance procedures).

V. PROHIBITIONS

A. Any discharge of wastewater from the SPWRF (including the wastewater collection system) at any point other than specifically described in this Order is prohibited.

B. There shall be no waste overflows or discharge of untreated or partially-treated waste from the SPWRF's treatment, storage or disposal facilities to adjacent drainage or water ways, adjacent properties, or to waters of the State at any time. The discharge of any wastewater to surface waters or surface water drainage courses is prohibited without a NPDES permit.

C. Industrial wastewater subject to the Prohibited Discharge Standards in 40 C.F.R. section 403.5 shall not be accepted by the SPWRF.

D. Wastes discharged shall not contain tastes, odors, color, foaming, any materials, or other objectionable characteristics in concentrations that would:

1. Affect human, animal, or plant life;

2. Cause nuisance or adversely affect any beneficial uses and quality of the receiving groundwater; and

3. Impact the Santa Clara River that may be in hydraulic connection with groundwater.

E. Odors originating at the SPWRF, including of sewage origin, shall not be perceivable any time outside the boundary of the SPWRF property owned by the City.

F. The percolation pond shall not contain floating materials, including solids, foams, or scum in concentrations that cause nuisance, adversely affect beneficial uses, or serve as a substrate for undesirable bacterial or algae growth or insect vectors. The wastewater treatment shall not result in nuisance conditions caused by breeding of mosquitoes, gnats, midges, or other pests.

G. Discharge of waste classified as "hazardous waste," as defined in CCR, Title 23, section 2521(a), is prohibited. Discharge of waste classified as "designated waste," as defined in California Water Code section 13173, in a manner that causes violation of receiving water limits is prohibited.

H. The percolation/evaporation ponds, drying beds, and the berms surrounding the ponds shall not contain plants, shrubs, or bushes that may damage the berms and the ponds.

I. The percolation pond shall not be altered without the approval by the Regional Board.

J. There shall be no onsite disposal of sludge. Sludge-drying activities are allowed, but only as an intermediate treatment prior to offsite disposal. Any offsite disposal of wastewater or sludge shall be made only to a legal point of disposal. For purposes of this Order, a legal disposal site is one for which requirements have been established by USEPA, and which is in full compliance therewith. Any wastewater or sludge handling shall be in such a manner as to prevent its reaching surface waters or watercourses.

K. Bypass (the intentional diversion of waste streams from any portion of the SPWRF) is prohibited. The Regional Board may take enforcement action against the City for bypass, unless:

1. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the SPWRF that cause it to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass.

2. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated waste, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance.

3. Notice

i. Anticipated bypass: If the City knows in advance of the need for a bypass, it shall submit written notice to the Regional Board, if possible at least 10 days before the date of the bypass.

ii. Unanticipated bypass: The City shall provide verbal notice to the Regional Board Executive Officer of an unanticipated bypass within 24 hours from the time the City becomes aware of the circumstances. A written submission shall also be provided within five (5) days of the time the City becomes aware of the circumstances.

L. The wastewater treatment and percolation ponds shall not result in nuisance conditions caused by breeding of mosquitoes, gnats, midges, or other pests.

VI. PROVISIONS

A. This Order includes "Attachment B - Standard Provisions Applicable to Waste Discharge Requirements" (Standard Provisions). If there is any conflict

between provisions stated herein and the Standard Provisions, the provisions stated herein prevail.

B. The City shall operate and maintain facilities, treatment operations, associated collection systems and outfalls in ways that preclude adverse impacts to surface or groundwater from impacts predicted to occur due to climate change.

C. The City shall evaluate the need to revise its Climate Change Effects Vulnerability Assessment and Management Plan (Climate Change Plan) when conditions change that may impact water quality. The City shall periodically submit a report of its evaluation or a revised Climate Change Plan based on its evaluation. Submittal of the Climate Change Plan is required pursuant to California Water Code section 13267. As required by this provision, a regional board may require a person to submit technical or monitoring program reports that the regional board requires. The Climate Change Plan is needed in order to assess and manage climate change related-effects associated with City operations that may affect water quality.

The Climate Change Plan shall include an assessment of short and long term vulnerabilities of the facility(ies) and operations as well as plans to address vulnerabilities of collection systems, facilities, treatment systems, and outfalls for predicted impacts in order to ensure that facility operations are not disrupted, compliance with permit conditions is achieved, and receiving waters are not adversely impacted by discharges. Control measures shall include, but are not limited to, emergency procedures, contingency plans, alarm/notification systems, training, backup power and equipment, and the need for planned mitigations to ameliorate climate-induced impacts including, but not limited to, changing influent and receiving water quality and conditions, as well as the impact of rising sea level (where applicable) storm surges and back-to-back severe storms that are expected to become more frequent.

D. The City shall comply with MRP No. CI-9259 (Attachment E), which is part of this Order, and any revisions thereto as ordered by the Executive Officer. The submittal dates of Discharger self-monitoring reports shall be no later than the submittal date specified in the MRP. If there is any conflict between the provisions stated herein and the MRP, the provisions stated herein prevail.

E. The City shall file with the Regional Board, under penalty of perjury, annual and quarterly reports on self-monitoring work performed according to the detailed specifications contained in the MRP attached hereto and incorporated herein by reference, as directed by the Executive Officer. The results of any monitoring done in addition to what is required or done more frequently than required at the location and/or times specified in the MRP shall be reported to the Regional Board. The City shall comply with all of the provisions and requirements of the MRP.

F. The City shall notify this Regional Board by telephone or electronic means within 24 hours of knowledge of any discharge exceeding the effluent limits prescribed in this Order from the SPWRF; written confirmation shall follow within 5 working days from date of notification, unless otherwise specified in this Order. The report shall include, but is not limited to, the following information, as appropriate:

1. Nature and extent of the violation;

2. Date and time: when the violation started, when compliance was achieved, and when injection was suspended and restored, as applicable;

3. Duration of violation;

4. Cause(s) of violation;

5. Corrective and/or remedial actions taken and/or will be taken with a time schedule for implementation to prevent future violations; and

6. Impact of the violation.

G. This Order does not exempt the City from compliance with any other laws, regulations, or ordinances that may be applicable; they do not legalize the recycling and use facilities; and they leave unaffected any further constraint on the use of recycled water at certain site(s) that may be contained in other statutes or required by other agencies.

H. This Order does not alleviate the responsibility of the City to obtain other necessary local, state, and federal permits to construct facilities necessary for compliance with this Order; nor does this Order prevent imposition of additional standards, requirements, or conditions by any other regulatory agency. Expansion of the recycled water distribution facility shall be contingent upon issuance of all necessary requirements and permits, including a conditional use permit.

I. After notice and opportunity for a hearing, this Order may be modified, revoked and reissued, or terminated for cause, that includes, but is not limited to: failure to comply with any condition in this Order, endangerment of human health, adverse impacts on water quality and/or beneficial uses of the receiving water resulting from the permitted activities in this Order, obtaining this Order by misrepresentation or failure to disclose all relevant facts, and acquisition of new information that could have justified the application of different conditions if known at the time of Order adoption.

The filing of a request by the City for modification, revocation and reissuance, or termination of this Order; or a notification of planned changes or anticipated noncompliance does not stay any condition of this Order.

J. The City shall furnish, within a reasonable time, any information that the Regional Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The City shall also provide the Regional Board, upon request, with copies of records required to be kept under this Order for at least three (3) years.

K. Spill Clean-Up Contingency Plan (SCCP) Requirements – The City is required to periodically submit an updated and revised SCCP, which describes the activities and protocols to address clean-up of spills, overflows, and bypasses of untreated or partially treated wastewater from the City's collection system or treatment facilities. At a minimum, this SCCP shall include sections on spill clean-up and containment measures, public notification, and monitoring. The City shall review and amend this SCCP as appropriate after each spill from the SPWRF or in the service area of the SPWRF. The City shall include a discussion in the annual summary report of any modifications to the SCCP and the application of the SCCP to all spills during the year.

L. Construction, Operation, and Maintenance Requirements

1. The City shall, at all times, properly operate and maintain the SPWRF, including its wastewater collection, treatment, and disposal facilities (and related appurtenances) to ensure compliance with this Order, as well as provide adequate and reliable transport, treatment, and disposal of all wastewater from planned future wastewater sources under the City's responsibilities. Proper operation and maintenance includes, but is not limited to: effective performance, repairs and upgrades when needed, adequate funding, adequate operator staffing and training, adequate operator supervision, and adequate laboratory and process controls (including appropriate quality assurance/quality control procedures).

2. The SPWRF shall be supervised and operated by persons possessing certificates of appropriate grade in accordance with CCR, Title 23, Division 3, Chapter 26 and California Water Code sections 13625 - 13633.

3. The SPWRF shall be operated and maintained in accordance with the operation and maintenance manual prepared by the municipality through the Clean Water Grant Program. The City's Operation, Maintenance, and Monitoring Plan (OMM Plan) shall be available for reference and use by all applicable personnel. The City shall maintain, regularly review, and revise or update as necessary the OMM Plan in order for the document(s) to remain useful and relevant to current equipment and operation practices. Reviews shall be conducted annually, and revisions or updates shall be completed as necessary and submitted to the Regional Board on an annual basis.

4. The City shall maintain in good working order a sufficient alternate power source for operating the wastewater treatment and disposal facilities. All

equipment shall be located to minimize failure due to moisture, liquid spray, flooding, and other physical phenomena. The alternate power source shall be designed to permit inspection and maintenance and shall provide for periodic testing. If such alternate power source is not in existence, the City shall halt, reduce, or otherwise control all discharges upon the reduction, loss, or failure of the primary source of power.

5. The City shall provide standby or emergency power facilities and/or sufficient storage capacity or other means so that in the event of plant upset, outage due to power failure or other cause, or heavy rainfall, discharge of raw or inadequately treated sewage does not occur and infiltration ponds do not exceed their hydraulic capacity.

M. Sludge Disposal Requirements

1. All sludge generated at the wastewater treatment plant shall be disposed of, treated, or applied to land in accordance with federal regulations contained in 40 C.F.R. Part 503. These requirements are enforceable by USEPA.

2. The City shall comply with requirements in State Water Board Order No. 2004-10-DWQ, *"General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural and Land Reclamation Activities"* for those sites receiving the City's biosolids that a regional water board has placed under this general order, and with the requirements in individual waste discharge requirements issued by a regional water board for sites receiving the City's biosolids.

3. The City shall comply, if applicable, with WDRs issued by other regional water boards to which jurisdiction the biosolids are transported and applied.

4. The City shall provide this Regional Board with a copy of any report(s) submitted to USEPA, the State Water Board, or other regional water boards, with respect to municipal sludge or biosolids.

N. Collection System Requirements

The City must properly enroll under the applicable General WDRs for Sanitary Sewer Systems and comply with the requirements specified in the General WDRs. The State Water Board adopted General WDRs for Sanitary Sewer Systems (Order No. 2006-0003-DWQ) on May 2, 2006 and amended the WDRs by Order No. WQ 2008-0002-EXEC and Order No. WQ 2013-0058-EXEC, to provide a consistent and statewide approach to regulating sanitary sewer systems to prevent and/or reduce sanitary sewer overflows (SSOs). Order No. 2006-0003-DWQ requires public agencies that own or operate sanitary sewer systems to develop and implement sewer system management

plans and report all SSOs to the State Water Board's online SSO database. The City's collection system is part of the system that is subject to Order No. 2006-0003-DWQ. The City enrolled in Order No. 2006-0003-DWQ on July 27, 2006. As such, the City must properly operate and maintain its collection system. The City must also report any non-compliance and mitigate any discharge from the collection system in violation of this Order.

O. Spill Reporting Requirements

1. Initial Notification – Although State and Regional Board staff do not have duties as first responders, this requirement is an appropriate mechanism to ensure that the agencies that do have first responder duties are notified in a timely manner in order to protect public health and beneficial uses. For certain spills, overflows and bypasses, the City shall make notifications as required below:

   i. In accordance with the requirements of Health and Safety Code section 5411.5, the City shall provide notification to the local health officer or the director of environmental health with jurisdiction over the affected water body of any unauthorized release of sewage or other waste that causes, or probably will cause, a discharge to any waters of the state as soon as possible, but no later than two (2) hours after becoming aware of the release.

   ii. In accordance with the requirements of California Water Code section 13271, the City shall provide notification to the California Emergency Management Agency (Cal EMA) of the release of reportable quantities of hazardous substances or sewage that causes, or probably will cause, a discharge to any waters of the state as soon as possible, but not later than two (2) hours after becoming aware of the release. CCR, Title 23, section 2250 establishes 1,000 gallons or more as a reportable quantity of sewage. The phone number for reporting these releases to the Cal EMA is (800) 852-7550.

   iii. The City shall notify the Regional Board of any unauthorized release of sewage from the SPWRF that causes, or probably will cause, a discharge to a water of the state as soon as possible, but not later than two (2) hours after becoming aware of the release. This initial notification does not need to be made if the City has notified Cal EMA and the local health officer or the director of environmental health with jurisdiction over the affected waterbody. The phone number for reporting these releases of sewage to the Regional Board is (213) 576-6683. The phone numbers for after hours and weekend reporting of releases of sewage to the Regional Board are (213) 305-2284 and (213) 305-2253.

At a minimum, the following information shall be provided to the Regional Board:

a. The location, date, and time of the release;

b. The water body that may be impacted by the discharge;

c. An estimate of the amount of sewage or other waste released and the amount that reached the receiving water at the time of notification;

d. If ongoing, the estimated flow rate of the release at the time of the notification;

e. The name, organization, phone number, and email address of the reporting representative; and

f. A certification that the State Office of Emergency Services and the local health officer or directors of environmental health with jurisdiction over the possibly affected water bodies have been notified of the discharge.

2. Monitoring – For spills, overflows and bypasses reported under Section VI.O.1., the City shall monitor as required below:

To define the geographical extent of the spill's impact, the City shall obtain grab samples (if feasible, accessible, and safe) for all spills, overflows or bypasses of any volume that reach any waters of the State (including surface and ground waters). The City shall analyze the samples for total and fecal coliforms, E. coli (if fecal coliform test shows positive), enterococcus, and relevant pollutants of concern, upstream and downstream of the point of entry of the spill (if feasible, accessible and safe). This monitoring shall be done on a daily basis from the time the spill is known until the results of two (2) consecutive sets of bacteriological monitoring indicate the return to the background level or the County Department of Public Health authorizes cessation of monitoring.

3. Reporting – The initial notification required under Section VI.O.1. shall be followed by:

i. As soon as possible, but not later than twenty-four (24) hours after becoming aware of an unauthorized discharge of sewage or other waste from its wastewater treatment plant to a water of the state, the City shall submit a statement to the Regional Board via email. If the discharge is 1,000 gallons or more, this statement shall certify that Cal EMA has been notified of the discharge in accordance with California Water Code section 13271. The statement shall also certify that the local health officer or director of environmental health

with jurisdiction over the affected water bodies has been notified of the discharge in accordance with Health and Safety Code section 5411.5. The statement shall also include at a minimum the following information:

a. Agency, Order No., and MRP CI No.;

b. The location, date, and time of the discharge;

c. The water body that received the discharge;

d. A description of the level of treatment of the sewage or other waste discharged;

e. An initial estimate of the amount of sewage or other waste released and the amount that reached the impacted water body;

f. The Cal EMA control number and the date and time that notification of the incident was provided to Cal EMA; and

g. The name of the local health officer or director of environmental health representative notified (if contacted directly); the date and time of notification; and the method of notification (e.g., phone, fax, email).

ii. A written preliminary report shall be submitted to the Regional Board within five (5) working days after disclosure of the incident via the State Water Board GeoTracker database under Global ID WDR100000359. The final written report shall be included in the next quarterly monitoring report submitted to the GeoTracker database above. The written report shall document the information required in Section VI.O.4. below, monitoring results and any other information required in provisions of the Standard Provisions (Attachment B) including corrective measures implemented or proposed to be implemented to prevent/minimize future occurrences.

iii. The City shall include a certification in the annual summary report (due according to the schedule in the MRP) that states that the sewer system emergency equipment, including alarm systems, backup pumps, standby power generators, and other critical emergency pump station components were maintained and tested in accordance with the City's preventive maintenance plan. Any deviations from or modifications to the preventive maintenance plan shall be approved by the Executive Officer.

4. Records – The City shall prepare and maintain a record of all spills, overflows or bypasses of raw or partially treated sewage from its collection system or the SPWRF. This record shall be made available to the

Regional Board upon request and a spill summary shall be included in the annual report, as required in the MRP. The record shall contain:

i. The date and time of each spill, overflow, or bypass;

ii. The location of each spill, overflow, or bypass;

iii. The estimated volume of each spill, overflow, or bypass including gross volume, amount recovered and amount not recovered, monitoring results as required by Section VI.O.2.;

iv. The cause of each spill, overflow, or bypass;

v. Whether each spill, overflow, or bypass entered a receiving water and, if so, the name of the water body and whether it entered via storm drains or other man-made conveyances;

vi. Any corrective measures implemented or proposed to be implemented to prevent/minimize future occurrences; and

vii. The mandatory information included in Sanitary Sewer Overflows (SSO) online reporting for finalizing and certifying the SSO report for each spill, overflow, or bypass under State Water Board Order No. 2006-0003-DWQ.

5. Activities Coordination – The Regional Board expects that the City will coordinate their compliance activities for consistency and efficiency with other entitles that have responsibilities to implement: (i) this Order, and (ii) State Water Board Order No. 2006-0003-DWQ.

6. Consistency with State Water Board Order No. 2006-0003-DWQ – The requirements contained in this Order in Sections VI.K. (SCCP Requirements), VI.L. (Construction, Operation, and Maintenance Requirements), and VI.O. (Spill Reporting Requirements) are intended to be consistent with the requirements of Order No. 2006-0003-DWQ. The Regional Board recognizes that there may be some overlap between this Order and Order No. 2006-0003-DWQ. The requirements of Order No. 2006-0003-DWQ are considered the minimum thresholds (see Finding 11 of Order No. 2006-0003-DWQ). To encourage efficiency, the Regional Board will accept the documentation prepared by the City under Order No. 2006-0003-DWQ for compliance purposes, as satisfying the requirements in Sections VI.K., VI.L., and VI.O. provided the more stringent provisions enumerated in this Order have also been addressed.

P. Pretreatment Requirements

1. This Order includes the City's Pretreatment Program, as previously submitted to this Regional Board and specified in Order No. R4-2007-

0028-R2, adopted by this Regional board on February 2, 2012. Any change to the Program shall be reported to the Regional Board in writing and shall not become effective until approved by the Executive Officer in accordance with procedures established in 40 C.F.R. section 403.18.

2. The City shall enforce the requirements under Sections 307(b), 307(c), 307(d), and 402(b) of the Federal Clean Water Act with timely, appropriate, and effective enforcement actions. The City shall require industrial users to comply with Federal Categorical Standards and shall initiate enforcement actions against those users who do not comply with the standards. The City shall require industrial users subject to the Federal Categorical Standards to achieve compliance no later than the date specified in those requirements or, in the case of a new industrial user, upon commencement of the discharge.

3. The City shall perform the pretreatment functions as required in 40 C.F.R. Part 403 including, but not limited to:

   i. Implement the necessary legal authorities as provided in 40 C.F.R. section 403.8(f)(1);

   ii. Enforce the pretreatment requirements under 40 C.F.R. sections 403.5 and 403.6;

   iii. Implement the programmatic functions as provided in 40 C.F.R. section 403.8(f)(2); and

   iv. Provide the requisite funding of personnel to implement the Pretreatment Program as provided in 40 C.F.R. section 403.8(f)(3).

4. The City shall submit an annual report of effectiveness of the City's Pretreatment Program. This annual report shall be submitted to the Regional Board, with copies to the State Water Board and USEPA Region 9, describing the City's pretreatment activities over the period and whether such activities have been effective. If the City is not in compliance with any conditions or requirements of this Order, the City shall include the reasons for noncompliance and shall state how and when the City will comply with such conditions and requirements.

5. The City shall be responsible and liable for the performance of all control authority pretreatment requirements contained in 40 C.F.R. Part 403, including subsequent regulatory revisions thereof. Where Part 403 or subsequent revision places mandatory actions upon the City as Control Authority, but does not specify a timetable for completion of the actions, the City shall complete the required actions within six months from the effective date of this Order or the effective date of Part 403 revisions, whichever comes later. For violations of pretreatment requirements, the City shall be subject to enforcement actions, penalties, fines, and other

remedies by the Regional Board, USEPA, or other appropriate parties, as provided in the Federal Clean Water Act. The Regional Board or USEPA may initiate enforcement action against an industrial user for noncompliance with acceptable standards and requirements as provided in the Federal Clean Water Act and/or the California Water Code.

VII. REOPENER

The Regional Water Board will review this Order periodically and will revise requirements when necessary. The waste discharge requirements and monitoring and reporting requirements in this Order were developed based on currently available technical information and applicable water quality laws, regulations, policies, and plans, and are intended to assure compliance with them. If applicable laws and regulations change, including but not limited to, establishment of total maximum daily loads, or once new information is obtained that will change the overall discharge and its potential to impact waters of the state, it may be appropriate to reopen this Order. This Order may also specifically be reopened to make revisions consistent with an approved salt and nutrient management plan.

VIII. TERMINATION

Except for enforcement purposes, Order No. R4-2007-0028, adopted by the Regional Board on May 3, 2007, and amended on May 6, 2010, February 2, 2012, April 6, 2017 and December 21, 2017, is hereby terminated.

The Regional Board's termination of prior waste discharge requirements and/or monitoring and reporting requirements do not extinguish any violations that may have occurred during the time those requirements were in effect. The Regional Board reserves the right to take enforcement actions to address violations of prior prohibitions, limitations, specifications, requirements, or provisions of rescinded requirements as allowed by law.

IX. EFFECTIVE DATE

This Order becomes effective immediately upon its adoption.

I, Renee Purdy, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order originally adopted on February 8, 2018 and amended and adopted by the California Regional Water Quality Control Board, Los Angeles Region on May 12, 2022.

Renee Purdy
Executive Officer



Figure 1 – The Vicinity of Santa Paula Water Recycling Facility (SPWRF)

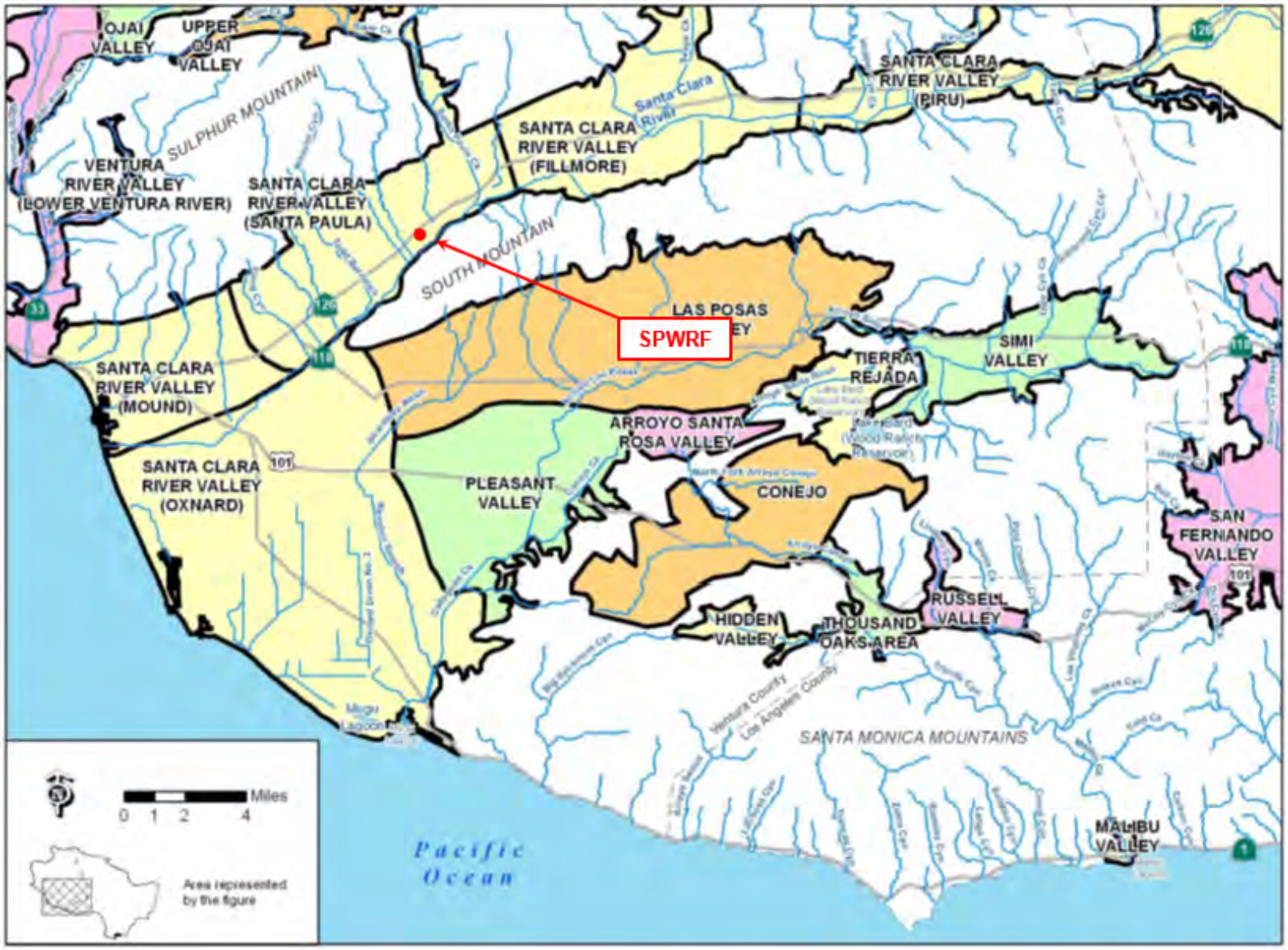


Figure 2 – Santa Paula Groundwater Basin

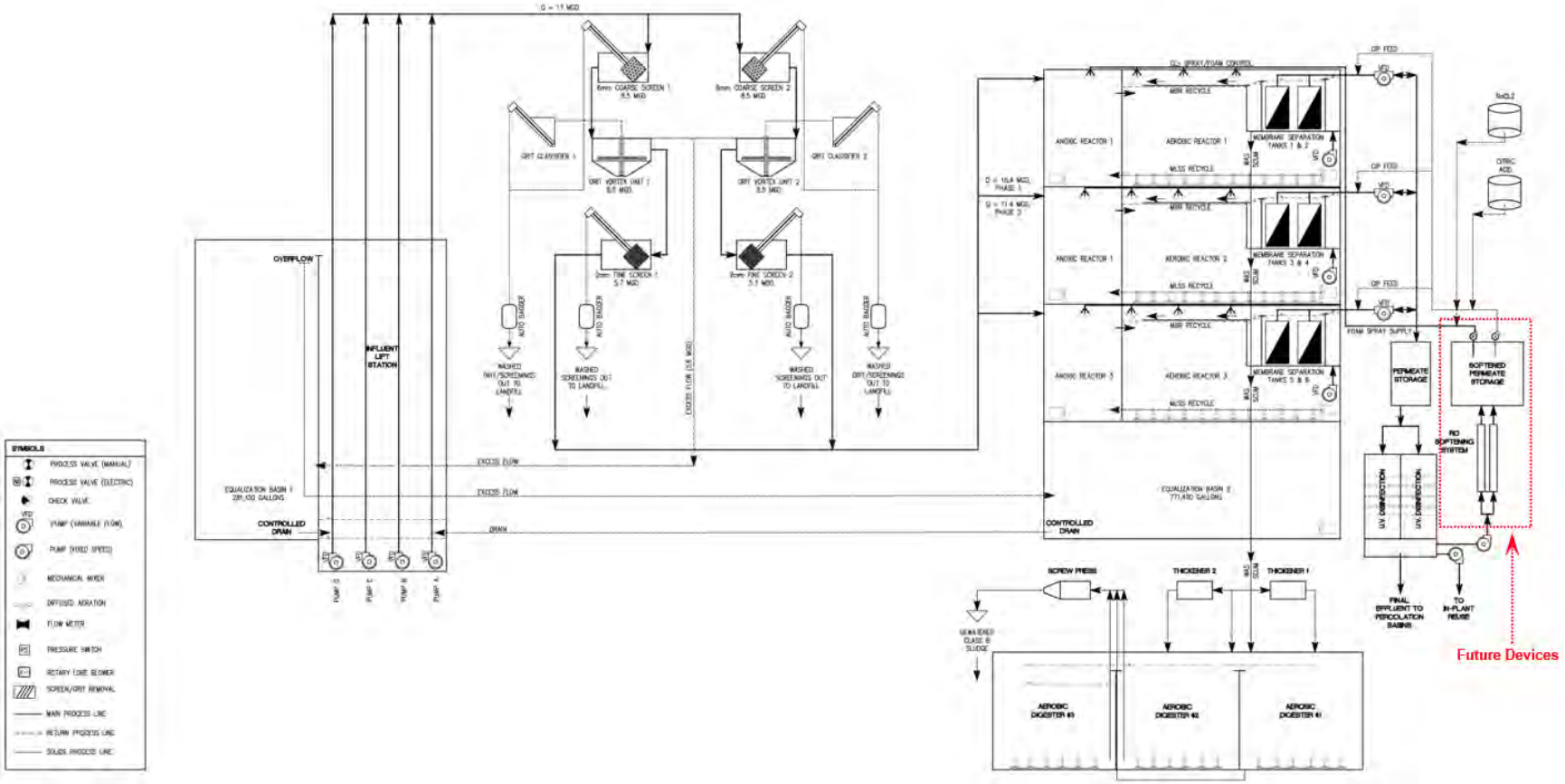
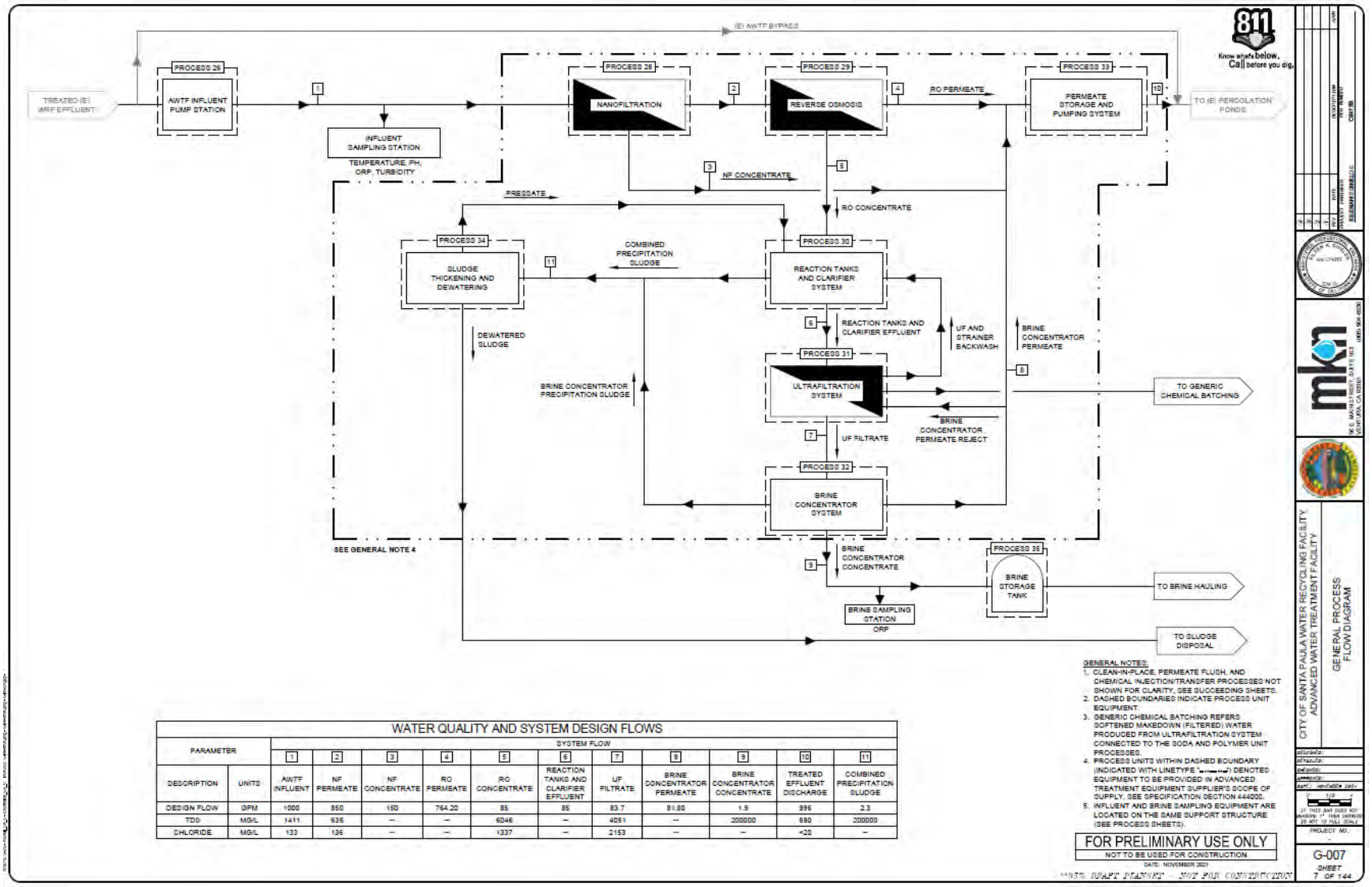


Figure 3 – Process Flow Schematic of Santa Paula Wastewater Recycling Facility



GENERAL NOTES:
1. CLEAN-IN-PLACE, PERMEATE FLUSH, AND CHEMICAL INJECTION/TRANSFER PROCESSES NOT SHOWN FOR CLARITY, SEE SUCCEEDING SHEETS.
2. DASHED BOUNDARIES INDICATE PROCESS UNIT EQUIPMENT.
3. GENERIC CHEMICAL BATCHING REFERS SOFTENED MAKEDOWN (FILTERED) WATER PRODUCED FROM ULTRAFILTRATION SYSTEM CONNECTED TO THE SODA AND POLYMER UNIT PROCESSES.
4. PROCESS UNITS WITHIN DASHED BOUNDARY (INDICATED WITH LINETYPE "- - - - -") DENOTES EQUIPMENT TO BE PROVIDED IN ADVANCED TREATMENT EQUIPMENT SUPPLIER'S SCOPE OF SUPPLY, SEE SPECIFICATION SECTION 444000.
5. INFLUENT AND BRINE SAMPLING EQUIPMENT ARE LOCATED ON THE SAME SUPPORT STRUCTURE (SEE PROCESS SHEETS).

WATER QUALITY AND SYSTEM DESIGN FLOWS

PARAMETER		SYSTEM FLOW										
		1	2	3	4	5	6	7	8	9	10	11
DESCRIPTION	UNITS	AWTF INFLUENT	NF PERMEATE	NF CONCENTRATE	RO PERMEATE	RO CONCENTRATE	REACTION TANKS AND CLARIFIER EFFLUENT	UF FILTRATE	BRINE CONCENTRATOR PERMEATE	BRINE CONCENTRATOR CONCENTRATE	TREATED EFFLUENT DISCHARGE	COMBINED PRECIPITATION SLUDGE
DESIGN FLOW	GPM	1000	850	150	764.20	85	85	83.7	81.80	1.9	996	2.3
TDS	MG/L	1411	535	--	--	6046	--	4051	--	200000	680	200000
CHLORIDE	MG/L	133	136	--	--	1337	--	2153	--	--	<20	--

Figure 4 – Process Flow Schematic of Reverse Osmosis Advanced Wastewater Treatment System at Santa Paula Water Recycling Facility

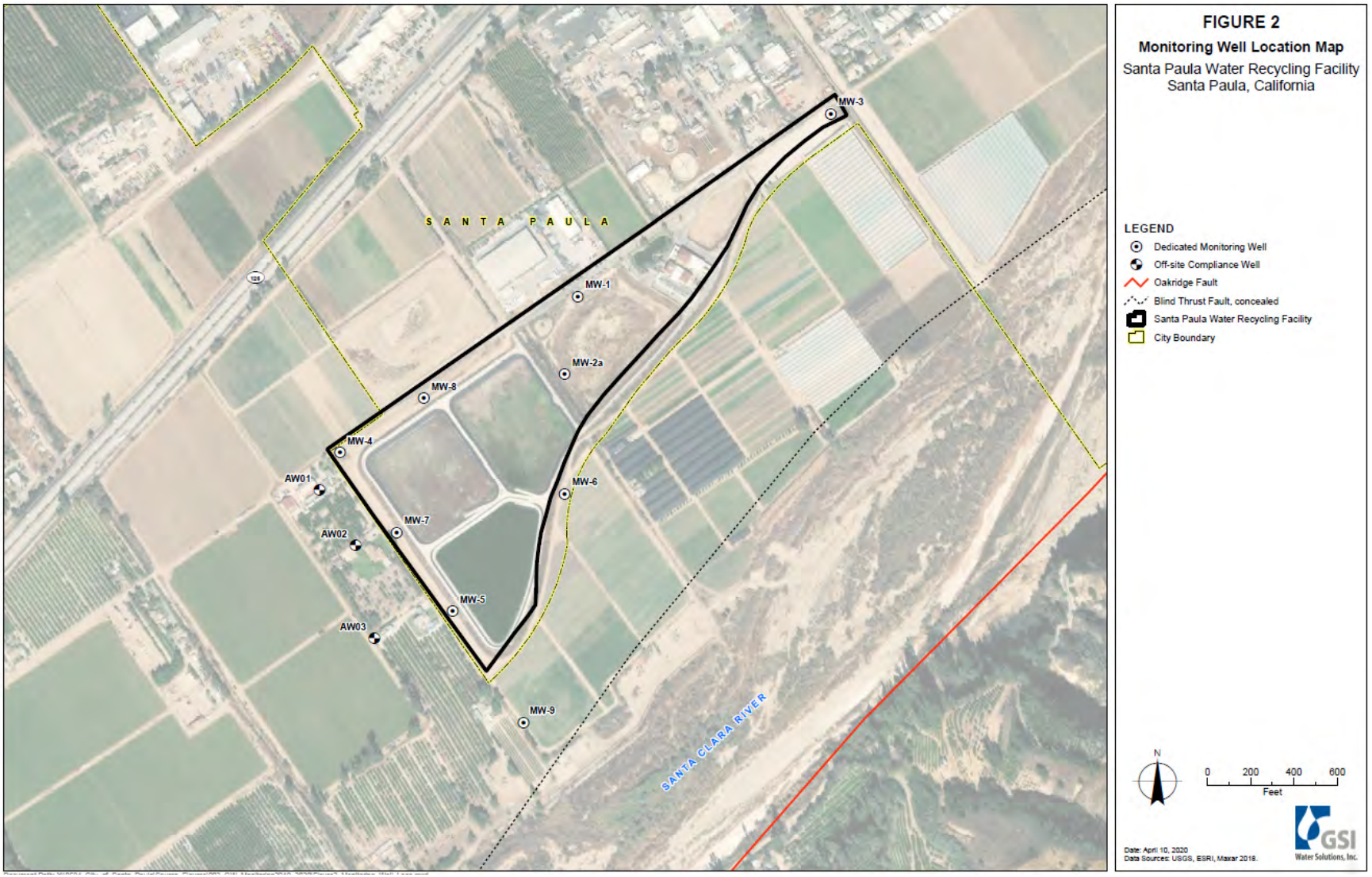


Figure 5 – Locations of Groundwater Monitoring Wells

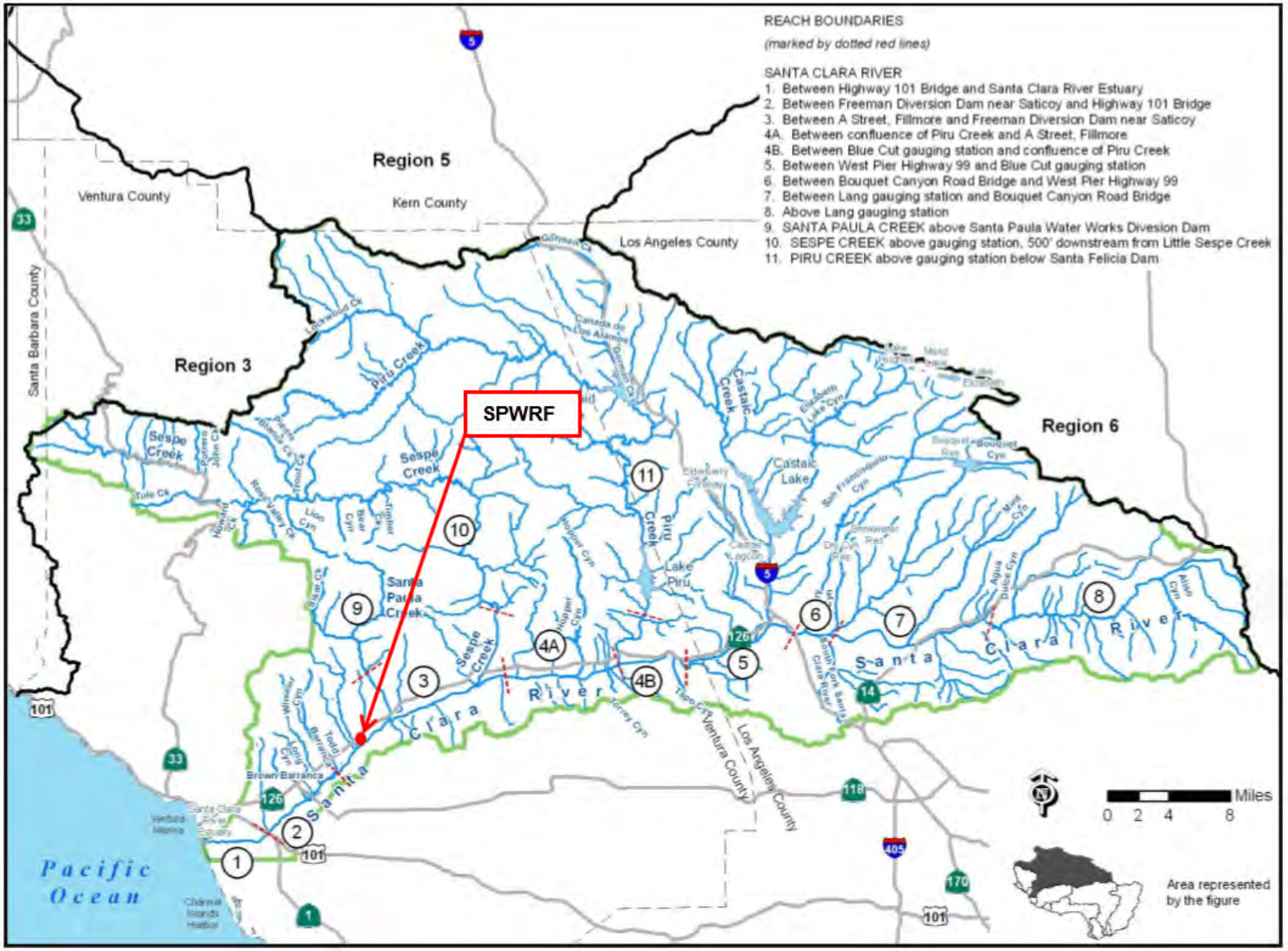


Figure 6 – Santa Clara River Watershed Surface Reaches

Attachment A – Maximum Contaminant Levels

Attachment A-1 Inorganic Chemicals

Table 64431-A

Chemical	Maximum Contaminant Levels (mg/L)	Reporting Detection Limit (mg/L)
Aluminum	1	0.05
Antimony	0.006	0.006
Arsenic	0.010	0.002
Asbestos	7 MFL [1]	0.2 MFL [2]
Barium	1	0.1
Beryllium	0.004	0.001
Cadmium	0.005	0.001
Chromium	0.05	0.01
Cyanide	0.15	0.1
Fluoride	2.0	0.1
Mercury	0.002	0.001
Nickel	0.1	0.01
Nitrate (as nitrogen)	10	0.4
Nitrate+Nitrite (sum as nitrogen)	10	
Nitrite (as nitrogen)	1	0.4
Perchlorate	0.006	0.002 0.001 [3]
Selenium	0.05	0.005
Thallium	0.002	0.001

Note: [1] MFL = million fibers per liter; MCL for fibers exceeding 10 µm in length.
[2] Reporting detection limit for fibers exceeding 10 µm in length.
[3] Effective January 1, 2024.

Attachment A-2 Radioactivity

Gross alpha and gross beta analysis must be performed. If gross alpha is greater than 1 picocurie per liter (pCi/L), uranium analysis must be performed. Compliance with this Order shall then be based on comparing gross alpha minus total uranium to the gross alpha limit of 15 pCi/L.

Radium-226 and radium-228 analysis must be performed, and combined Radium-226 and radium-228 activity must be less than or equal to 5 pCi/L. If gross alpha is less than 50 pCi/L, one can assume radium-226 activity is equal to gross alpha activity for purposes of meeting the 5 pCi/L limit.

Table 64442

Radionuclide	Maximum Contaminant Level (pCi/L)	Reporting Detection Limit (pCi/L)
Radium-226		1
Radium-228		1
Combined radium-226 and radium-228	5	
Gross Alpha particle activity (excluding radon and uranium)	15	3
Uranium	20	1

Note: pCi/L = picocuries per liter

Table 64443

Radionuclide	Maximum Contaminant Level (pCi/L)	Reporting Detection Limit (pCi/L)
Beta/photon emitters	4 millirem per year annual dose equivalent to the total body or any internal organ	Gross Beta particle activity: 4
Strontium-90	8 (= 4 millirem per year dose to bone marrow)	2
Tritium	20,000 (=4 millirem per year dose to total body)	1,000

Attachment A-3 Organic Chemicals

Table 64444-A

(a) Volatile Organic Chemicals (VOCs)

Chemical	Maximum Contaminant Levels (mg/L)	Reporting Detection Limit (mg/L)
Benzene	0.001	0.0005
Carbon Tetrachloride	0.0005	0.0005
1,2-Dichlorobenzene	0.6	0.0005
1,4-Dichlorobenzene	0.005	0.0005
1,1-Dichloroethane	0.005	0.0005
1,2-Dichloroethane	0.0005	0.0005
1,1-Dichloroethylene	0.006	0.0005
cis-1,2-Dichloroethylene	0.006	0.0005
trans-1,2-Dichloroethylene	0.01	0.0005
Dichloromethane	0.005	0.0005
1,2-Dichloropropane	0.005	0.0005
1,3-Dichloropropene	0.0005	0.0005
Ethylbenzene	0.3	0.0005
Methyl-*tert*-butyl ether	0.013	0.003
Monochlorobenzene	0.07	0.0005
Styrene	0.1	0.0005
1,1,2,2-Tetrachloroethane	0.001	0.0005
Tetrachloroethylene	0.005	0.0005
Toluene	0.15	0.0005
1,2,4-Trichlorobenzene	0.005	0.0005
1,1,1-Trichloroethane	0.200	0.0005
1,1,2-Trichloroethane	0.005	0.0005
Trichloroethylene	0.005	0.0005
Trichlorofluoromethane	0.15	0.005

1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2	0.01
Vinyl Chloride	0.0005	0.0005
Xylenes	1.750 [1]	0.0005

(b) Synthetic Organic Chemicals (SOCs)

Chemical	**Maximum Contaminant Levels (mg/L)**	**Reporting Detection Limit (mg/L)**
Alachlor	0.002	0.001
Atrazine	0.001	0.0005
Bentazon	0.018	0.002
Benzo(a)pyrene	0.0002	0.0001
Carbofuran	0.018	0.005
Chlordane	0.0001	0.0001
2,4-D	0.07	0.01
Dalapon	0.2	0.01
Dibromochloropropane	0.0002	0.00001
Di(2-ethylhexyl)adipate	0.4	0.005
Di(2-ethylhexyl)phthalate	0.004	0.003
Dinoseb	0.007	0.002
Diquat	0.02	0.004
Endothall	0.1	0.045
Endrin	0.002	0.0001
Ethylene Dibromide	0.00005	0.00002
Glyphosate	0.7	0.025
Heptachlor	0.00001	0.00001
Heptachlor Epoxide	0.00001	0.00001
Hexachlorobenzene	0.001	0.0005
Hexachlorocyclopentadiene	0.05	0.001
Lindane	0.0002	0.0002

Chemical	Maximum Contaminant Levels (mg/L)	Reporting Detection Limit (mg/L)
Methoxychlor	0.03	0.01
Molinate	0.02	0.002
Oxamyl	0.05	0.02
Pentachlorophenol	0.001	0.0002
Picloram	0.5	0.001
Polychlorinated Biphenyls	0.0005	0.0005
Simazine	0.004	0.001
Thiobencarb	0.07	0.001
Toxaphene	0.003	0.001
1,2,3-Trichloropropane	0.000005	0.000005
2,3,7,8-TCDD (Dioxin)	3×10^{-8}	5×10^{-9}
2,4,5-TP (Silvex)	0.05	0.001

Note: [1] MCL is for either a single isomer or the sum of the isomers.

Attachment A-4 Secondary Maximum Contaminant Levels

Table 64449-A

Chemical	Levels/Units
Aluminum	0.2 mg/L
Color	15 Units
Copper	1.0 mg/L
Foaming Agents (MBAS)	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Methyl-tert-butyl ether (MTBE)	0.005 mg/L
Odor -Threshold	3 Units
Silver	0.1 mg/L
Thiobencarb	0.001 mg/L
Turbidity	5 Units
Zinc	5.0 mg/L

Attachment A-5 Disinfection Byproducts

Table 64533-A

Chemical	Maximum Contaminant Levels (mg/L)	Reporting Detection Limit (mg/L)
Total trihalomethanes (TTHM)	0.080	
Bromodichloromethane		0.0010
Bromoform		0.0010
Chloroform		0.0010
Dibromochloromethane		0.0010
Haloacetic acids (five) (HAA5)	0.060	
Monochloroacetic Acid		0.0020
Dichloroacetic Acid		0.0010
Trichloroacetic Acid		0.0010
Monobromoacetic Acid		0.0010
Dibromoacetic Acid		0.0010
Bromate [1]	0.010	0.0050 0.0010 [2]
Chlorite [3]	1.0	0.020

Notes: [1] Bromate is listed for plant using ozone disinfection only.
[2] For analysis performed using EPA Method 317.0 Revision 2.0, 321.8, or 326.0.
[3] Chlorite is listed for plant using chlorine dioxide only.

Attachment B – Standard Provisions
Applicable to Waste Discharge Requirements

1. **Duty to Comply**

The discharger must comply with all conditions of these waste discharge requirements. A responsible party has been designated in the Order for this project, and is legally bound to maintain the monitoring program and permit. Violations may result in enforcement actions, including Regional Board orders or court orders requiring corrective action or imposing civil monetary liability, or in modification or revocation of these waste discharge requirements by the Regional Board. (California Water Code, Sections 13261, 13263, 13265, 13268, 13300, 13301, 13304, 13340, and 13350). Failure to comply with any waste discharge requirement, monitoring and reporting requirement, or other order or prohibition issued, reissued or amended by the Los Angeles Water Board or State Water Resources Control Board is a violation of these waste discharge requirements and the Water Code, which can result in the imposition of civil liability. (California Water Code, Section 13350, subdivision (a).)

2. **General Prohibition**

Neither the treatment nor the discharge of waste shall create a pollution, contamination or nuisance, as defined by California Water Code section 13050. In addition, the discharge of waste classified as hazardous, as defined in California Code of Regulations, Title 23, Section 2521, subdivision (a) is also prohibited.

3. **Availability**

A copy of these waste discharge requirements shall be maintained at the discharge facility and be available at all times to operating personnel. (California Water Code, Section 13263)

4. **Change in Ownership**

The discharger must notify the Executive Officer, in writing at least 30 days in advance of any proposed transfer of this Order's responsibility and coverage to a new discharger containing a specific date for the transfer of this Order's responsibility and coverage between the current discharger and the new discharger. This agreement shall include an acknowledgement that the existing discharger is liable for violations up to the transfer date and that the new discharger is liable from the transfer date forward. (California Water Code, Sections 13267 and 13263)

5. **Change in Discharge**

In the event of a material change in the character, location, or volume of a discharge, the discharger shall file with this Regional Board a new Report of Waste Discharge.

(California Water Code, Section 13260, subdivision (c)). A material change includes, but is not limited to, the following:

(a) Addition of a major industrial waste discharge to a discharge of essentially domestic sewage, or the addition of a new process or product by an industrial facility resulting in a change in the character of the waste.

(b) Significant change in disposal method, e.g., change from a land disposal to a direct discharge to water, or change in the method of treatment which would significantly alter the characteristics of the waste.

(c) Significant change in the disposal area, e.g., moving the discharge to another drainage area, to a different water body, or to a disposal area significantly removed from the original area potentially causing different water quality or nuisance problems.

(d) Increase in flow beyond that specified in the waste discharge requirements.

(e) Increase in the area or depth to be used for solid waste disposal beyond that specified in the waste discharge requirements. (California Code of Regulations, Title 23, Section 2210)

6. **Revision**

These waste discharge requirements are subject to review and revision by the Regional Board. (California Water Code, Sections 13263)

7. **Notification**

Where the discharger becomes aware that it failed to submit any relevant facts in a Report of Waste Discharge or submitted incorrect information in a Report of Waste Discharge or in any report to the Regional Board, it shall promptly submit such facts or information. (California Water Code, Sections 13260 and 13267)

8. **Vested Rights**

This Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, do not protect the discharger from his liability under Federal, State or local laws, nor do they create a vested right for the discharger to continue the waste discharge. (California Water Code, Section 13263, subdivision (g).)

9. **Severability**

Provisions of these waste discharge requirements are severable. If any provisions of these requirements are found invalid, the remainder of the requirements shall not be affected.

10. **Operation and Maintenance**

The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with conditions of this Order. Proper operation and maintenance include effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this Order. (California Water Code, Section 13263, subdivision (f).)

11. **Notification Requirement**

Except for a discharge which is in compliance with these waste discharge requirements, any person who, without regard to intent or negligence, causes or permits any hazardous substance or sewage to be discharged in or on any waters of the State, or discharged or deposited where it is, or probably will be, discharged in or on any waters of the State, shall, as soon as (a) that person has knowledge of the discharge, (b) notification is possible, and (c) notification can be provided without substantially impeding cleanup or other emergency measures, immediately notify the Office of Emergency Services of the discharge in accordance with the spill reporting provision of the State toxic disaster contingency plan adopted pursuant to Article 3.7 (commencing with Section 8574.7) of Chapter 7 of Division 1 of Title 2 of the Government Code, and immediately notify the State Board or the appropriate Regional Board of the discharge. This provision does not require reporting of any discharge of less than a reportable quantity as provided for under subdivisions (f) and (g) of Section 13271 of the Water Code unless the discharger is in violation of a prohibition in the applicable Water Quality Control plan. (California Water Code, Section 13271, subdivision (a).)

12. **Oil or Petroleum Releases**

Except for a discharge which is in compliance with these waste discharge requirements, any person who without regard to intent or negligence, causes or permits any oil or petroleum product to be discharged in or on any waters of the State, or discharged or deposited where it is, or probably will be, discharged in or on any waters of the State, shall, as soon as (a) such person has knowledge of the discharge, (b) notification is possible, and (c) notification can be provided without substantially impeding cleanup or other emergency measures, immediately notify the Office of Emergency Services of the discharge in accordance with the spill reporting provision of the State oil spill contingency plan adopted pursuant to Article 3.5 (commencing with Section 8574.1) of Chapter 7 of Division 1 of Title 2 of the Government Code. This provision does not require reporting of any discharge of less than 42 gallons unless the discharge is also required to be reported pursuant to Section 311 of the Clean Water Act or the discharge is in violation of a prohibition in the applicable Water Quality Control Plan. (California Water Code, Section 13272)

13. **Investigations and Inspections**

The discharger shall allow the Regional Board, or an authorized representative upon the presentation of credentials and other documents as may be required by law, to:

(a) Enter upon the discharger's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Order;

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order;

(c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; and

(d) Sample or monitor at reasonable times, for the purposes of assuring compliance with this Order, or as otherwise authorized by the California Water Code, any substances or parameters at any location. (California Water Code, Section 13267)

(e) Except for material determined to be confidential in accordance with applicable law, all reports prepared in accordance with the terms of this Order shall be available for public inspection at the office of the Los Angeles Water Board. Data on waste discharges, water quality, geology, and hydrogeology shall not be considered confidential.

14. **Monitoring Program and Devices**

The discharger shall furnish, under penalty of perjury, technical monitoring program reports; such reports shall be submitted in accordance with specifications prepared by the Executive Officer, which specifications are subject to periodic revisions as may be warranted. (California Water Code, Section 13267)

All monitoring instruments and devices used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated at least once per year, or more frequently, to ensure continued accuracy of the devices. Annually, the discharger shall submit to the Executive Office a written statement, signed by a registered professional engineer, certifying that all flow measurement devices have been calibrated and will reliably achieve the accuracy required.

The analysis of any material required pursuant to Division 7 of the Water Code shall be performed by a laboratory that has accreditation or certification pursuant to Article 3 (commencing with Section 100825) of Chapter 4 of Part 1 of Division 101 of the Health and Safety Code. However, this requirement does not apply to field tests, such as test for color, odor, turbidity, pH, temperature, dissolved oxygen,

conductivity, and disinfectant residual chlorine. (California Water Code, Section 13176). Unless otherwise permitted by the Regional Board Executive officer, all analyses shall be conducted at a laboratory certified for such analyses by the State Water Resources Control Board's Division of Drinking Water. All analyses shall be required to be conducted in accordance with the latest edition of "Guidelines Establishing Test Procedures for Analysis of Pollutants" (40 CFR Part 136) promulgated by the United States, Environmental Protection Agency (USEPA). (California Code of Regulation, Title 23, Section 2230)

The Quality Assurance-Quality Control Program must conform to the USEPA Guidelines "Laboratory Documentation Requirements for Data Validation", January 1990, USEPA Region 9) or procedures approved by the Los Angeles Regional Water Quality Control Board.

All quality assurance and quality control (QA/QC) analyses must be run on the same dates when samples were actually analyzed. All QA/QC data shall be reported, along with the sample results to which they apply, including the method, equipment, analytical detection and quantitation limits, the percent recovery, and explanation for any recovery that falls outside the QC limits, the results of equipment and method blanks, the results of spiked and surrogate samples, the frequency of quality control analysis, and the name and qualifications of the person(s) performing the analyses. Sample results shall be reported unadjusted for lank results or spike recoveries. In cases where contaminants are detected in QA/QC samples (e.g., field, trip, or lab blanks); the accompanying sample results shall be appropriately flagged.

The Discharger shall make all QA/QC data available for inspection by Regional Board staff and submit the QA/QC documentation with its respective quarterly report. Proper chain of custody procedures must be followed and a copy of that documentation shall be submitted with the quarterly report.

15. **Treatment Failure**

In an enforcement action, it shall not be a defense for the discharger that it would have been necessary to halt or to reduce the permitted activity in order to maintain compliance with this Order. Upon reduction, loss, or failure of the treatment facility, the discharger shall, to the extent necessary to maintain compliance with this Order, control production or all discharges, or both, until the facility is restored or an alternative method of treatment is provided. This provision applies, for example, when the primary source of power of the treatment facility fails, is reduced, or is lost. (California Water Code, Section 13263, subdivision (f).)

16. **Discharge to Navigable Waters**

A person who discharges pollutants or proposes to discharge pollutants or proposes to discharge pollutants to the navigable waters of the United States within the jurisdiction of this state or a person who discharges dredged or fill material or proposes to discharge dredged or fill material into the navigable waters of the United

States within the jurisdiction of this state shall file a report of waste discharge in compliance with the procedures set forth in Water Code section 13260. (California Water Code, Section 13376)

17. **Endangerment to Health and Environment**

The discharger shall report any noncompliance which may endanger health or the environment. Any such information shall be provided verbally to the Executive Officer within 24 hours from the time the discharger becomes aware of the circumstances. A written submission shall also be provided within five days of the time the discharger becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected; the anticipated time it is expected to continue and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance. The Executive officer, or an authorized representative, may waive the written report on a case-by-case basis if the oral report has been received within 24 hours. The following occurrence(s) must be reported to the Executive Office within 24 hours:

(a) Any bypass from any portion of the treatment facility.

(b) Any discharge of treated or untreated wastewater resulting from sewer line breaks, obstruction, surcharge or any other circumstances.

(c) Any treatment plan upset which causes the effluent limitation of this Order to be exceeded. (California Water Code, Sections 13263 and 13267)

18. **Maintenance of Records**

The discharger shall retain records of all monitoring information including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies off all reports required by this Order, and record of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the sample, measurement, report, or application. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Regional Board Executive Officer.

Records of monitoring information shall include:

(a) The date, exact place, and time of sampling or measurement;

(b) The individual(s) who performed the sampling or measurement;

(c) The date(s) analyses were performed;

(d) The individual(s) who performed the analyses;

(e) The analytical techniques or method used; and

(f) The results of such analyses.

19. (a) All application reports or information to be submitted to the Executive Office shall be signed and certified as follows:

(1) For a corporation – by a principal executive officer or at least the level of vice president.

(2) For a partnership or sole proprietorship – by a general partner or the proprietor, respectively.

(3) For a municipality, state, federal, or other public agency – by either a principal executive officer or ranking elected official.

(b) A duly authorized representative of a person designated in paragraph (a) of this provision may sign documents if:

(1) The authorization is made in writing by a person described in paragraph (a) of this provision.

(2) The authorization specifies either an individual or position having responsibility for the overall operation of the regulated facility or activity; and

(3) The written authorization is submitted to the Executive Officer.

Any person signing a document under this Section shall make the following certification:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. [California Water Code Sections 13263, 13267, and 13268]"

20. **Operator Certification**

Supervisors and operators of municipal wastewater treatment plants and privately owned facilities regulated by the Public Utilities Commission, used in the treatment or reclamation of sewage and industrial waste shall possess a certificate of appropriate grade in accordance with California Code of Regulations, Title 23, section 3680. State Boards may accept experience in lieu of qualification training. (California Code of Regulations, Title, 23, Sections 3680 and 3680.2.) In lieu of a properly certified wastewater treatment plant operator, the State Board may approve

use of a water treatment plant operator of appropriate grade certified by the State Department of Public Health where reclamation is involved. (California Code of Regulations, Title, 23, Section 3670.1, subdivision (b).)

ADDITIONAL PROVISIONS APPLICABLE TO PUBLICLY OWNED TREATEMENT WORKS' ADEQUATE CAPACITY

21. Whenever a regional board finds that a publicly owned wastewater treatment plant will reach capacity within four years, the board shall notify the discharger. Such notification shall inform the discharger that the regional board will consider adopting a time schedule order pursuant to Section 13300 of the Water Code or other enforcement order unless the discharger can demonstrate that adequate steps are being taken to address the capacity problem. The notification shall require the discharger to submit a technical report to the regional board within 120 days showing how flow volumes will be prevented from exceeding existing capacity or how capacity will be increased. A copy of such notification shall be sent to appropriate local elected officials, local permitting agencies and the press. The time for filing the required technical report may be extended by the regional board. An extension of 30 days may be granted by the executive officer. Longer extensions may be granted by the regional board itself. (California Code of Regulations, Title, 23, Section 2232.)

Attachment C – Monitoring for Constituents of Emerging Concern (CECs)

Table C-1. Health-based and Performance Indicator CECs and Required Reporting Limits [1]

Constituent	Constituent Group	Reporting Limit (µg/L)
1,4-Dioxane	Industrial chemical	0.1
N-Nitrosodimethylamine (NDMA)	Disinfection byproduct	0.002
N-Nitrosomorpholine (NMOR)	Industrial chemical	0.002
Perfluorooctane sulfonate (PFOS)	Consumer/industrial chemical	0.0065
Perfluorooctanoic acid (PFOA)	Consumer/industrial chemical	0.007
Sucralose	Food additive	0.1
Sulfamethoxazole	Antibiotic	0.01

Note: [1] *Water Quality Control Policy for Recycled Water* (Recycled Water Policy), effective April 8, 2019.

Attachment D – Monitoring for Priority Pollutants

Acenaphthene
Acrolein
Acrylonitrile
Benzene
Benzidine
Carbon tetrachloride
Chlorobenzene
1,2,4-trichlorobenzene
Hexachlorobenzene
1,2-dichloroethane
1,1,1-trichloreothane
Hexachloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
Chloroethane
Bis(2-chloroethyl) ether
2-chloroethyl vinyl ethers
2-chloronaphthalene
2,4,6-trichlorophenol
Parachlorometa cresol
Chloroform
2-chlorophenol
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3-dichlorobenzidine
1,1-dichloroethylene
1,2-trans-dichloroethylene
2,4-dichlorophenol
1,2-dichloropropane
1,3-dichloropropylene
2,4-dimethylphenol
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
Ethylbenzene
Fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
Bis(2-chloroisopropyl) ether
Bis(2-chloroethoxy) methane
Methylene chloride
Methyl chloride
Methyl bromide
Bromoform
Dichlorobromomethane
Chlorodibromomethane
Hexachlorobutadiene
Hexachlorocyclopentadiene
Isophorone
Naphthalene
Nitrobenzene
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-o-cresol
N-nitrosodimethylamine
N-nitrosodiphenylamine
N-nitrosodi-n-propylamine
Pentachlorophenol
Phenol
Bis(2-ethylhexyl) phthalate
Butyl benzyl phthalate
Di-N-Butyl Phthalate 2
Di-n-octyl phthalate
Diethyl Phthalate
Dimethyl phthalate
Benzo(a) anthracene
Benzo(a) pyrene
Benzo(b) fluoranthene
Benzo(k) fluoranthene
Chrysene
Acenaphthylene
Anthracene
Benzo(ghi) perylene
Fluorene
Phenanthrene
Dibenzo(,h) anthracene
Indeno (1,2,3-cd) pyrene
Pyrene
Tetrachloroethylene
Toluene
Trichloroethylene
Vinyl chloride
Aldrin
Dieldrin
Chlordane

4,4-DDT
4,4-DDE
4,4-DDD
Alpha-endosulfan
Beta-endosulfan
Endosulfan sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Alpha-BHC
Beta-BHC
Gamma-BHC
Delta-BHC
PCB-1242 (Arochlor 1242)
PCB-1254 (Arochlor 1254)
PCB-1221 (Arochlor 1221)
PCB-1232 (Arochlor 1232)
PCB-1248 (Arochlor 1248)
PCB-1260 (Arochlor 1260)
PCB-1016 (Arochlor 1016)
Toxaphene
Antimony
Arsenic
Asbestos
Beryllium
Cadmium
Chromium
Copper
Cyanide, Total
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc
2,3,7,8-TCDD

Attachment E

MONITORING AND REPORTING PROGRAM NO. CI-9259
FOR
CITY OF SANTA PAULA
(SANTA PAULA WATER RECYCLING FACILITY)
(File No. 06-189)

This Monitoring and Reporting Program (MRP) No. CI-9259 is issued pursuant to California Water Code section 13267, which authorizes the Regional Water Quality Control Board, Los Angeles Region (Regional Board) to require the City of Santa Paula (City), who discharges tertiary-treated wastewater generated from the Santa Paula Water Recycling Facility (SPWRF) to groundwater via three percolation ponds, to furnish technical or monitoring reports.

The reports required herein are necessary to:

- Determine compliance with Waste Discharge Requirements (WDRs) Order No. R4-2018-0022 and assure protection of the waters of the state and their beneficial uses.
- Assess treatment plant performance, identify operational problems, and improve plant performance.
- Assess effectiveness of the City's Pretreatment Program.
- Provide information on wastewater characteristics and flows for use in interpreting water quality and biological data.
- Determine total maximum daily load (TMDL) effectiveness.

The evidence that supports the need for the reports is set forth in the WDRs and the Regional Board record.

I. SUBMITTAL OF REPORTS

A. The City shall comply with the Electronic Submittal of Information (ESI) requirements by submitting all reports required under this MRP, including electronic data format (EDF) groundwater and surface water monitoring data, injection location data, and monitoring reports. These reports shall be received by the Regional Board via the State Water Resources Control Board's (State Water Board) GeoTracker database under Global ID WDR100000849 on the dates indicated as follows:

1. **Quarterly Monitoring Reports** shall be received by the Regional Board by the 30th day of the month following the end of each quarterly monitoring period according to Table 1 below. The first Quarterly Monitoring Report

under this program must be received by the Regional Board by April 30, 2018.

Table 1. Reporting Period and Due

Reporting Period	Report Due
January – March	April 30
April – June	July 30
July – September	October 30
October - December	January 30

2. **Annual Summary Report** shall be received by the Regional Board by March 1 of each year. The first Annual Summary Report under this program must be received by the Regional Board no later than March 1, 2018.

B. If there is no discharge during any reporting period, the report shall still be submitted and so state.

C. Data collected from monitoring wells shall be included in the quarterly monitoring reports and annual summary report. The data shall include the well specifications, ordinances, well heads elevation to mean sea level (MSL) and the method to develop the well. The California Department of Water Resources sets standards for the construction of groundwater wells, as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 74-81* (December 1981). These well standards, and any more stringent standards adopted by the state or county pursuant to Water Code section 13801, apply to all monitoring wells used to monitor the impacts of wastewater storage or disposal governed by waste discharge or monitoring and reporting requirements.

D. In accordance with California Business and Profession Code sections 6735, 7835, and 7835.1, engineering and geologic evaluations and judgments shall be performed by or under the direction of registered professionals competent and proficient in the fields pertinent to the required activities. All reports submitted to the Regional Board pursuant to waste discharge or monitoring and reporting requirements that contain work plans for investigations and studies, that describe the conduct of investigations and studies, or that contain technical conclusions and recommendations concerning engineering and geology shall be prepared by or under the direction of appropriately qualified professional(s), such a licensed engineer or a certified hydrogeologist in the State of California, even if not explicitly stated. Each report must submitted by the Discharger shall bear the professional's signature and stamp.

E. All monitoring reports must include, at minimum, the following:

1. Well or location identification, date and time of sampling;

2. Sampler identification, laboratory identification, and chain of custody;

3. Quarterly observation of groundwater levels, recorded to 0.01 feet mean sea level (MSL), and flow direction; and

4. Calculation of vertical separation of the water table from the bottom of the disposal system.

II. MONITORING REQUIREMENTS

A. Monitoring shall be used to determine compliance with waste discharge requirements and shall include, but is not limited to, implementation and documentation of the following:

1. Locations of each groundwater well where representative samples can be obtained and the rationale for the selection. The City must include a map, at a scale of 1 inch equals 1,200 feet or less, that clearly identifies the locations of the SPWRF, and all groundwater monitoring wells.

2. Sampling protocols (specified in 40 C.F.R. Part 136 or American Water Works Association standards where appropriate) and chain of custody procedures.

3. For groundwater monitoring, outline the methods and procedures to be used for measuring water levels; purging wells; collecting samples; decontaminating equipment; containing, preserving, and shipping samples; and maintaining appropriate documentation. Also include the procedures for handling, storing, testing, and disposing of purge and decontamination waters generated from the sampling events.

4. Laboratory or laboratories, which conducted the analyses. Include copy or copies of laboratory certifications by the Environmental Laboratory Accreditation Program (ELAP) of the State Water Board's Division of Drinking Water (DDW) every year or when the City changes their contract laboratory.

5. Analytical test methods used and the corresponding Detection Limits for Purposes of Reporting (DLR) for unregulated and regulated chemicals. Please see the DDW's website at http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/EDT.shtml for unregulated and regulated chemicals.

6. Quality assurance and control measures.

B. The samples shall be analyzed using analytical methods described in 40 C.F.R. Part 136; or where no methods are specified for a given pollutant, by

commercially available methods approved by the United State Environmental Protection Agency (USEPA) or DDW, Regional Board and/or State Board. The City shall select the analytical methods that provide reporting detection limits (RDLs) lower than the limits prescribed in waste discharge requirements.

C. The City shall instruct its laboratories to establish calibration standards so that the RDLs (or its equivalent if there is a different treatment of samples relative to calibration standards) are the lowest calibration standard. At no time shall the City use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

D. Upon request by the City, the Regional Board, in consultation with the USEPA or DDW and the State Board Quality Assurance Program, may establish RDLs in any of the following situations:

1. When the pollutant has no established method under 40 C.F.R. Part 136 (revised May 14, 1999, or subsequent revision);

2. When the method under 40 C.F.R. Part 136 for the pollutant has a RDL higher than the limit specified in this Order; or

3. When the City agrees to use a test method that is more sensitive than those specified in 40 C.F.R. Part 136 and is commercially available.

E. Samples of influent and disinfected effluent must be analyzed within allowable holding time limits as specified in 40 C.F.R. section 136.3. All quality assurance/quality control (QA/QC) analyses must be run on the same dates when samples were actually analyzed. The City shall make available for inspection and/or submit the QA/QC documentation upon request by the Regional Board. Proper chain of custody procedures must be followed and a copy of that documentation shall be submitted with the quarterly monitoring report.

F. Constituents of emerging concern (CECs): In recent years, the Regional Board has required monitoring of a select group of anthropogenic chemicals, particularly pesticides, pharmaceuticals and personal care products, known collectively as CECs, into monitoring and program requirements to better understand the propensity, persistence and effects of CECs in our environment. Recently adopted permits in this region contain requirements for CEC effluent monitoring, including identification of the CECs to be monitored in the effluent, sample type, sampling frequency, and sampling methodology.

1. The City shall monitor a selective list of CECs identified in Attachment C in the SPWRF's effluent discharge and in the groundwater. The reporting limits in Attachment C shall be used for these constituents.

2. The City shall select methods according to the following approach:

i. Use USEPA drinking water methods, if available;

ii. Use DDW-recommended methods for CECs, if available;

iii. If there is no DDW-recommended drinking water method for a chemical, and more than a single USEPA-approved method is available, use the most sensitive USEPA-approved method;

iv. If there is no USEPA-approved method for a chemical, and more than one method is available from the scientific literature and commercial laboratory, after consultation with DDW, use the most sensitive method; or

v. If no approved method is available for a specific chemical, the City's laboratory may develop or use its own methods and should provide the analytical methods to DDW or the Regional Board for review and approval. Those methods may be used until DDW-recommended or USEPA-approved methods are available.

vi. In the event that subsections II.F.2.i. or II.F.2.v. are applicable, the City shall inform the Regional Board.

3. CECs identified in Attachment C shall be monitored once within six months from the effective date of this Order (by May 2, 2018) and once every five years thereafter. The Regional Board Executive Officer may add or delete chemicals from Attachment C as new analytical methods become available and may also make revisions to approved analytical methods as needed. A revised CECs list will be made available to the City when changes occur. The City shall request (and submit a justification for) any deviation from the attached list for Executive Officer approval, if a change is required, before collecting samples.

4. Monitoring results shall be reported as part of the annual report. Analysis under this section is for monitoring purposes only as there are currently no standards for these constituents.

III. REPORTING REQUIREMENTS

The City shall submit all reports to the Regional Board by the dates indicated in Section I. All quarterly and annual reports shall clearly list all non-compliance with WDRs, as well as all excursions of effluent limits. All quarterly and annual monitoring reports shall contain a separate section titled "Summary of Non-Compliance", which discusses the compliance records and corrective actions taken or planned that may be needed to bring the discharge into full compliance with WDRs.

A. Quarterly Monitoring Reports

1. These reports shall include, at a minimum, the following information:

   i. The volume of the effluent used for land disposal via percolation.

   ii. The date and time of sampling and analyses on the influent, effluent, and groundwater.

   iii. All analytical results of samples collected during the monitoring period of the influent, effluent, and groundwater.

   iv. Documentation of all QA/QC procedures that were followed during sampling and laboratory analyses.

   v. Records of any operational problems, plant upset and equipment breakdowns or malfunctions, and any discharge(s) used for land disposal via percolation.

   vi. Discussion of compliance, non-compliance, or violation of waste discharge requirements.

   vii. All corrective and/or preventive action(s) taken or planned with schedule of implementation, if any violation occurs.

2. For the purpose of reporting compliance with numerical limitations, analytical data shall be reported using the following reporting protocols:

   i. Sample results greater than or equal to the RDL must be reported "as measured" by the laboratory (i.e., the measured chemical concentration in the sample);

   ii. Sample results less than the RDL, but greater than or equal to the laboratory's method detection limit (MDL), must be reported as "Detected, but Not Quantified" (DNQ). The laboratory must write the estimated chemical concentration of the sample next to DNQ as well as the words "Estimated Concentration" (may be shortened to Est. Conc.); or

   iii. Sample results less than the laboratory's MDL must be reported as "None-Detected" (ND).

3. If the City samples and performs analyses (other than for process/operational control, startup, research, or equipment testing) on any sample more frequently than required in this MRP using approved analytical methods, the results of those analyses shall be included in the report. These results shall be included in the calculation of the average

used in demonstrating compliance with average effluent limits, receiving groundwater limits, etc.

4. The Regional Board may request supporting documentation, such as daily logs of operations.

B. Annual Summary Reports

These reports shall include, at a minimum, the following information:

1. Tabular and graphical summaries of the monitoring data (quality of influent, effluent, and groundwater; quantity of influent and effluent to percolation ponds,) obtained during the previous calendar year. A comparison of laboratory results against effluent limits contained in these WDRs and notations of any exceedances of limits or other requirements shall be summarized and submitted at the beginning of the report.

2. Discussion of the compliance record and corrective and/or preventive action(s) taken or planned that may be needed to bring the treated effluent, including the treated effluent used for recycled water, into full compliance with the requirements in the WDRs.

3. An in-depth discussion of the results of the final effluent monitoring and groundwater monitoring conducted during the previous year includes:

   i. Any change of receiving groundwater resulting from effluent discharges at percolation ponds; and

   ii. Any change of groundwater flow pattern resulting from discharge via percolation ponds.

   Temporal and spatial trends in the data shall be analyzed, with particular reference to comparisons between stations with respect to distances from the monitoring wells and comparisons to data collected during previous years. Appropriate statistical tests and indices, subject to approval by the Regional Board Executive Officer, shall be calculated and included in the annual report.

4. The description of any changes and anticipated changes including any impacts in operation of any unit processes or facilities shall be provided.

5. A list of the analytical methods employed for each test and associated laboratory QA/QC procedures shall be included. The report shall restate the laboratories used by the City to monitor compliance with the accompanying Order, their status of certification, and provide a summary of analyses.

6. The report shall confirm operator certification and provide a list of current operating personnel, their responsibilities, and their corresponding grade of certification.

7. The report shall also summarize any change of the Operation, Maintenance, and Monitoring Plan (OMM Plan) due to the optimization of the existing SPWRF operation. The summary shall discuss conformance with the SPWRF's OMM Plan for operations, maintenance, and monitoring of the SPWRF, and whether the OMM Plan requires revision for the current facilities.

IV. WATER QUALITY MONITORING REQUIREMENTS

A. Influent Monitoring

1. The City shall monitor influent to the SPWRF at Influent Pump Station located in the main stream of the influent channel prior to the headworks as specified in Table 2 below.

Table 2. Influent Monitoring

Constituents	Units[1]	Type of Sample	Minimum Frequency of Analysis
Total waste flow	gpd	Recorder	Continuous[2]
$BOD_{5@20^oC}$	mg/L	Grab	Monthly
Total suspended solids	mg/L	Grab	Monthly
Chloride	mg/L	24-hour composite	Monthly
Sulfate	mg/L	Grab	Monthly
Boron	mg/L	Grab	Monthly
Total dissolved solids	mg/L	Grab	Monthly
Metals[3]	µg/L	Grab	Quarterly

Table nots: [1] gpd: gallons per day; mg/L: milligrams per liter; µg/L: micrograms per liter
[2] The City shall report the daily minimum, maximum, and average values.
[3] Metals include antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

B. Effluent Monitoring

1. The City shall monitor its discharge of tertiary-treated effluent at downstream of all treated effluent passing through the effluent sampling station, including the final disinfection process.

2. The following shall constitute the effluent monitoring program, specified in Table 3 below:

Table 3. Effluent Monitoring

Constituent	Unit[1]	Type of Sample[2]	Minimum Frequency of Analysis
Total flow	gpd	Recorder	Continuous[3]
UV	mW-s/cm^2	Recorder	Continuous[3]
Turbidity	NTU	Recorder	Continuous[3][4]
pH	pH units	Grab	Daily
Fecal coliform	MPN/100mL	Grab	Daily
Total coliform	MPN/100mL	Grab	Daily
Enterococcus	MPN/100mL	Grab	Weekly
Total suspended solids	mg/L	24-hour composite	Monthly
$BOD_{5@20^oC}$	mg/L	24-hour composite	Monthly
Oil and grease	mg/L	Grab	Monthly
Ammonia as nitrogen	mg/L	Grab	Monthly
Nitrate as nitrogen	mg/L	Grab	Monthly
Nitrite as nitrogen	mg/L	Grab	Monthly
Organic nitrogen	mg/L	Grab	Monthly
Residual chlorine	mg/L	Grab	Monthly
Total dissolved solids	mg/L	Grab	Monthly
Sulfate	mg/L	Grab	Monthly
Chloride	mg/L	Grab	Weekly
Boron	mg/L	Grab	Monthly
MBAS[5]	mg/L	Grab	Quarterly
CTAS[6]	mg/L	Grab	Quarterly
Total hardness	mg/L	24-hour composite	Quarterly
Total phosphorus	mg/L	24-hour composite	Quarterly
Constituents listed in Attachment A-1 to A-6	various	Grab/24-hour composite	Quarterly

Constituent	Unit[1]	Type of Sample[2]	Minimum Frequency of Analysis
CECs in Attachment C	various	Grab	Once within 6 months and every 5 years thereafter[7]
Remaining priority pollutants in Attachment D	µg/L	Grab/24-hour composite	Annually

Table notes: [1] NTU: Nephelometric turbidity unit; mW-s/cm^2:milli-watts seconds per square centimeter; MPN/100mL: most probable number per 100 milliliter; µg/L: micrograms per liter

[2] Grab sample is an individual sample collected in a short period of time not exceeding 15 minutes. Grab samples shall be collected during normal peak loading conditions for the parameter of interest, which may or may not be during hydraulic peaks. When an automatic composite sampler is not used, composite sampling shall be done as follows. If the duration of the discharge is equal to or less than 24 hours but greater than eight (8) hours, at least eight (8) flow-weighted samples shall be obtained during the discharge period and composited. For discharge duration of less than eight (8) hours, individual "grab" sample may be substituted. 24-hour composite is for semi-volatile and volatile chemicals.

[3] The City shall report the daily minimum, maximum, and average values.

[4] In the event the continuous turbidity meter and recorder fail, grab sampling may be substituted for a period of up to 24 hours. The turbidity samples must be taken at intervals of no more than 1.2 hours over a 24-hour period to determine compliance for turbidity.

[5] MBAS: Methylene Blue Active Substances

[6] CTAS: Cobalt Thiocyanate Active Substances

[7] CECs shall be monitored once within six months from the effective date of this Order (by May 2, 2018) and once every five years thereafter.

C. Groundwater Monitoring

1. The City shall monitor the groundwater at and surrounding the SPWRF to assess the water quality impact of the SPWRF's discharges to groundwater.

2. The City shall continue to conduct groundwater monitoring from all existing wells, including MW-1, MW-2a, MW-3, MW-4, MW-5, MW-6, MW-7a, MW-8, and MW-9 until such time as the City's work plan proposing a modified groundwater monitoring network, described in Section IV.C.3 below, is approved by the Executive Officer and is implemented by the City.

3. By May 1, 2018, the City shall submit to the Regional Board a work plan proposing a modified groundwater monitoring network for compliance determination with the groundwater limitations. The proposed

groundwater monitoring network shall include groundwater monitoring wells upgradient, cross gradient, and downgradient to the percolation pond. In addition to installation of new wells, the City may propose continuing to use some or all of the existing groundwater monitoring wells (MW-1, MW-2a, MW-3, MW-4, MW-5, MW-6, MW-7a, MW-8, and MW-9). For compliance determination with the groundwater limitation for chloride, the City's proposed modified groundwater monitoring network shall include wells at approximately 150 feet downgradient from the percolation pond. The work plan shall be submitted to the Regional Board for the Executive Officer's review and approval. If the City proposes to use existing wells (such as water supply or irrigation wells) not owned by the City, or proposes to install new wells on property not owned by the City, the City shall include as part of its work plan any access agreements between the City and property owner(s) to use and/or install groundwater wells on non-City-owned property. The City shall implement the work plan, by completing installation of any new wells and commencing monitoring from them, within 60 days after the Executive Officer's approval.

4. The required groundwater monitoring of constituents/parameter with sample type and frequencies is specified in Table 4 below.

Table 4. Groundwater Monitoring

Constituents	Units	Type of Sample	Minimum Frequency of Analysis[2]
Water level elevation[1]	feet	Recorder	Monthly
pH	pH units	Grab	Monthly
Total coliform	MPN/100mL	Grab	Monthly
Fecal coliform	MPN/100mL	Grab	Monthly
Enterococcus	MPN/100mL	Grab	Monthly
Ammonia as nitrogen	mg/L	Grab	Monthly
Nitrate as nitrogen	mg/L	Grab	Monthly
Nitrite as nitrogen	mg/L	Grab	Monthly
Organic nitrogen	mg/L	Grab	Monthly
Total dissolved solids	mg/L	Grab	Monthly
Sulfate	mg/L	Grab	Monthly
Chloride	mg/L	Grab	Monthly
Boron	mg/L	Grab	Monthly

Constituents	Units	Type of Sample	Minimum Frequency of Analysis[2]
Constituents listed in Attachments A-1 to A-5	various	Grab	Annually
CECs in Attachment C	µg/L	Grab	Once within 6 months and every 5 years thereafter
Remaining priority pollutants in Attachment D	µg/L	Grab	Annually

Table notes: [1] Annual samples shall be collected during the dry season each year.
[2] Water level elevations must be measured to the nearest 0.01 feet, and referenced to mean sea level.

D. Monitoring of Effluent Flow to Percolation Ponds

The City shall record the volume in gallons per day (GPD) of treated wastewater discharged to the three percolation ponds. This information shall be submitted as part of the quarterly monitoring reports.

V. GENERAL MONITORING AND REPORTING REQUIREMENTS

A. The City shall comply with all Standard Provisions (Attachment B) related to monitoring, reporting, and recordkeeping.

B. For every requirement not met, the City shall submit a statement of the actions undertaken or proposed that will bring the treated effluent into full compliance with requirements at the earliest possible time, and submit a timetable for implementation of the corrective measures.

C. Monitoring reports shall be signed by either the principal Executive Officer or ranking elected official. A duly authorized representative of the aforementioned signatories may sign documents if:

1. The authorization is made in writing by the signatory;

2. The authorization specifies the representative as either an individual or position having responsibility for the overall operation of the regulated facility or activity; and

3. The written authorization is submitted to the Regional Board Executive Officer.

D. The monitoring report shall contain the following completed declaration:

"I certify under penalty of law that this document, including all attachments and supplemental information, was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly

gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment."

Executed on the ___ day of _____ at _____

_____ Signature

_____ Title

E. The City shall retain records of all monitoring information, including all calibration and maintenance, monitoring instrumentation, and copies of all reports required by this Order, for a period of at least three (3) years from the date of sampling measurement, or report. This period may be extended by request of the Regional Board at any time and shall be extended during the course of any unresolved administrative proceeding or judicial litigation regarding the regulated activity.

F. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements;

2. The individual(s) who performed the sampling or measurements;

3. The date(s) analyses were performed;

4. The individual(s) who performed the analysis;

5. The analytical techniques or methods used; and

6. The results of such analyses.

G. The City shall submit to the Regional Board, together with the first monitoring report required by this Order, a list of all chemicals and proprietary additives that could affect the quality of the treated effluent. Any subsequent changes in types and/or quantities shall be reported promptly. An annual summary of the quantities of all chemicals, listed by both trade and chemical names that are used in the treatment process shall be included in the annual report.

VI. WASTE HAULING REPORTING

In the event that waste sludge, septage, or other wastes are hauled offsite, the name and address of the hauler shall be reported, along with types and quantities hauled during the reporting period and the location of final point of disposal. In the event that

no wastes are hauled during the reporting period, a statement to that effect shall be submitted in the quarterly monitoring report.

VII. PRETREATMENT REPORTING

The City shall submit annual reports to the Regional Board, with copies to the State Board, and USEPA Region 9, describing the City's pretreatment activities over the period.

A. The annual reports shall identify:

1. All significant industrial users (SIUs) that violated any standards or reporting requirements during that year;

2. The violations committed;

3. The enforcement actions undertaken; and

4. The status of active enforcement actions from previous periods, including closeouts (facilities under previous enforcement actions that attained compliance during the quarter).

B. By March 1 of each year, beginning January 1, 2018, the City shall submit an annual summary report to the Regional Board describing the pretreatment activities within the service area during the previous year. In the event that any control authority within the service area is not in compliance with any conditions or requirements of this Order or their approved pretreatment program (such as due to industrial user discharges, interjurisdictional agency agreement implementation issues, or other causes,) then the City shall also include the reasons for noncompliance and state how and when the City and the control authority shall comply with such conditions and requirements. The report shall contain, but not be limited to, the following information:

1. A summary of analytical results from representative, flow-proportioned, 24-hour composite sampling of the SPWRF's influent and effluent wastewaters for those pollutants that are known or suspected to be discharged by industrial users (IUs) as identified by the pretreatment program.

2. The summary shall include the result of annual full priority pollutant scan, with quarterly samples analyzed only for those pollutants detected in the full scan.

3. The City shall also provide any influent or effluent monitoring data for non-priority pollutants that the City believes may be causing or contributing to Interference, Pass Through or adversely impacting sludge quality.

4. Sampling and analysis shall be performed in accordance with the techniques prescribed in pretreatment program and amendments thereto.

5. A discussion of any upset, interference, or pass-through incidents at the treatment plant (if any), which the City knows or suspects were caused by IUs of the SPWRF system. The discussion shall include the following:

    i. The reasons why the incidents occurred, the corrective actions taken, and, if known, the name and address of the IU(s) responsible.

    ii. A review of the applicable pollutant limitations to determine whether any additional limitations, or changes to existing requirements, may be necessary to prevent pass through, interference or noncompliance with sludge disposal requirements, if any.

6. A complete and updated list of the City's significant industrial users (SIUs), including names, Standard Industrial Classification code(s) and addresses, and a list of any SIU deletions and/or additions.

7. The City shall provide a brief explanation for each deletion. The SIU list shall identify the SlUs equivalent to Federal Categorical Standards by specifying which standards are applicable to each SIU. The list shall also indicate which SlUs are subject to local limitations and those that are not subject to local limits.

8. A list or table characterizing the industrial compliance status of each SIU, including:

    i. SIU name and address;

    ii. Industrial category;

    iii. The type (processes) of wastewater treatment in place;

    iv. Number of samples taken by the SPWRF during the year;

    v. Number of samples taken by the SIU during the year;

    vi. Whether all needed certifications (if allowed) were provided by SlUs that have limits for total toxic organics;

    vii. Regional Standards violated during the year, reported separately;

    viii. whether the SIU at any time in the year was in Significant Noncompliance (SNC), equivalent to that defined in 40 C.F.R. section 403.12(f)(2)(vii);

ix A summary of enforcement actions against the SIU taken during the year, including the type of action, final compliance date, and amount of fines assessed/collected (if any). Proposed actions, if known, should be included; and

x. Number of inspections conducted at each SIU during the year.

9. A compliance summary table that includes:

   i. SIU's which were in SNC at any time during the year;

   ii. The total number of SIUs that are in SNC with pretreatment, compliance schedules during the year; and

   iii. The total number of notices of violation and administrative orders issued against SIUs during the year:

      a. The total number of civil and criminal judicial actions filed against SIUs during the year;

      b. The number of SIUs that were published as being in SNC during the year; and

      c. The number of IUs from which penalties were collected during the year.

10. A short description of any significant changes in operating the pretreatment program that differ from the previous year including, but not limited to changes concerning:

   i. The program's administrative structure;

   ii. Local industrial discharge limitations;

   iii. Monitoring program or monitoring frequencies;

   iv. Legal authority or enforcement policy;

   v. Funding mechanisms; and

   vi. Resource requirements and/or staffing levels.

11. A summary of the annual pretreatment budget, including the cost of pretreatment program functions and equipment purchases.

12. A summary of public participation activities to involve and inform the public.

13. A description of any changes in sludge disposal methods and a discussion of any concerns not described elsewhere in the report.

14. The cumulative number of industrial users that the City has notified regarding Baseline Monitoring Reports and the cumulative number of industrial user responses.

15. The City shall submit the quarterly compliance status reports and the annual pretreatment report to the Regional Board.

VIII. MONITORING FREQUENCIES

The Regional Board Executive Officer is delegated authority to revise this Monitoring and Reporting Program, including monitoring frequencies and parameters. The City may make a request (with justification) to reduce the monitoring frequency or to modify the list of monitoring constituents. The City shall not make any adjustment until the Executive Officer provides written approval after determining that the request is adequately justified.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION

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CEASE AND DESIST ORDER FOR CITY OF SANTA PAULA ORDER NO. R4-2018-0023, AS AMENDED BY ORDER NO. R4-2018-0023-A01 (SANTA PAULA WATER RECYCLING FACILITY) (FILE NO. 16-189)

REQUIRING CITY OF SANTA PAULA
TO UNDERTAKE ACTIONS TOWARD COMPLIANCE WITH
CHLORIDE REQUIREMENTS IN WASTE DISCHARGE REQUIREMENTS FOR
DISCHARGES FROM SANTA PAULA WATER RECYCLING FACILITY

TENTATIVE

The California Regional Water Quality Control Board, Los Angeles Region (Regional Water Board) finds:

1. The City of Santa Paula (City or Discharger) is the owner of the Santa Paula Water Recycling Facility (SPWRF), a Publicly-Owned Treatment Works (POTW), located at 920 Corporation Street in Santa Paula, California. The SPWRF is operated by Ventura Regional Sanitation District and discharges tertiary-treated wastewater to groundwater via three percolation ponds adjacent to the facility.

2. The SPWRF treats wastewater generated within the City and is designed for a flow of 4.2 million gallons per day (MGD). Based on the discharge records between July 2010 and June 2017, the monthly average effluent discharged from the SPWRF ranged between 1.36 and 2.44 MGD, with an average of 1.86 MGD.

3. The wastewater treatment process at the SPWRF consists of preliminary treatment (coarse and fine mechanical screening and grit removal at the Influent Lift Station), flow equalization (two flow equalization tanks), secondary treatment (three aeration tanks with nitrification and denitrification activated sludge), tertiary treatment (six biomembrane reactors, providing further carbonaceous oxidation, nitrification/denitrification and solids removal to meet the limits of the WDRs), and disinfection (UV). Treated and disinfected effluent is discharged to three percolation ponds. The returned activated sludge is treated at two of three aerobic digesters (one aerobic digester is for backup) after being thickened at two thickeners. The solids generated at the aerobic digesters receive final dewatering at the screw dewatering press. Final solids meeting the United States Environmental Protection Agency (USEPA) Class B reuse standards are sent to the Ventura County Regional Bio-Solids facility.

4. The SPWRF is able to meet all final effluent limitations in the City's waste discharge requirements (WDRs) except for chloride. This is due to the SPWRF not being

designed to remove chloride. Since the SPWRF has no ability to remove chloride, chloride is passed through to the effluent and then groundwater via discharges to the percolation pond. Noncompliance with chloride effluent and groundwater limitations is the most problematic issue with the SPWRF. Table 1 summarizes the chloride concentrations of effluent discharged from the SPWRF.

Table 1. Annual Average Chloride Concentrations[1] (milligrams per liter, mg/L) in SPWRF Effluent

Period	Effluent of SPWRF
2010	156
2011	153
2012	149
2013	155
2014	145
2015	134
2016	137
2017	131
2018	121
2019	120
2020	118.88
2021	112
Range[2]	135.99 ± 15.61

Table 1 notes:

[1] All data were collected from grab samples.

[2] Data range is based on one standard deviation.

A. The monthly effluent chloride concentration ranged from 125 to 166 mg/L between July 2010 and June 2017, which continuously exceeded the chloride effluent limitation of 110 mg/L. This has led to an escalation of the chloride concentrations in groundwater below and surrounding the three percolation ponds with a range of 121 to 168 mg/L and an average of 140 mg/L since July 2010. The groundwater and effluent data indicate that the chloride discharges from the SPWRF have impacted the receiving groundwater quality in the vicinity of the SPWRF.

B. The elevated chloride concentrations in the effluent were believed to be associated with the approximately 1,250 Self-Regenerating Water Softeners (SRWS) installed in the households of the City. These SRWS generate brine

TENTATIVE

containing elevated chloride concentrations, which are discharged to sewers and delivered to the SPWRF as influent.

C. According to the effluent data collected between October 2015 and June 2017, a total of 2,479 pounds/day (lbs/day) of chloride, based on the effluent flow rate of 2.2 MGD [95 percentile of monthly average effluent flows, resulting from data recorded between October 2015 (beginning of the SRWS Buyback Program) and June 2017] and a chloride effluent concentration of 135 mg/L, were discharged to the groundwater underlying the percolation pond.

D. The chloride interim effluent limit of 1,983 lbs/day was exceeded twice between 2018 and 2021: 2,040 lbs/day in February 2021, calculated from February 8, 2021 through March 7, 2021, and 2,030 lbs/day in March 2021, calculated from March 8, 2021 through April 7, 2021.

E. The chloride interim groundwater limitation was exceeded at downgradient wells AW01 in July 2018 and at AW03 in August 2020.

5. The Regional Water Board issued three Notices of Violation (NOVs), described below, to the City for exceedances of the chloride effluent and groundwater limitations in Order No. R4-2007-0028. These NOVs required the City to implement corrective and preventative actions to bring the City's discharge into full compliance with chloride effluent limitations and receiving water requirements specified in Order No. R4-2007-0028, previously adopted by this Regional Water Board on May 3, 2007.

   A. The November 3, 2011 NOV summarized chloride limit exceedances between the second quarter of 2010 and the third quarter of 2011. These violations included 15 exceedances of chloride and one exceedance of total nitrogen, di(2-ethyl)phthalate, and dioxin in effluent; and 1 exceedance of sulfate, 5 exceedances of chromium, 10 exceedances of aluminum, 1 exceedance of nickel and boron and nitrate plus nitrite, and 26 chloride exceedances of groundwater limitations.

   B. The December 30, 2014 NOV summarized 36 and 88 chloride exceedances in effluent and groundwater, respectively, between the fourth quarter of 2011 and the third quarter of 2014.

   C. The March 20, 2017 NOV summarized 27 and 50 chloride exceedances in effluent and groundwater, respectively, between the fourth quarter of 2011 and the fourth quarter of 2016.

6. The City's efforts to reduce the chloride concentration in the influent to the SPWRF are summarized below:

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A. The City identified that the influent to the SPWRF contains brine with elevated chloride concentration from Self-Regenerating Water Softeners (SRWS). There are approximately 1,250 residential SRWS used in the City.

B. On September 5, 2006, the City established Ordinance No. 1160 prohibiting the installation or replacement of residential SRWS.

C. On June 22, 2015, the City adopted Resolution No. 6918 approving a SRWS Buyback and Incentive Program. This program offers a financial incentive to residents to voluntarily remove SRWS. A Kick-Off SRWS Buyback event was held on September 19, 2015. The removal of SRWS under this program began in October 2015. Three hundred (300) of the approximately 1,250 SRWS have been removed from October 2015 through February 2022. A reliable decreasing trend for chloride has not been observed in the effluent.

7. To address the City's chloride exceedances in the effluent and groundwater, the Regional Water Board required the City to submit a Chloride Reduction Workplan. Board staff also met with the City on several occasions to discuss the City's chloride exceedances. A summary of these events are as follows:

A. On December 19, 2013 and May 11, 2015, the Regional Water Board met with the City to discuss its Chloride Reduction Workplan. The City's Chloride Reduction Workplan includes the following tasks:

i. Prohibit SRWS installations or replacements;

ii. Implement a SRWS Buyback Program;

iii. Implement a Recycled Water Program to reduce effluent discharged to the three percolation ponds; and

iv. Implement Supplemental Strategies, if needed, including advanced treatment (e.g., reverse osmosis) and disposal of brine.

B. On January 28, 2016, Regional Water Board staff discussed with the City the necessary actions to reduce the chloride concentration in the effluent, which included the SRWS Buyback Program. The City also proposed to explore application of recycled water at locations other than identified groundwater hot spots and to conduct groundwater impact investigation and remediation activities. The City was notified that detailed schedules and milestones were required for all actions.

C. On March 8, 2016 and September 14, 2016, the City met with Regional Water Board staff to provide an update of its SRWS Buyback Program efforts. The City noted that five City employees were deployed to conduct door-to-door visits to encourage participation in the SRWS Buyback Program among 7,500 dwellings within the City.

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D. On October 31, 2016, the City met with Regional Water Board staff to provide an update on the following topics:

   i. Status of implementing the chloride compliance strategy and potential for reduction of effluent discharged to the three percolation ponds via the City's Recycled Water Program;

   ii. Assimilative capacities for chloride at different groundwater locations beneath the City based on the Salt and Nutrient Management Plan for the Lower Santa Clara River Basin; and

   iii. Groundwater hot spots (i.e., chloride impaired areas with no assimilative capacity for recycled water applications) in the City.

E. On May 1, 2018, the City submitted the Self-Regenerating Water Softener Buyback Program Evaluation Report to comply with CDO requirements. The report concluded that the Buyback Program is partially effective in reducing chloride loadings to the SPWRF, but the estimated reduction in the chloride concentration in the effluent has not been met.

F. On January 30, 2019, the City submitted the Recycled Water Project Layout Report to identify potential recycled water opportunities, conduct outreach to potential recycled water users, and draft conceptual recycled water projects and evaluate them. During the process, the City met with potential project partners and interested parties to discuss opportunities, project components, design criteria, and project feasibility. However, the City was unable to accomplish the recycled water project due to an incompatibility in schedules between the City and potential recycled water partners.

G. On September 20, 2019, the City submitted the Alternative Effluent Chloride Mitigation Workplan to request a Basin Plan amendment to adopt a site-specific groundwater quality objective for chloride after discussions on January 30, 2019 and June 27, 2019.

H. On February 28, 2020, the Regional Water Board provided comments on the Alternative Effluent Chloride Mitigation Workplan. The comments required the City to provide supporting information regarding a site-specific chloride groundwater quality objective that would be protective of beneficial uses for agricultural water supply for salt sensitive crops.

I. On April 15, 2020, the City notified the Regional Water Board of its modified approach to upgrade the SPWRF with reverse osmosis (RO), in lieu of the proposed recycled water project, to reduce chloride concentrations in the treated effluent to meet the permit requirements.

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J. On July 13, 2020, the City requested development of a site-specific groundwater quality objective for chloride of 117 mg/L as a Basin Plan amendment to reduce the cost of the RO implementation.

K. On December 1, 2021, the City and Regional Water Board staff discussed the progress of the RO plant development and the requested Basin Plan amendment. The City decided to implement the advanced wastewater treatment system with RO based on the existing groundwater quality objective for chloride of 110 mg/L.

8. On July 9, 2015, the Regional Water Board adopted Resolution No. R15-007, an amendment to the Basin Plan that incorporated stakeholder-developed groundwater quality management plan for salts and nutrients in the Lower Santa Clara River groundwater basins. Groundwater quality management measures were developed by stakeholders as part of the Salt and Nutrient Management Plan (SNMP) for the Lower Santa Clara River Basins in Ventura County. Such plans are a requirement of the State Water Resources Control Board's (State Water Board) Recycled Water Policy and are intended to maintain high quality waters and to protect the beneficial uses of groundwater while promoting recycled water use throughout the state. The SNMP utilized a groundwater quality model that characterized the water quality in the Santa Paula Basin and examined the degree of impairment to water quality in the Basin. The model shows there is available assimilative capacity for salts and nutrients, including chloride, in most areas of the Santa Paula Basin to allow for recycled water projects consistent with the Recycled Water Policy. As described below, the City is planning to recycle effluent that is currently discharged to the percolation pond.

9. The City developed and utilized a simple spreadsheet mixing model, the *Groundwater Chloride Transportation Model* (Chloride Model), to analyze the effect of future effluent discharges on groundwater overtime at various distances from the percolation pond. The City's modeling assumed some degradation of groundwater with respect to chloride within a limited range of mixing zone radius below and adjacent to the SPWRF, measured from the boundaries of the percolation pond. This distance is the maximum allowable distance where SPWRF effluent disposed to the percolation pond can mix with groundwater and result in receiving water chloride concentrations of 110 mg/L or less in order to provide protection to groundwater beneficial uses at the first encountered water supply wells which are at 150 feet away from the percolation ponds. Groundwater within the mixing zone will exceed the chloride groundwater quality objective (GQO) of 110 mg/L. Mass-volume balance calculations along with Darcy's Law are used to account for travel in porous media. The Chloride Model simulates instantaneous and complete mixing of ambient groundwater with effluent seepage reaching the water table from the percolation pond using SPWRF data for flow and chloride effluent concentrations. It was conservatively assumed that any effluent discharge to the percolation pond would infiltrate into the underlying aquifer and not be diverted for other uses. Groundwater parameters within the spreadsheet model were selected based on recent monitoring reports in order to be representative of average conditions within the vicinity of the

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SPWRF. The Chloride Model assumes an initial volume of groundwater underlying the ponds possessing background chloride concentrations of 136 mg/L. The volume of the existing groundwater body is calculated as the product of the radius of interest (150-1200 feet), an assumed saturated thickness of potentially impacted groundwater (50 feet), and the porosity of the underlying sediments (assumed to be 0.2) based on the low end of published literature values for a sand and gravel mixture. Based on the regional groundwater quality data documented in the SNMP, regional groundwater inflow is assumed to have a chloride concentration of 91 mg/L.

On December 14, 2016, Regional Water Board staff met with the City to discuss the results of the Chloride Model, which evaluated compliance with the groundwater quality objectives beneath and adjacent to the three percolation ponds, for various discharge scenarios. Based on Regional Water Board staff's comments, the City implemented additional discharge scenarios in the Chloride Model, which was discussed in meetings held on February 8, 2017, February 17, 2017, July 24, 2017, and August 7, 2017.

10. The Chloride Model simulated chloride concentrations in the receiving groundwater resulting from chloride mass loading reduction in the three percolation ponds. The Model predicted GQOs being achieved at 150 feet away from the percolation pond when the total mass of chloride in the effluent is significantly reduced. The initial mass of chloride is calculated based on the average chloride effluent concentration of 135 mg/L and the discharge rate of 2.2 MGD, which results in 2,479 pounds total mass of chloride discharged per day. The reduction of chloride mass discharged to the percolation pond can be achieved by improving the effluent chloride concentration (e.g., source control or treatment), or diverting a significant amount of flow for recycled water uses, or a combination of both in order to protect water supply wells AW01, AW02, and AW03, approximately 150, 150, and 300 feet, respectively, away from percolation pond. Water produced from these wells is primarily for agricultural irrigation use.

    To achieve the chloride GQO of 110 mg/L in groundwater at least 150 feet away from the percolation pond, the City provided various effluent chloride concentrations and allowable flow combinations (Table 2). Based on the hydrology and hydrogeologic condition at the SPWRF percolation ponds area, the higher the concentration of chloride in the effluent, the less volume and mass can be discharged to percolation ponds to comply with the chloride GQO in the Basin Plan. For example, if the chloride concentration in the effluent is 135 mg/L, only 0.07 MGD, which is equivalent to 79 pounds of chloride per day, could be discharged to the percolation pond to achieve the chloride GQO of 110 mg/L at 150 feet away from the percolation pond. If the chloride concentration in the effluent is reduced to 120 mg/L, then more flow (0.2 MGD) can be discharged to the percolation pond and achieve the chloride GQO 150 feet away from the percolation pond.

Table 2. Groundwater Chloride Transportation Model – Continuous Discharge

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Chloride Effluent Concentration	Flow to Percolation Ponds (% of 2.2 MGD)	Allowable Effluent Mass Load to Groundwater (Daily)	Chloride Groundwater Concentration at 150 feet
135 mg/L	0.07 MGD (3.2%)	79 pounds (lbs)	110 mg/L
130 mg/L	0.1 MGD (4.5%)	108 lbs	110 mg/L
125 mg/L	0.13 MGD (5.9%)	135 lbs	110 mg/L
120 mg/L	0.2 MGD (9.1%)	200 lbs	110 mg/L
115 mg/L	0.4 MGD (18.2%)	384 lbs	110 mg/L

11. To achieve compliance with the chloride GQO and to conserve potable water, the City will construct the advanced wastewater treatment system with RO as proposed in the April 15, 2020 letter. The Regional Board has evaluated the proposed RO system and determined that it will be consistent with the State Water Board's Recycled Water Policy and will preserve available assimilative capacity within the Santa Paula Basin consistent with the SNMP. The mass-based effluent limitation for chloride previously established in the WDRs will no longer be applicable, but the concentration-based effluent limitation for chloride is appropriate after implementing the RO system. The groundwater limitations are based on the GQOs in the Basin Plan.

12. On December 22, 2015, the City submitted the Recycled Water Program Technical Report and Notice of Intent with the Title 22 Engineering Report to the State Water Board's Division of Drinking Water (DOW) for approval. DOW conditionally approved the Title 22 Engineering Report on August 19, 2016. On June 14, 2017, the Regional Water Board enrolled the City's recycled water program under separate Water Reclamation Requirements for Recycled Water Use Order WQ 2016-0068-DDW, issued by the State Water Board on June 7, 2016.

    In March 2020, the City decided to upgrade the SPWRF with the RO process to reduce the chloride concentrations in the effluent to meet the permit requirements. In December 2021, the City stated that the RO system would be able to produce 110 mg/L of chloride in the effluent to meet the groundwater quality objective in the Basin Plan. Currently, the City has completed the State Water Board Clean Water State Revolving Fund application with the State Water Board Division of Financial Assistance. The City plans to complete construction of the RO system within two years of receiving the Final Funding Agreement but no later than December 2024.

13. In the City's report, *Chloride Load Reduction Milestones,* submitted to the Regional Water Board on March 14, 2017, the City included the construction of reverse osmosis treatment at the SPWRF as an option (under Supplemental Strategies), if needed, in order to comply with the chloride groundwater quality objective of 110 mg/L. The City will continue its source control efforts to remove SRWSs and will first focus on recycling most of its effluent in order to bring the groundwater back into

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compliance with GQOs. Progress with these efforts will be assessed at Year 2022 and determination will be made as to whether advanced treatment will be required to meet the chloride GQO at Year 2027. If advanced treatment is required, effluent limits will be applied in a way to ensure protection of all beneficial uses, including salt-sensitive crops.

In March 2020, the City decided to upgrade the SPWRF with an advanced treatment system, including RO, to reduce the chloride concentrations in the effluent to meet the permit requirements. In December 2021, the City stated that the RO system would be able to produce effluent with a chloride concentration of 110 mg/L to meet the groundwater quality objective in the Basin Plan. The City has submitted a State Water Board Clean Water State Revolving Fund application with the State Water Board Division of Financial Assistance. The City plans to complete construction of the RO system within two years of receiving the Final Funding Agreement but no later than December 2024.

14. Due to the following reasons, the City cannot immediately comply with the chloride effluent and groundwater limitations prescribed in this Order: (1) elevated chloride concentrations in the influent, (2) the wastewater treatment process not currently designed to remove chloride out of the waste stream, and (3) time needed to construct the advanced wastewater treatment system with RO. In addition, the current progress of the City's SRWS Buyback Program does not reliably ensure that the SPWRF will comply with the chloride effluent and groundwater limitations. Therefore, the Regional Board has determined that issuance of an accompanying CDO is appropriate and necessary to put the City on the path towards compliance with the effluent and groundwater limitations for chloride set forth in this Order. The CDO requires the City to comply with interim chloride effluent and groundwater limitations and implement actions pursuant to a prescribed time schedule.

    During the pendency of the CDO schedule, there will be permitted degradation of groundwater with respect to chloride within a limited mixing zone radius downgradient and adjacent to the SPWRF percolation ponds, measured from the boundaries of the percolation ponds to 150 feet. This distance is the shortest distance where SPWRF effluent disposed to the percolation pond can mix with groundwater and result in receiving water chloride concentrations of 110 mg/L or less. Groundwater within the 150-foot mixing zone will exceed the chloride GQO of 110 mg/L for the duration of the CDO schedule. Based on the available data, there are no water supply wells within the 150-foot mixing zone. The City can arrange for alternative water supplies for any well owners in the mixing zone, if any are discovered. At the end of the CDO schedule, the mixing zone is no longer allowed, and compliance with the chloride limitation of 110 mg/L at monitoring wells adjacent to and downgradient from the boundaries of the percolation ponds is required.

15. California Water Code (CWC) section 13301 provides in pertinent part "When a regional board finds that a discharge of waste is taking place, or threatening to take place, in violation of requirements or discharge prohibitions prescribed by the regional board or the state board, the board may issue an order to cease and desist

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and direct that those persons not complying with the requirements or discharge prohibitions (a) comply forthwith, (b) comply in accordance with a time schedule set by the board, or (c) in the event of a threatened violation, take appropriate remedial or preventive action ... Cease and desist orders may be issued directly by a board, after notice and hearing."

16. As a result of the historical monitoring data and other activities described in this CDO, the Regional Water Board finds that a discharge of waste is taking place or threatening to take place in violation of requirements or discharge prohibitions prescribed by the Regional Water Board in the City's WDRs, Order No. R4-2018-0022. This CDO requires the City to take appropriate remedial action and to comply in accordance with the time schedule set forth below. The compliance schedules provide the City sufficient time to achieve compliance with the chloride requirements in its WDRs.

17. This Order includes interim effluent and groundwater limitations, identified below, and actions and milestones proposed by the City leading to compliance with the effluent and groundwater limitations for chloride. The interim effluent and groundwater limitations are based on gradual reductions in chloride mass loading. The established compliance schedule is as short as possible, taking into account the technological, operation, and economic factors that affect the design, development, and implementation of the remedial actions that are necessary to comply with the effluent and groundwater limitations.

18. A CDO is appropriate in these circumstances to allow time for the City to implement the advanced wastewater treatment system to bring the SPWRF into compliance with the effluent and groundwater limitations. The temporary exceedances allowed by this CDO are in the public interest given the significant environmental benefits associated with reducing chloride loading to groundwater to promptly achieve compliance with the effluent and groundwater limitations, and to allow for potential recycled water use throughout the City of Santa Paula, especially in light of California's historic drought and predictions for future climatological effects from climate change.

19. CWC section 13267 provides in pertinent part:

    (a) A regional board, in establishing or reviewing any water quality control plan or waste discharge requirements, or in connection with any action relating to any plan or requirement or authorized by this division, may investigate the quality of any waters of the state within its region.

    (b)(1) In conducting an investigation specified in subdivision (a). the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region ... shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the

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report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports.

20. The technical and/or monitoring reports required by this CDO are necessary to assure compliance with the WDRs Order No. R4-2018-0022 and this CDO. The City operates the SPWRF that produces and discharges the waste subject to WDRs. The actions and reports required by this CDO are directly related to the City's compliance with these requirements and do not require expense that is not already required pursuant to the WDRs. This CDO provides time for the City to comply and to spread costs over several years. The burden of these actions and reports bears a reasonable relationship to the need for the actions and reports.

21. This CDO concerns an existing facility and does not significantly alter the status with respect to the SPWRF. The issuance of this Order is an enforcement action by a regulatory agency and is being taken for the protection of the environment. Therefore, issuance of this Order is exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21100, et seq.) in accordance with sections 15061(b)(3), 15301, 15306, 15307, 15308, and 15321 (a)(2) of Title 14 of the California Code of Regulations.

22. The Regional Water Board has notified the City and interested agencies and persons of its intent to issue this CDO concerning compliance with the WDRs. The Regional Water Board accepted written comments, and heard and considered all comments and evidence pertaining to this matter in a public hearing.

23. Any person aggrieved by this action of the Regional Water Board may petition the State Water Board to review the action in accordance with California Water Code section 13320 and California Code of Regulations, title 23, sections 2050 and following. The State Water Board must *receive* the petition by 5:00 p.m., 30 days after the date of this Order, except that if the thirtieth day following the date of this Order falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day. Copies of the law and regulations applicable to filing petitions may be found on the Internet at Water Quality Petitions | California State Water Resources Control Board (http://www.waterboards.ca.gov/public_notices/petitions/water_quality) or will be provided upon request.

THEREFORE, IT IS HEREBY ORDERED that, pursuant to California Water Code sections 13301 and 13267, the City of Santa Paula, as owner of the SPWRF, shall comply with the following measures to ensure compliance with Order No. R4-2018-0022:

1. Cease and desist discharging chloride in violation or threatened violation of Order No. R4-2018-0022. No term or condition of Order No. R4-2018-0022 is superseded or stayed by this CDO.

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2. The discharge of treated wastewater from the SPWRF shall not cause the exceedance of the following groundwater limitations in Table 3 below. Comply immediately with the interim effluent and groundwater limitations for chloride prescribed in Table 3 below, and in accordance with the following schedule.

Table 3. Interim Chloride Limitations

Effluent Limitation (Monthly Average)[0]	Mass Reduction	Groundwater Limitation (Monthly Average)	Deadline
2,479 lbs/day[1]	0%	136 mg/L[2]	February 8, 2018
2,231 lbs/day[1]	10%	136 mg/L[2]	February 8, 2020
1,983 lbs/day[1]	20%	136 mg/L[2]	February 8, 2021
1,983 lbs/day[5][6]	20%	136 mg/L[2]	July 1, 2022
110 mg/L[3]	Not applicable	129 mg/L[4]	March 30, 2025
110 mg/L[3]	Not applicable	114 mg/L[4]	February 8, 2027

Table 3 notes:

[0] Monthly Average except as noted.

[1] Based on the City's *Chloride Load Reduction Milestones* dated August 8, 2017.

[2] Based on the 95th percentile of chloride effluent concentrations during the implementation of the SRWS Buyback Program from October 2015 to September 2017.

[3] The concentration-based effluent limitation is based on the groundwater quality objective in the Santa Paula Groundwater Basin-West of Peck Road Subbasin. The deadline considers the date of December 30, 2024 for completion of construction of the reverse osmosis unit and a 90-day optimization period.

[4] The change in the groundwater concentration is not expected to be immediate.

[5] Based on paragraph No. 4.D, the City cannot consistently comply with the effluent limitation on a monthly basis due to a lack of flow control measures that would have been in place with the recycled water project.

[6] Compliance with the effluent limitation is based on an annual monthly running average. For example, to meet the July 1, 2022 compliance date, the monthly average from July 2021 to June 2022 must be no greater than 1,983 lbs/day.

3. Comply with the following remedial actions and milestones according to the time schedule below:

A. By **May 1, 2018,** the City shall submit a technical report evaluating the long-term effectiveness of the SRWS Buyback Program for the reduction of chloride concentration in the SPWRF's effluent and the groundwater.

B. By **August 1, 2018,** the City shall submit a *Groundwater Chloride Investigation and Well Protection Workplan* (with schedules and milestones) for the Executive Officer's review and approval. The City shall implement this

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Workplan within 120 days from the Executive Officer's approval. The Workplan shall:

i. Identify the names/numbers and locations of the groundwater monitoring wells to determine site-specific groundwater flow direction and gradient for the purposes of adequately assessing any impacts of chloride discharges to the quality of the receiving groundwater;

ii. Identify all water supply wells that may be influenced by the discharge of chloride from the SPWRF, the well structures, ownership and associated groundwater quality; and

iii. Include an approach to ensure that groundwater quality influenced by the discharge of chloride from the SPWRF and delivered from agricultural water supply wells to irrigate salt-sensitive crops be no higher than 117 mg/L. Alternatively, the City may voluntarily provide alternative water supplies to private well owners to irrigate salt-sensitive crops, upon request by the well owners.

C. By **March 15, 2022,** the City shall submit the final design report for the advanced treatment system at the SPWRF, including brine concentration facility and brine management plan.

D. By **October 15, 2022,** the City shall complete all necessary regulatory requirements, including compliance with the California Environmental Quality Act (CEQA), and obtain all necessary permits for construction and/or installation of the advanced treatment system.

E. **Within three months** of receiving the Final Funding Agreement from the Department of Financial Assistance, but no later than **March 30, 2023**, the City shall complete and release a Bid Package for the advanced wastewater treatment system with a reverse osmosis process.

F. No later than **June 30, 2023**, the City shall complete contractor selection and award the contract for construction of the advanced wastewater treatment system with a reverse osmosis process.

G. **Within twenty-four months** of receiving the Final Funding Agreement from the Department of Financial Assistance, but no later than **December 30, 2024**, the City shall complete construction and start-up of the advanced wastewater treatment system with a reverse osmosis process.

H. As soon as possible, but no later than **February 8, 2028,** the City shall achieve full compliance with the effluent and groundwater limitations for chloride prescribed in Order No. R4-2018-0022.

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I. After each date listed in subsection A through G above, the City shall provide a verbal report at the next regularly scheduled Board meeting pertaining to the compliance, or lack thereof, with the requirement.

J. Subsections F and G, above, do not limit the City's ability to propose a Basin Plan amendment for Regional Water Board consideration prior to November 14, 2024. At any time during the term of this CDO, the City may propose a Basin Plan amendment that the Regional Water Board will consider, including an averaging period and/or a site-specific chloride GQO that protects beneficial uses. As with subsection G, the City shall include supporting scientific and technical information and analysis demonstrating that beneficial uses would be protected, as well as documentation that such a proposal was discussed in detail by a stakeholder working group.

4. Submit quarterly progress reports on the status of the City's compliance with the effluent and groundwater limitations for chloride in Order No. R4-2018-0022 and this CDO.

A. Each quarterly progress report shall include, but is not limited to:

i. Continuous SRWS Buyback Program Assessment - The City shall report its progress on the SRWS Buyback Program and evaluate whether the Program is resulting in chloride reductions in the effluent and groundwater.

ii. Groundwater and Well Protection Program - The City shall report its progress on implementing the Groundwater Chloride Investigation and Well Protection Workplan, including the actions taken to protect water supply wells influenced by the discharge of chloride from the SPWRF.

iii. Alternative Effluent Chloride Mitigation Implementation - The City shall provide the progress of implementing the alternative effluent chloride mitigation workplan and evaluate the compliance with the schedule and milestones set forth in the CDO and WDRs.

B. Quarterly progress reports shall be *received* by the Regional Water Board by the 30th day of the month following the end of each quarterly monitoring period according to Table 4 below. The first report is due by April 30, 2018.

Table 4. Reporting Period and Due

Quarterly Report	Reporting Period	Report Due
First Quarter	January – March	April 30
Second Quarter	April – June	July 30
Third Quarter	July – September	October 30

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Quarterly Report	Reporting Period	Report Due
Fourth Quarter	October – December	January 30
Annual	January – December	April 30

Table 4 notes if a deadline falls on a Saturday, Sunday, or State holiday, the report must be received by the next business day.

5. Any person signing a document submitted under this CDO shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

6. In accordance with California Business and Professions Code sections 6735, 7835, and 7835.1, engineering and geologic evaluations and judgments shall be performed by or under the direction of registered professionals competent and proficient in the fields pertinent to the required activities. All technical reports specified herein that contain work plans for, that describe the conduct of investigations and studies, or that contain technical conclusions and recommendations concerning engineering and geology shall be prepared by or under the direction of appropriately qualified professional(s), even if not explicitly stated. Each technical report submitted by the City shall contain the professional's signature and/or stamp of the seal.

7. The City shall submit all reports required under this CDO, including groundwater monitoring data in Electronic Data Format, well and discharge location data, and searchable Portable Document Format (PDF) of reports and correspondence, to the State Water Board's GeoTracker database under Global ID WDR100000849.

8. If the City fails to comply with any provision of this CDO, the Regional Water Board may take any further action authorized by law. The Executive Officer, or his/her delegee, may take appropriate administrative enforcement action pursuant, but not limited to, California Water Code sections 13268 and/or 13350. The Regional Water Board may also refer any violations to the Attorney General for judicial enforcement, including injunction and civil monetary remedies.

9. This CDO may be reopened at the Regional Water Board's discretion to consider limits or other requirements for the SPWRF and may specifically be reopened to make revisions consistent with the City's efforts to reduce chloride discharge from the SPWRF.

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10. This Order becomes effective immediately upon issuance.

I, Renee Purdy, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Los Angeles Region, on May 12, 2022.

Renee Purdy
Executive Officer

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Appendix D – Trussel Technologies, Inc., Evaluation of Biological Design and Process Sizing Technical Memorandum

Technical Memorandum

City of Santa Paula Water Recycling Facility
Design, Build, Operate, Finance

Date: 6 January 2008
Revised: 25 January 2008

Authors: R. Shane Trussell, Ph.D., P.E.
Joanne Chiu

Subject: Evaluation of Biological Design and Process Sizing

OBJECTIVE OF THIS MEMORANDUM

The purpose of this document is to evaluate the biological design and determine process equipment sizing using process simulation software. The process will be evaluated at the design capacity, at the current wastewater flows, and solids stabilization and handling will also be assessed. In addition, process aeration demands will be determined and recommendations for maintaining a healthy biology through careful process design will also be discussed.

DESCRIPTION OF EVALUATION PROCEDURE

The City of Santa Paula has selected the membrane bioreactor (MBR) technology to serve as the principle wastewater treatment process for this Water Reclamation Facility (WRF). An MBR is a biological process that combines secondary and tertiary treatment using low-pressure membrane filtration. Because membranes are used to provide the necessary solids-liquid separation, MBR effluent is consistently high quality with low turbidity, low chemical oxygen demand (COD), and non-detect total suspended solids (TSS), making it suitable for feeding directly into an RO process (if required in the future). However, using membranes for solids-liquid separation also means that the biological design requires careful consideration. MBRs are a perfect trap for filamentous bacteria that float and cause biological foaming events. MBRs are also operated at 2 to 4 times the mixed liquor suspended solids (MLSS) concentration compared to conventional activated sludge processes, which means that special attention must be paid to the aeration design. Finally, MBRs have especially high dissolved oxygen (DO) concentrations in the membrane tanks and this fact,

accompanied with required high rates of mixed liquor circulation, means that caution must be exercised to ensure that intended anoxic zones remain anoxic.

Biological modeling simulations were performed using GPS-X process simulator. GPS-X is a modular, multi-purpose modeling environment for the simulation of municipal and industrial wastewater treatment plants (GPS-X Technical Reference, Chapter 3). GPS-X from Hydromantis is similar to BIOWIN or other wastewater models.

INFLUENT DESIGN CRITERIA

The flow information and annual average influent wastewater characteristics presented in Table 1 and Table 2 were obtained from the Request For Proposal (RFP), Appendix B – Performance Specification, from the City of Santa Paula for a new Water Recycling Facility (WRF).

Table 1. Design influent wastewater flows

Flow	*Unit*	*2005*	*2015*
Average Annual Influent Flow	MGD	2.5	3.4
Peak Day Flow	MGD	6.3	7.2
Peak Hour (8 hours) Flow	MGD	-	10.4

Table 2. Raw influent wastewater characteristics

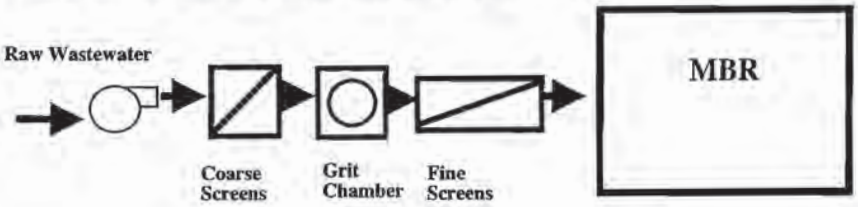
Parameters	*Unit*	*Raw Influent*
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD)	mg/L	320
Chemical Oxygen Demand (COD)	mg/L	736
Total Kjeldahl Nitrogen (TKN)	mg/L	53
Ammonia (NH_3)	mg/L	32
Total Suspended Solid (TSS)	mg/L	210
Alkalinity (as $CaCO_3$)	mg/L	300

However, screened influent wastewater characteristics presented in Table 3 were used for the described modeling efforts. This is because the changes in wastewater properties through the screening process generally reduce the ratio of BOD/TKN, which will have an important impact on a biological design for nitrogen removal. Additionally, all MBR manufacturers require fine screening of influent wastewater to protect the membranes from physical damage. For this design, the headworks consists of three steps (see Figure 1):

1) coarse bar screens (6 mm),
2) circular grit chambers,
3) Huber Rotomat fine drum screens (2 mm)

The headworks are one of the most common "headaches" associated with operating an MBR facility. With this in mind, this facility is designed with 2 gross solids removal processes ahead of the fine screens to reduce the loading to the fine screens. Additionally, all of these headwork process units are oversized to reduce the frequency of required maintenance and ensure consistent performance. The coarse bar screens and grit chamber have a rated capacity of 17 MGD and the fine screens have a rated capacity of 10.4 MGD when treating raw wastewater. A decision was made not to use 1 mm fine screens because of their increased susceptibility to blinding and the additional unwanted screenings produced by these units. Even though 1 mm fine screens may provide additional protection for the membranes, both membrane manufacturers considered in this design (Koch Puron and GE/Zenon) allow 2 mm fine screens.

Figure 1. Physical treatment flow schematic



Based on the specifications provided by Huber Technologies, a 5% to 10% COD reduction and 20% to 40% suspended solid reduction can be achieved in a single step, 1 mm fine screening process of raw wastewater. As a result, it is reasonable to assume a 10% loading reduction of COD, BOD, TKN-organic nitrogen, and TSS could be achieved through the 3-step physical removal process described above. Screened influent wastewater characteristics are summarized in Table 3.

Table 3. Design screened influent wastewater characteristics

Influent Parameters	*Unit*	*Screened Influent*
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD)	mg/L	288
Chemical Oxygen Demand (COD)	mg/L	662
Total Kjeldahl Nitrogen (TKN)	mg/L	51
Ammonia (NH_3)	mg/L	32
Total Suspended Solid (TSS)	mg/L	189
Alkalinity (as $CaCO_3$)	mg/L	300

The peak day flow was used to evaluate the adequacy of the biological sizing of this facility. The peak day flow was estimated in the RFP based on the additional 3.8 MG of inflow volume from a 100-year storm to the annual average flow. It is appropriate to assume that the additional 3.8 MG of wet weather flow contains low organics and solids concentrations and will thus have a limited impact on the

influent loadings of organics and solids as lbs per day. However, to ensure a robust biological process design, the loadings of TSS, BOD, COD, and TKN were all increased by 20% to represent the peak day influent wastewater loads, as detailed in Table 4.

Table 4. Average and peak day influent loads

Influent Parameters	*Unit*	*3.4 MGD*	*7.2 MGD*
TSS	1000 lb/day	5.4	6.4
BOD	1000 lb/day	8.2	9.8
TKN	1000 lb/day	1.4	1.7
COD	1000 lb/day	18.8	22.6

As a result of the 20% safety factor that was applied to the peak day loads, the peak day influent wastewater concentrations need to be estimated and are presented in Table 5.

Table 5. Design peak day influent organic wastewater characteristics

Influent Parameters	*Unit*	*Values*
Flow	MGD	7.2
TSS	mg/L	107
BOD	mg/L	163
TKN	mg/L	28.8
COD	mg/L	375
Min Design Temperature	°C	19

The influent fractions and coefficients presented in Table 6 were adjusted from the GPS-X default values to accommodate the wastewater characteristics presented in Tables 3 and 5. These adjustments were made using an "Influent Advisor" which was developed by Hydromantis to help users better understand the influent water quality characteristics and to avoid assumption errors.

Table 6. Influent wastewater fractions and coefficients

Fractions/Coefficients	*Default Value*	*Value Used*
xCOD/VSS Ratio	2.20	3.0 - 3.4
VSS/TSS Ratio	0.60	0.785
Ammonia/TKN Ratio	0.65	0.63

EFFLUENT DESIGN CRITERIA

Since the MBR process produces non-detect TSS and low COD water for a wide-range of operating conditions (Merlo et al., 2007), the MBR sizing was controlled by the effluent nitrogen limits that the City is required to meet in its *Waste Discharge Requirements ORDER NO. R4-2007- 0028*. The monthly, or 30-day,

average nitrate + nitrite as nitrogen concentration of 5 mg/L must be achieved through the WRF. For this design, a safety factor of 20% was applied that produced a performance target of nitrate+nitrite as nitrogen of 4 mg/L (Table 7).

Table 7. WRF Required Effluent Limits and Performance Targets

Constituent	*Unit*	*Effluent Limit*	*Performance Target*
Nitrate + Nitrite as nitrogen	mg/L	5	< 4

PROCESS DESIGN CRITERIA

The following table presents the proposed process tank sizes provided by the PERC team for this MBR design. Approximately one quarter of the biological reactor volume will be used as a dedicated anoxic zone for denitrification. Different from the Kennedy/Jenks design, the second anoxic zone was eliminated as biological modeling (results presented in upcoming sections) demonstrated that this was not needed. Additionally, there were significant concerns expressed by the project team about having an anoxic zone just prior to the membrane separation tank in an MBR. This is because increased rates of membrane fouling have been attributed to anoxic sludge conditions (Jang et al., 2006).

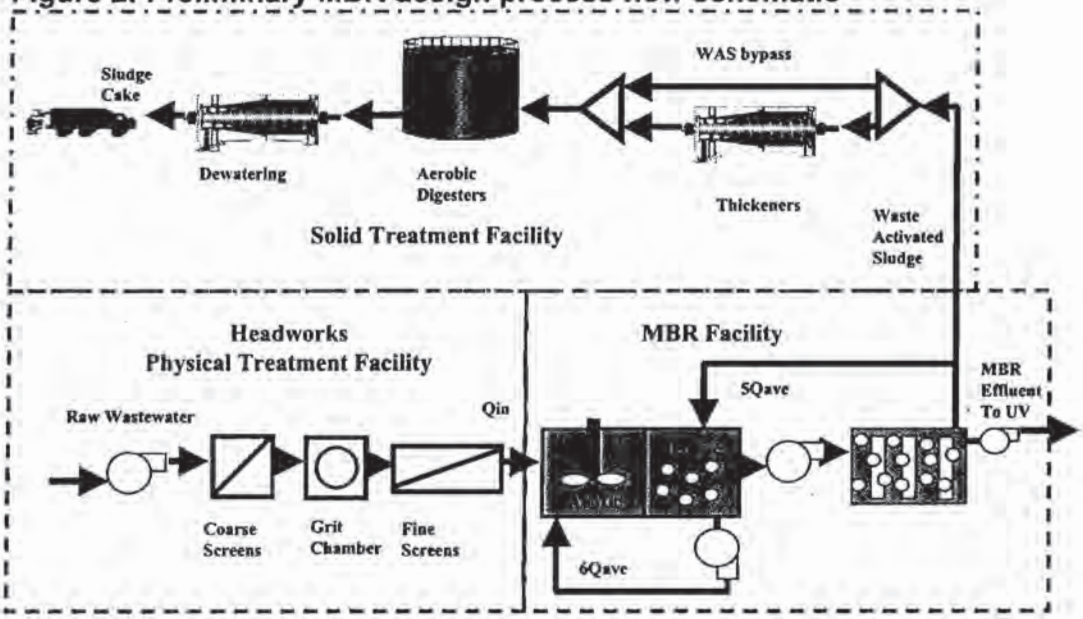
Table 8. Preliminary tank design operating volumes

MBR VOLUME DISTRIBUTION	*Size, cu.ft*	*%*	*Size, gal*
Anoxic Volume	71,205	26.7	532,650
Aerobic Volume	180,428	67.7	1,349,700
Membrane Tank Volume	15,039	5.6	112,500
Total Operating Reactor Volume	*266,672*	*100*	*1,994,850*

Process Flow Schematic

A process flow diagram for the MBR process is presented in Figure 2. The screened raw wastewater first flows into the anoxic zone, then to the aerobic zone, and continues to the membrane tank. Nitrified mixed liquor is recirculated (internal recycle) at a rate of 20.4 MGD (6 Q_{ave}) from the end of the aerobic zone to the head of the anoxic zone to provide nitrate and biomass for denitrification. Additionally, 17 MGD (5 Q_{ave}) of return activated sludge (RAS) is returned from the membrane tank to the head of the aerobic zone to prevent excessive solids concentrations from occurring in the membrane tank. For the peak day flow, the RAS rate will be increased to 30 MGD.

Figure 2: Preliminary MBR design process flow schematic



BIOLOGICAL MODELING RESULTS FOR THE DESIGN FLOWS

Based on the design criteria presented in previous sections, modeling simulations were performed. A solids residence time (SRT) of 14.7 d was determined for the predicted average flow of 3.4 MGD and 14.0 d for the peak day flow of 7.2 MGD. An SRT of more than 14 d ensures that nitrification will be stable and helps to minimize membrane fouling (Trussell et al., 2006). The MLSS concentrations and operational parameters are summarized in Table 9.

Table 9. Biological process control and MLSS concentration

Process Control Parameters	*Units*	*3.4 MGD*	*7.2 MGD*
F/M	gCOD/gMLSS.d	0.07	0.08
Wasting Rate	MGD	0.11	0.11
SRT	d	14.7	13.8
Internal Recycle Rate	MGD	20.4	20.4
RAS Rate	MGD	17	30
MLSS Concentrations			
Anoxic Zone	g/L	5.7	5.3
Aerobic Zone	g/L	6.6	7.1
Membrane Tank	g/L	7.9	8.8

With a total reactor volume of 1,994,850 gal, the hydraulic retention time (HRT) is 14.1 h for the average annual flow and 6.6 h for the peak day flow. The filtrate water quality for the annual average and peak day flows is listed in Table 10. Effluent TSS and BOD are essentially non-detect. Also, the total nitrate + nitrite as nitrogen concentration meets the effluent design target value in Table 7.

Table 10. Filtrate water quality

Filtrate Qualities	*3.4 MGD*	*7.2 MGD*
TSS, mg/L	0.8	0.9
COD, mg/L	33.0	33.0
BOD, mg/L	1.2	1.3
Total Nitrogen, mg/L	6.2	6.1
TKN, mg/L	3.1	3.0
NH_3-N, mg/L	0.10	0.11
$NO3^-$+$NO2^-$, mg/L	3.1	3.0

BIOLOGICAL MODELING RESULTS FOR THE CURRENT FLOW

Based on the design volumes presented in Table 8, biological modeling was performed with one aeration train offline (of the total 3 trains) and two membrane tanks offline (of the total 6 tanks) for the historical flow of 2.5 MGD. A solids residence time (SRT) of 14.2 d was determined. The mixed liquor suspended solids (MLSS) concentrations and process control parameters are summarized in Table 11 and the simulated filtrate water quality is listed in Table 12.

Table 11. Biological process control and MLSS concentration

Process Control Parameters	*Units*	*2.5 MGD*
F/M	gCOD/gMLSS.d	0.08
Wasting Rate	MGD	0.075
SRT	d	14.2
Internal Recycle Rate	MGD	20.4
RAS Rate	MGD	17
MLSS Concentrations		
Anoxic Zone	g/L	6.7
Aerobic Zone	g/L	7.5
Membrane Tank	g/L	8.6

Table 12. Filtrate water quality

Filtrate Qualities	*2.5 MGD*
TSS, mg/L	0.9
COD, mg/L	33.0
BOD, mg/L	1.3
Total Nitrogen, mg/L	5.6
TKN, mg/L	3.0
NH_3-N, mg/L	0.14
$NO3^-$+$NO2^-$, mg/L	2.5

With a total in-service reactor volume of 1,329,900 gal, the hydraulic retention time (HRT) is 12.8 h. Effluent TSS and BOD are essentially non-detect. Total nitrate+nitrite as nitrogen concentration also meets the effluent design target value in Table 7. As a result, it is concluded that one aeration train and two membrane tanks can be used as standby under the current flow conditions.

BIOLOGICAL AERATION DESIGN

The adequacy of an aeration system to provide necessary oxygen to the biology is a common concern of process design engineers with any biological process, but is of special concern with the MBR process. In the early days of MBR design, aeration systems were often inadequate for maintaining appropriate dissolved oxygen levels. For this MBR design, the required airflow rates to maintain the aerobic zones at dissolved oxygen (DO) concentrations of 2 mg/L were determined using an alpha-factor of 0.45 (justification for this selected alpha factor is discussed further in the next section) and a standard oxygen transfer efficiency (SOTE) of 30 percent for the membrane aeration panels. The SOTE of 30 percent is conservative for the membrane aeration panels used in this design and is representative of fouled aeration panels. The aeration panel manufacturer claims SOTEs as high as 40 percent for new panels. Using these established design criteria, the required airflow rates were determined for the aerobic zone and are presented in Table 13 for the annual average and peak day flows.

Table 13. Design criteria and resulting airflows for fine bubble diffusers

Parameter	*2.5 MGD*	*3.4 MGD*	*7.2 MGD*
α, --	0.45	0.45	0.45
SOTE, %	30	30	30
Air Flow Rate, scfm	2969	3703	4385

α-FACTOR AND IMPORTANCE OF MLSS IN MBR AERATION DESIGNS

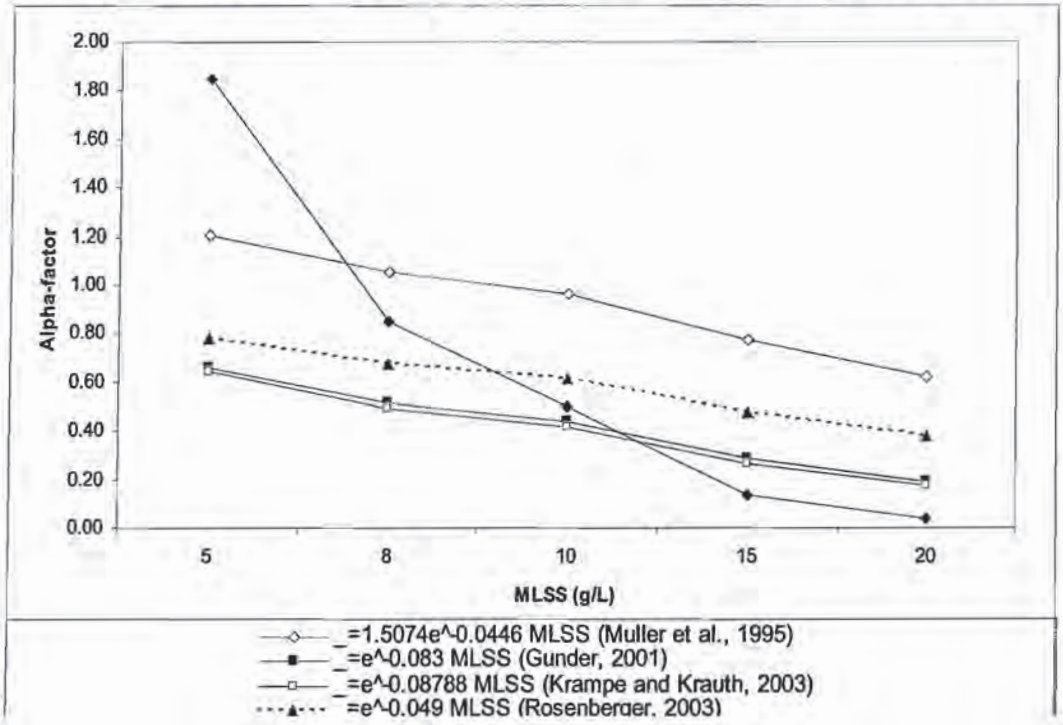
The α-factor is an oxygen transfer correction factor used to estimate the K_La value (i.e. mass transfer coefficient) in the actual process system (Metcalf & Eddy, 2003) and the *oxygen transfer rate* is directly proportional to the K_La value (ASCE & WEF, 2001):

$$\alpha \text{ - factor} = \frac{K_L a \text{ (process water)}}{K_L a \text{ (clean water)}}$$

Values of α-factor vary with the type of aeration devices, the basin geometry, the degree of mixing, and the wastewater characteristics (Metcalf & Eddy, 2003). A study of a ceramic disc grid system operating in a conventional activated-sludge basin found variations in α-factor from 0.2 when the flow first entered into the aeration tank to 0.55 after the flow had traveled a tank length of 280 ft (ASCE & WEF, 2001). Another study of flexible membrane diffusers installed in a plug-flow aeration system that was not nitrifying, found that the apparent α-factor increase from 0.27 at the aeration tank inlet to 0.42 in the effluent outlet (ASCE &

WEF, 2001). In the membrane bioreactor (MBR) process, additional attention needs to be given to the design of the aeration system due to the increased MLSS concentrations at which MBRs operate compared to conventional processes. This is a classic problem with pioneer MBR facilities (e.g. inadequate dissolved oxygen concentrations) and is still something that requires careful consideration by MBR design engineers today. In fact, the *oxygen transfer rate* is lower at a given airflow rate for the same aeration device in an MBR plant than in a conventional-activated sludge process due to the increased levels of MLSS (Muller et al., 1995; Krampe and Krauth, 2003). The α-factor and MLSS concentration correlation for MBR type sludge was first introduced in by Muller et al. (1995) and the results are shown in Figure 3. Several other studies have also reported an exponential correlation between α-factor and the MLSS concentration. These additional studies are also presented in Figure 3. The results show that an increase in the MLSS concentration leads to an exponential decrease in α-factor.

Figure 3 – Comparison of the correlations obtained between α-factor and MLSS concentration for several studies (adapted from Germain et al., 2007)



Although the length of the biological reactor is not known for the data presented in Figure 3, it is known that the α-factor increases as the flow proceeds along the biological reactor and this is an important consideration that provides additional support, other than the more obvious increased oxygen demand, to the concept of tapered aeration (e.g. higher air demand at the head of the reactor than at the end). For this MBR design, the project team has incorporated an aeration system

that will use multiple, redundant DO sensors, to determine aeration demands at various points along the aerobic zone with a target DO of 2 mg/L. To determine the required air flows for this MBR design, the PERC team has modeled the aeration device using an α-factor of 0.45, which provides more than a 10% safety factor from the observed α-factors presented in Figure 3 at the design MLSS concentration of 8 g/L.

MAJOR PROCESS EQUIPMENT SIZING

Based on the airflow rates presented in Table 13, the required minimum horse power for the aeration blowers have been calculated and are presented in Table 14. These blowers were sized based on the maximum horse power requirement, which occurred at the 7.2 MGD flow as presented in Table 15. The internal recycle rate and membrane RAS rate were used to size the internal recycle pumps and membrane RAS pumps. A 70% operational efficiency was applied in these equipment sizings.

Table 14. Operation process control rates

	Unit	*2.5 MGD*	*3.4 MGD*	*7.2 MGD*
Actual Required Air Flowrate	scfm	2969	3702	4385
Aeration Blowers, Required Min hp	hp/blower	45	55	65
Internal Recycle Rate	MGD	20.4	20.4	20.4
Membrane RAS Rate	MGD	17	17	30

Table 15. Operation energy loads and required equipment sizes

Equipments	*Duty*	*Standby*	*Total Quantity*	*hp/Ea*	*Total hp*	*Specs.*
Aeration Blowers	3	1	4	100	400	1470 SCFM @ 12 psi
Internal Recycle Pumps	3	1	4	4	16	4730 GPM @ 1.2 psi
Membrane RAS Pumps	3	1	4	27	108	6950 GPM @ 5.4 psi

CONTROL OF BIOLOGICAL FOAMING

MBRs provide a perfect trapping environment for filamentous bacteria that float and cause biological foaming (Trussell et al., 2006). This means that biological foaming is ubiquitous in MBR facilities. Biological foaming at an MBR facility is more than nuisance and can often result in undesired loss of biomass and increased membrane fouling rates. Since the entire process basin will be completely covered in this MBR design, the project team has included a sprayer system that will spray chlorinated MBR effluent over the biological reactor three to four times per day. This has proven to be a very effective means of controlling biological foaming in an MBR (Adham and Trussell, 2001) and essentially oxidizes bacteria that live on the surface, preventing them from establishing a large enough population to cause a biological foaming event.

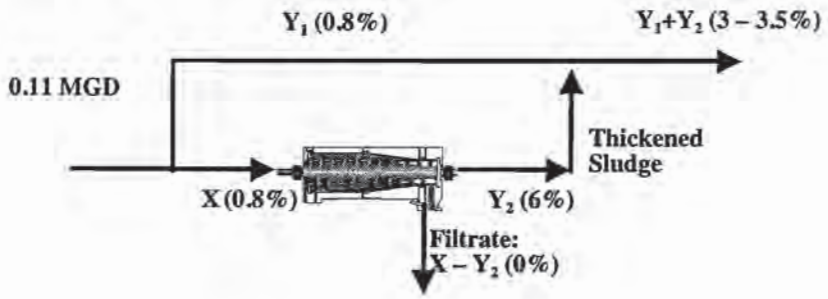
SOLIDS HANDLING

The solids stabilization process selected for this design is an aerobic digester (Figure 2). The target feed WAS solids concentration into the aerobic digesters is about 3 to 3.5%. Drum thickeners will be used to thicken the MBR WAS prior to feeding the solids into the aerobic digester and since the drum thickener will increase the solids concentration to 6 - 8%, about 89% of the WAS flow will be thickened and then combined with a WAS bypass flow stream to produce the target concentrations (details described in upcoming section on the Sludge Thickening Design). This aerobic digester has been designed to produce Class B biosolids. According to EPA Class B biosolids regulations, values for the mean cell residence time (MCRT) and temperature shall be greater than 40 days at 20˚C or greater than 60 days at 15˚C.

Sludge Thickening Design

Based on the GPS-X process simulation results, the waste activated sludge (WAS) production rate is about 0.11 MGD and the WAS solids concentration is approximately 0.8% for the design average flowrate of 3.4 MGD. The target solids concentration of sludge feed to the digesters is about 3 to 3.5%. Since the drum thickener will increase the solids concentration of the sludge feed to 6 - 8%, a portion of WAS will be fed to the drum thickener and the rest of the WAS will be bypassed; these streams will be combined to produce the target solids concentration of 3 to 3.5%. It is critical to determine the amount of WAS flow being fed to the drum thickener to determining the appropriate sizing and number of required sludge thickeners. Calculations are detailed below and Figure 4 is the sludge thickening flow diagram.

Figure 4: Sludge thickening flow schematics



Performing a flow balance on the WAS split flow point, we attain:

$Y_1 = 0.11 \text{ MGD} - X$ (1)

Performing a solids mass balance around the thickener gives:

$X\ (0.8\%) = Y_2\ (6\%) + (X-Y_2)\ (?\%)$ (2)

Where X is the WAS flow to the Drum Thickener, MGD
Y_1 is the bypass WAS, MGD
Y_2 is the thickened flowrate, MGD

Assuming a solids recovery of 100%, then the filtrate stream (e.g. $X-Y_2$) solids concentration is 0 % and equation 2 simplifies to:

$$X\ (0.8\%) = Y_2\ (6\%) \qquad (3)$$

The solids concentration of sludge feed can be calculated by equation 4.

$$(Y_1)\ (0.8\%) + Y_2\ (6\%) = (Y_1 + Y_2)\ (3 \text{ to } 3.5\%) \qquad (4)$$

For a 3% sludge feed, we can substitute equation 1 into equation 4 and we get:

$$(0.11 - X)\ (0.8\%) + Y_2\ (6\%) = (0.11 - X + Y_2)\ (3\%)$$

$$3Y_2 + 2.2\ X = 0.242$$

Substitute in equation 3, and we get:

$$3Y_2 + 2.2\ (7.5Y_2) = 0.242$$

$$Y_2 = 0.0124$$

and

$$X = 0.0931$$

Thus, X = 0.093 MGD or about 85% of the total WAS flow (e.g. 0.11 MGD) required to be thickened to produce a combined sludge feedflow with 3% solids content.

Following the same procedure for a 3.5% sludge feed concentration, we attain:

$$Y_2 = 0.0131$$

and

$$X = 0.0983$$

As a result, 0.098 MGD or about 89% of the total WAS flow required to be thickened to produce a combined sludge feedflow with 3.5% solids content.

For reference purposes, solids concentration of 2% and 4% are also being calculated as summarized in Table 16.

Table 16. Percentage of the total WAS flow required to be thickened to attain various feed sludge solids concentrations

	2%	3%	3.5%	4%
% of the total WAS flow	69%	85%	89%	92%

The thickening capacity of the drum thickener is sized based on the design upper limit solids concentration of 3.5%. Assume the wasting system operates 5 days a week for maximum of 8 hours per day, the required WAS pumping rate is 321 gpm. With the WAS solids concentration of 0.8%, the required solids pumping rate is 1610 lbs/hr. With 89% of the WAS flow feeding to the drum thickener, the required thickening capacity is 1433 lbs/hr. For a thickener operating at 860 lbs/hr, 2 units will be required.

Current Regulations on Aerobic Digestion Processes

In aerobic digestion, sewage sludge is biochemically oxidized by bacteria in an aerobic environment that can operate in either a batch or continuous mode (EPA, 2003). According to the Environmental Regulations and Technology – Control of Pathogens and Vector Attraction in Sewage Sludge (EPA/625/R-92/013), there are three alternatives of the Class B pathogen requirements for sewage sludge (biosolids). The three alternative requirements exist as follows (EPA, 2003):

1. Sewage Sludge Alternative 1: Monitoring of Fecal Coliforms [503.32(b)(2)]
   Seven samples of treated sewage sludge (biosolids) be collected and that the geometric mean fecal coliform density of these samples be less than 2 million CFU or MPN per gram of bioslids (dry weight basis).

2. Sewage Sludge Alternative 2: Use of a Process to Significantly Reduce Pathogens (PSRPs) [503.32(b)(3)]
   For aerobic digestion, sewage sludge is agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 40 days at 20˚C (68°F) and 60 days at 15˚C (59°F).

3. Sewage Sludge Alternative 3: Use of Processes Equivalent to PSRP [503.32(b)(4)]
   1. *Alkaline Addition to achieve Lime Stabilization*
   2. *OxyOzonation*

Class B biosolids and domestic septage also must meet one of the vector attraction reduction requirements. The requirements for aerobic digesters are as follows (EPA, 2003):

1. At least 38% reduction in volatile solids during sewage sludge treatment.

2. The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature between 10 to 20˚C.

3. Less than 15% additional volatile solids reduction can occur during bench-scale aerobic batch digestion for 30 additional days at 20˚C.

DESIGN OF AEROBIC DIGESTOR

Based on the Sewage Sludge Alternative 2 of the Class B Pathogen Requirements for Biosolids, GPS-X modeling simulations were performed to estimate the digester volumes. The total digester volume provided in this design is 1.14 MG, which is broken up into two stages. Thickened sludge will be fed to

two of three digesters in parallel and then the digested sludge will be transferred to the third digester which also acts as a sludge storage tank. Based on the GPS-X modeling simulation results (Q_i, X_i, and X), minimum digester volumes for the various wastewater influent flows modeled for this WRF design were calculated using equation 6(Metcalf&Eddy, 2003):

$$V = \frac{Q_i X_i}{X(k_d P_v + 1/SRT)} \qquad (6)$$

Where V = volume of aerobic digester, MG
Q_i = influent flowrate to digester, mgd
X_i = influent suspended solid, mg/L
X = digester suspended solid, mg/L
k_d = reaction rate constant, d^{-1}
P_v = volatile fraction of digester suspended solids
SRT = solids residence time, d

P_v is approximately 0.8 and k_d is typically equal to 0.1 and 0.06 d^{-1} at 20 and 15°C, respectively. The results of the modeling and calculations for a digester operating with a 40 d SRT at 20°C and with a 60 d SRT at 15°C are summarized in Tables 17 and 18, respectively. The maximum required digester volumes were 0.5 and 0.82 MG when the digester was operated at 20 and 15°C, respectively.

Table 17. Digester sludge volumes at 20°C

Wastewater Influent Flow	*2.5MGD*	*3.4MGD*	*7.2MGD*	*10.4MGD*
Q_i	0.0203	0.0253	0.0322	0.03121
X_i	31670	34190	29850	29600
X	17600	20110	19640	18340
k_d	0.1	0.1	0.1	0.1
P_v	0.8	0.8	0.8	0.8
SRT	40	40	40	40
V	0.35	0.41	0.47	0.48

Table 18. Digester sludge volumes at 15°C

Wastewater Influent Flow	*2.5MGD*	*3.4MGD*	*7.2MGD*	*10.4MGD*
Q_i	0.0203	0.0253	0.0322	0.03121
X_i	31660	34190	29800	29550
X	17600	20110	18600	18300
k_d	0.06	0.06	0.06	0.06
P_v	0.8	0.8	0.8	0.8
SRT	60	60	60	60
V	0.56	0.67	0.80	0.78

It can be observed from Tables 17 and 18 that the design digester volume of 1.14 MG is more than adequate to meet the 40 day MCRT at 20°C or 60 day MCRT at 15°C.

However, the PERC design digesters will be operated at a temperature closer to 30°C; therefore, the required SRT to produce Class B biosolids needs to be evaluated. With temperature correction, the required SRT at 30°C can be estimated with equation 7.

$$SRT_T = SRT_{20^oC}(\theta_d)^{T-20^oC} \qquad (7)$$

Where θ_d is a temperature variation constant for SRT.

First of all, θ_d is calculated by using the given detention times and temperatures provided in the definition of Class B biosolids.

$$60 = 40(\theta_d)^{15^oC-20^oC}$$
$$\theta_d = 0.922$$

Then, for digester operating at 30°C, we can calculate the minimum SRT:

$$SRT_{30^oC} = 40\,(0.922)^{30^oC-20^oC}$$
$$SRT_{30^oC} = 18\ days$$

Therefore, the required SRT for aerobic digesters to produce Class B biosolids is approximately 18 days at a digester temperature of 30°C.

In the option #1 of the vector attraction reduction requirements, it states that a least 38% reduction in volatile solids needs to be achieved during sewage sludge treatment. As shown in Figure 5, with sludge age of 18 days at 30°C, more than 40% of the volatile solids reduction can be achieved.

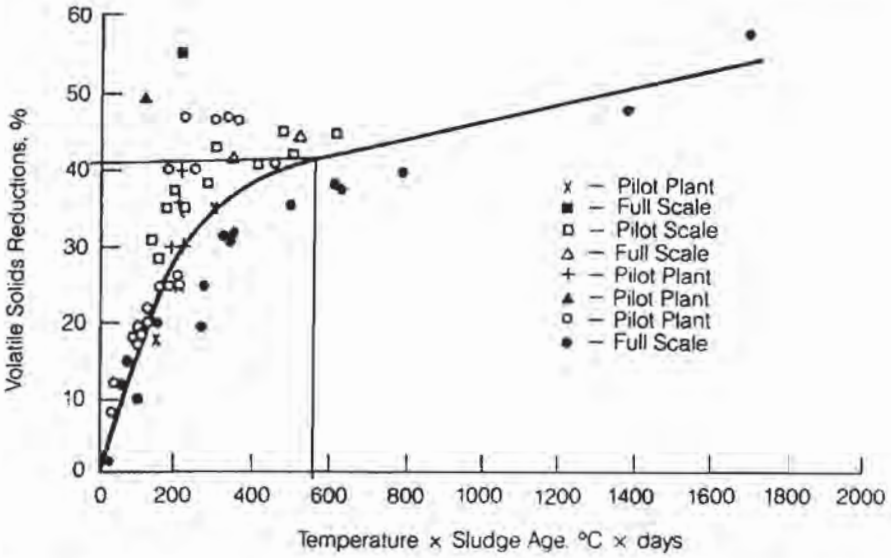


Figure 18.31 **Typical volatile solids reductions as a function of digester liquid temperature and digester sludge age.[37] VS reduction depends on many variables, including prior processing, sludge characteristics, and digester operating conditions.[37]**

Figure 5. Typical volatile solids reduction as a function of digester liquid temperature and digester sludge age (adapted from WEF, 1992)

GPS-X Modeling Simulation

Operating the digesters in a CSTR (continuous stirred-tank reactor) mode (e.g. no settling mode), the hydraulic detention time (HRT) is equivalent to the SRT, which can be calculated by equation 8.

$$HRT = SRT = \frac{V}{Q} \qquad (8)$$

Where V = total volume of the digesters, MG
Q = influent sludge feed to the digesters, MGD

To evaluate the digesters performance at 30°C, a GPS-X modeling simulation was performed with the design criteria listed in Table 19 and the modeling results are detailed in Table 20.

Table 19. Digester design criteria.

Parameters	
SOTE, %	25
α, –	0.85
Temperature, °C	30

Table 20. Digester simulation results.

	Unit	*3.4 MGD*	*7.2 MGD*	*2.5 MGD*
Digester #1	scfm	552	615	458
Digester #2	scfm	552	615	458
Digester #3	scfm	258	282	186
%VS reduction	%	53	51	59
SRT (full capacity)	days	39.9	35.7	56

Observing the data in Table 20, the SRTs vary from 35.7 days for the peak day flow of 7.2 MGD to 56 days for the current annual average influent flow of 2.5 MGD. The percentages of VS reduction are all above 50% which meets the vector attraction reduction requirement of 38%. Thus, it is concluded that the PERC project team's design digester volume is adequate to produce Class B biosolids at an operating temperature of 30˚C.

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Technical Memorandum

City of Santa Paula Water Recycling Facility
Design, Build, Operate, Finance

Date: 24 January 2008

Authors: R. Shane Trussell, Ph.D., P.E.
Joanne Chiu

Subject: Phase II Evaluation of Biological Design and Process Sizing

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OBJECTIVE OF THIS MEMORANDUM

The purpose of this document is to evaluate the ability of the Phase I (year 2015) biological and process equipment design to handle the predicted flow from the Phase II design (year 2025) using process simulation software, GPS-X from Hydromantis, Inc. The process will be evaluated at the Phase II flow capacity and solids handling will also be assessed. Recommendations for maintaining a healthy biology at a higher influent flow rate will also be discussed.

INFLUENT DESIGN CRITERIA

The flow information and annual average influent wastewater characteristics for the Phase II design presented in Tables 1 and 2 were obtained from the Request For Proposal (RFP), Appendix B – Performance Specification, from the City of Santa Paula for a new Water Recycling Facility (WRF).

Table 1. Design influent wastewater flows

Flow	*Unit*	*2025*
Average Annual Influent Flow	MGD	4.2
Peak Day Flow	MGD	8.0

Table 2. Raw influent wastewater characteristics

Parameters	*Unit*	*Raw Influent*
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD)	mg/L	320
Chemical Oxygen Demand (COD)	mg/L	736
Total Kjeldahl Nitrogen (TKN)	mg/L	53
Ammonia (NH_3)	mg/L	32
Total Suspended Solid (TSS)	mg/L	210
Alkalinity (as $CaCO_3$)	mg/L	300

A10% loading reduction of COD, BOD, TKN-organic nitrogen, and TSS through the 3-step physical removal process was applied. Screened influent wastewater characteristics are summarized in Table 3.

Table 3. Design screened influent wastewater characteristics

Influent Parameters	*Unit*	*Screened Influent*
Minimum Temperature	°C	19
Biochemical Oxygen Demand (BOD)	mg/L	288
Chemical Oxygen Demand (COD)	mg/L	662
Total Kjeldahl Nitrogen (TKN)	mg/L	51
Ammonia (NH_3)	mg/L	32
Total Suspended Solid (TSS)	mg/L	189
Alkalinity (as $CaCO_3$)	mg/L	300

The peak day flow was used to evaluate the adequacy of the biological sizing of this facility. The peak day flow was estimated in the RFP based on the additional 3.8 MG of inflow volume from a 100-year storm to the annual average flow. It is appropriate to assume that the additional 3.8 MG of wet weather flow contains low organics and solids concentrations and will thus have a limited impact on the influent loadings of organics and solids as lbs per day. However, to ensure a robust biological process design, the loadings of TSS, BOD, COD, and TKN were all increased by 20% to represent the peak day influent wastewater loads, as detailed in Table 4.

Table 4. Average and peak day influent loads

Influent Parameters	*Unit*	*4.2 MGD*	*8.0 MGD*
TSS	1000 lb/day	6.6	7.9
BOD	1000 lb/day	10.1	12.1
TKN	1000 lb/day	1.8	2.1
COD	1000 lb/day	23.2	27.8

As a result of the 20% safety factor that was applied to the peak day loads, the peak day influent wastewater concentrations need to be estimated and are presented in Table 5.

Table 5. Design peak day influent organic wastewater characteristics

Influent Parameters	*Unit*	*Values*
Flow	MGD	8.0
TSS	mg/L	119
BOD	mg/L	181
TKN	mg/L	32
COD	mg/L	417
Min Design Temperature	°C	19

The influent fractions and coefficients presented in Table 6 were adjusted from the GPS-X default values to accommodate the wastewater characteristics presented in Table 3 and 5. These adjustments were made using an "Influent Advisor" which was developed by Hydromantis to help users better understand the influent water quality characteristics and to avoid assumption errors.

Table 6. Influent wastewater fractions and coefficients

Fractions/Coefficients	*Default Value*	*Value Used*
xCOD/VSS Ratio	2.20	3.3 - 3.4
VSS/TSS Ratio	0.60	0.79
Ammonia/TKN Ratio	0.65	0.63

EFFLUENT DESIGN CRITERIA

Since the MBR process produces non-detect TSS and low COD water for a wide-range of operating conditions (Merlo et al., 2007), the MBR sizing was controlled by the effluent nitrogen limits that the City is required to meet in its *Waste Discharge Requirements ORDER NO. R4-2007- 0028*. The monthly, or 30-day, average nitrate + nitrite as nitrogen concentration of 5 mg/L must be achieved through the WRF. For this design, a safety factor of 20% was applied that produced a performance target of nitrate+nitrite as nitrogen of 4 mg/L (Table 7).

Table 7. WRF Required Effluent Limits and Performance Targets

Constituent	*Unit*	*Effluent Limit*	*Performance Target*
Nitrate + Nitrite as nitrogen	mg/L	5	< 4

PROCESS DESIGN CRITERIA

The following table presents the proposed process tank sizes provided by the PERC team for the Phase I MBR design.

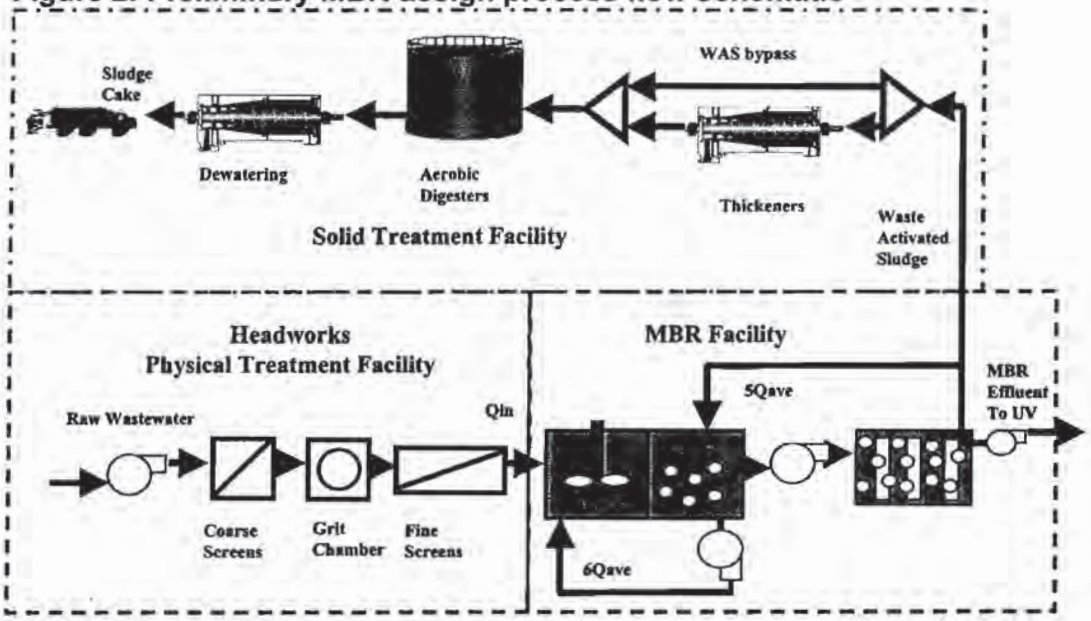
Table 8. Preliminary tank design operating volumes

MBR VOLUME DISTRIBUTION	*Size, cu.ft*	*%*	*Size, gal*
Anoxic Volume	71,205	26.7	532,650
Aerobic Volume	180,428	67.7	1,349,700
Membrane Tank Volume	15,039	5.6	112,500
Total Operating Reactor Volume	*266,672*	*100*	*1,994,850*

Process Flow Schematic

A process flow diagram for the Phase II MBR process is presented in Figure 2. The screened raw wastewater first flows into the anoxic zone, then to the aerobic zone, and continues to the membrane tank. Nitrified mixed liquor is recirculated (internal recycle) at a rate of 25.2 MGD (6 Q_{ave}) from the end of the aerobic zone to the head of the anoxic zone to provide nitrate and biomass for denitrification. Additionally, 21 MGD (5 Q_{ave}) of return activated sludge (RAS) is returned from the membrane tank to the head of the aerobic zone to prevent excessive solids concentrations from occurring in the membrane tank. A 30 MGD of RAS rates will be operated during peak day.

Figure 2: Preliminary MBR design process flow schematic



BIOLOGICAL MODELING RESULTS FOR THE DESIGN FLOWS

Based on the design criteria presented in previous sections, modeling simulations were performed for the Phase I design reactor volumes for the Phase II influent flow rate and wastewater characteristics. A solids residence time

(SRT) of 14.7 d was determined for the predicted average flow of 4.2 MGD and 12.4 d for the peak day flow of 8.0 MGD. An SRT of more than 14 d ensures that nitrification will be stable and helps to minimize membrane fouling (Trussell et al., 2006). The MLSS concentrations and operational parameters for both Phase I and Phase II designs are presented in Table 9 for comparison purposes.

Table 9. Biological process control and MLSS concentration

Process Control Parameters	*Units*	*Phase I*		*Phase II*	
		3.4 MGD	*7.2 MGD*	*4.2 MGD*	*8.0 MGD*
F/M	gCOD/gMLSS.d	0.07	0.08	0.07	0.09
Wasting Rate	MGD	0.11	0.11	0.11	0.12
SRT	d	14.7	13.8	14.7	12.4
Internal Recycle Rate	MGD	20.4	20.4	25.2	25.2
RAS Rate	MGD	17	30	21	30
MLSS Concentrations					
Anoxic Zone	g/L	5.7	5.3	7.0	6.1
Aerobic Zone	g/L	6.6	7.1	8.1	8.0
Membrane Tank	g/L	7.9	8.8	9.7	10.1

As shown in Table 9, with the Phase I design reactor volume of 1,994,850 gal, the MLSS concentration has increased, but it is still well below the target upper limit of 12 g/L in the membrane tank. The hydraulic retention time (HRT) for Phase II design is 11.4 h for the average annual flow and 6.0 h for the peak day flow. The filtrate water quality for the annual average and peak day flows is provided in Table 10. Effluent TSS and BOD are essentially non-detect. Also, the total nitrate + nitrite as nitrogen concentration meets the effluent design target value in Table 7.

Table 10. Filtrate water quality

Filtrate Qualities	*4.2 MGD*	*8.0 MGD*
TSS, mg/L	1.0	1.0
COD, mg/L	33.0	33.0
BOD, mg/L	1.3	1.3
Total Nitrogen, mg/L	6.2	6.3
TKN, mg/L	3.1	3.1
NH_3-N, mg/L	0.10	0.12
$NO3^-$+$NO2^-$, mg/L	3.1	3.2

BIOLOGICAL AERATION DESIGN

For this MBR design, the required airflow rates to maintain the aerobic zones at dissolved oxygen (DO) concentrations of 2 mg/L were determined using an alpha-factor of 0.45 and a standard oxygen transfer efficiency (SOTE) of 30 percent for the membrane aeration panels. Using these established design

criteria, the required airflow rates were determined for the aerobic zone and are presented in Table 11 for the annual average and peak day flows.

Table 11. Design criteria and resulting airflows for fine bubble diffusers

Parameter	*4.2 MGD*	*8.0 MGD*
α, --	0.45	0.45
SOTE, %	30	30
Air Flow Rate, scfm	4609	5431

MAJOR PROCESS EQUIPMENT SIZING

Based on the airflow rates presented in Table 11, the required minimum horse power for the aeration blowers have been calculated and are presented in Table 12. A 70% operational efficiency was applied in these equipment sizings.

Table 12. Operation process control rates

	Unit	*4.2 MGD*	*8.0 MGD*
Actual Required Air Flowrate	scfm	4609	5431
Aeration Blowers, Required Min hp	hp/blower	65	76
Internal Recycle Rate	MGD	25.2	25.2
Membrane RAS Rate	MGD	21	30

Table 13 has detailed the operation energy loads and required equipment sizes for the Phase I design. The aeration blowers from Phase I design are sufficient to handle the flows from the Phase II design based on the required minimum hp listed in Table 12. With the internal recycle rate of 25.2 MGD, 3 hp per pump is required; therefore, the recycle pumps from the Phase I design are also sufficient to handle the higher recycle rate. Since the RAS pumps will be operated at the same rate as the Phase I design for the peak flow, no changes on the RAS pumps is needed. Thus, no additional equipment appears to be required for the biological reactor to achieve the Phase II design.

Table 13. Operation energy loads and required equipment sizes

Equipments	*Duty*	*Standby*	*Total Quantity*	*hp/Ea*	*Total hp*
Aeration Blowers	3	1	4	100	400
Internal Recycle Pumps	3	1	4	4	16
Membrane RAS Pumps	3	1	4	27	108

SOLIDS HANDLING

With the temperature correction, the estimated SRT for the digesters to produce Class B biosolids was calculated to be 18 days at the digester temperature of 30°C.

To evaluate the digesters performance, a GPS-X modeling simulation was performed with the design criteria listed in Table 16 and the modeling results are detailed in Table 17.

Table 16. Digester design criteria

Parameters	
SOTE, %	25
α, --	0.85
Temperature, °C	30

Table 17. Digester simulation results

	Unit	*4.2 MGD*	*8 MGD*
Digester #1	scfm	633	748
Digester #2	scfm	633	748
Digester #3	scfm	317	357
%VS reduction	%	49	49
SRT (full capacity)	days	32	29.7

With an SRT of 29.7 days and 49 % volatile reduction (min vector attraction reduction requirement is 38%) for the peak day flow, it is concluded that the PERC design digester volume is adequate to produce Class B biosolids for the Phase II design.





REFERENCES

Merlo, R. P., Trussell, R. S., Hermanowicz, S. W. and Jenkins, D. (2007) A comparison of the physical, chemical, and biological properties of sludges from a complete-mix activated sludge reactor and a submerged membrane bioreactor. *Water Environment Research*, **79**, 320.

Trussell, R. S., Merlo, R. P., Hermanowicz, S. W. and Jenkins, D. (2006) The effect of organic loading on process performance and membrane fouling in a submerged membrane bioreactor treating municipal wastewater. *Water Research*, **40**, 2675.

Appendix E – Lift Station Condition Assessment

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harding Park_____ Date:___9/12/23_____

Location (Add Sketch Pg. 5):_____ Weather:___Sunny_____

Personnel:____Morgan and Tanner_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			- round wet well - submersibles in wet well - collects from 1 house located 350+ ft NW of LS and 1 restroom directly W of LS - recent seal failure (per operator)
Wet well w/ submers. Or suction Lift			
Wet well / dry well			
Number of Pumps	2		
VFDs	N		
Wet well shape and size			
# of inlets	2		
Size?			
Depth relative to Pumps/Floor			
Known Pump Issues			
Overheating/ Noise/ Ragging			
Lift Station Safety Features:			- lighting comes from parking lot
Fall protection	N		
Bollards	N		
Lifting equipment	N		
Explosion-proof fixtures			
Ventilation of wet well/ dry well			
Lighting			
Locks of hatches/ covers/ etc.	Y		
Stair Railing			
Eye wash (if chemical treatment)			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harding Park_____ Date:___9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Flood Resilience:			
Backup power			- some flooding issues historically but not recently
Redundant controls			
Flood doors			
Elevated station (or barriers)			
Backup Power:			
Perm. Generator	N		- use submersible pump
Generator Plug Panel			- vactor truck
Type of fuel			
Automatic Transfer Switch	N		
Manual Transfer Switch	N		
Space for Temporary Gen.			
Wet Well Structure:			
Material type / condition	Y		- coating ok
Liner (presence / type)			- odor issues
Offsets			- debris issues
Protrusions			- grease buildup
Exposed reinforcing			
Access hatch-type/condition			
Scratch test			
Odor Control			
Overflow Level			
FOG Issues			
High Water Level Stains			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harding Park_____ Date:___9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Dry Well Structure:			
Shape			- good
Dimensions			
Structural Condition			
Lighting			
Ventilation			
Access to Equipment			
Perm. Lifting Equipment			
Sump Pump			
Pipe Supports			
Equipment Anchors			
Coatings:			
Pipe coatings-exposed			- good
Valve coatings-exposed			
Pipe coatings-wet well			
Valve coatings-wet well			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings (other than wet well)			
Instrumentation:			
Level controls			- level sensor
Flow meter			- antenna radios to lemonwood 1 (power failure, high level)
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harding Park_____ Date:___9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			- parking lot leads to LS
Vehicular			
Maint. Equip. (ie vactor truck / crane			
Surfacing (paved, gravel)			
Height/orientation of panels			
Bypassing Provisions:			- none
Points of connection			
Quick connects			
Site Features:			- located in park
Potable water	Y		
Spill containment			
On-site Eqpt. Storage			
Gates, Site Fencing			
Lighting			
Overflow Tank / Containment			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harding Park_____ Date:___9/12/23_____

- rain water comes down through ceiling conduit into panel; fried some of the safeties

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Lemonwood 1_____ Date:____9/12/23_____

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____Morgan and Tanner_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			- 2 aboveground pumps over wetwell suction lift - flow conditions are ok following installation of new lift station - pumps are old, not super strong - operators stated they prefer submersible pumps
Wet well w/ submers. Or suction Lift			
Wet well / dry well			
Number of Pumps	2	Y	
VFDs	N		
Wet well shape and size			
# of inlets			
Size?			
Depth relative to Pumps/Floor			
Known Pump Issues			
Overheating/ Noise/ Ragging			
Lift Station Safety Features:			- lighting upgrades are recent
Fall protection	N		
Bollards	N		
Lifting equipment			
Explosion-proof fixtures			
Ventilation of wet well/ dry well	N		
Lighting	Y		
Locks of hatches/ covers/ etc.	Y		
Stair Railing	N/A		
Eye wash (if chemical treatment)	N		

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Lemonwood 1_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Flood Resilience:			
Backup power			- runoff problems
Redundant controls			- no flooding issues historically
Flood doors			
Elevated station (or barriers)			
Backup Power:			
Perm. Generator			- manual transfer switch
Generator Plug Panel			- portable generator if needed
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			
Wet Well Structure:			
Material type / condition			- coating is ok
Liner (presence / type)			- low inlets
Offsets			
Protrusions			
Exposed reinforcing			
Access hatch-type/condition			
Scratch test			
Odor Control			
Overflow Level			
FOG Issues			
High Water Level Stains			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Lemonwood 1_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Dry Well Structure:			
Shape			- N/A
Dimensions			
Structural Condition			
Lighting			
Ventilation			
Access to Equipment			
Perm. Lifting Equipment			
Sump Pump			
Pipe Supports			
Equipment Anchors			
Coatings:			
Pipe coatings-exposed			- OK
Valve coatings-exposed			
Pipe coatings-wet well			
Valve coatings-wet well			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings (other than wet well)			
Instrumentation:			
Level controls			- radio; works fine; operator called it "sensophone"
Flow meter			- flow meter
Gauges			- level sensor (~ 3 yrs)
Pressure switches			- bubbler control panel; bubbler is cycling consistently
SCADA/Telemtry			
Antennae	Y		
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)	Y		
Shade structure (Instr.)			
Intrusion Alarms			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Lemonwood 1_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			- Pavement has some condition issues - Access by homeless; fence broken - Hard to turn around in vehicle; small site
Vehicular	Y		
Maint. Equip. (ie vactor truck / crane			
Surfacing (paved, gravel)	Y		
Height/orientation of panels			
Bypassing Provisions:			
Points of connection	Y		
Quick connects	Y		
Site Features:			- graffiti on walls
Potable water	Y		
Spill containment	N		
On-site Eqpt. Storage			
Gates, Site Fencing			
Lighting	Y		
Overflow Tank / Containment			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Lemonwood 1_____ Date:____9/12/23_____

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harvest_____ Date:____9/12/23_____

Location (Add Sketch Pg. 5):_____ Weather:____Sunny_____

Personnel:_____Morgan and Tanner_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			
Wet well w/ submers. Or suction Lift			- round wet well shape
Wet well / dry well			- submersibles
Number of Pumps	3		- no issues w/ pumps
VFDs	N		
Wet well shape and size			
# of inlets			
Size?			
Depth relative to Pumps/Floor			
Known Pump Issues			
Overheating/ Noise/ Ragging			
Lift Station Safety Features:			
Fall protection	Y		
Bollards	N		
Lifting equipment			
Explosion-proof fixtures			
Ventilation of wet well/ dry well			
Lighting	Y		
Locks of hatches/ covers/ etc.	Y		
Stair Railing			
Eye wash (if chemical treatment)			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harvest_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Flood Resilience:			
Backup power			- N/A
Redundant controls			
Flood doors			
Elevated station (or barriers)			
Backup Power:			
Perm. Generator	Y		
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			
Wet Well Structure:			
Material type / condition			- H2S damage on metal piping, switches, electronics, etc.
Liner (presence / type)			- structure doing well; just coating and piping damage
Offsets			- ongoing H2S issues
Protrusions			- has capsule-shaped 10,000 gal overflow tank
Exposed reinforcing			
Access hatch-type/condition			
Scratch test			
Odor Control			
Overflow Level			
FOG Issues			
High Water Level Stains			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harvest_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Dry Well Structure:			
Shape			
Dimensions			
Structural Condition			
Lighting			
Ventilation			
Access to Equipment			
Perm. Lifting Equipment			
Sump Pump			
Pipe Supports			
Equipment Anchors			
Coatings:			
Pipe coatings-exposed			- general corrosion
Valve coatings-exposed			- vault had previous leakage
Pipe coatings-wet well			- vault has some H2S due to drain to wet well
Valve coatings-wet well			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings (other than wet well)			
Instrumentation:			
Level controls			- level sensing transmitter
Flow meter			- no flow metering
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harvest_____ Date:____9/12/23_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			- gated
Maint. Equip. (ie vactor truck / crane			- no issues
Surfacing (paved, gravel)			- access a bit tight
Height/orientation of panels			
Bypassing Provisions:			
Points of connection	Y		
Quick connects			
Site Features:			
Potable water	Y		- site ~ 3 yrs old
Spill containment	N		
On-site Eqpt. Storage			
Gates, Site Fencing	Y		
Lighting	Y		
Overflow Tank / Containment	Y		

Lift Station Visual Inspection Checklist

Lift stations are considered confined spaced. DO NOT ENTER FOR ANY REASON.
Make observations from the surface using photo/video equipment and lighting.

Name of Observer: _____Sarah Mathews_____

Lift Station Name: _____Harvest_____ Date:____9/12/23_____

Appendix F – Treated Effluent Monthly Average Monitoring Results 2019-2023

Treated Effluent Monthly Average Monitoring Results (2019-2023)							
		Total Dissolved Solids (mg/L)	Chloride[1] (mg/L)	Sulfate (mg/L)	Boron (mg/L)	Nitrite-N (mg/L)	Ammonia-N + Nitrate-N + Nitrite-N (mg/L)
WDR Limit		**2,000**	**110**	**800**	**1**	**1**	**10**
2019	January	1190	*118*	427	0.752	0	7.07
	February	1370	*125*	569	0.889	0	7.95
	March	1250	*129*	511	0.74	0.02	3.74
	April	1270	*126*	500	0.766	0.01	7.48
	May	1280	*119*	474	0.842	0.02	4.62
	June	1250	*124*	521	0.694	0.04	5.24
	July	1180	*122*	482	0.685	0.2	0.54
	August	1200	*116*	457	0.846	0.04	1.58
	September	1150	*112*	437	0.787	ND	0.7
	October	1200	*114*	446	0.673	ND	1.5
	November	1270	*117*	435	0.736	0.03	9.07
	December	1160	*116*	413	0.684	0.02	7.36
2020	January	1270	*120*	458	0.77	0.03	5.31
	February	1230	*121*	458	0.689	0.04	4.38
	March	1220	*122*	458	0.72	0.03	1.62
	April	1300	*126*	481	0.798	0.03	6.22
	May	1250	*120*	469	0.77	ND	2.51
	June	1250	*118*	444	0.631	0.05	4.42
	July	1260	*116*	421	0.759	0.03	4.13
	August	1220	*116*	418	0.723	0.03	3.44
	September	1210	*117*	432	0.659	0.05	4.8
	October	1240	*116*	451	0.781	0.07	5.4
	November	1190	*118*	381	0.848	0.04	7.8
	December	1200	*118*	421	0.775	ND	8.86
2021	January	1210	*113*	444	0.766	ND	5.31
	February	1250	*122*	449	0.984	ND	*17.9*
	March	1260	*128*	400	0.772	ND	8.32
	April	1250	*112*	467	0.737	0.05	9.4
	May	1250	*117*	414	0.835	0.04	8.6
	June	1310	*115*	414	0.729	<0.1	6.7
	July	1260	106	447	0.77	0.02	9.9
	August	1220	107	422	0.874	0.03	6.1
	September	1210	110	427	0.711	0.03	9.6
	October	1240	104	453	0.874	0.03	7.71
	November	1240	97	457	0.849	0.03	*11.7*
	December	1210	109	383	0.849	0.03	*10.2*

		Total Dissolved Solids (mg/L)	Chloride[1] (mg/L)	Sulfate (mg/L)	Boron (mg/L)	Nitrite-N (mg/L)	Ammonia-N + Nitrate-N + Nitrite-N (mg/L)
WDR Limit		2,000	110	800	1	1	10
2022	January	1240	105	493	0.914	0.2	3.57
	February	1220	107	409	0.776	0.03	9.4
	March	1200	109	442	0.866	0.04	6.4
	April	1200	110	387	0.833	0.07	7.06
	May	1260	101	407	0.612	ND	6.8
	June	1220	106	394	0.763	0.02	8.7
	July	1240	108	420	0.794	0.04	*16.85*
	August	1250	101	418	0.91	0.05	*22.3*
	September	1230	109	435	0.962	0.3	8.5
	October	1200	*118*	400	*1.15*	0.04	5.54
	November	1230	*120*	469	0.832	0.04	8
	December	1170	*116*	445	0.836	ND	*11.2*
2023	January	1380	*116*	556	0.994	0.03	7.18
	February	1290	*124*	457	0.881	0.04	4.4
	March	1420	*116*	584	*1.12*	0.03	8.9
	April	1390	*121*	543	0.921	0.02	*13.62*
	May	1310	*124*	418	0.852	ND	*11.3*
	June	1250	*122*	458	0.089	ND	9.3
	July	1390	*116*	543	0.921	0.02	*13.62*
	August	1290	*113*	446	0.909	<0.1	6.3
	September	1230	*114*	472	0.9	0.03	6.5
	October	1260	*115*	456	0.755	ND	7.5
	November	1250	*122*	476	0.972	0.03	8.03
	December	1240	*120*	462	0.854	0.03	7.7

Notes:
1. Exceedances are underlined and italicized.
2. ND = Not detected

Appendix G – WRF Condition Assessment Checklist

Wastewater Treatment Plant Visual Inspection Checklist

Name of Observer: Mike Nunley, PE

WWTP Name: Santa Paula Water Recycling Facility

Date: 7/27/23

Personnel: Pete, Ethan

Weather: Clear

Year Built/Improved: 2010

As-Builts Available: Yes

Design Capacity: 4.1 MGD

Item

Influent Pump Station

Mechanical

- Lifting chain corroded - needs to be replaced
- Check valves on lift station have issues
- Volutes are in good shape (VRSO, CPO)
- Lift station pumps are the original pumps - evaluate pumps to repair or replace

Instrumentation

- Seal failure
- No local HMI

Electrical

- Consider changing cords out

Structural

- Concrete/liners in bad shape - haven't been in ILS
- Aluminum cover - should be fiberglass, support brackets are failing
- Spalling of slab near influent meter
- Replace manhole cover and ring
- Influent flow weir is worn concrete, no metal protection
- Influent channel needs to be repaired and relined

Influent Pump Station (Continued)

Safety

- Need harnesses, hoists, blowers, gas detectors (confined space equipment; VRSD is currently charging for their own equipment)
- Grating worn
- No fall arrest on any ladder

Operator Notes and Observations

- N/A

Grit Removal/Coarse & Fine Screens

Mechanical

- #2 Grit classifier failing - stainless steel rotting out, wear plates missing and need to be replaced
- Total of 2 coarse screen, 2 fine screens, 2 classifiers
- Need manufacturer's maintenance, bearing replacement, screens and augers

Instrumentation

- Total of 2 space level transducer, 6 endress hauser panels
- H2S gas causing problem w/ electrical cords + panels
- H2S will damage Huber stainless equipment

Wastewater Treatment Plant Visual Inspection Checklist

Grit Removal/Coarse & Fine Screens (Cont.)

Electrical
- N/A

Structural
- N/A

Safety
- N/A

Operator Notes and Observations
- Replaced bagging system, which has been working well - less dumpster corrosion

Flow Equalization Tank 1

Mechanical
- No aeration

Instrumentation
- Pacing used to be automatic; now operator has to log in every night for shaving
- SCADA needs to be set to work automatically with flow rates, auto shaving

Electrical
- Conduit getting corroded (intermittent)

Structural
- EQ weirs - concrete doesn't have knife's edge, worn
- Aluminum & orange grating needs to be replaced

Safety
- N/A

Operator Notes and Observations
- N/A

Flow Equalization Tank 2

Mechanical
- N/A

Instrumentation
- N/A

Electrical
- N/A

Structural
- EQ weirs - concrete doesn't have knife's edge, worn
- Aluminum & orange grating needs to be replaced

Safety
- N/A

Operator Notes and Observations
- Rarely used; except when plant has high flow events

Wastewater Treatment Plant Visual Inspection Checklist

Anoxic Tanks

Mechanical

- April/May - exceeded NO3 due to failed RAS/WAS pump
- EQ valve in #3 failed - can now be isolated with first 2 valves

Instrumentation

- N/A

Electrical

- N/A

Structural

- Top 3 ft starting to corrode

Safety

- N/A

Operator Notes and Observations

- N/A

Aeration Tanks

Mechanical

- Need RAS spare pump
- Issues with mixers in RAS + WAS tangling, rails bending, skewed, cut up cables etc.

Instrumentation

- N/A

Electrical

- N/A

Structural

- Upper 3-4 ft in general are worn - potential need for coating
- Tank 1 has scars from mixer

Safety

- N/A

Operator Notes and Observations

- Working well

Thickeners/Screw Press

Mechanical

- Self clean not working - won't run in reverse for cleaning, brushes worn out - needs maintenance
- Oil box needs 10 year overhaul
- Feed pump doesn't prime well
- Rotary lobe pumps feed thickener + press, rotary lobe pumps have worn plates
- Replace bristles

Instrumentation

- N/A

Electrical

- N/A

Wastewater Treatment Plant Visual Inspection Checklist

Thickeners/Screw Press (Cont.)

Structural

• N/A

Safety

• N/A

Operator Notes and Observations

• Needs redundancy

• Need second unit

• Auger to trailer needs maintenance

Aerobic Digesters

Mechanical

• Both blowers working

• Software not compatible with old blower - microsoft doesn't cover HMIs anymore - results in needing new inverter

Instrumentation

• N/A

Electrical

• N/A

Structural

• N/A

Safety

• N/A

Operator Notes and Observations

• N/A

Membrane Separation Tanks

Mechanical

• One blower (MBR #1) shuts off randomly at times

• Return channel - blower not sized adequately

Instrumentation

• #2 WAS pump fault - turns off

• Tie citric acid pump into MBR PLC

• MBR PLC #M needs redundant back up just like PLC A&B (not in back up PLC list order #1)

Electrical

• N/A

Structural

• Coatings starting to chip off

Safety

• N/A

Operator Notes and Observations

• Tie citric acid pump into MBR PLC

• Permeate pumps need to be evaluated and rebuilt

• Operators prefer separate turbidity meters for each train on MBR

Wastewater Treatment Plant Visual Inspection Checklist

UV Disinfection

Mechanical

- Only 3 out of 5 modules are seeing flow
- Replaced 2/3 of bulbs
- Lot of shattered bulbs
- Bulbs at 30,000 hrs - should be replaced at 12,000 hrs per manufacturer recommendation

Instrumentation

- N/A

Electrical

- N/A

Structural

- N/A

Safety

- N/A

Operator Notes and Observations

- 3 modules in use at any time
- Recently maintenance had shattered valves
- Electronics need to be replaced - many back panels not working

Percolation Pond Diversion Structure

Mechanical

- N/A

Instrumentation

- N/A

Electrical

- N/A

Structural

- N/A

Safety

- N/A

Operator Notes and Observations

- N/A

Percolation Pond

Mechanical

- Irrigation system not working - cracked pipeline

Instrumentation

- N/A

Electrical

- N/A

Structural

- N/A

Safety

- N/A

Operator Notes and Observations

- Water is beginning to pool in one pond
- Rocks, etc. need to be cleared out
- Replace liners (rips in ponds), perform weed control

Wastewater Treatment Plant Visual Inspection Checklist

Biofilter

Mechanical
- N/A

Instrumentation
- N/A

Electrical
- N/A

Structural
- N/A

Safety
- N/A

Operator Notes and Observations
- N/A

Controls Building

- No insulation on roof
- Windows - leak in control room
- Screens damaged - replace
- Doors - repaint; door locks damaged
- Paint trim
- Fire alarm system - replace panel; smoke detector in building failed
- Two HVAC units need to be replaced
- Lighting poor - replace with LEDs; ballasts need to be replaced

Headworks Building

- No insulation on roof
- Windows - leak in control room
- Screens damaged - replace
- Doors - repaint; door locks damaged
- Paint trim
- Lighting poor - replace with LEDs; ballasts need to be replaced

Decorative Pond

- Remove sludge
- Replace transformer
- Need new sump pumps
- New exhaust fan - should be automatic when vault opens and current one is not
- Repair circ. pump and valves
- Fix water leaks into vault
- New pond lights
- Liner is in ok condition
- Ladder rusting
- Hatch is in good condition

Wastewater Treatment Plant Visual Inspection Checklist

General Observations

- Dump Station - not used and they do not plan on using it in the future
- Crane - needs maintenance and load certification
- Concrete spalled on pad for old odor control system - repair
- Reuse line - a lot of movement on startup
- Operators requested new tools - tap and die set (SAE and Metric), multi-function welder for SS, electric winches for gantry, blower, battery rachet
- Portable ladders - old, worn out, sun damaged; all fixed ladders are good
- Add rolling stair for sludge truck - 12 foot step ladder unsafe
- Effluent meter - no weir/flume, does not measure accurately
- Paint condition is poor throughout plant
- Blowers need to be replaced or rebuilt in general
- Wasting pumps have problems with SCADA on start
- Generator needs service, filters, hoses, fuel polish, batteries, oil change, and paint
- Transfer switch needs service
- Irrigation system timer runs numerous cycles a day, should only be running once (needs replacement)

Appendix H – WRF Condition Assessment Photos

Headworks



Fine Screen Unit



Coarse Screen Unit



Grit Classifier

Dewatering



Screw Press



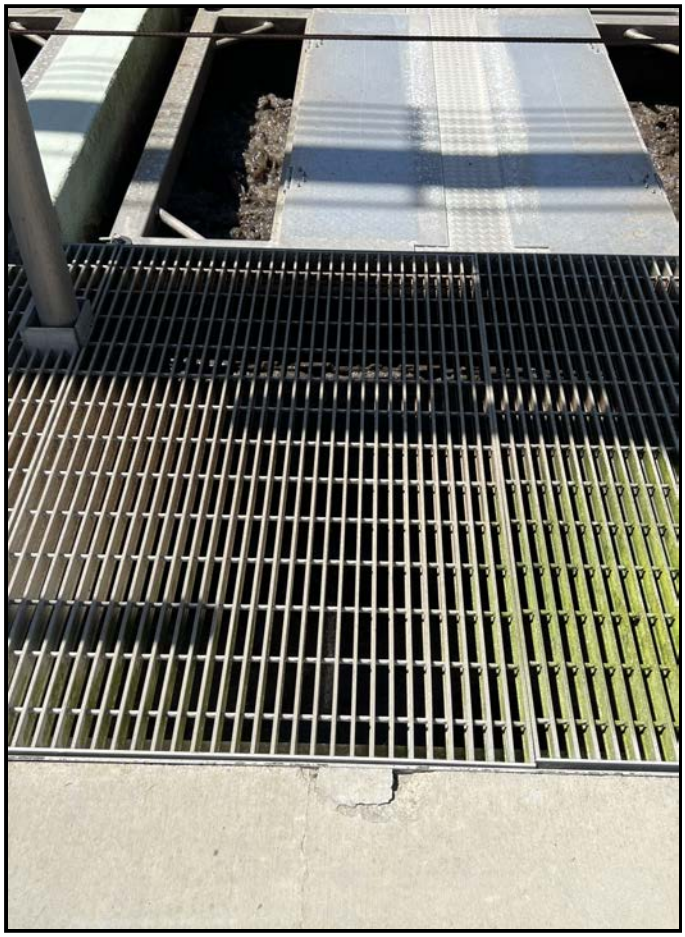
Thickener Feed Pump

Gravity Belt Thickener



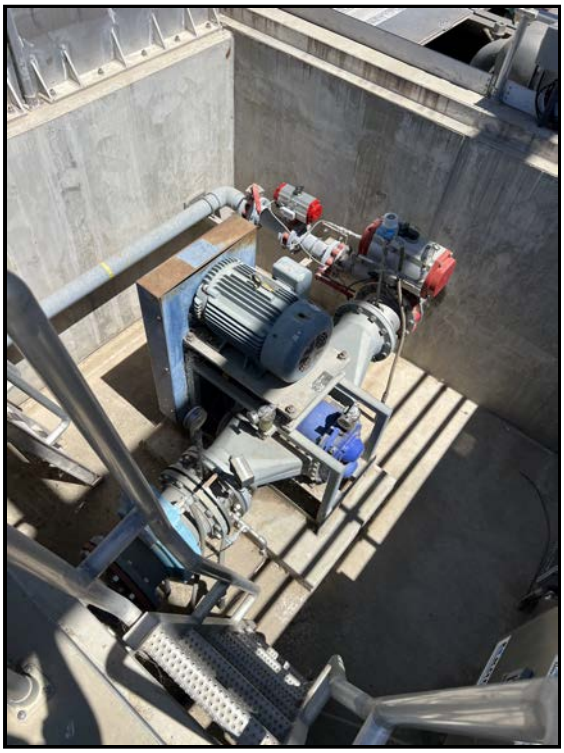
MBR Basins





MBR Basins

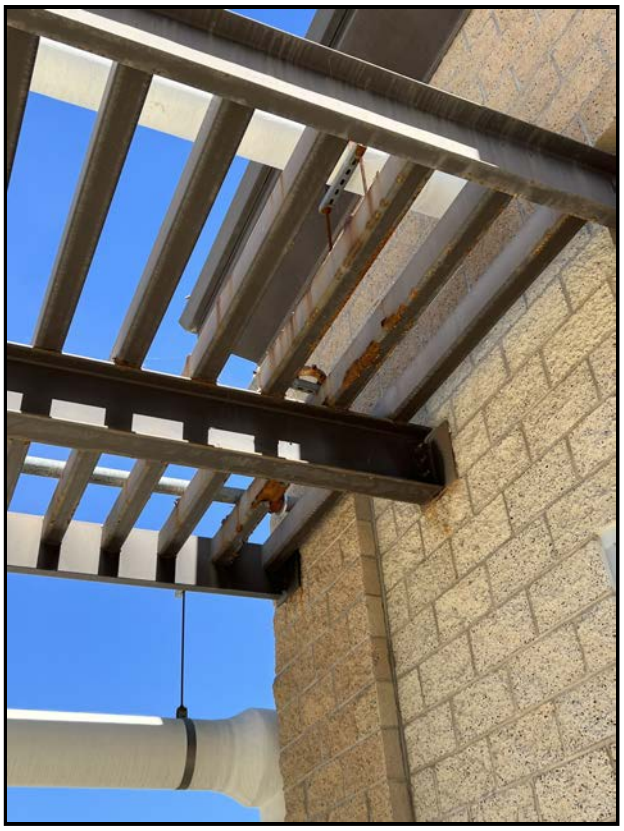
Permeate Pump



Headworks/Dewatering and Controls Building









UV Disinfection



CIP Pump



UV Channels



RO Low Pressure Pump



UV Module Instrumentation

Appendix I – MBR Process Design Calculations

Existing Conditions

MBR WW Treatment Process Design Calculations - U.S. Units
User Inputs and Constants

WW INFORMATION

I. Wastewater Parameters/Characteristics

Enter values in yellow cells only.

Design ww Flow Rate, Q_o =	3.00	MGD	Influent TSS, TSS_o =	329	mg/L
Influent BOD, BOD_o =	420	mg/L	Influent VSS, VSS_o =	260	mg/L
Influent sBOD, $sBOD_o$ =	168	mg/L			
			Influent TKN, TKN_o =	70	mg/L
Influent COD, COD_o =	857	mg/L	TKN peak/ave factor, FS =	1.0	
Influent sCOD, $sCOD_o$ =	129	mg/L	Influent NH_4-N, NH_4-N_o =	42	mg/L
Influent rbCOD, $rbCOD_o$ =	86	mg/L	Influent Alkalinity, Alk_o = (mg/L as $CaCO_3$)	300	
ratio, bCOD/BOD =	1.6		Aeration WW Temp, T_{ww} =	66.2	°F

BIOL. KINETIC COEFFICIENTS

II. Biological Kinetic Coefficients - For BOD Removal

Synth. Yield Coeff., Y =	0.40	lb VSS/lb bCOD	Half Veloc. Coeff., K_s =	20	mg/L
Temp coeff., q, for mm =	1.07		Temp coeff., q, for kd =	1.04	
			Resid. biomass fract., f_d =	0.15	
Max spec. gwth rate at 20°C, μ_{m20} =	6	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{d20} =	0.12	lb VSS/d/lb VSS			

III. Biological Kinetic Coefficients - For Nitrification

Synth. Yield Coeff., Y_n =	0.12	lb VSS/lb NOx			
Temp coeff., q, for mmn =	1.070		Half Veloc. Coeff. at 20°C, K_n =	0.7	mg/L
Temp coeff., q, for kdn =	1.040		Half Veloc. Coeff. at 20°C, K_o =	0.5	mg/L
Temp coeff., q, for Kn =	1.053		Temp coeff., q, for Ko =	1	
Max spec. gwth rate at 20°C, μ_{mn20} =	0.8	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{dn20} =	0.08	lb VSS/d/lb VSS			

CONSTANTS

IV. Constants Used in the Calculations

			Saturation D.O. in water		
Ratio of BOD_5 to BOD_u, f =	0.68		at 20°C & 1 atm, C_{ss} =	9.17	mg/L
BOD_u equiv. of VSS =	1.42	lb BOD_u/lb VSS	Standard Pressure =	14.7	psi
Spec Wt of water, γ_{H2O} =	62.4	lb/ft^3	Standard Temperature =	68.0	°F
Mol. Wt. of Air =	28.97		Mol. Wt. of Oxygen =	32.0	
Temp Coeff. for O_2 rate, θ =	1.024		O_2 mole fraction in Air =	0.209	

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Activated Sludge Kinetic Coefficients for heterotrophic bacteria at 20°C (for BOD removal)

Coefficient	Unit	Range	Typical Value
μ_m	kg VSS/day/kg VSS	3.0 - 13.2	6.0
K_s	mg/L bCOD	5.0 - 40.0	20.0
Y	kg VSS/day/kg bCOD	0.30 - 0.50	0.40
k_d	kg VSS/day/kg VSS	0.06 - 0.20	0.12
f_d	dimensionless	0.08 - 0.20	0.15
θ values for temperature corrections			
for μ_m	dimensionless	1.03 - 1.08	1.07
for k_d	dimensionless	1.03 - 1.08	1.04
for K_s	dimensionless	1.00	1.00

The source for the values in the table above is:
Introduction to Water Resource Recovery Facility Design, 2nd Ed., Table 6.1

Activated Sludge Nitrification Kinetic Coefficients at 20°C

Coefficient	Unit	Range	Typical Value
μ_{mn}	kg VSS/day/kg VSS	0.2 - 0.90	0.75
K_n	mg/L NH_4-N	0.50 - 1.0	0.74
Y_n	kg VSS/kg NH_4-N	0.10 - 0.15	0.12
k_{dn}	kg VSS/day/kg VSS	0.05 - 0.15	0.08
K_o	mg/L	0.40 - 0.60	0.50
θ values for temperature corrections			
for μ_{mn}	dimensionless	1.06 - 1.123	1.07
for k_{dn}	dimensionless	1.03 - 1.08	1.04
for K_n	dimensionless	1.03 - 1.123	1.053

The source for the values in the table above is:
Introduction to Water Rsource Recovery Facility Design, 2nd Ed., Table 6.2

INPUTS

CALCULATIONS

MBR WW Treatment Process Design Calculations - U.S. Units
Membrane Module Sizing Calculations

I. Membrane/Membrane Module Parameters

(Values typically available from membrane manufacturer or vendor - Enter values in yellow cells)

Module packing density, ϕ =	182	m^2/m^3	equals	55.5	ft^2/ft^3
Specific Aer. Demand, **SAD_M** =	0.2	m^3 air/hr/m^2 membrane			
		equals	0.656	ft^3 air/hr/ft^2 membrane	

II. Process Design Calculations (done by worksheet)

Membrane Flux, **J** =	21.1	L/hr/m^2	equals	0.518	gal/hr/ft^2
Membrane Area, **A_M** =	241,123	ft^2			
Membrane Module Vol., **V_M** =	4,347	ft^3			
Scouring Air Flow Required =	2,637	ft^3/min (ACFM) =		2,625	SCFM

(This is the scouring air flow rate needed for the membrane module, typically provided by a coarse bubble diffuser system.)

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Values given for MBR specific area (module packing density) range from 150 -334 m^2/m^3 in Table 8-35 of Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery, 5th Ed.,* McGraw-Hill, 2014

Equations Used in the Calculations:

Module packing density, ϕ, in ft^2/ft^3 = (ϕ in m^2/m^3)/3.28084

Specific Aeration Demand, **SAD_M**, in ft^3 air/hr/ft^2 membrane =
= SAD_M in m^3 air/hr/m^2 membrane/3.28084

Membrane Flux, **J,** in L/hr/m^2 = 0.4056**T_{ww}** - 5.7278 (with **T_{ww}** in ^oF)
(See Worksheet 6 for derivation of this eqution)

Membrane Flux, **J**, in gal/hr/ft^2 = [(Membrane Flux (**J**) in L/hr/m^2)/3.7854]/(3.28084^2)

Membrane Area, **A_M = $(Q_o*10^6/24)/J$**

Membrane Module Volume, **V_M = A_M/ϕ**

Scouring Air Flow Required, **ACFM** = **$(SAD_M)(A_M)/60$** ACFM

Scouring Air Flow Req'd, **SCFM** = (**ACFM**)[(T_{std} + 459.67)/(T_{ww} + 459.67)](P_{atm}/P_{std}) SCFM

MBR WW Treatment Process Design Calculations - U.S. Units

BOD Removal and Nitrification

INPUTS

I. User Inputs - Enter values in yellow cells only

Target Effluent Concentrations:

MLSS in Aer Tank, **MLSS** =	8,500	mg/L	**BOD_e** =	10	mg/L
MLSS in Waste Sludge, **X_w** =	8,500	mg/L	**TSS_e** =	10	mg/L
DO in Aer. Tank, **DO_o** =	2	mg/L	**NH_4-N_e** =	1.0	mg/L
Number of Aeration Tanks =	2		Tank Freeboard =	2.0	ft
Liquid Depth in Tank =	22	ft	Tank L:W ratio =	2.3	
Initial Estimate of **NO_x** =	44.93	mg/L	**(Tank L:W ratio is only used for rectangular tanks)**		

Note that an initial estimate is needed for NO_x in cell D14 to start an iterative calculation of NO_x below. 80% of the influent TKN is suggested for this initial estimate.

Influent TKN, **TKN_o** = 70 mg/L (value transferred from Worksheet 2)

80% of TKN_o = 56.0 mg/L

II. Calculate Design SRT

μ_{mn} at T_{ww} =	0.70	lb VSS/d/lb VSS	K_n at T_{ww} =	0.70	mg/L
k_{dn} at T_{ww} =	0.08	lb VSS/d/lb VSS	Theor. SRT =	3.96	days
μ_n =	0.25	lb VSS/d/lb VSS	Design **SRT** =	3.96	days

III. Calculate the Biomass Production Rate

μ_m at T_{ww} =	5.61	lb VSS/d/lb VSS	**bCODo** =	672	mg/L
k_d at T_{ww} =	0.1154	lb VSS/d/lb VSS	**S** =	1.404	mg bCOD/L

Biomass Production Rate, **$P_{x,bio}$** = 5029 lb VSS/day

IV. Determine the Amount of Nitrogen Oxidized to Nitrate

Calculated amount of nitrogen oxidized to nitrate, **NO_x** =	44.932	mg/L
Difference between estimated and calculated values **NO_x** =	0.00000	mg/L

Goal Seek Result:

Amount of nitrogen oxidized to nitrate, **NO_x** = **44.93** mg/L

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the NO_x value as follows: Place the cursor on the green cell G42 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell:" G42, "To value:" 0, "By changing cell:" D14, and click on "OK". The calculated value of NO_x will appear in cell F44 and G42 should be zero if the process worked properly. Note that cell D14 needs an initial estimate for NO_x in order for the iterative solution to work properly.

PROCESS DESIGN CALCULATIONS

IV. Calc. the Prod. Rate and Mass of VSS and TSS in Aeration Basin

bpCOD/pCOD =	0.554	**nbVSS** =	115.9	mg/L
Aeration Tank VSS Production Rate, **$P_{X,VSS}$** =	7928	lb VSS/day		
Aeration Tank TSS Production Rate, **$P_{X,TSS}$** =	9656	lb TSS/day		
Mass of **MLVSS** =	31,413	lb VSS	Mass of **MLSS** = 38,258	lb TSS

AER. TANK CALC'NS

V. Aeration Tank Calculations (User input needed in yellow cells)

Req. Aeration Vol., **$V_{aer,min}$** =	72,149	ft^3	**Click on green box & then on the arrow**	
Aer. + Membr. Vol., **V_{tot}** =	76,496	ft^3	**to select tank shape**	**rectangular**
Req. Vol. per tank, **V_{tank}** =	38,248	ft^3	**Actual Tank Width =**	38.3 ft
Calculated Tank Width =	27.6	ft	**Actual Tank Length =**	71.8 ft
Calculated Tank Length =	63.9	ft	Act. Aer. Vol., **$V_{aer,act}$** =	57,500 ft^3
Tank Wall Height =	23.7	ft	Memb. Mod. Vol/Tank:	2,173 ft^3
Aer. Detention Time, **τ_{aer}** =	6.9	hr	**MLVSS** =	6,979 mg/L
Vol. BOD Loading =	91.4	lb BOD/d/1000 ft^3		
F:M ratio =	0.210	lb BOD/d/lb MLVSS		
Sludge Wasting Rate, **Q_w** =	217,112	gal/day		

OXYGEN/AIR/BLOWER REQUIREMENTS

VI. User Inputs - Enter values in yellow cells only

Standard O_2 transf. Effic., **SOTE** = (from diffuser mfr or vendor)	30.0%	Design Elevation above Sea Level, **Elev** =	225	ft
		ambient air Temp., **T_{amb}** =	70	°F
Ratio of oxygen transfer rate in wastewater to that in clean water, **α** =	0.5	Diffuser Fouling Factor, **F** =	0.8	
Ratio of D.O. saturation in ww to that in clean water at same T & P, **B** =	1.0	Depth of Diffuser, **d_{diff}** =	21.7	ft
D.O sat'n conc. for clean water at ww temp. & 1 atm, **C_s** =	9.3 mg/L	Pressure drop across diffuser, **ΔP_{diff}** = (from diffuser mfr or vendor)	10.8	in H_2O

NOTE: Derivation of the equation for **C_s** as a function of **T_{ww}** is shown in wksht 7.

VII. Air Requirement/Blower Design Calculations

Barom. Pressure, **P_{atm}** =	14.6	psia	Des. Air Flow Rate, **SCFM:**	4,311	scfm
Pressure at Mid Depth, **P_D** =	19.3	psia			
Standard Air Density, **ρ_{air}** = (from Ideal Gas Law)	0.07521	lb/ft^3	Des. Air Flow Rate, **ACFM:** (at delivery point)	2591	acfm
O_2 Utilization Rate, **m_{O2}** =	8,976	lb/day	Blower Outlet Press., **P_{B2}** =	24.38	psia
Actual O_2 transf. Efficiency, **AOTE** =	8.33%				

(This is the air flow rate needed for the aeration tank, typically provided by a fine bubble diffuser system.)

ALKALINITY REQUIREMENT

VIII. User Inputs and Constants - Enter value in yellow cell only

Target Effluent Alkalinity =	20	mg/L as $CaCO_3$
Equiv. Weight of $CaCO_3$ =	50	g/equiv.
Equiv. Weight of $NaHCO_3$ =	84	g/equiv.
Alkalinity used for Nitrification =	7.14	g $CaCO_2$/g NH_3-N

IX. Calculation of Alkalinity Requirement

Alkalinity used for Nitrification =	320.8	mg/L as $CaCO_3$
Alkalinity needed =	40.8	mg/L as $CaCO_3$
Alkalinity needed =	1,021	lb/day as $CaCO_3$
Sodium Bicarbonate needed per day to maintain alkalinity =	1,716	lb/day $NaHCO_3$

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rectangular
cylindrical

Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

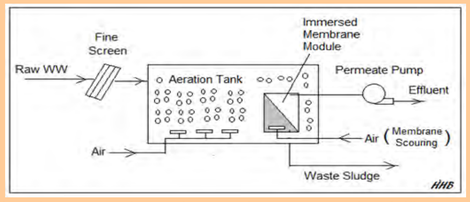
Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

As noted in all four of the above references, MLSS and X_w for MBR processes are typically in the range from 8,000 to 12,000 mg/L.



Flow Diagram - Membrane Bioreactor for BOD Removal & Nitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process

Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

Equations Used in the Calculations:

μ_{mn} at $T_{ww} = (\mu_{mn\_20})*\theta_{\mu mn}^{[(Tww-32)/1.8)-20]}$

k_{dn} at $T_{ww} = (k_{mn\_20})*\theta_{Kdn}^{[(Tww-32)/1.8)-20]}$

K_n at $T_{ww} = (K_{n\_20})*\theta_{Kn}^{[(Tww-32)/1.8)-20]}$

$\mu_n = [\mu_{mn}*NH_4\text{-}N_e/(K_n + NH_4\text{-}N_e)]*[DO_o/(0.5 + DO_o)] - k_{dn}$

Theor. $SRT = 1/\mu_n$

Design $SRT = (\text{Theor. } SRT)FS$ (**FS** = TKN Peak/Ave Factor)

μ_m at $T_{ww} = (\mu_{m\_20})*\theta_{\mu m}^{[(Tww-32)/1.8)-20]}$

k_d at $T_{ww} = (k_{m\_20})*\theta_{Kdn}^{[(Tww-32)/1.8)-20]}$ $\quad bCODo = 1.6*BODo$

$S = K_s*[1 + (k_d*SRT)]/[SRT*(\mu_m - k_d) - 1]$

$P_{x,bio} = (Q_o*Y*(\mu_m - k_d)*8.34/(1 + (k_d*SRT)))$
$+ (f_d*k_d*Q_o*Y*(\mu_m - k_d)SRT*8.34/(1 + (k_d*SRT)))$
$+ (Q_o*Y_n*NO_x*8.34/(1 + (k_{dn}*SRT)))$

$NO_x = TKN_o - NH_4\text{-}N_e - [(0.12\ P_{x,bio}/8.34)/Q_o]$

$bpCOD/pCOD = (bCOD/BOD)*(BOD_o - sBOD_o)/(COD_o - sCOD_o)$

$nbVSS = [1 - (bpCOD/pCOD)]VSS_o$

$P_{x,VSS} = P_{x,bio} + (Q_o*nbVSS*8.34)$ $\quad P_{x,TSS} = P_{x,VSS} + [Q_o(TSS_o - VSS_o)8.34]$

Mass of **MLVSS** $= P_{X,VSS}*SRT$ $\quad$ Mass of **MLSS** $= P_{X,TSS}*SRT$

Required Aeration Volume = $V_{aer,min} = (\text{Mass of MLSS}/(MLSS*8.34))*(10^6/7.48)$

Aeration Detntion Time, $\tau = (V_{aer,act}*7.48/10^6)*N*24/Q_o$

Vol. BOD Loading = $Q_o*BOD_o*8.34/((V_{aer,act}/1000)*N)$

$MLVSS = MLSS(\text{Mass of MLVSS/Mass of MLSS})$

$F\text{:}M \text{ ratio} = Q_o*8.34*BOD_o/((MLVSS*8.34*(V_{aer,act}*7.48/10^6)*N))$

$Q_w = ((N*V_{aer,act}*7.48/10^6)*MLSS/(SRT*X_w))*10^6$

Air Requirement/Blower Design Calculations

$P_{atm} = 14.696*EXP[-32.17*MW_{air}*Elev/(g_c*R*T_{amb})]$

This equation for P_{atm} as a function of elev. above sea level and ambient temperature comes from:
Water Reuse: Issues, Technologies, and Applications, Sec. 2.2

$P_D = P_{atm} + (62.4*d_{diff}/2)/144$ $\quad \rho_{air} = MW_{air}*P_{std}/(10.73*(T_{std} + 459.67))$

lb/day O_2: $m_{O2} = Q_o*8.34*(BOD_o - BODe)/f - (1.42*P_{x,VSS}) + (4.57*Q_o*8.34*NO_x)$

This equation for oxygen utilization rate comes from:
Nalco Water Handbook, 4th Ed., Ch. 23 Eqns 23.6 and 23.7

The equation below for the actual oxygen transfer efficiency, AOTE, is found as
Design of Water Resource Recovery Facilities, 6th Ed., Equation 12.32

$$AOTE = SOTE\ \alpha\ F\ \frac{\left(B\left(\frac{P_D}{P_{std.}}\right)C_s - C_L\right)}{C_{ss}}\ \theta^{(Tww-20)}$$

Note that for use in this equation Tww must be converted to °C

Design Air Flow Rate, $SCFM = (m_{O2}/AOTE)*MW_{air}/(O_2\_\text{mole fraction}*MW\_O_2*\rho_{air}\_std*60*24$

Design Air Flow Rate, $ACFM = SCFM*(P_{std}/P_{blower})*((T_{ww} + 459.67)/(T_{std} + 459.67))$

Blower Outlet Press., $P_{B2} = P_{atm} + \Delta P_{diff}*0.036126 + 62.4*d_{diff}/144$

Alkalinity used for Nitrification, $Alk_{Nitrif} = 7.14*NOx$ mg/L as $CaCO_3$

Alkalinity needed = $Alk_{Nitrif} + Alk_{Effl} - Alk_o$ mg/L as $CaCO_3$

Alkalinity needed $Alk\_perday = (Alk_{Nitrif} + Alk_{Effl} - Alk_o)Qo*8.34$ lb/day as $CaCO_3$

Sodium Bicarbonate needed to maintain alkalinity = $Alk\_perday*84/50$ lb/day $NaHCO_3$

MBR WW Treatment Process Design Calculations - U.S. Units
PreAnoxic Denitrification

This worksheet makes the design calculations for preanoxic denitrification basin(s) to go with the Aeration Tank(s) designed for BOD removal and Nitrification in Worksheet 4. (Wastewater parameters/characteristics and biological kinetic coefficients entered on Worksheet 2 will also be used in this worksheet)

INPUTS

I. User Inputs - Enter values in yellow cells only

Effluent Nitrate conc., N_e =	5.0	mg/L	Mixing Energy		
Nitrate conc. in RAS, N_{RAS} =	5.0	mg/L	for Anoxic Reactor =	0.38	hp/10^3 ft^3
Temp. Coeff. For **SDNR** =	1.026	.	Design % Excess		
Tank Freeboard =	2.3	ft	Nitrif. Capacity =	2%	
No. of Anoxic Tanks, N_{an} =	2	.	Liquid Depth in Tank =	22	ft
Est. of detention time, t_{an} =	0.9654	hr	Tank L:W ratio =	1	

Note that an initial estimate is needed for anoxic detention time in cell D19 to start an iterative calculation of minimum required anoxoc detention time below.

(Tank L:W ratio is only used for rectangular tanks)

PROCESS DESIGN CALCULATIONS

II. Calculate RAS Ratio and Anoxic Tank Active Biomass Conc.

RAS ratio, **RAS** =	7.99	Aer. Tank Act. Biomass, P_{xb} =	4609	lb/d
An. Tank MLSS, $MLSS_{AN}$ =	7554	mg/L		
Aeration Tank Active Biomass Fraction, $X_{aer,b}$ =	0.4773			
Anoxic Tank Active Biomass Conc., $X_{an,b}$ =	3606	mg/L		

III. Calc Feed Rate of NO_x to Anoxic Tank and Anoxic Tank Volume

Flow rate to Anoxic Tank =	24.0	MGD		
(RAS flow containing nitrate)		Anoxic Tank Volume, V_{an} =	16,132	ft^3
NO_x rate to Anoxic Tank =	999	lb/day	(based on detention time value in cell D19)	

IV. Calculate the SDNR (Specific Denitrification Rate)

Anoxic Tank **F/M** ratio =	2.8979	lb BOD/day/lb MLVSS	
rbCODo/bCODo ratio =	0.1275		
Next lower rbCOD/bCOD value from table =		0.1	
Next higher rbCOD/bCOD value from table =		0.2	
SDNR for rbCOD/bCOD =	0.1	is equal to	0.26899
SDNR for rbCOD/bCOD =	0.2	is equal to	0.33855
SDNR for rbCOD/bCOD =	0.1275	is equal to	0.2881 (at 20°C)
SDNR at T_{ww} =	0.2808	lb NO_3-N/day/lb biomass (at T_{ww})	

TANK VOLUME AND DIMENSIONS

V. Calculate Anoxic Tank Volume, Dimensions, and Detention Time

NO_3-N reduction capacity =	1019	lb/day	% Excess Nitrif Capacity = 2.0%
Difference between Design and Calculated % Excess Nitrif. Capacity =	0.000		
Anoxic Tank min. Vol, V_{an} =	16,132	ft^3	
Min. Anoxic Det'n Time, t_{an} =	0.97	hr	

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the V_{an} and t_{an} values as follows: Place the cursor on the green cell G64 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell" G64 "To value:" 0, "By changing cell:" D19, and click on "OK". The calculated values of V_{an} and t_{an} will be in cells D66 and D68. Cell G64 should be zero if the process worked right. A preliminary estimate for t_{an} is needed in cell D19 in order for the iterative solution to work.

Min. Vol. per tank, V_{tank} =	8,066	ft^3	Click on green box & then on the arrow	
Calculated Tank Width =	19.3	ft	to select tank shape	rectangular
Calculated Tank Length =	19.3	ft	Actual Tank Width =	28.0 ft
Tank Wall Height =	24.0	ft	Actual Tank Length =	38.0 ft
			Act. Tank Liq. Vol. =	23,089 ft^3
Anoxic Detention Time, τ_{an} =	2.763	hr	(Preanoxic Tank Liquid Volume)	

FINAL CALCULATIONS

VI. Calc. Revised Air Requirement & Alkalinity Requirement, Mixing Power & Sludge Wasting Rate

Oxygen Credit =	2857	lb/day	equals:	119.1 lb/hr
O_2 Utilization Rate =	255	lb/hr		
Required Air Flow Rate (in Aeration Tank), SCFM =			2938.6	SCFM
Required Air Flow Rate (in Aeration Tank), ACFM =			1766.0	ACFM

Alkalinity Produced =	142.6	mg/L as $CaCO_3$	
Alkalinity Needed =	-101.7	mg/L as $CaCO_3$	
Alkalinity Needed =	-2546	lb/day as $CaCO_3$	
Sodum Bicarbonate Needed per Day to Maintain Alkalinity (lb/day $NaHCO_3$) =			-4277

Required Anoxic Tank Mixing Power =	17.5	hp
Sludge Wasting Rate =	254,094	gal/day

Discussion and References

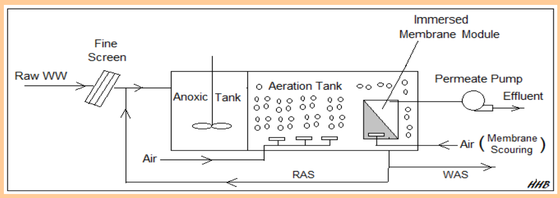
For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes



Membrane Bioreactor for Preanoxic Denitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process
Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

RAS ratio, $RAS = (NO_x/N_{RAS}) - 1$
Aer Tank Act. Biomass, $P_{xb} = [Q_o*Y*(bCOD_o - S)*8.34]/[1 + (k_d*SRT)]$
Anaer. Tank MLSS, $MLSS_{AN} = [RAS/(RAS + 1)]\ MLSS_w$
Aeration Tank Active Biomass Fraction, $X_{aer,b} = P_{xb}/P_{x,vss}$
Anoxic Tank Active Biomass Conc., $X_{an,b} = X_{aer,b}*MLSS_{AN}$

Flow Rate to Anoxic Tank , $Q_{AN} = RAS*Q_o$
NO_x Rate to Anoxic Tank $= Q_{AN}*N_{RAS}*8.34$
Anoxic Tank Volume, $V_{an} = (Q_o*10^6/7.48)*t_{AN}/24$

Anoxic Tank F:M ratio, $F:M = Q_o*BOD_o*8.34/((V_{an}*7.48/10^6)*X_{an,b}/8.34)$

Coefficients for: $SDNR = b_o + b_1\ [ln(F:M)]$

rbCOD/bCOD	b_o	b_1
0.1	0.186	0.078
0.2	0.213	0.118
0.3	0.235	0.141
0.4	0.242	0.152
0.5	0.27	0.162
0.10	0.1860	0.0780
0.20	0.2130	0.1180

The SDNR equation, coefficient values, and temperature correction equations are from: Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery* , 5th Ed., McGraw-Hill, 2014

Note that for F:M < 0.5, SDNR at 20°C is calculated as: $SDNR = 0.24*F:M$

$SDNR$ at $T_{ww} = (SDNR$ at $20^oC)*\theta_{SDNR}^{[(Tww-32)/1.8)-20]}$

NO_3-N reduction capacity $= (V_{an}*7.48/10^6)*SDNR*X_{an,b}*8.34$

% Excess Nitrif. Capac. = $\frac{(NO_3\text{-N Reduction Capacity} - NO_x\text{ Rate to Anoxic Tank})}{NO_x\text{ Rate to Anoxic Tank}}$

Min. Anoxic Det'n Time, $t_{an} = V_{an}*24/(Q_o*10^6/7.48)$

Min. Vol. per Tank, $V_{tank} = V_{an}/N_{an}$

Oxygen credit for nitrate reduction $= 2.86\ Q_o(NO_x - N_e)$

Alkalinity produced by nitrate reduction $= 3.57(NO_x - N_e)$

Sludge Wasting Rate:
$Q_w = [(V_{aer}*MLSS + V_{anox}*X_b)/SRT)]/(TSS_w)$

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rectangular
cylindrical

Near-Term Conditions

WW INFORMATION

BIOL. KINETIC COEFFICIENTS

CONSTANTS

MBR WW Treatment Process Design Calculations - U.S. Units
User Inputs and Constants

I. Wastewater Parameters/Characteristics

Enter values in yellow cells only.

Design ww Flow Rate, Q_o =	3.51	MGD	Influent TSS, TSS_o =	329	mg/L
Influent BOD, BOD_o =	420	mg/L	Influent VSS, VSS_o =	260	mg/L
Influent sBOD, $sBOD_o$ =	168	mg/L			
			Influent TKN, TKN_o =	70	mg/L
Influent COD, COD_o =	857	mg/L	TKN peak/ave factor, FS =	1.0	
Influent sCOD, $sCOD_o$ =	129	mg/L	Influent NH_4-N, NH_4-N_o =	42	mg/L
Influent rbCOD, $rbCOD_o$ =	86	mg/L	Influent Alkalinity, Alk_o = (mg/L as $CaCO_3$)	300	
ratio, bCOD/BOD =	1.6		Aeration WW Temp, T_{ww} =	66.2	°F

II. Biological Kinetic Coefficients - For BOD Removal

Synth. Yield Coeff., Y =	0.40	lb VSS/lb bCOD	Half Veloc. Coeff., K_s =	20	mg/L
Temp coeff., q, for mm =	1.07		Temp coeff., q, for kd =	1.04	
			Resid. biomass fract., f_d =	0.15	
Max spec. gwth rate at 20°C, μ_{m20} =	6	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{d20} =	0.12	lb VSS/d/lb VSS			

III. Biological Kinetic Coefficients - For Nitrification

Synth. Yield Coeff., Y_n =	0.12	lb VSS/lb NOx			
Temp coeff., q, for mmn =	1.070		Half Veloc. Coeff. at 20°C, K_n =	0.7	mg/L
Temp coeff., q, for kdn =	1.040		Half Veloc. Coeff. at 20°C, K_o =	0.5	mg/L
Temp coeff., q, for Kn =	1.053		Temp coeff., q, for Ko =	1	
Max spec. gwth rate at 20°C, μ_{mn20} =	0.8	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{dn20} =	0.08	lb VSS/d/lb VSS			

IV. Constants Used in the Calculations

			Saturation D.O. in water		
Ratio of BOD_5 to BOD_u, f =	0.68		at 20°C & 1 atm, C_{ss} =	9.17	mg/L
BOD_u equiv. of VSS =	1.42	lb BOD_u/lb VSS	Standard Pressure =	14.7	psi
Spec Wt of water, γ_{H2O} =	62.4	lb/ft^3	Standard Temperature =	68.0	°F
Mol. Wt. of Air =	28.97		Mol. Wt. of Oxygen =	32.0	
Temp Coeff. for O_2 rate, θ =	1.024		O_2 mole fraction in Air =	0.209	

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Activated Sludge Kinetic Coefficients for heterotrophic bacteria at 20°C (for BOD removal)

Coefficient	Unit	Range	Typical Value
μ_m	kg VSS/day/kg VSS	3.0 - 13.2	6.0
K_s	mg/L bCOD	5.0 - 40.0	20.0
Y	kg VSS/day/kg bCOD	0.30 - 0.50	0.40
k_d	kg VSS/day/kg VSS	0.06 - 0.20	0.12
f_d	dimensionless	0.08 - 0.20	0.15
θ values for temperature corrections			
for μ_m	dimensionless	1.03 - 1.08	1.07
for k_d	dimensionless	1.03 - 1.08	1.04
for K_s	dimensionless	1.00	1.00

The source for the values in the table above is:
Introduction to Water Resource Recovery Facility Design, 2nd Ed., Table 6.1

Activated Sludge Nitrification Kinetic Coefficients at 20°C

Coefficient	Unit	Range	Typical Value
μ_{mn}	kg VSS/day/kg VSS	0.2 - 0.90	0.75
K_n	mg/L NH_4-N	0.50 - 1.0	0.74
Y_n	kg VSS/kg NH_4-N	0.10 - 0.15	0.12
k_{dn}	kg VSS/day/kg VSS	0.05 - 0.15	0.08
K_o	mg/L	0.40 - 0.60	0.50
θ values for temperature corrections			
for μ_{mn}	dimensionless	1.06 - 1.123	1.07
for k_{dn}	dimensionless	1.03 - 1.08	1.04
for K_n	dimensionless	1.03 - 1.123	1.053

The source for the values in the table above is:
Introduction to Water Rsource Recovery Facility Design, 2nd Ed., Table 6.2

INPUTS

CALCULATIONS

MBR WW Treatment Process Design Calculations - U.S. Units
Membrane Module Sizing Calculations

I. Membrane/Membrane Module Parameters

(Values typically available from membrane manufacturer or vendor - Enter values in yellow cells)

Module packing density, ϕ =	148	m^2/m^3	equals	45.0	ft^2/ft^3
Specific Aer. Demand, **SAD_M** =	0.2	m^3 air/hr/m^2 membrane			
		equals	0.656	ft^3 air/hr/ft^2 membrane	

II. Process Design Calculations (done by worksheet)

Membrane Flux, **J** =	21.1	L/hr/m^2	equals	0.518	gal/hr/ft^2
Membrane Area, **A_M** =	282,113	ft^2			
Membrane Module Vol., **V_M** =	6,271	ft^3			
Scouring Air Flow Required =	3,085	ft^3/min (ACFM) =		3,071	SCFM

(This is the scouring air flow rate needed for the membrane module, typically provided by a coarse bubble diffuser system.)

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Values given for MBR specific area (module packing density) range from 150 -334 m^2/m^3 in Table 8-35 of Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery, 5th Ed.,* McGraw-Hill, 2014

Equations Used in the Calculations:

Module packing density, ϕ, in ft^2/ft^3 = (ϕ in m^2/m^3)/3.28084

Specific Aeration Demand, **SAD_M**, in ft^3 air/hr/ft^2 membrane =
= SAD_M in m^3 air/hr/m^2 membrane/3.28084

Membrane Flux, **J,** in L/hr/m^2 = 0.4056**T_{ww}** - 5.7278 (with **T_{ww}** in ^oF)
(See Worksheet 6 for derivation of this eqution)

Membrane Flux, **J**, in gal/hr/ft^2 = [(Membrane Flux (**J**) in L/hr/m^2)/3.7854]/(3.28084^2)

Membrane Area, **A_M = $(Q_o*10^6/24)/J$**

Membrane Module Volume, **V_M = A_M/ϕ**

Scouring Air Flow Required, **ACFM** = **$(SAD_M)(A_M)/60$** ACFM

Scouring Air Flow Req'd, **SCFM** = (**ACFM**)[(T_{std} + 459.67)/(T_{ww} + 459.67)](P_{atm}/P_{std}) SCFM

MBR WW Treatment Process Design Calculations - U.S. Units

BOD Removal and Nitrification

INPUTS

I. User Inputs - Enter values in yellow cells only

			Target Effluent Concentrations:		
MLSS in Aer Tank, **MLSS** =	8,500	mg/L	**BOD_e** =	10	mg/L
MLSS in Waste Sludge, **X_w** =	8,500	mg/L	**TSS_e** =	10	mg/L
DO in Aer. Tank, **DO_o** =	2	mg/L	**NH_4-N_e** =	1.0	mg/L
Number of Aeration Tanks =	2		Tank Freeboard =	2.0	ft
Liquid Depth in Tank =	22	ft	Tank L:W ratio =	2.3	
Initial Estimate of **NO_x** =	44.93	mg/L	**(Tank L:W ratio is only used for rectangular tanks)**		
Note that an initial estimate is needed for NO_x in cell D14 to start an iterative calculation of NO_x below. 80% of the influent TKN is suggested for this initial estimate. 80% of TKN_o =	56.0	mg/L	Influent TKN, **TKN_o** = (value transferred from Worksheet 2)	70	mg/L

PROCESS DESIGN CALCULATIONS

II. Calculate Design SRT

μ_{mn} at T_{ww} =	0.70	lb VSS/d/lb VSS	K_n at T_{ww} =	0.70	mg/L
k_{dn} at T_{ww} =	0.08	lb VSS/d/lb VSS	Theor. SRT =	3.96	days
μ_n =	0.25	lb VSS/d/lb VSS	Design **SRT** =	3.96	days

III. Calculate the Biomass Production Rate

μ_m at T_{ww} =	5.61	lb VSS/d/lb VSS	**bCODo** =	672	mg/L
k_d at T_{ww} =	0.1154	lb VSS/d/lb VSS	**S** =	1.404	mg bCOD/L

Biomass Production Rate, $P_{x,bio}$ = 5883 lb VSS/day

IV. Determine the Amount of Nitrogen Oxidized to Nitrate

Calculated amount of nitrogen oxidized to nitrate, **NO_x** =	44.932	mg/L
Difference between estimated and calculated values **NO_x** =	0.00000	mg/L

Goal Seek Result:

Amount of nitrogen oxidized to nitrate, **NO_x** = **44.93** mg/L

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the NO_x value as follows: Place the cursor on the green cell G42 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell:" G42, "To value:" 0, "By changing cell:" D14, and click on "OK". The calculated value of NO_x will appear in cell F44 and G42 should be zero if the process worked properly. Note that cell D14 needs an initial estimate for NO_x in order for the iterative solution to work properly.

IV. Calc. the Prod. Rate and Mass of VSS and TSS in Aeration Basin

bpCOD/pCOD =	0.554	**nbVSS** =	115.9	mg/L
Aeration Tank VSS Production Rate, $P_{X,VSS}$ =	9276	lb VSS/day		
Aeration Tank TSS Production Rate, $P_{X,TSS}$ =	11298	lb TSS/day		
Mass of **MLVSS** =	36,753	lb VSS	Mass of **MLSS** = 44,762	lb TSS

AER. TANK CALC'NS

V. Aeration Tank Calculations (User input needed in yellow cells)

Req. Aeration Vol., $V_{aer,min}$ =	84,415	ft^3	**Click on green box & then on the arrow**		
Aer. + Membr. Vol., V_{tot} =	90,686	ft^3	**to select tank shape**	**rectangular**	
Req. Vol. per tank, V_{tank} =	45,343	ft^3	**Actual Tank Width =**	38.3	ft
Calculated Tank Width =	30.0	ft	**Actual Tank Length =**	71.8	ft
Calculated Tank Length =	69.6	ft	Act. Aer. Vol., $V_{aer,act}$ =	56,538	ft^3
Tank Wall Height =	23.7	ft	Memb. Mod. Vol/Tank:	3,135	ft^3
Aer. Detention Time, τ_{aer} =	5.8	hr	**MLVSS** =	6,979	mg/L
Vol. BOD Loading =	108.8	lb BOD/d/1000 ft^3			
F:M ratio =	0.250	lb BOD/d/lb MLVSS			
Sludge Wasting Rate, Q_w =	213,479	gal/day			

VI. User Inputs - Enter values in yellow cells only

Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice

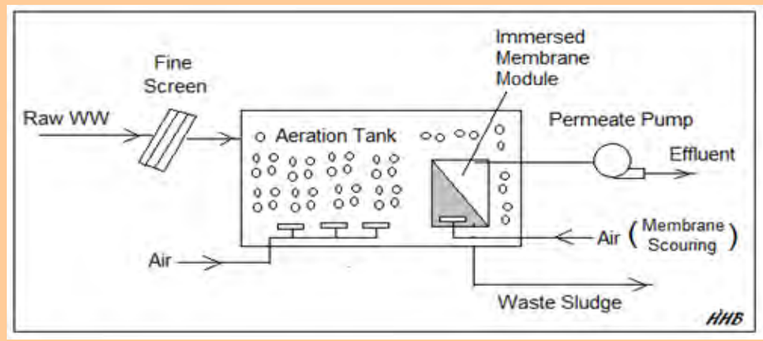
Section 23.8, Membrane Bioreactor Design Practice

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As noted in all four of the above references, MLSS and X_w for MBR processes are typically in the range from 8,000 to 12,000 mg/L.



Flow Diagram - Membrane Bioreactor for BOD Removal & Nitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process

Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

Equations Used in the Calculations:

μ_{mn} at $T_{ww} = (\mu_{mn\_20})*\theta_{\mu mn}^{[((Tww-32)/1.8)-20]}$

k_{dn} at $T_{ww} = (k_{mn\_20})*\theta_{kdn}^{[((Tww-32)/1.8)-20]}$

K_n at $T_{ww} = (K_{n\_20})*\theta_{Kn}^{[((Tww-32)/1.8)-20]}$

$\mu_n = [\mu_{mn}*NH_4\text{-}N_e/(K_n + NH_4\text{-}N_e)]*[DO_o/(0.5 + DO_o)] - k_{dn}$

Theor. $SRT = 1/\mu_n$

Design $SRT = (\text{Theor. } SRT)FS$ (FS = TKN Peak/Ave Factor)

μ_m at $T_{ww} = (\mu_{m\_20})*\theta_{\mu m}^{[((Tww-32)/1.8)-20]}$

k_d at $T_{ww} = (k_{m\_20})*\theta_{kd}^{[((Tww-32)/1.8)-20]}$

$bCODo = 1.6*BODo$

$S = K_s*[1 + (k_d*SRT)]/[SRT*(\mu_m - k_d) - 1]$

$P_{x,bio} = (Q_o*Y*(\mu_m - k_d)*8.34/(1 + (k_d*SRT)))$
$+ (f_d*k_d*Q_o*Y*(\mu_m - k_d)SRT*8.34/(1 + (k_d*SRT)))$
$+ (Q_o*Y_n*NO_x*8.34/(1 + (k_{dn}*SRT)))$

$NO_x = TKN_o - NH_4\text{-}N_e - [(0.12\ P_{x,bio}/8.34)/Q_o]$

$bpCOD/pCOD = (bCOD/BOD)*(BOD_o - sBOD_o)/(COD_o - sCOD_o)$

$nbVSS = [1 - (bpCOD/pCOD)]VSS_o$

$P_{x,VSS} = P_{x,bio} + (Q_o*nbVSS*8.34)$ $P_{x,TSS} = P_{x,VSS} + [Q_o(TSS_o - VSS_o)8.34]$

Mass of $MLVSS = P_{X,VSS}*SRT$ Mass of $MLSS = P_{X,TSS}*SRT$

Required Aeration Volume = $V_{aer,min} = (\text{Mass of MLSS}/(MLSS*8.34))*(10^6/7.48)$

Aeration Detntion Time, $\tau = (V_{aer,act}*7.48/10^6)*N*24/Q_o$

Vol. BOD Loading = $Q_o*BOD_o*8.34/((V_{aer,act}/1000)*N)$

$MLVSS = MLSS(\text{Mass of MLVSS/Mass of MLSS})$

$F\text{:}M \text{ ratio} = Q_o*8.34*BOD_o/((MLVSS*8.34*(V_{aer,act}*7.48/10^6)*N))$

$Q_w = ((N*V_{aer,act}*7.48/10^6)*MLSS/(SRT*X_w))*10^6$

Air Requirement/Blower Design Calculations

$P_{atm} = 14.696*EXP[-32.17*MW_{air}*Elev/(g_c*R*T_{amb})]$

OXYGEN/AIR/BLOWER REQUIREMENTS

Standard O_2 transf. Effic., **SOTE** = (from diffuser mfr or vendor)	30.0%		Design Elevation above Sea Level, **Elev** =	225	ft
			ambient air Temp., T_{amb} =	70	°F
Ratio of oxygen transfer rate in wastewater to that in clean water, **α** =	0.5		Diffuser Fouling Factor, **F** =	0.8	
Ratio of D.O. saturation in ww to that in clean water at same T & P, **B** =	1.0		Depth of Diffuser, d_{diff} =	21.7	ft
D.O sat'n conc. for clean water at ww temp. & 1 atm, C_s =	9.3	mg/L	Pressure drop across diffuser, ΔP_{diff} = (from diffuser mfr or vendor)	10.8	in H_2O

NOTE: Derivation of the equation for C_s as a function of T_{ww} is shown in wksht 7.

VII. Air Requirement/Blower Design Calculations

Barom. Pressure, P_{atm} =	14.6	psia	Des. Air Flow Rate, **SCFM:**	5,044	scfm
Pressure at Mid Depth, P_D =	19.3	psia			
Standard Air Density, ρ_{air} = (from Ideal Gas Law)	0.07521	lb/ft^3	Des. Air Flow Rate, **ACFM:** (at delivery point)	3031	acfm
O_2 Utilization Rate, m_{O2} =	10,502	lb/day	Blower Outlet Press., P_{B2} =	24.38	psia
Actual O_2 transf. Efficiency, **AOTE** =	8.33%				

(This is the air flow rate needed for the aeration tank, typically provided by a fine bubble diffuser system.)

ALKALINITY REQUIREMENT

VIII. User Inputs and Constants- Enter value in yellow cell only

Target Effluent Alkalinity =	20	mg/L as $CaCO_3$
Equiv. Weight of $CaCO_3$ =	50	g/equiv.
Equiv. Weight of $NaHCO_3$ =	84	g/equiv.
Alkalinity used for Nitrification =	7.14	g $CaCO_2$/g NH_3-N

IX. Calculation of Alkalinity Requirement

Alkalinity used for Nitrification =	320.8	mg/L as $CaCO_3$
Alkalinity needed =	40.8	mg/L as $CaCO_3$
Alkalinity needed =	1,195	lb/day as $CaCO_3$
Sodium Bicarbonate needed per day to maintain alkalinity =	2,007	lb/day $NaHCO_3$

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This equation for P_{atm} as a function of elev. above sea level and ambient temperature comes from:
Water Reuse: Issues, Technologies, and Applications, Sec. 2.2

$P_D = P_{atm} + (62.4*d_{diff}/2)/144$ $\rho_{air} = MW_{air}*P_{std}/(10.73*(T_{std} + 459.67))$

lb/day O_2: $m_{O2} = Q_o*8.34*(BOD_o - BODe)/f - (1.42*P_{x,VSS}) + (4.57*Q_o*8.34*NO_x)$

This equation for oxygen utilization rate comes from:
Nalco Water Handbook, 4th Ed., Ch. 23 Eqns 23.6 and 23.7

The equation below for the actual oxygen transfer efficiency, AOTE, is found as
Design of Water Resource Recovery Facilities, 6th Ed., Equation 12.32

$$AOTE = SOTE\ \alpha\ F\ \frac{\left(B\left(\frac{P_D}{P_{std.}}\right)C_s - C_L\right)}{C_{ss}}\ \theta^{(Tww-20)}$$

Note that for use in this equation Tww must be converted to °C

Design Air Flow Rate, **$SCFM = (m_{O2}/AOTE)*MW_{air}/(O_2\_mole\ fraction*MW\_O_2*\rho_{air}\_std*60*24$**

Design Air Flow Rate, **$ACFM = SCFM*(P_{std}/P_{blower})*((T_{ww} + 459.67)/(T_{std} + 459.67))$**

Blower Outlet Press., **$P_{B2} = P_{atm} + \Delta P_{diff}*0.036126 + 62.4*d_{diff}/144$**

Alkalinity used for Nitrification, **$Alk_{Nitrif} = 7.14*NOx$ mg/L as $CaCO_3$**

Alkalinity needed = **$Alk_{Nitrif} + Alk_{Effl} - Alk_o$ mg/L as $CaCO_3$**

Alkalinity needed **$Alk\_perday = (Alk_{Nitrif} + Alk_{Effl} - Alk_o)Qo*8.34$ lb/day as $CaCO_3$**

Sodium Bicarbonate needed to maintain alkalinity = **$Alk\_perday*84/50$ lb/day $NaHCO_3$**

rectangular
cylindrical

MBR WW Treatment Process Design Calculations - U.S. Units
PreAnoxic Denitrification

This worksheet makes the design calculations for preanoxic denitrification basin(s) to go with the Aeration Tank(s) designed for BOD removal and Nitrification in Worksheet 4. (Wastewater parameters/characteristics and biological kinetic coefficients entered on Worksheet 2 will also be used in this worksheet)

INPUTS

I. User Inputs - Enter values in yellow cells only

Effluent Nitrate conc., N_e =	5.0	mg/L	Mixing Energy		
Nitrate conc. in RAS, N_{RAS} =	5.0	mg/L	for Anoxic Reactor =	0.38	hp/10^3 ft^3
Temp. Coeff. For **SDNR** =	1.026	.	Design % Excess		
Tank Freeboard =	2.3	ft	Nitrif. Capacity =	2%	
No. of Anoxic Tanks, N_{an} =	2	.	Liquid Depth in Tank =	22	ft
Est. of detention time, t_{an} =	0.9654	hr	Tank L:W ratio =	1	

Note that an initial estimate is needed for anoxic detention time in cell D19 to start an iterative calculation of minimum required anoxoc detention time below.

(Tank L:W ratio is only used for rectangular tanks)

PROCESS DESIGN CALCULATIONS

II. Calculate RAS Ratio and Anoxic Tank Active Biomass Conc.

RAS ratio, **RAS** =	7.99	Aer. Tank Act. Biomass, P_{xb} =	5393	lb/d
An. Tank MLSS, $MLSS_{AN}$ =	7554	mg/L		
Aeration Tank Active Biomass Fraction, $X_{aer,b}$ =	0.4773			
Anoxic Tank Active Biomass Conc., $X_{an,b}$ =	3606	mg/L		

III. Calc Feed Rate of NO_x to Anoxic Tank and Anoxic Tank Volume

Flow rate to Anoxic Tank =	28.0	MGD		
(RAS flow containing nitrate)		Anoxic Tank Volume, V_{an} =	18,875	ft^3
NO_x rate to Anoxic Tank =	1169	lb/day	(based on detention time value in cell D19)	

IV. Calculate the SDNR (Specific Denitrification Rate)

Anoxic Tank **F/M** ratio =	2.8979	lb BOD/day/lb MLVSS	
rbCODo/bCODo ratio =	0.1275		
		Next lower rbCOD/bCOD value from table =	0.1
		Next higher rbCOD/bCOD value from table =	0.2
SDNR for rbCOD/bCOD =	0.1	is equal to	0.26899
SDNR for rbCOD/bCOD =	0.2	is equal to	0.33855
SDNR for rbCOD/bCOD =	0.1275	is equal to	0.2881 (at 20°C)
SDNR at T_{ww} =	0.2808	lb NO_3-N/day/lb biomass (at T_{ww})	

TANK VOLUME AND DIMENSIONS

V. Calculate Anoxic Tank Volume, Dimensions, and Detention Time

NO_3-N reduction capacity =	1192	lb/day	% Excess Nitrif Capacity = 2.0%
Difference between Design and Calculated % Excess Nitrif. Capacity =	0.000		
Anoxic Tank min. Vol, V_{an} =	18,875	ft^3	
Min. Anoxic Det'n Time, t_{an} =	0.97	hr	

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the V_{an} and t_{an} values as follows: Place the cursor on the green cell G64 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell" G64 "To value:" 0, "By changing cell:" D19, and click on "OK". The calculated values of V_{an} and t_{an} will be in cells D66 and D68. Cell G64 should be zero if the process worked right. A preliminary estimate for t_{an} is needed in cell D19 in order for the iterative solution to work.

Min. Vol. per tank, V_{tank} =	9,437	ft^3	Click on green box & then on the arrow		
Calculated Tank Width =	20.9	ft	to select tank shape	rectangular	
Calculated Tank Length =	20.9	ft	Actual Tank Width =	28.0	ft
Tank Wall Height =	24.0	ft	Actual Tank Length =	38.0	ft
			Act. Tank Liq. Vol. =	23,089	ft^3
Anoxic Detention Time, τ_{an} =	2.362	hr	(Preanoxic Tank Liquid Volume)		

IONS

VI. Calc. Revised Air Requirement & Alkalinity Requirement, Mixing Power & Sludge Wasting Rate

Oxygen Credit =	3343	lb/day	equals:	139.3 lb/hr
O_2 Utilization Rate =	298	lb/hr		

Discussion and References

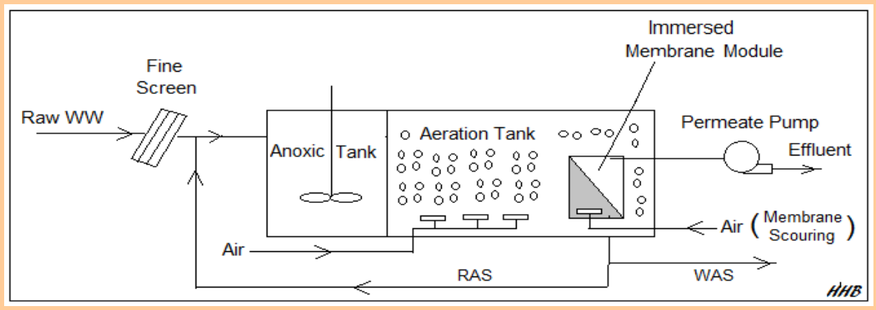
For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes



Membrane Bioreactor for Preanoxic Denitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process
Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

RAS ratio, $RAS = (NO_x/N_{RAS}) - 1$

Aer Tank Act. Biomass, $P_{xb} = [Q_o*Y*(bCOD_o - S)*8.34]/[1 + (k_d*SRT)]$

Anaer. Tank MLSS, $MLSS_{AN} = [RAS/(RAS + 1)]\ MLSS_w$

Aeration Tank Active Biomass Fraction, $X_{aer,b} = P_{xb}/P_{x,vss}$

Anoxic Tank Active Biomass Conc., $X_{an,b} = X_{aer,b}*MLSS_{AN}$

Flow Rate to Anoxic Tank, $Q_{AN} = RAS*Q_o$

NO_x Rate to Anoxic Tank $= Q_{AN}*N_{RAS}*8.34$

Anoxic Tank Volume, $V_{an} = (Q_o*10^6/7.48)*t_{AN}/24$

Anoxic Tank F:M ratio, $F:M = Q_o*BOD_o*8.34/((V_{an}*7.48/10^6)*X_{an,b}/8.34)$

Coefficients for: $SDNR = b_o + b_1\ [ln(F:M)]$

rbCOD/bCOD	b_o	b_1
0.1	0.186	0.078
0.2	0.213	0.118
0.3	0.235	0.141
0.4	0.242	0.152
0.5	0.27	0.162
0.10	0.1860	0.0780
0.20	0.2130	0.1180

The SDNR equation, coefficient values, and temperature correction equations are from: Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery*, 5th Ed., McGraw-Hill, 2014

Note that for F:M < 0.5, SDNR at 20°C is calculated as: $SDNR = 0.24*F:M$

SDNR at T_{ww} = (**SDNR** at 20°C)*$\theta_{SDNR}^{[((Tww-32)/1.8)-20]}$

NO_3-N reduction capacity $= (V_{an}*7.48/10^6)*SDNR*X_{an,b}*8.34$

% Excess Nitrif. Capac. = (NO_3-N Reduction Capacity - NO_x Rate to Anoxic Tank) / NO_x Rate to Anoxic Tank

Min. Anoxic Det'n Time, $t_{an} = V_{an}*24/(Q_o*10^6/7.48)$

Min. Vol. per Tank, $V_{tank} = V_{an}/N_{an}$

Oxygen credit for nitrate reduction $= 2.86\ Q_o(NO_x - N_e)$

Alkalinity produced by nitrate reduction $= 3.57(NO_x - N_e)$

Sludge Wasting Rate:

$Q_w = [((V_{aer}*MLSS + V_{anox}*X_b)/SRT)]/(TSS_w)$

FINAL CALCULAT

Required Air Flow Rate (in Aeration Tank), SCFM =	3438.1	SCFM
Required Air Flow Rate (in Aeration Tank), ACFM =	2066.2	ACFM

Alkalinity Produced =	142.6	mg/L as $CaCO_3$
Alkalinity Needed =	-101.7	mg/L as $CaCO_3$
Alkalinity Needed =	-2978	lb/day as $CaCO_3$

Sodum Bicarbonate Needed per Day to Maintain Alkalinity (lb/day $NaHCO_3$) = -5004

Required Anoxic Tank Mixing Power =	17.5	hp
Sludge Wasting Rate =	250,461	gal/day

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rectangular
cylindrical

Ultimate Conditions

MBR WW Treatment Process Design Calculations - U.S. Units
User Inputs and Constants

WW INFORMATION

I. Wastewater Parameters/Characteristics

Enter values in yellow cells only.

Design ww Flow Rate, Q_o =	4.12	MGD		Influent TSS, TSS_o =	329	mg/L
Influent BOD, BOD_o =	420	mg/L		Influent VSS, VSS_o =	260	mg/L
Influent sBOD, $sBOD_o$ =	168	mg/L				
				Influent TKN, TKN_o =	70	mg/L
Influent COD, COD_o =	857	mg/L		TKN peak/ave factor, FS =	1.0	
Influent sCOD, $sCOD_o$ =	129	mg/L		Influent NH_4-N, NH_4-N_o =	42	mg/L
Influent rbCOD, $rbCOD_o$ =	86	mg/L		Influent Alkalinity, Alk_o = (mg/L as $CaCO_3$)	300	
ratio, bCOD/BOD =	1.6			Aeration WW Temp, T_{ww} =	66.2	°F

BIOL. KINETIC COEFFICIENTS

II. Biological Kinetic Coefficients - For BOD Removal

Synth. Yield Coeff., Y =	0.40	lb VSS/lb bCOD	Half Veloc. Coeff., K_s =	20	mg/L
Temp coeff., q, for mm =	1.07		Temp coeff., q, for kd =	1.04	
			Resid. biomass fract., f_d =	0.15	
Max spec. gwth rate at 20°C, μ_{m20} =	6	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{d20} =	0.12	lb VSS/d/lb VSS			

III. Biological Kinetic Coefficients - For Nitrification

Synth. Yield Coeff., Y_n =	0.12	lb VSS/lb NOx				
Temp coeff., q, for mmn =	1.070		Half Veloc. Coeff. at 20°C, K_n =	0.7	mg/L
Temp coeff., q, for kdn =	1.040		Half Veloc. Coeff. at 20°C, K_o =	0.5	mg/L
Temp coeff., q, for Kn =	1.053		Temp coeff., q, for Ko =	1	
Max spec. gwth rate at 20°C, μ_{mn20} =	0.8	lb VSS/d/lb VSS			
Endog. Decay coeff. at 20°C, k_{dn20} =	0.08	lb VSS/d/lb VSS			

CONSTANTS

IV. Constants Used in the Calculations

Ratio of BOD_5 to BOD_u, f =	0.68		Saturation D.O. in water at 20°C & 1 atm, C_{ss} =	9.17	mg/L
BOD_u equiv. of VSS =	1.42	lb BOD_u/lb VSS	Standard Pressure =	14.7	psi
Spec Wt of water, γ_{H2O} =	62.4	lb/ft^3	Standard Temperature =	68.0	°F
Mol. Wt. of Air =	28.97		Mol. Wt. of Oxygen =	32.0	
Temp Coeff. for O_2 rate, θ =	1.024		O_2 mole fraction in Air =	0.209	

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Activated Sludge Kinetic Coefficients for heterotrophic bacteria at 20°C (for BOD removal)

Coefficient	Unit	Range	Typical Value
μ_m	kg VSS/day/kg VSS	3.0 - 13.2	6.0
K_s	mg/L bCOD	5.0 - 40.0	20.0
Y	kg VSS/day/kg bCOD	0.30 - 0.50	0.40
k_d	kg VSS/day/kg VSS	0.06 - 0.20	0.12
f_d	dimensionless	0.08 - 0.20	0.15
θ values for temperature corrections			
for μ_m	dimensionless	1.03 - 1.08	1.07
for k_d	dimensionless	1.03 - 1.08	1.04
for K_s	dimensionless	1.00	1.00

The source for the values in the table above is:
Introduction to Water Resource Recovery Facility Design, 2nd Ed., Table 6.1

Activated Sludge Nitrification Kinetic Coefficients at 20°C

Coefficient	Unit	Range	Typical Value
μ_{mn}	kg VSS/day/kg VSS	0.2 - 0.90	0.75
K_n	mg/L NH_4-N	0.50 - 1.0	0.74
Y_n	kg VSS/kg NH_4-N	0.10 - 0.15	0.12
k_{dn}	kg VSS/day/kg VSS	0.05 - 0.15	0.08
K_o	mg/L	0.40 - 0.60	0.50
θ values for temperature corrections			
for μ_{mn}	dimensionless	1.06 - 1.123	1.07
for k_{dn}	dimensionless	1.03 - 1.08	1.04
for K_n	dimensionless	1.03 - 1.123	1.053

The source for the values in the table above is:
Introduction to Water Rsource Recovery Facility Design, 2nd Ed., Table 6.2

INPUTS

CALCULATIONS

MBR WW Treatment Process Design Calculations - U.S. Units
Membrane Module Sizing Calculations

I. Membrane/Membrane Module Parameters

(Values typically available from membrane manufacturer or vendor - Enter values in yellow cells)

Module packing density, ϕ =	148	m^2/m^3	equals	45.0	ft^2/ft^3
Specific Aer. Demand, **SAD_M** =	0.2	m^3 air/hr/m^2 membrane			
		equals	0.656	ft^3 air/hr/ft^2 membrane	

II. Process Design Calculations (done by worksheet)

Membrane Flux, **J** =	21.1	L/hr/m^2	equals	0.518	gal/hr/ft^2
Membrane Area, **A_M** =	331,142	ft^2			
Membrane Module Vol., **V_M** =	7,361	ft^3			
Scouring Air Flow Required =	3,621	ft^3/min (ACFM) =		3,605	SCFM

(This is the scouring air flow rate needed for the membrane module, typically provided by a coarse bubble diffuser system.)

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Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

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Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes

Values given for MBR specific area (module packing density) range from 150 -334 m^2/m^3 in Table 8-35 of Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery, 5th Ed.,* McGraw-Hill, 2014

Equations Used in the Calculations:

Module packing density, ϕ, in ft^2/ft^3 = (ϕ in m^2/m^3)/3.28084

Specific Aeration Demand, **SAD_M**, in ft^3 air/hr/ft^2 membrane =
= SAD_M in m^3 air/hr/m^2 membrane/3.28084

Membrane Flux, **J,** in L/hr/m^2 = 0.4056**T_{ww}** - 5.7278 (with **T_{ww}** in ^oF)
(See Worksheet 6 for derivation of this eqution)

Membrane Flux, **J**, in gal/hr/ft^2 = [(Membrane Flux (**J**) in L/hr/m^2)/3.7854]/(3.28084^2)

Membrane Area, **A_M = $(Q_o*10^6/24)/J$**

Membrane Module Volume, **V_M = A_M/ϕ**

Scouring Air Flow Required, **ACFM** = **$(SAD_M)(A_M)/60$** ACFM

Scouring Air Flow Req'd, **SCFM** = (**ACFM**)[(T_{std} + 459.67)/(T_{ww} + 459.67)](P_{atm}/P_{std}) SCFM

MBR WW Treatment Process Design Calculations - U.S. Units

BOD Removal and Nitrification

INPUTS

I. User Inputs - Enter values in yellow cells only

			Target Effluent Concentrations:		
MLSS in Aer Tank, **MLSS** =	8,500	mg/L	**BOD_e** =	10	mg/L
MLSS in Waste Sludge, **X_w** =	8,500	mg/L	**TSS_e** =	10	mg/L
DO in Aer. Tank, **DO_o** =	2	mg/L	**NH_4-N_e** =	1.0	mg/L
Number of Aeration Tanks =	2		Tank Freeboard =	2.0	ft
Liquid Depth in Tank =	22	ft	Tank L:W ratio =	2.3	
Initial Estimate of **NO_x** =	44.93	mg/L	**(Tank L:W ratio is only used for rectangular tanks)**		
Note that an initial estimate is needed for NO_x in cell D14 to start an iterative calculation of NO_x below. 80% of the influent TKN is suggested for this initial estimate. 80% of TKN_o =	56.0	mg/L	Influent TKN, **TKN_o** = (value transferred from Worksheet 2)	70	mg/L

PROCESS DESIGN CALCULATIONS

II. Calculate Design SRT

μ_{mn} at T_{ww} =	0.70	lb VSS/d/lb VSS	K_n at T_{ww} =	0.70	mg/L
k_{dn} at T_{ww} =	0.08	lb VSS/d/lb VSS	Theor. SRT =	3.96	days
μ_n =	0.25	lb VSS/d/lb VSS	Design **SRT** =	3.96	days

III. Calculate the Biomass Production Rate

μ_m at T_{ww} =	5.61	lb VSS/d/lb VSS	**bCODo** =	672	mg/L
k_d at T_{ww} =	0.1154	lb VSS/d/lb VSS	**S** =	1.404	mg bCOD/L

Biomass Production Rate, $P_{x,bio}$ = 6906 lb VSS/day

IV. Determine the Amount of Nitrogen Oxidized to Nitrate

Calculated amount of nitrogen oxidized to nitrate, **NO_x** =	44.932	mg/L
Difference between estimated and calculated values **NO_x** =	0.00000	mg/L

Goal Seek Result:

Amount of nitrogen oxidized to nitrate, **NO_x** = **44.93** mg/L

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the NO_x value as follows: Place the cursor on the green cell G42 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell:" G42, "To value:" 0, "By changing cell:" D14, and click on "OK". The calculated value of NO_x will appear in cell F44 and G42 should be zero if the process worked properly. Note that cell D14 needs an initial estimate for NO_x in order for the iterative solution to work properly.

IV. Calc. the Prod. Rate and Mass of VSS and TSS in Aeration Basin

bpCOD/pCOD =	0.554	**nbVSS** =	115.9	mg/L
Aeration Tank VSS Production Rate, $P_{X,VSS}$ =	10888	lb VSS/day		
Aeration Tank TSS Production Rate, $P_{X,TSS}$ =	13261	lb TSS/day		
Mass of **MLVSS** =	43,141	lb VSS	Mass of **MLSS** = 52,541	lb TSS

AER. TANK CALC'NS

V. Aeration Tank Calculations (User input needed in yellow cells)

Req. Aeration Vol., $V_{aer,min}$ =	99,085	ft^3	**Click on green box & then on the arrow**		
Aer. + Membr. Vol., V_{tot} =	106,446	ft^3	**to select tank shape**	**rectangular**	
Req. Vol. per tank, V_{tank} =	53,223	ft^3	**Actual Tank Width =**	38.3	ft
Calculated Tank Width =	32.5	ft	**Actual Tank Length =**	71.8	ft
Calculated Tank Length =	75.4	ft	Act. Aer. Vol., $V_{aer,act}$ =	55,993	ft^3
Tank Wall Height =	23.7	ft	Memb. Mod. Vol/Tank:	3,680	ft^3
Aer. Detention Time, τ_{aer} =	4.9	hr	**MLVSS** =	6,979	mg/L
Vol. BOD Loading =	129.0	lb BOD/d/1000 ft^3			
F:M ratio =	0.296	lb BOD/d/lb MLVSS			
Sludge Wasting Rate, Q_w =	211,422	gal/day			

VI. User Inputs - Enter values in yellow cells only

Discussion and References

For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice

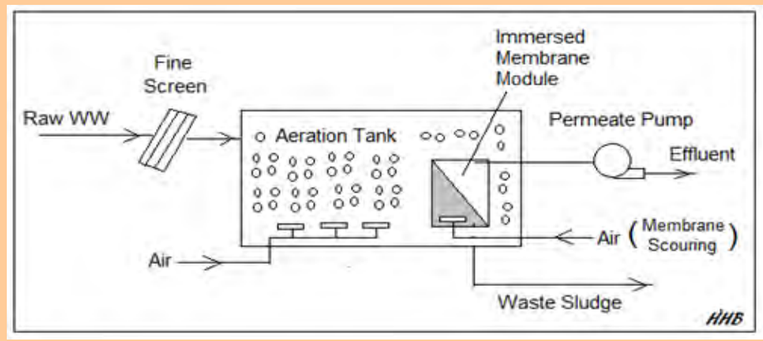
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Section 7.8, Analysis and Design of Membrane Bioreactor Processes

As noted in all four of the above references, MLSS and X_w for MBR processes are typically in the range from 8,000 to 12,000 mg/L.



Flow Diagram - Membrane Bioreactor for BOD Removal & Nitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process

Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

Equations Used in the Calculations:

μ_{mn} at $T_{ww} = (\mu_{mn\_20})*\theta_{\mu mn}^{[(Tww-32)/1.8)-20]}$

k_{dn} at $T_{ww} = (k_{mn\_20})*\theta_{kdn}^{[(Tww-32)/1.8)-20]}$

K_n at $T_{ww} = (K_{n\_20})*\theta_{Kn}^{[(Tww-32)/1.8)-20]}$

$\mu_n = [\mu_{mn}*NH_4\text{-}N_e/(K_n + NH_4\text{-}N_e)]*[DO_o/(0.5 + DO_o)] - k_{dn}$

Theor. $SRT = 1/\mu_n$

Design **SRT** = (Theor. **SRT**)**FS** (**FS** = TKN Peak/Ave Factor)

μ_m at $T_{ww} = (\mu_{m\_20})*\theta_{\mu m}^{[(Tww-32)/1.8)-20]}$

k_d at $T_{ww} = (k_{m\_20})*\theta_{kd}^{[(Tww-32)/1.8)-20]}$ **bCODo = 1.6*BODo**

$S = K_s*[1 + (k_d*SRT)]/[SRT*(\mu_m - k_d) - 1]$

$P_{x,bio} = (Q_o*Y*(\mu_m - k_d)*8.34/(1 + (k_d*SRT)))$
$+ (f_d*k_d*Q_o*Y*(\mu_m - k_d)SRT*8.34/(1 + (k_d*SRT)))$
$+ (Q_o*Y_n*NO_x*8.34/(1 + (k_{dn}*SRT)))$

$NO_x = TKN_o - NH_4\text{-}N_e - [(0.12\ P_{x,bio}/8.34)/Q_o]$

$bpCOD/pCOD = (bCOD/BOD)*(BOD_o - sBOD_o)/(COD_o - sCOD_o)$

$nbVSS = [1 - (bpCOD/pCOD)]VSS_o$

$P_{x,VSS} = P_{x,bio} + (Q_o*nbVSS*8.34)$ $P_{x,TSS} = P_{x,VSS} + [Q_o(TSS_o - VSS_o)8.34]$

Mass of **MLVSS** = $P_{X,VSS}$*SRT Mass of **MLSS** = $P_{X,TSS}$*SRT

Required Aeration Volume = $V_{aer,min} = (Mass\ of\ MLSS/(MLSS*8.34))*(10^6/7.48)$

Aeration Detntion Time, $\tau = (V_{aer,act}*7.48/10^6)*N*24/Q_o$

Vol. BOD Loading = $Q_o*BOD_o*8.34/((V_{aer,act}/1000)*N)$

MLVSS = MLSS(Mass of MLVSS/Mass of MLSS)

F:M ratio = $Q_o*8.34*BOD_o/((MLVSS*8.34*(V_{aer,act}*7.48/10^6)*N))$

$Q_w = ((N*V_{aer,act}*7.48/10^6)*MLSS/(SRT*X_w))*10^6$

Air Requirement/Blower Design Calculations

$P_{atm} = 14.696*EXP[-32.17*MW_{air}*Elev/(g_c*R*T_{amb})]$

OXYGEN/AIR/BLOWER REQUIREMENTS

Standard O_2 transf. Effic., **SOTE** = (from diffuser mfr or vendor)	30.0%		Design Elevation above Sea Level, **Elev** =	225	ft
			ambient air Temp., T_{amb} =	70	°F
Ratio of oxygen transfer rate in wastewater to that in clean water, α =	0.5		Diffuser Fouling Factor, **F** =	0.8	
Ratio of D.O. saturation in ww to that in clean water at same T & P, **B** =	1.0		Depth of Diffuser, d_{diff} =	21.7	ft
D.O sat'n conc. for clean water at ww temp. & 1 atm, C_s =	9.3	mg/L	Pressure drop across diffuser, ΔP_{diff} = (from diffuser mfr or vendor)	10.8	in H_2O

NOTE: Derivation of the equation for C_s as a function of T_{ww} is shown in wksht 7.

VII. Air Requirement/Blower Design Calculations

Barom. Pressure, P_{atm} =	14.6	psia	Des. Air Flow Rate, **SCFM:**	5,920	scfm
Pressure at Mid Depth, P_D =	19.3	psia			
Standard Air Density, ρ_{air} = (from Ideal Gas Law)	0.07521	lb/ft^3	Des. Air Flow Rate, **ACFM:** (at delivery point)	3558	acfm
O_2 Utilization Rate, m_{O2} =	12,327	lb/day	Blower Outlet Press., P_{B2} =	24.38	psia
Actual O_2 transf. Efficiency, **AOTE** =	8.33%				

(This is the air flow rate needed for the aeration tank, typically provided by a fine bubble diffuser system.)

ALKALINITY REQUIREMENT

VIII. User Inputs and Constants- Enter value in yellow cell only

Target Effluent Alkalinity =	20	mg/L as $CaCO_3$
Equiv. Weight of $CaCO_3$ =	50	g/equiv.
Equiv. Weight of $NaHCO_3$ =	84	g/equiv.
Alkalinity used for Nitrification =	7.14	g $CaCO_2$/g NH_3-N

IX. Calculation of Alkalinity Requirement

Alkalinity used for Nitrification =	320.8	mg/L as $CaCO_3$
Alkalinity needed =	40.8	mg/L as $CaCO_3$
Alkalinity needed =	1,403	lb/day as $CaCO_3$
Sodium Bicarbonate needed per day to maintain alkalinity =	2,356	lb/day $NaHCO_3$

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This equation for P_{atm} as a function of elev. above sea level and ambient temperature comes from:
Water Reuse: Issues, Technologies, and Applications, Sec. 2.2

$P_D = P_{atm} + (62.4*d_{diff}/2)/144$ $\rho_{air} = MW_{air}*P_{std}/(10.73*(T_{std} + 459.67))$

lb/day O_2: $m_{O2} = Q_o*8.34*(BOD_o - BODe)/f - (1.42*P_{x,VSS}) + (4.57*Q_o*8.34*NO_x)$

This equation for oxygen utilization rate comes from:
Nalco Water Handbook, 4th Ed., Ch. 23 Eqns 23.6 and 23.7

The equation below for the actual oxygen transfer efficiency, AOTE, is found as
Design of Water Resource Recovery Facilities, 6th Ed., Equation 12.32

$$AOTE = SOTE\ \alpha\ F\ \frac{\left(B\left(\frac{P_D}{P_{std.}}\right)C_s - C_L\right)}{C_{ss}}\ \theta^{(Tww-20)}$$

Note that for use in this equation Tww must be converted to °C

Design Air Flow Rate, **$SCFM = (m_{O2}/AOTE)*MW_{air}/(O_2\_mole\ fraction*MW\_O_2*\rho_{air}\_std*60*24$**

Design Air Flow Rate, **$ACFM = SCFM*(P_{std}/P_{blower})*((T_{ww} + 459.67)/(T_{std} + 459.67))$**

Blower Outlet Press., **$P_{B2} = P_{atm} + \Delta P_{diff}*0.036126 + 62.4*d_{diff}/144$**

Alkalinity used for Nitrification, **$Alk_{Nitrif} = 7.14*NOx$ mg/L as $CaCO_3$**

Alkalinity needed = **$Alk_{Nitrif} + Alk_{Effl} - Alk_o$ mg/L as $CaCO_3$**

Alkalinity needed **$Alk\_perday = (Alk_{Nitrif} + Alk_{Effl} - Alk_o)Qo*8.34$ lb/day as $CaCO_3$**

Sodium Bicarbonate needed to maintain alkalinity = **$Alk\_perday*84/50$ lb/day $NaHCO_3$**

rectangular
cylindrical

MBR WW Treatment Process Design Calculations - U.S. Units
PreAnoxic Denitrification

This worksheet makes the design calculations for preanoxic denitrification basin(s) to go with the Aeration Tank(s) designed for BOD removal and Nitrification in Worksheet 4. (Wastewater parameters/characteristics and biological kinetic coefficients entered on Worksheet 2 will also be used in this worksheet)

INPUTS

I. User Inputs - Enter values in yellow cells only

Effluent Nitrate conc., N_e =	5.0	mg/L	Mixing Energy		
Nitrate conc. in RAS, N_{RAS} =	5.0	mg/L	for Anoxic Reactor =	0.38	hp/10^3 ft^3
Temp. Coeff. For **SDNR** =	1.026	.	Design % Excess		
Tank Freeboard =	2.3	ft	Nitrif. Capacity =	2%	
No. of Anoxic Tanks, N_{an} =	2	.	Liquid Depth in Tank =	22	ft
Est. of detention time, t_{an} =	0.9654	hr	Tank L:W ratio =	1	

Note that an initial estimate is needed for anoxic detention time in cell D19 to start an iterative calculation of minimum required anoxoc detention time below.

(Tank L:W ratio is only used for rectangular tanks)

PROCESS DESIGN CALCULATIONS

II. Calculate RAS Ratio and Anoxic Tank Active Biomass Conc.

RAS ratio, **RAS** =	7.99	Aer. Tank Act. Biomass, P_{xb} =	6330	lb/d
An. Tank MLSS, $MLSS_{AN}$ =	7554	mg/L		
Aeration Tank Active Biomass Fraction, $X_{aer,b}$ =	0.4773			
Anoxic Tank Active Biomass Conc., $X_{an,b}$ =	3606	mg/L		

III. Calc Feed Rate of NO_x to Anoxic Tank and Anoxic Tank Volume

Flow rate to Anoxic Tank =	32.9	MGD		
(RAS flow containing nitrate)		Anoxic Tank Volume, V_{an} =	22,155	ft^3
NO_x rate to Anoxic Tank =	1372	lb/day	(based on detention time value in cell D19)	

IV. Calculate the SDNR (Specific Denitrification Rate)

Anoxic Tank **F/M** ratio =	2.8979	lb BOD/day/lb MLVSS	
rbCODo/bCODo ratio =	0.1275		
		Next lower rbCOD/bCOD value from table =	0.1
		Next higher rbCOD/bCOD value from table =	0.2
SDNR for rbCOD/bCOD =	0.1	is equal to	0.26899
SDNR for rbCOD/bCOD =	0.2	is equal to	0.33855
SDNR for rbCOD/bCOD =	0.1275	is equal to	0.2881 (at 20°C)
SDNR at T_{ww} =	0.2808	lb NO_3-N/day/lb biomass (at T_{ww})	

V. Calculate Anoxic Tank Volume, Dimensions, and Detention Time

NO_3-N reduction capacity =	1399	lb/day	% Excess Nitrif Capacity = 2.0%
Difference between Design and Calculated % Excess Nitrif. Capacity =	0.000		
Anoxic Tank min. Vol, V_{an} =	22,155	ft^3	
Min. Anoxic Det'n Time, t_{an} =	0.97	hr	

TANK VOLUME AND DIMENSIONS

NOTE: This is an iterative solution. You must use Excel's "Goal Seek" to find the V_{an} and t_{an} values as follows: Place the cursor on the green cell G64 and click on "goal seek" (in the "tools" menu or under "Data - What If Analysis" depending on the version of Excel). Enter values to "Set cell" G64 "To value:" 0, "By changing cell:" D19, and click on "OK". The calculated values of V_{an} and t_{an} will be in cells D66 and D68. Cell G64 should be zero if the process worked right. A preliminary estimate for t_{an} is needed in cell D19 in order for the iterative solution to work.

Min. Vol. per tank, V_{tank} =	11,078	ft^3	Click on green box & then on the arrow		
Calculated Tank Width =	22.6	ft	to select tank shape	rectangular	
Calculated Tank Length =	22.6	ft	Actual Tank Width =	28.0	ft
Tank Wall Height =	24.0	ft	Actual Tank Length =	38.0	ft
			Act. Tank Liq. Vol. =	23,089	ft^3
Anoxic Detention Time, τ_{an} =	2.012	hr	(Preanoxic Tank Liquid Volume)		

IONS

VI. Calc. Revised Air Requirement & Alkalinity Requirement, Mixing Power & Sludge Wasting Rate

Oxygen Credit =	3924	lb/day	equals: 163.5	lb/hr
O_2 Utilization Rate =	350	lb/hr		

Discussion and References

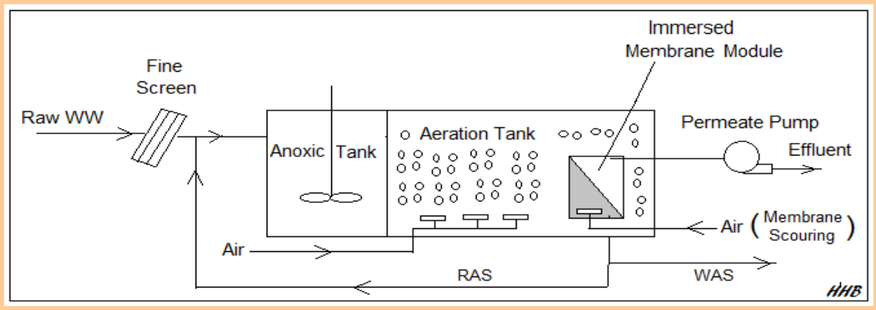
For background information about Membrane Bioreactors (MBRs) see:

Design of Water Resource Recovery Facilities, 6th Ed., Sec. 12.6 Membrane Bioreactors

Water and Wastewater Engineering: Design Principles and Practice
Section 23.8, Membrane Bioreactor Design Practice

Membrane Bioreactors: WEF MOP No. 36, Chap. 4, Membrane Bioreactor Process Design

Water Reuse: Issues, Technologies, and Applications
Section 7.8, Analysis and Design of Membrane Bioreactor Processes



Membrane Bioreactor for Preanoxic Denitrification

The biological treatment process design calculations for the MBR process are carried out using biological kinetics constants and equations typically used for completely mixed activated sludge systems as described in the following references:

Water and Wastewater Calculations Manual, 3rd Ed., Sec. 6.21, Activated Sludge Process
Handbook of Environmental Eng. Calculations, 2nd Ed., Sec. 1.7.21, Activated Sludge Process

RAS ratio, $RAS = (NO_x/N_{RAS}) - 1$

Aer Tank Act. Biomass, $P_{xb} = [Q_o*Y*(bCOD_o - S)*8.34]/[1 + (k_d*SRT)]$

Anaer. Tank MLSS, $MLSS_{AN} = [RAS/(RAS + 1)]\ MLSS_w$

Aeration Tank Active Biomass Fraction, $X_{aer,b} = P_{xb}/P_{x,vss}$

Anoxic Tank Active Biomass Conc., $X_{an,b} = X_{aer,b}*MLSS_{AN}$

Flow Rate to Anoxic Tank, $Q_{AN} = RAS*Q_o$

NO_x Rate to Anoxic Tank $= Q_{AN}*N_{RAS}*8.34$

Anoxic Tank Volume, $V_{an} = (Q_o*10^6/7.48)*t_{AN}/24$

Anoxic Tank F:M ratio, $F:M = Q_o*BOD_o*8.34/((V_{an}*7.48/10^6)*X_{an,b}/8.34)$

Coefficients for: $SDNR = b_o + b_1\ [ln(F:M)]$

rbCOD/bCOD	b_o	b_1
0.1	0.186	0.078
0.2	0.213	0.118
0.3	0.235	0.141
0.4	0.242	0.152
0.5	0.27	0.162
0.10	0.1860	0.0780
0.20	0.2130	0.1180

The SDNR equation, coefficient values, and temperature correction equations are from: Metcalf & Eddy, *Wastewater Engineering Treatment and Resource Recovery*, 5th Ed., McGraw-Hill, 2014

Note that for F:M < 0.5, SDNR at 20°C is calculated as: $SDNR = 0.24*F:M$

SDNR at T_{ww} = (**SDNR** at 20°C)*$\theta_{SDNR}^{[((Tww-32)/1.8)-20]}$

NO_3-N reduction capacity $= (V_{an}*7.48/10^6)*SDNR*X_{an,b}*8.34$

% Excess Nitrif. Capac. = (NO_3-N Reduction Capacity - NO_x Rate to Anoxic Tank) / NO_x Rate to Anoxic Tank

Min. Anoxic Det'n Time, $t_{an} = V_{an}*24/(Q_o*10^6/7.48)$

Min. Vol. per Tank, $V_{tank} = V_{an}/N_{an}$

Oxygen credit for nitrate reduction = $2.86\ Q_o(NO_x - N_e)$

Alkalinity produced by nitrate reduction = $3.57(NO_x - N_e)$

Sludge Wasting Rate:

$Q_w = [((V_{aer}*MLSS + V_{anox}*X_b)/SRT)]/(TSS_w)$

FINAL CALCULAT

Required Air Flow Rate (in Aeration Tank), SCFM =	4035.6	SCFM
Required Air Flow Rate (in Aeration Tank), ACFM =	2425.3	ACFM

Alkalinity Produced =	142.6	mg/L as $CaCO_3$
Alkalinity Needed =	-101.7	mg/L as $CaCO_3$
Alkalinity Needed =	-3496	lb/day as $CaCO_3$

Sodum Bicarbonate Needed per Day to Maintain Alkalinity (lb/day $NaHCO_3$) = -5873

Required Anoxic Tank Mixing Power =	17.5	hp
Sludge Wasting Rate =	248,404	gal/day

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rectangular
cylindrical

Appendix J – Annual Major Service and Replacement Budget

TECHNICAL MEMORANDUM

To: Clete Saunier, Public Works Director
City of Santa Paula

From: Becca Bugielski – PE | MKN & Associates, Inc.
Mike Nunley– PE | MKN & Associates, Inc.

Date: 3/4/2024

Re: Annual Major Service and Replacement Budget

1.0 Objectives

As part of the Santa Paula Wastewater Master Plan Update, MKN identified major mechanical equipment and developed recommendations for budgeting to repair and/or replace that equipment. The City of Santa Paula completed the WRF in 2010, and many of the mechanical systems have required replacement or major service since the ten-year milestone is a critical event for evaluating membranes, blowers, pumps, and other major pieces of equipment.

1.1 Purpose

The purpose of this evaluation is to allow the City to develop a budget for major service and/or replacement of critical mechanical equipment. These recommendations are based on observation of existing plant systems, cost for ongoing service, and cost for services at similar facilities or for similar pieces of equipment.

2.0 Annual Major Service and Replacement Budget

The table on the following page is based on the equipment schedules in Section 4.4 of the Draft Wastewater Master Plan Update. Five year and ten-year intervals are identified, since these are typically the major milestones or design lives for blowers, pumps, and other mechanical equipment.

Major Service and Replacement Recommendations					
		5 Year		10 Year	
Processes	Quantity	Cost Opinion	Comment	Cost Opinion	Comment
Influent Lift Station					
Pumps	4	$ 40,000	New seals and Impellers	$ 100,000	Replacement
Plug Valves	4	$ 20,000	New internals and operator service	$ 20,000	New internals and operator service
Swing-Flex Check Valves	4	$ 20,000	New internals and operator service	$ 20,000	New internals and operator service
Slide Gates	2	$ 10,000	New internals and operator service	$ 10,000	New internals and operator service
Flap Gates	2	$ 10,000	Inspection and repairs	$ 10,000	Inspection and repairs
Headworks					
Primary Screens	2	$ 30,000	New bearings and inspection/ repairs	$ 200,000	Screen replacement
Grit Vortex	2	$ 10,000	New bearings and inspection/ repairs	$ 100,000	Replacement
Grit Classifier	2	$ 15,000	New bearings and inspection/ repairs	$ 30,000	Replacement
Primary Screens Conveyor	2	$ 10,000	New bearings and inspection/ repairs	$ 100,000	Replacement
Fine Screens	2	$ 30,000	New bearings and inspection/ repairs	$ 200,000	Screen replacement
Fine Screens Conveyor	2	$ 10,000	New bearings and inspection/ repairs	$ 100,000	Replacement
Slide Gates	6	$ 30,000	New internals and operator service	$ 30,000	New internals and operator service
EQ Basins					
Slide Gates	2	$ 20,000	Inspection and repairs	$ 20,000	Inspection and repairs
Anoxic Basins					
Anoxic Mixer	3	$ 15,000	Replacement	$ 15,000	Replacement
Diversion Channel Slide Gates	3	$ 20,000	New internals and operator service	$ 20,000	New internals and operator service
Aeration Basins					
MBR Feed Pumps	3	$ 30,000	New seals and Impellers	$ 210,000	Replacement
RAS Pumps	3	$ 30,000	New seals and Impellers	$ 210,000	Replacement
Aeration Panels	207	$ 100,000	Replace panels	$ 100,000	Replace panels
Biological Aeration Blowers	4	$ 200,000	Inspection and repairs	$ 400,000	Replacement
ML Collection and MLSS Recirculation Channels					
WAS Pumps	2	$ 20,000	New seals and Impellers	$ 140,000	Replacement

Mud Valves	6	$ 30,000	New internals and operator service	$ 30,000	New internals and operator service
Slide Gates	3	$ 30,000	Inspection and repairs	$ 30,000	Inspection and repairs
Channel Aeration Blowers	2	$ 100,000	Inspection and repairs	$ 200,000	Replacement
MBR Filtration Modules					
Mud Valves	6	$ 30,000	New internals and operator service	$ 30,000	New internals and operator service
Membrane Filtration Modules	24	$ 50,000	Inspection and repairs	$ 250,000	Replacement
Permeate Pumps	6	$ 60,000	New seals and impellers	$ 420,000	Replacement
Membrane Module Aeration	3	$ 150,000			
UV Disinfection					
UV Modules	10	$ 50,000	Inspect modules and replace lamps	$ 100,000	Replace modules and lamps
UV Air Flush-out Compressor	1	$ 15,000	Replacement	$ 15,000	Replacement
Automatic Level Gate	2	$ 20,000	Inspection and repairs	$ 20,000	Inspection and repairs
Channel Weir Gates	2	$ 20,000	Inspection and repairs	$ 20,000	Inspection and repairs
CIP Storage Tanks and Foam Spray System					
CIP Pumps	2	$ 60,000	Replacement	$ 60,000	Replacement
Chemical Metering/Injection Pumps	2	$ 20,000	Replacement	$ 20,000	Replacement
Foam Spray Pumps	2	$ 20,000	Replacement	$ 20,000	Replacement
Foam Spray Nozzles	270	$ 50,000	Inspection and repairs	$ 100,000	Inspection and repairs
Storage Tank Drain - Mud Valves	2	$ 10,000	New internals and operator service	$ 10,000	New internals and operator service
Solids Processing System					
Gravity Belt Thickeners	2	$ 50,000	Inspection and repairs	$ 300,000	Replacement
Digester Blowers	3	$ 150,000	Inspection and repairs	$ 300,000	Replacement
Rethickening Pumps	2	$ 20,000	New seals and impellers	$ 140,000	Replacement
Screw Press Feed Pumps	1	$ 10,000	New seals and impellers	$ 70,000	Replacement
Screw Press	1	$ 30,000	Inspection and repairs	$ 150,000	New internals and motor
Polymer Units	3	$ 15,000	Inspection and repairs	$ 60,000	Replacement
Odor Control System					

Foul Air Blower	1	$ 10,000	Inspection and repairs	$ 50,000	Replacement
Biological Trickling Filter	1	$ 100,000		$ 100,000	
Total (Rounded)		**$ 1,800,000**		**$ 4,600,000**	

Notes

1) ENR LA CCI (Jan 2024) = 15299.7
2) Future Costs have not been escalated. It is assumed costs will be escalated during development of the rate study.

As shown in the attached table, 5-year major expenditures of $1.8M and 10-year expenditures of $4.6M should be anticipated by the City. These costs are not escalated, but it is recommended the City budget annually to build reserves for payment of these expenses. An annual allocation of $640,000, with annual escalation as recommended by the City's financial consultant, would allow the City to prepare to cover these anticipated costs at these 5- and 10-year milestones.

TECHNICAL MEMORANDUM

To: Dale Goodman – Public Works Director
City of Santa Paula

From: Alex Maher, PE – Project Manager | MKN
Luis Garcia, EIT – Assistant Engineer II | MKN

Date: February 6, 2026

Re: Santa Paula Water Master Plan – Condition Assessment Technical Memorandum

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1.0 Background and Objective

1.1 Background

The City of Santa Paula (City) contracted with Michael K. Nunley & Associates, LLC (MKN), an Ardurra Group, Inc. (Ardurra) company, to assist in the development of a comprehensive Water System Capital Improvement Plan (CIP) to identify infrastructure improvements needed to meet existing and future water demands. As part of this effort, MKN was tasked with conducting site assessments of aboveground potable water facilities. These assessments included site visits and facility walk-throughs, with the findings documented in this Technical Memorandum (TM) to support the development of the CIP.

The City owns and operates various aboveground potable water facilities. The facilities included in the scope of this assessment are listed below:

- **Storage Facilities (7 Total):** Anderson Tank, Case Tank, Cherry Hill Tank, Fuchsia Tank, Limoneira Tank, Peck Tank, and Main Reservoir
- **Booster Pump Stations (BPS; 7 Total):** Anderson BPS, Canyon BPS, Glade BPS (inactive), Park BPS, Terracina No. 1 BPS (inactive), Terracina No. 2 BPS, and View Drive BPS (abandoned)
- **Production Wells and Treatment (5 Total):** Well 1-B, Well 11, Well 12, Well 13, and Well 14

Maps showing the general locations of each facility can be found in **Appendix A.**

1.2 Report Objective

The purpose of this assessment report is to summarize the existing condition of select potable water facilities and provide recommendations for future improvements to support the City in developing CIP budgets for upcoming fiscal years.

This TM documents the condition of each potable water storage tank, well site, and BPS as well as the Steckel Conditioning Facility. Structural and seismic evaluations were performed by MKN's subconsultant Buehler Engineering, Inc. (Buehler) while underwater inspections and heavy metals analyses of the storage facilities were conducted by MKN's subconsultant CSI Services (CSI).

This report does not include assessments of belowground facilities or pipelines, which were outside the scope of work.

2.0 Observations

MKN and Buehler visited the City's aboveground facilities July 9-10, 2025. Characteristics such as site layout, general condition of facilities, site safety features, and types of equipment present were documented. Condition and functionality of electrical and instrumentation features were not assessed.

In addition to MKN and Buehler's field observations, CSI performed interior tank dive inspections for the Anderson, Peck, Case, Cherry Hill, Fuchsia, and Limoneira Tanks. These detailed inspection reports, along with a tank priority matrix prepared by CSI summarizing relative interior and exterior coating condition and maintenance priority, were incorporated into the evaluation presented in this section.

Site assessment forms that were completed by MKN and Buehler for each site visited can be found in **Appendix B**, while the full CSI inspection reports and priority matrix are included in **Appendix C**.

2.1 Tank Sites

The following assessments are based on site visits conducted by all parties, as well as review of the individual maintenance inspection reports and tank priority rankings prepared by CSI. Seismic evaluations, conducted by Buehler, were performed in accordance with ASCE 7-22 using default Site Class D seismic design parameters due to the absence of geotechnical information for the tank sites.

In general, the tank sites appear to be reasonably well maintained, with exceptions noted in the individual evaluations. However, many of the tanks share common deficiencies, such as age-related wear, structural concerns, and outdated safety features that reflect the age and original construction of these facilities. Multiple tanks fail to meet current AWWA D100 code requirements for anchorage, shell plate thickness, and freeboard, and several have foundation or settlement conditions that cannot be corrected without major reconstruction. While selective rehabilitation (e.g., recoating, minor structural repairs, drainage improvements) may extend short-term service

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life, such work will not address the underlying structural limitations associated with the tank's age and original construction. Given these conditions, it is recommended that the City consider full tank replacement as it may provide a more reliable and cost-effective long-term solution.

2.1.1 Anderson Tank

Overview

The Anderson Tank is located on North Peck Road and was constructed in 1953. The site consists of a 620,000-gallon aboveground welded steel tank. No concrete foundation or seismic anchorage was observed, but based on the tank's age and construction era, it is likely supported on a buried granular or oil sand base rather than a concrete foundation. Access to the site is limited and requires foot travel via a steep, degraded asphalt path.

The tank serves the 200-foot (ft) pressure zone, along with the Main Reservoir and Limoneira Tank, and is supplied by the City's groundwater wells.

Figure 2-1: Anderson Tank



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Tank Characteristics

A summary of the characteristics of the Anderson Tank is presented in **Table 2-1** below. Information is based on site observations and information provided by the City.

Table 2-1: Anderson Tank Summary				
Year Installed	**Type**	**Capacity (MG*)**	**Diameter (ft)**	**Shell Height (ft)**
1953	Steel	0.62	50	42
**MG = million gallon*				

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** Piping is in poor condition with visible signs of corrosion and inadequate support. Flexible couplings are not present at the inlet and outlet. The drain valve is partially buried, and the tank connection is missing. A cracked thrust anchor was also observed. Corrosion was observed at the sample ports and outlet penetrations.
- ***Foundation/Chime Condition –*** No concrete foundation, gravel ring, or other defined support structure was visible at the site. Gunite applied at the base is failing, and burrowing animal activity was noted around the tank perimeter, which could further undermine structural stability. Tank settlement was observed, with up to approximately 3 inches of differential elevation between high and low sides.
- ***Coating Condition –***
    - *Exterior:* The paint system on the exterior was found to be relatively thin and in poor condition on the roof but in good condition on the shell. All surfaces on the roof have isolated spot rust and areas of peeling. The overall system is severely weathered and has poor adhesion.
    - *Interior:* The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. Spot peeling and cracking were observed throughout the roof. The shell was found to be in poor condition with areas of dark rust and pitting especially within the mean water-level segment of the shell.
- ***Site Access and Grading –*** Site access is poor. Grading issues were observed, with soil sloped directly up to tank piping and the tank wall, which may lead to accelerated corrosion and hinder maintenance access. Overall drainage at the site is poor.
- ***Site Security –*** The perimeter fencing is compromised, with visible gaps underneath that could allow unauthorized entry or animal intrusion.
- ***Level Monitoring Systems –*** The level monitoring system appears to be present, though functionality was not verified during the site visit.
- ***Cathodic Protection –*** No cathodic protection system present.

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- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio exceeds the allowable threshold for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard, perform ultrasonic testing to evaluate wall thickness, and add a ringwall footing and anchorage system or lower operating level to reduce seismic uplift demand.
- ***General –*** The retaining wall near the tank is showing signs of failure. Roof vents are box-style. Electrical components in the area are corroded.

2.1.2 Case Tank

Overview

The Case Tank is located on North Ojai Road, across Santa Paula Creek from Steckel Park. Constructed in 1966, this 500,000-gallon tank is an aboveground welded steel tank. No concrete foundation or seismic anchorage was observed, but based on the tank's age and construction era, it is likely supported on a buried granular or oil sand base rather than a concrete foundation. It serves as the only storage facility within the 900-ft pressure zone.

Vehicle access to the site is currently limited due to a landslide and the lack of a paved access road; the tank can currently only be reached by foot. The Case Tank is supplied by the Canyon BPS.

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Figure 2-2: Case Tank



Tank Characteristics

A summary of the characteristics of the Case Tank is presented in **Table 2-2** below. Information is based on site observations and information provided by the City.

Table 2-2: Case Tank Summary				
Year Installed	**Type**	**Capacity (MG)**	**Diameter (ft)**	**Shell Height (ft)**
1966	Steel	0.50	60	24

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** Outlet piping is exposed and not properly restrained. Hose tap on-site was found unlocked and lacks an access tap.
- ***Foundation/Chime Condition –*** The tank rests on a gravel base. Stakes were noted around the tank perimeter being used as support. Sediment and soil have built up against the tank, covering the gravel ring, particularly along the northeast side, where the grade appears to be approximately one foot above the tank base. Evidence of a prior slope failure and continued hillside movement was noted.
- ***Coating Condition –***

  - *Exterior:* The paint system was found to be relatively thin and in fair condition. The exterior surfaces have only isolated spot rust, and the paint appears to have significantly weathered from chalking. Adhesion at the shell was found to be moderate and satisfactory on the roof.
  - *Interior:* The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout the roof with dark corrosion appearing from undercutting. Lining on the shell was found to be in fair condition with areas of dark rust. A large amount of sediment was found upon the tank bottom but spot checks revealed the lining to be in good condition.

- ***Site Access and Grading –*** Access to the site is poor due to steep and narrow unpaved roadways. Grading is inadequate, with no formal drainage in place. Runoff appears to flow toward the rear of the site, where bank erosion was reported during a storm event two years ago.
- ***Site Security –*** The site is enclosed by a barbed wire fence; however, there is no chain link or solid barrier present.
- ***Level Monitoring Systems –*** A water depth gauge board was present and appeared to be functional.
- ***Cathodic Protection –*** A cathodic protection system was present and appeared to be inactive.
- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio exceeds the allowable threshold for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard, perform ultrasonic testing to evaluate wall thickness, and add a ringwall footing and anchorage system or lower operating level to reduce seismic uplift demand.
- ***General –*** The site is overgrown with vegetation and shows signs of ongoing slope movement and erosion.

2.1.3 Cherry Hill Tank

Overview

The Cherry Hill Tank was constructed in 1954 and is located west of State Highway 150. The site consists of a 470,000-gallon aboveground welded steel tank resting on an oil sand foundation with a gravel grade band. Access to the site is via an unpaved dirt road, which is in poor condition. The tank serves the 400-ft east pressure zone and is supplied primarily by the Park BPS.

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Figure 2-3: Cherry Hill Tank



Tank Characteristics

A summary of the characteristics of the Cherry Hill Tank is presented in **Table 2-3** below. Information is based on site observations and information provided by the City.

Table 2-3: Cherry Hill Tank Summary				
Year Installed	**Type**	**Capacity (MG)**	**Diameter (ft)**	**Shell Height (ft)**
1954	Steel	0.50	66	21

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** A sample tap is present but lacks a secure lock. Overflow piping is contributing to localized erosion around the tank footing. No other issues with visible piping or valve components were noted during the assessment.

- ***Foundation/Chime Condition –*** Visible portions indicate chime is in fair condition. Erosion from the overflow discharge piping is visibly affecting the area surrounding the tank footing. A retrofit of the bank was reportedly performed in 1985, though the long-term stability of the slope should be further evaluated. The tank is constructed on an uneven slope. The lower shell plates have a height difference of approximately 21 to 24 inches noted along the base perimeter. One tank shell segment appears to be welded on only three sides.
- ***Coating Condition –***
    - *Exterior:* The paint on the roof is in good condition with minimal chalking. Dark rust was present in areas where paint was peeling. At the shell, the paint system is in good condition. Adhesion at the shell was found to be moderate and satisfactory on the roof.
    - *Interior:* The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout the roof with dark corrosion appearing from undercutting. Lining on the shell was found to be in fair condition with areas of dark rust. A large amount of sediment was found upon the tank bottom but spot checks revealed the lining to be in good condition.
- ***Site Access and Grading –*** Site access is limited. The access gate is not set back from the adjacent roadway, making vehicle entry and maneuvering difficult. On-foot access is possible but constrained. The tank is located on a steep slope, and grading around the tank is poor, contributing to drainage issues and erosion.
- ***Site Security –*** A gate is present but poorly situated near the roadway. The site fencing is a chain link fence with barbed wire type. Additional measures such as securing the sample tap and confirming overall perimeter protection are recommended.
- ***Level Monitoring Systems –*** A water depth gauge board was present and appeared to be functional.
- ***Cathodic Protection –*** A cathodic protection system was present and appeared to be operational.
- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio was found to be within acceptable limits for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard and perform ultrasonic testing to evaluate wall thickness.
- ***General –*** The site shows evidence of rodent activity. The tank ladder does not include any fall protection features.

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2.1.4 Fuchsia Tank

Overview

The Fuchsia Tank is located at the end of 10th Street, within a residential neighborhood on Coronado Circle. Constructed in 1955, the site consists of a 500,000-gallon aboveground welded steel tank. No concrete foundation or seismic anchorage was observed, but based on the tank's age and construction era, it is likely supported on a buried granular or oil sand base rather than a concrete foundation. Access to the site is provided via a well-paved road, though maneuverability around the tank is limited due to a narrow perimeter. The tank serves the 400-ft east pressure zone and is supplied primarily by the Park BPS.

Figure 2-4: Fuchsia Tank



Tank Characteristics

A summary of the characteristics of the Fuchsia Tank is presented in **Table 2-4** below. Information is based on site observations and information provided by the City.

Table 2-4: Fuchsia Tank Summary

Year Installed	Type	Capacity (MG)	Diameter (ft)	Shell Height (ft)
1955	Steel	0.50	60	24

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** An altitude valve is present and actively leaking. Two manways were noted on the tank and appear to be in good condition. No other significant piping deficiencies were observed.
- ***Foundation/Chime Condition –*** The tank does not have a concrete foundation and is supported directly on soil. Settlement was measured at up to 2.2 inches, with the tank settling toward the uphill side. Evidence of burrowing animals was observed beneath tank edges. Localized shell deformation consistent with an “elephant foot bulge” was observed at the tank base.
- ***Coating Condition –***
    - *Exterior:* The paint on the roof is in excellent condition with minimal chalking. Dark rust was present in areas where paint was peeling. At the shell, the paint system is in excellent condition. Adhesion at the shell was found to be moderate and satisfactory on the roof.
    - *Interior:* The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout the roof with dark corrosion appearing from undercutting. Lining on the shell was found to be in fair condition with areas of dark rust within tank accessories and edges. A large amount of sediment was found upon the tank bottom but spot checks revealed the lining to be in good condition.
- ***Site Access and Grading –*** The road around the tank is narrow, which may limit access for maintenance equipment. Erosion concerns are present and site drainage should be evaluated to prevent future undermining of the tank base or surrounding infrastructure.
- ***Site Security –*** Perimeter fencing is present but in poor condition. Locks were noted on the tank roof access, but overall site security should be improved to limit unauthorized access.
- ***Level Monitoring Systems –*** A water depth gauge board was present and appeared to be functional.
- ***Cathodic Protection –*** A cathodic protection system was present and appeared to be operational.
- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio exceeds the allowable threshold for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard, perform ultrasonic testing to evaluate wall thickness, and add a ringwall footing and anchorage system or lower operating level to reduce seismic uplift demand.

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2.1.5 Limoneira Tank

Overview

The Limoneira Tank is located approximately 2,000 feet west of the Cummings Road and Foothill Road intersection, situated on private property. The tank consists of a 480,000-gallon aboveground welded steel tank. No concrete foundation or seismic anchorage was observed, but based on the tank's age and construction era, it is likely supported on a buried granular or oil sand base rather than a concrete foundation. It serves the 200-ft west pressure zone and is currently active. Site access is via a dirt roadway that passes through a large orchard.

Figure 2-5: Limoneira Tank



Tank Characteristics

A summary of the characteristics of the Limoneira Tank is presented in **Table 2-5** below. Information is based on site observations and information provided by the City.

Table 2-5: Limoneira Tank Summary

Year Installed	Type	Capacity (MG)	Diameter (ft)	Shell Height (ft)
-	Steel	0.48	50	35.33

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** Coating failure was observed on exposed piping. A gauge is located on the back side of the tank. No significant valve deficiencies were noted, but piping corrosion will require attention to prevent further deterioration.
- ***Foundation/Chime Condition –*** The subgrade appears unstable. No concrete foundation, gravel ring, or other defined support structure was visible at the site. This presents a potential long-term structural concern, especially given the age of the facility.
- ***Coating Condition –***
    - *Exterior:* The paint on the roof is in poor condition with moderate chalking. Dark rust was present in areas where paint was peeling. At the shell, the paint system is in good condition. Overall, the paint system was estimated to exhibit poor adhesion.
    - *Interior:* The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and edges of roof plates. Spot peeling and cracking were observed throughout the roof. The shell surfaces were found to be covered with heavy sediment and the lining was found to be in poor condition with areas of dark rust and pitting especially within the mean water-level segment of the shell. A large amount of sediment was found upon the tank bottom but spot checks revealed the lining to be in good condition.
- ***Site Access and Grading –*** Site access is poor, which may complicate routine maintenance or emergency response. No significant grading or drainage improvements appear to have been implemented.
- ***Site Security –*** Ladder protection is inadequate, and there is no safety rail at the roof perimeter. The vent at the top of the tank lacks a screen.
- ***Level Monitoring Systems –*** The tank does not have a functioning external level gauge; water level is monitored using pressure gauge readings.
- ***Cathodic Protection –*** No cathodic protection system present.
- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio exceeds the allowable threshold for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard, perform ultrasonic testing to evaluate wall thickness, and add a ringwall footing and anchorage system or lower operating level to reduce seismic uplift demand.
- ***General –*** The tank was not in active use at the time of the site visit, and City staff indicated it is not critical for service in the west zone due to sufficient storage capacity at the Anderson Tank.

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2.1.6 Peck Tank

Overview

The Peck Tank is located at the north end of Peck Road and has a capacity of 500,000 gallons. Constructed in 1988, this aboveground welded steel tank rests on a granular berm with a steel retainer ring around the tank perimeter and is accessed via an inclined paved roadway. The facility serves the 400-ft west pressure zone, providing water to a small number of residences, and is supplied by the Anderson BPS.

Figure 2-6: Peck Tank



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Tank Characteristics

A summary of the characteristics of the Peck Tank is presented in **Table 2-6** below. Information is based on site observations and information provided by the City.

Table 2-6: Peck Tank Summary

Year Installed	Type	Capacity (MG)	Diameter (ft)	Shell Height (ft)
1988	Steel	0.50	60	24

Observations

The following field observations were made during the site assessment and dive inspection:

- ***Piping and Valve Condition –*** Pipe supports are not bolted, reducing stability and increasing the risk of joint stress or failure. A flexible connector is present, but overall piping condition warrants further evaluation. The overflow piping discharges directly to the surface, which may cause erosion or ponding.
- ***Foundation/Chime Condition –*** Severe ground settling was observed at the rear of the tank near the roadway, with elevation differences of up to 4.9 inches.
- ***Coating Condition –***
    - *Exterior:* The paint on the roof is in good condition with minimal chalking. Dark rust was present in areas where paint was peeling. At the shell, the paint system is in good condition. Adhesion at the shell was found to be moderate and satisfactory on the roof.
    - *Interior:* The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout the roof with dark corrosion appearing from undercutting. Lining on the shell was found to be in fair condition with areas of dark rust. A large amount of sediment was found upon the tank bottom but spot checks revealed the lining to be in good condition.
- ***Site Access and Grading –*** Grading and drainage around the tank are inadequate and require redesign. Surrounding asphalt concrete around the tank is in poor condition; several cracking systems were observed.
- ***Site Security –*** Security is poor, with significant graffiti present on the tank. A chain link fence with barbed wire is present. Additional protection measures, such as improved fencing and lockable gates, are recommended. Bollards should be installed around exposed piping and appurtenances.
- ***Level Monitoring Systems –*** No issues with level monitoring systems were observed.
- ***Cathodic Protection –*** A cathodic protection system was present and appeared to be operational.
- ***Seismic Evaluation –*** Structural analysis indicates the tank does not meet current seismic criteria. The overturning ratio exceeds the allowable threshold for a self-anchored tank, sliding resistance is exceeded, and shell stresses under seismic loading are greater than allowable limits. Freeboard is also inadequate. It is recommended that the City reduce the tank operating level to provide sufficient freeboard, perform ultrasonic testing to evaluate wall thickness, and add a ringwall footing and anchorage system or lower operating level to reduce seismic uplift demand.

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2.1.7 Main Reservoir

Overview

The Main Reservoir is the City's first major reservoir, built in 1896, and remains the largest potable water storage facility with a capacity of 4.4 MG. Constructed as a predominantly buried reservoir with an irregular shape, it is located near the intersection of North 10th Street and Terracina Drive. Access to the site is provided via a well-paved driveway directly off North 10th Street through a locked gate. The reservoir serves the 200-ft pressure zone and is supplied by the City's groundwater wells.

Figure 2-7: Main Reservoir



Tank Characteristics

A summary of the characteristics of the Main Reservoir is presented in **Table 2-7** below. Information is based on site observations and information provided by the City.

Table 2-7: Main Reservoir Summary				
Year Installed	**Type**	**Capacity (MG)**	**Diameter (ft)**	**Shell Height (ft)**
1896	Buried	4.4	-	30

Observations

The following field observations were made during the site assessment:

- ***Piping and Valve Condition –*** No major deficiencies in exposed piping or valves were observed.
- ***Foundation/Chime Condition –*** Tank is buried; unable to assess foundation.
- ***Coating Condition –*** Not applicable.
- ***Roof and Wall Condition –*** Roof hatches are in good condition. There is evidence of ponding on the tank roof. Fascia boards around the wall perimeter require repainting. Cracks are also observed in the surrounding shotcrete walls, with vegetation growing through concrete.
- ***Site Access and Grading –*** Site access is adequate via a paved road; however, localized grading improvements are recommended to correct ponding and improve drainage away from the structure. A V-ditch around the perimeter showed cracking with minor debris accumulation.
- ***Site Security –*** The existing perimeter fence lacks barbed wire, reducing deterrence against unauthorized access. The site does have live security monitoring, which provides some mitigation.
- ***Level Monitoring Systems –*** A HydroRanger level controller was present and appears to be operational.
- ***General –*** Potential structural concerns were noted, including signs that may indicate localized failure. The wood structural support columns should be replaced with aluminum or steel. Additional evaluation is recommended to confirm tank wall integrity. A concrete evaluation of the side walls is recommended to assess overall structural integrity. Due to the relatively short remaining useful life of this 100+ year old reservoir and the significant anticipated retrofitting cost, consider full replacement of existing reservoir with new.

2.2 Pump Stations

The assessments below are based on MKN and Buehler's observations during the site visits as well as discussions with operations staff. The City's potable water BPSs are equipped with vertical turbine pumps in a parallel configuration. All site installations are outdoors and enclosed behind fencing and/or walls. The pump station layouts generally consist of buried suction piping and above-grade discharge manifolds.

2.2.1 Anderson Booster Pump Station

Overview

The Anderson BPS is located near 639 North Peck Road, adjacent to the Anderson Tank. Access to the site is through a locked gate in the perimeter fence. The station is bordered by a hillside to the west and residential properties along North Peck Road to the east. The BPS is equipped with two vertical turbine pumps operating in parallel, which convey water to the Peck Tank.

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Figure 2-8: Anderson Booster Pump Station



Pumps and Hydraulics

Pump information and a hydraulic summary of the Anderson BPS are presented in **Table 2-8** below. Information is based on site observations and information provided by the City.

Table 2-8: Anderson Booster Pump Information and Hydraulic Summary

Pump Style	Pump Configuration	Motor Size (HP[1])	Design Capacity per Pump	Permanent Generator
Vertical Turbine	Parallel (2 pumps)	15	242 gpm[2,3]	Yes
Vertical Turbine		7.5	135 gpm[3]	Yes

Notes:

1. *HP = horsepower.*
2. *gpm = gallon per minute.*
3. *Per Southern California Edison Pump Tests dated October 11, 2024.*

Observations

The following field observations were made during the site assessment:

- ***Pump and Piping Condition –*** Piping is in poor condition with inadequate supports and visible coating deterioration.
- ***Structural Condition –*** The station is partially enclosed by concrete masonry unit (CMU) retaining walls. Cracking was observed near the embedded fence post at the top of the wall. Minor cracking was observed at slab penetrations.
- ***Electrical and Controls –*** Electrical components show signs of notable weathering and corrosion. The steel support frame for the electrical equipment shows coating failure and surface corrosion.
- ***Emergency Backup Power –*** A portable generator connection is available; however, no permanent onsite backup generator is present.
- ***Site Condition and Grading –*** Site access is acceptable. No significant grading or drainage concerns were observed.
- ***Site Security –*** A gap under the perimeter fence was observed. Additional security upgrades are recommended.

2.2.2 Canyon Booster Pump Station

Overview

The Canyon BPS is located at the northern end of the City, off State Highway 150 just north of Bridge Road. The station supplies the Case Tank through a single pump with a capacity of 137 gpm. Site access is currently open, and the area is undergoing construction due to recent landslide activity. City staff indicated this site is scheduled for a complete rehab in 2026.

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Figure 2-9: Canyon Booster Pump Station



Pumps and Hydraulics

Pump information and a hydraulic summary of the Canyon BPS are presented in **Table 2-9** below. Information is based on site observations and information provided by the City.

Table 2-9: Canyon Booster Pump Information and Hydraulic Summary

Pump Style	Pump Configuration	Motor Size (HP)	Design Capacity per Pump	Permanent Generator
Vertical Turbine	Single	Unknown	137 gpm[1]	No

Note:

1. *Per "City of Santa Paula Potable Water System Master Plan" prepared by Boyle Engineering Corp., October 2005.*

Observations

The Canyon BPS site was found to be in poor overall condition. The station is located within an area impacted by landslide activity, lacks pavement, and has no site security measures in place.

2.2.3 Glade Booster Pump Station

Overview

The Glade BPS is located on Glade Drive, north of View Drive. The pump station is currently inactive. City staff indicated that this station will be reconfigured to a pressure reducing station that will allow water from the 600-zone back to the 400-zone.

Figure 2-10: Glade Booster Pump Station



Pumps and Hydraulics

Pump information and a hydraulic summary of the Glade BPS are presented in **Table 2-10** below. Information is based on site observations and information provided by the City.

Table 2-10: Glade Booster Pump Information and Hydraulic Summary

Pump Style	Pump Configuration	Motor Size (HP)	Design Capacity per Pump	Permanent Generator
Vertical Turbine	Single	20	260 gpm[1]	No

Note:
1. *Per existing pump plate.*

Observations

The following field observations were made during the site assessment of this inactive BPS:

- ***Pump and Equipment Condition –*** The station is inactive, and the equipment appears to be in poor condition.
- ***Piping Condition –*** Above-grade piping is deteriorated and shows signs of corrosion. Connections and supports are inadequate.
- ***Structural and Building Condition –*** The CMU enclosure housing the pump is set on a slope and retains soil on multiple sides. The walls appeared in good condition with no major cracks observed. The slab-on-grade foundation showed only minor cracking.
- ***Electrical and Controls –*** Electrical equipment is outdated and inactive. Corrosion was noted.
- ***Site Condition and Grading –*** Access to the site is through a CMU wall. Grading is not adequate for reliable long-term use.
- ***Site Security –*** Security features are minimal, with no fencing or barriers to restrict access.

2.2.4 Park Booster Pump Station

Overview

The Park BPS is located north of Park Street, between Mill Street and Ojai Road. The station operates with two parallel vertical turbine pumps that primarily serve the Ojai Road area. In addition, the Park BPS supplies water to both the Fuchsia Tank and Cherry Hill Tank within the 400-ft pressure zone.

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Figure 2-11: Park Booster Pump Station



Pumps and Hydraulics

Pump information and a hydraulic summary of the Park BPS are presented in **Table 2-11** below. Information is based on site observations and information provided by the City.

Table 2-11: Park Booster Pump Information and Hydraulic Summary

Pump Style	Pump Configuration	Motor Size (HP)	Design Capacity per Pump	Permanent Generator
Vertical Turbine	Parallel (2 pumps)	40	696 gpm[1]	No
Vertical Turbine		50	889 gpm[1]	No

Note:

1. *Per Southern California Edison Pump Tests dated April 26, 2024.*

Observations

The following field observations were made during the site assessment:

- ***Pump and Equipment Condition –*** Pump seals were observed leaking when the pumps were off. Pump #2 was not in use due to cracked supports. Additionally, the cooling fan on Pump #2 was cracked. Pedestals for the pumps have cracking and the pump sole plate is not anchored to the pedestal.
- ***Piping Condition –*** Piping appeared functional, with no major deficiencies observed. The slabs at pipe supports have extensive cracking with exposed rebar. Pipe stands are anchored.
- ***Electrical and Controls –*** Electrical equipment was in place but should be reviewed to ensure compliance.
- ***Site Condition and Grading –*** Site access is acceptable. No significant grading or drainage concerns were observed.
- ***Site Security –*** Security at the site is poor. Site lighting, security cameras, and intrusion alarms were not evident.

2.2.5 Terracina No. 1 Booster Pump Station

Overview

The Terracina No. 1 BPS is located near Terracina Drive and North 10th Street. This station is currently inactive; however, it can be used as a backup to the Park BPS. The facility was originally constructed to supply the Teague Tank within the 400-ft pressure zone.

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Figure 2-12: Terracina No. 1 Booster Pump Station



Observations

The station is inactive and shows limited signs of upkeep. Minor site deficiencies were noted, including worn equipment and lack of recent maintenance. No active pumping or operational systems are in service at this location.

2.2.6 Terracina No. 2 Booster Pump Station

Overview

The Terracina No. 2 BPS is located near Terracina Drive and North 10th Street. The station consists of two primary vertical turbine pumps, a fire pump, associated aboveground piping and appurtenances, and electrical and controls equipment. The pumps and electrical systems are housed within a CMU building, while the onsite generator is located adjacent to the building within a walled enclosure secured by a locked gate. The Terracina No. 2 BPS boosts water to both Mesa Tanks within the 600-ft pressure zone.

Figure 2-13: Terracina No. 2 Booster Pump Station



Pumps and Hydraulics

Pump information and a hydraulic summary of the Terracina No. 2 BPS are presented in **Table 2-12** below. Information is based on site observations and information provided by the City.

Table 2-12: Terracina No. 2 Booster Pump Information and Hydraulic Summary

Pump Style	Pump Configuration	Motor Size (HP)	Design Capacity per Pump	Permanent Generator
Vertical Turbine (primary)	Parallel	60	425 gpm[1]	Yes
Vertical Turbine (primary)		60	425 gpm[1]	
Vertical Turbine (fire)		200	1,500 gpm[1]	

Note:

1. *Per existing pump plates.*

Observations

The following field observations were made during the site assessment:

- ***Pump and Piping Condition –*** Primary pumps and the fire pump are understood to be in good working condition. Pump and pipe coatings appear to be in good condition. Piping appears to be in good working condition. Sufficient check and isolation valves are in place and are understood to be in good working condition. Steel pipe supports are in place and appear to be in good condition.
- ***Metering and Pressure Monitoring –*** Magnetic flow meters are in place and are understood to be in good working condition. Pressure gauges are present and appear to be in good working condition.
- ***Emergency Backup Power –*** A permanent backup power generator is in place and understood to be in good working condition.
- ***Site Condition and Grading –*** Site access via the adjacent road appears to be sufficient. No significant grading or drainage concerns were observed.
- ***Site Security –*** Pump station facilities are secured inside a locked building. Site lighting, cameras, and intrusion alarms were present and appear to be functioning.

2.2.7 View Drive Booster Pump Station

Overview

The View Drive BPS is located near View Drive and Bradley Street. This station is currently inactive but was originally constructed to supply the Teague Tank within the 400-ft pressure zone.

Figure 2-14: View Drive Booster Pump Station



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Observations

The View Drive BPS is currently inactive and not in service. The site shows evidence of structural and site deterioration, including a failing wall, poor security features, and lack of drainage. Electrical components appear outdated, and pumps are not operational. Discussions with City staff indicated potential interest in repurposing the site for backfeed to another zone; however, the station is not currently functional nor contributing to the active distribution system.

2.3 Well Sites

The assessments below are based on MKN and Buehler's site visits and discussions with operators. The City's potable water wells consist of primarily vertical turbine pumps.

2.3.1 Well 1-B

Overview

Well 1-B is located within the City's Palm Maintenance Yard at South Palm Avenue and Ventura Street. The well historically supplied water to the 200-ft pressure zone tanks and, unlike other sources, does not pump through the Steckel Conditioning Facility but directly into the City's distribution system. Water produced at this site is treated with sodium hypochlorite for disinfection and sodium polyphosphate for corrosion control.

Recently, City staff reported that the well began producing sand, leading to its removal from active service. City has indicated that Well 1-B has been permanently inactivated and will require abandonment in the near term.

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Figure 2-15: Well 1-B



Well Site Characteristics

A summary of the characteristics of the Well 1-B site is presented in **Table 2-13** below. Information is based on site observations and information provided by the City.

Table 2-13: Well 1-B Summary

Type	Motor Size (HP)	Reported Production Rate	Emergency Generator
Vertical Turbine	150	1,200 gpm	No

Observations

The following field observations were made during the site assessment:

- ***Well and Pumping Equipment –*** The pump is not securely bolted to its base and the 10-inch steel discharge piping shows signs of age. Well is on standby due to production of sand.
- ***Site Security –*** The maintenance yard is surrounded by a chain link fence with barbed wire and a locked gate. The well site within the yard is surrounded by a chain link fence and locked gate.
- ***Emergency Backup Power –*** A generator was not present.
- ***Onsite Treatment –*** The hypochlorite feed system is in poor condition. Tubing is broken and not adequately covered. The line to the injector is exposed. The hypochlorite shed

foundation shows slab spalling but no major movement. Siding and trim are weathered and in poor condition.

- ***Electrical –*** Electrical equipment is outdated and shows signs of wear.

2.3.2 Well 11

Overview

Well 11 is located on Cemetery Road, north of Main Street, and supplies water to the 200-ft pressure zone. This well discharges to the City's distribution system through the Steckel Conditioning Facility. The design capacity of the well is approximately 1,300 gpm.

Figure 2-16: Well 11



Well Site Characteristics

A summary of the characteristics of the Well 11 site is presented in **Table 2-14** below. Information is based on site observations and information provided by the City.

Table 2-14: Well 11 Summary

Type	Motor Size (HP)	Reported Production Rate	Emergency Generator
Vertical Turbine	150	1,300 gpm	No

Observations

The following field observations were made during the site assessment:

- ***Well and Pumping Equipment –*** The pump is mounted to a concrete pad in good condition, but it is not securely anchored. Corrosion was observed on the pump mounting plate and pipe stands. Piping supports are either not bolted or not in contact with the pipe. Piping coatings are in poor to fair condition. Operating pressure was reported at approximately 105 pounds per square inch.
- ***Electrical and Controls –*** Electrical equipment is mounted to a galvanized steel structure and concrete slab, which are in good condition. Electrical equipment appears outdated, and generator connections would benefit from replacement.
- ***Chemical Feed Systems –*** The sodium hypochlorite shed is prefabricated fiber-reinforced polymer construction. The slab foundation is obscured by secondary containment. Anchorage is not visible and the storage tank is not anchored. Hypochlorite tubing is exposed, and the secondary containment conduit is not secure.
- ***Site Condition and Drainage –*** Surface drainage is inadequate, with the drain discharging into a creek and contributing to bank erosion. Asphalt concrete paving at the site is in poor condition, with weeds growing through pavement cracks and joints. The bypass discharge building is not secure.
- ***Site Security and Protection –*** Site is located in a residential area and surrounded by a chain link fence and roller gate in poor condition. Barbed wire on the fencing is broken. No bollards are present around critical features such as exposed piping.

2.3.3 Well 12

Overview

Well 12 is located at the southeast part of the City, south of State Route 126 on Lemonwood Drive. The well supplies water to the 200-ft pressure zone and is equipped with an onsite iron and manganese removal facility prior to discharge into the City's distribution system. The well has a design capacity of approximately 1,500 gpm.

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Figure 2-17: Well 12





Well Site Characteristics

A summary of the characteristics of the Well 12 site is presented in **Table 2-15** below. Information is based on site observations and information provided by the City.

Table 2-15: Well 12 Summary			
Type	**Motor Size (HP)**	**Reported Production Rate**	**Emergency Generator**
Vertical Turbine	150	1,500 gpm	Yes

Observations

The following field observations were made during the site assessment:

- ***Well and Pumping Equipment –*** The site includes surge protection with three vessels plus one additional vessel. Piping and appurtenances appear to be in fair condition. The level gauge is broken. Unsecured ball valves were observed on the side of the backwash tank. The well pump pedestal shows cracks and the pump anchorage was not visible.
- ***Electrical and Controls –*** The electrical building is in poor condition. Electrical components are functional but aged.
- ***Emergency Backup Power –*** A portable generator was present.
- ***Chemical Feed Systems –*** The hypochlorite fill line includes a live valve that is not locked. Containment for hypochlorite storage appears inadequate. Tanks inside the chemical shed are unanchored, and the shed exterior shows deterioration and corrosion at the fascia.
- ***Tanks and Appurtenances –*** The 57,200-gallon bolted backwash tank, constructed in 1994, is anchored and in good condition. Cracks were observed in the tank foundation. The external galvanized ladder is in good condition. Three Trusco tanks supported on unbraced legs are in good condition, with anchorage intact. The pipe rack system, consisting of wide flange steel frames with Unistrut supports, appears in good condition.
- ***Site Security –*** The well is located in an industrial area, surrounded by a CMU wall and locked gate. The site has security camera monitoring. However, signs of graffiti and vandalism indicate that the existing security monitoring is not fully effective.

2.3.4 Well 13

Overview

Well 13 is located on Cemetery Road north of Santa Barbara Road. The well supplies water to the 200-ft pressure zone and is controlled by the Anderson Tank and Main Reservoir. It pumps through the Steckel Conditioning Facility prior to discharge into the City's distribution system. The well has a capacity ranging from approximately 1,800 to 2,220 gpm, depending on pump speed.

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Figure 2-18: Well 13



Well Site Characteristics

A summary of the characteristics of the Well 13 site is presented in **Table 2-16** below. Information is based on site observations and information provided by the City.

Table 2-16: Well 13 Summary

Type	Motor Size (HP)	Reported Production Rate	Emergency Generator
Vertical Turbine	300	1,800 gpm	No

Observations

The following field observations were made during the site assessment:

- ***Well and Pumping Equipment –*** The pump is anchored to a 50-inch square pad and has large cracks visible. Piping and supports show minor corrosion and coating failure. Pump operation can be controlled automatically based on tank level, but this functionality is currently not working per operators.

- ***Chemical Feed Systems –*** Sodium hypochlorite tubing is unprotected. The building exhaust fan used for chemical ventilation is not working.
- ***Electrical Systems –*** The electrical room wall showed signs of efflorescence.
- ***Building and Structural Condition –*** The CMU structure housing the well is in good condition. The slab foundation has small cracks and the CMU walls have minor cracks near the large pump room opening. The fascia on the removable roof over the pump room showed rot and damage.
- ***Site Conditions and Security –*** Security at the site is poor, with graffiti present and fencing lacking barbed wire. Vandal-proof valve locks would improve protection of exposed equipment. A palm tree on the site obstructs camera views. Accessibility is restricted via a narrow road.

2.3.5 Well 14 and Steckel Conditioning Facility

Overview

Well 14 is located within the Steckel Conditioning Facility on Steckel Drive, south of Main Street near Glen City Elementary School. The well supplies water to the 200-ft pressure zone and is controlled by the Anderson Tank and Main Reservoir. It is equipped with a variable frequency drive and has a maximum pumping capacity of approximately 3,400 gpm, though flows are limited by the Steckel Conditioning Facility to around 2,800 gpm.

The Steckel Conditioning Facility, constructed in February 2000, receives water from Wells 11, 13, and 14. The facility has a maximum flow capacity of about 3,200 gpm under clean filter conditions and removes dissolved iron and manganese prior to discharge into the City's distribution system.

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Figure 2-19: Well 14 and Steckel Conditioning Facility





Well Site Characteristics

A summary of the characteristics of the Well 14 and Steckel Conditioning Facility site is presented in **Table 2-17** below. Information is based on site observations and information provided by the City.

Table 2-17: Well 14 and Steckel Conditioning Facility Summary			
Type	**Motor Size (HP)**	**Reported Production Rate**	**Emergency Generator**
Vertical Turbine	500	3,200 gpm	Yes

Observations

The following field observations were made during the site assessment:

- ***Pump and Piping Condition –*** The pump does not appear to be securely bolted to its base. Seal leakage was observed. Corrosion and cracking were observed on the flexible couplings.
- ***Electrical and Controls –*** Electrical equipment is housed in the same room as water process equipment.
- ***Coatings and Structural –*** Vessel coatings around hatches are in poor condition. Exterior vessel and piping coatings were generally in good condition. Asphalt concrete around the facility was recently rebuilt and in good condition.
- ***Emergency Backup Power –*** The site has rental generators. The site would benefit from the installation of permanent generators.
- ***Site Condition –*** Poor drainage was observed. General clutter typical of operational sites was also noted.

3.0 Capital and Maintenance Recommendations

This section summarizes the recommended capital and maintenance improvements for the City's aboveground potable water facilities based on field observations, structural evaluations, and tank inspection reports.

3.1 Tank Sites Recommendations

Many of the City's older steel tanks exhibit structural and seismic deficiencies that prevent them from meeting current AWWA D100 design requirements. Common issues identified across multiple sites include insufficient shell plate thickness, inadequate freeboard, lack of anchorage, foundation settlement, and seismic vulnerabilities such as excessive overturning ratios and sliding resistance deficiencies. These inherent structural limitations cannot be fully addressed through coating replacement or appurtenance rehabilitation alone.

If the City elects to rehabilitate these tanks without correcting the underlying structural code deficiencies, the tanks will continue to fall short of current seismic standards—even after significant investment in linings, coatings, piping upgrades, and site improvements. As a result, the City would be committing substantial capital funds to extend the life of tanks that remain non-compliant, structurally limited, and more vulnerable during a seismic event.

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Given the age of many of the tanks, the extent of observed deterioration, and the costs associated with bringing them up to current standards, full tank replacement should be carefully considered as part of long-term capital planning, particularly for tanks with foundational instability, seismic non-conformance, or extensive corrosion and settlement.

The following recommendations presented in **Table 3-1** were developed for the tank sites.

Table 3-1: Project Recommendations – Tank Sites

Site	Recommended Projects
Anderson Tank	• Remove and replace the lining system at all interior surfaces • Remove and replace the exterior paint system • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Stabilize slope and improve drainage and site grading around tank • Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell • Install cathodic protection following completion of interior relining • Improve site security and site access • Consider full tank replacement
Case Tank	• Remove and replace the lining system at all interior surfaces • Repair the exterior paint system by spot repair and/or overcoat • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Stabilize slope and improve drainage and site grading around tank • Repair or reconstruct the tank foundation and base support • Replace or reactivate cathodic protection following completion of interior relining • Improve site security and access • Consider full tank replacement

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Table 3-1: Project Recommendations – Tank Sites	
Site	**Recommended Projects**
Cherry Hill Tank	• Remove and replace the lining system at all interior surfaces • Repair the exterior paint system by spot repair and/or overcoat • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Repair shell plate irregularities • Stabilize slope and improve drainage and site grading around tank • Repair or replace overflow piping • Improve site security and access • Evaluate the operation of the cathodic protection system • Consider full tank replacement
Fuchsia Tank	• Place tank on a 3-to-5-year maintenance inspection schedule as recommended by AWWA and continue to repair interior surfaces as needed by patch repairs • Repair the exterior paint system by spot repair • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Repair shell plate irregularities • Repair or replace leaking altitude valve • Improve drainage and site grading around tank • Improve site security • Conduct a detailed structural and seismic retrofit evaluation • Evaluate the operation of the cathodic protection system • Consider full tank replacement
Limoneira Tank	• Remove and replace the lining system at all interior surfaces • Remove and replace the exterior paint system • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Improve drainage and site grading around tank • Install cathodic protection following completion of interior relining • Install a new external level gauge • Evaluate long-term need for tank given redundancy with Anderson Tank

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Table 3-1: Project Recommendations – Tank Sites	
Site	**Recommended Projects**
Peck Tank	• Place tank on a 3-to-5-year maintenance inspection schedule as recommended by AWWA and continue to repair interior surfaces as needed by patch repairs • Repair the exterior paint system by spot repair and/or overcoat • Address structural deficiencies, including lack of foundation, observed settlement, inadequate freeboard, and seismic noncompliance (overturning, sliding, and shell stresses) • Replace and anchor pipe supports and secure overflow discharge piping • Reconstruct and regrade the foundation area • Improve site drainage and pavement conditions • Evaluate the operation of the cathodic protection system • Improve site security and access • Consider full tank replacement
Main Reservoir	• Address structural deficiencies, including potential rafter/column damage, aging concrete roof support structure, and seismic vulnerabilities • Investigate evidence of ponding and potential structural issues • Evaluate roof condition and replace if needed • Improve site drainage • Consider replacing wood columns with aluminum/steel • Evaluate tank walls • Consider full tank replacement

3.2 Booster Pump Stations Recommendations

Recommendations presented in **Table 3-2** for the City's booster pump stations reflect observed conditions of pumps, piping, site security, drainage, electrical systems, structural elements, and general site conditions.

Table 3-2: Project Recommendations – Pump Stations	
Site	**Recommended Projects**
Anderson Booster Pump Station	• Repair/replace corroded electrical equipment • Replace piping and valve supports • Repair retaining wall • Address drainage and grading around tank connection • Address gunite deterioration and coating failures

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Table 3-2: Project Recommendations – Pump Stations	
Site	**Recommended Projects**
Canyon Booster Pump Station	• Full replacement recommended due to landslide damage, lack of pavement, and no security
Glade Booster Pump Station	• Consider full replacement or permanent decommissioning if not needed for system operations (site inactive)
Park Booster Pump Station	• Repair leaking seals • Replace cooling fan on Pump #2 • Anchor safety plates • Improve security (fencing, locks) • Address aging pumps and piping as needed
Terracina No. 1 Booster Pump Station	• Consider full replacement or permanent decommissioning if not needed for system operations (site inactive)
Terracina No. 2 Booster Pump Station	• Inspect and repair/replace pumps and associated piping as needed
View Drive Booster Pump Station	• Replace failing walls • Improve security • Improve drainage • Consider repurposing as backfeed to another zone per City discussion or fully decommission if not needed

3.3 Well Sites Recommendations

Recommendations presented in **Table 3-3** for the well sites include mechanical, structural, electrical, security, and chemical system improvements based on field observations and structural notes.

Table 3-3: Project Recommendations – Well Sites	
Site	**Recommended Projects**
Well 1-B	• Repair pump anchorage • Replace broken hypochlorite tubing and secure injector line • Upgrade electrical systems • Improve site security • Evaluate long-term usefulness given standby status

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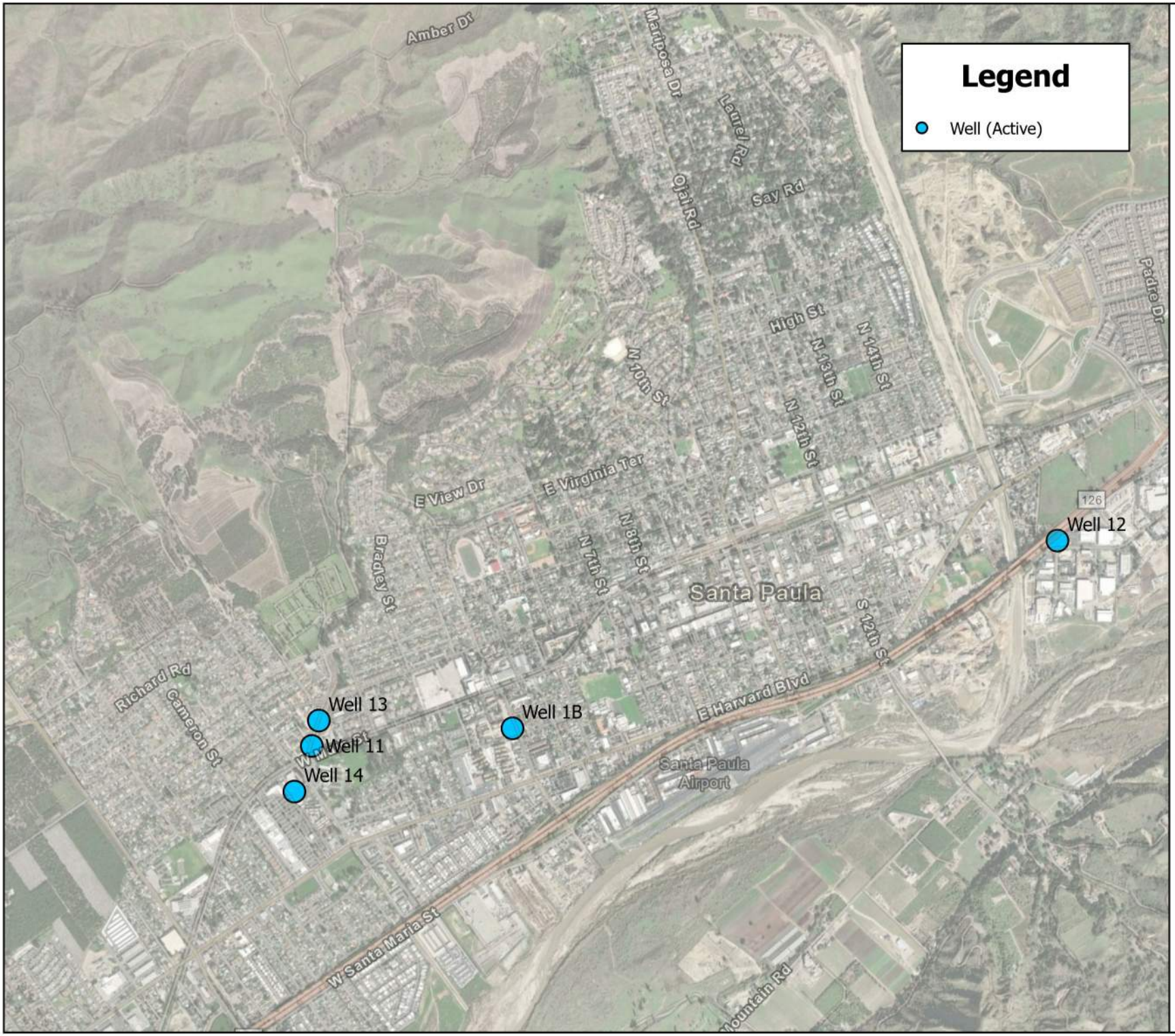
Table 3-3: Project Recommendations – Well Sites	
Site	**Recommended Projects**
Well 11	• Replace pump and piping supports • Recoat piping • Upgrade electrical systems and generator connections • Secure hypochlorite tubing • Improve surface drainage • Replace asphalt concrete paving • Install bollards for equipment protection • Secure chemical storage shed/building
Well 12	• Replace/rehabilitate electrical building • Secure hypochlorite fill valve and improve containment • Replace broken level gauge • Improve site security • Address coating deficiencies • Improve pavement condition
Well 13	• Restore automatic control to tank-level operation • Replace building exhaust fan • Replace existing VFD • Improve site security (fencing with barbed wire, vandal-proof valve locks) • Clear vegetation obstructing site camera • Remove graffiti
Well 14 & Steckel Conditioning Facility	• Anchor pump base • Repair seal leakage • Replace corroded/cracked flexible couplings • Improve drainage • Replace or rehabilitate vessel coatings at hatches • Install permanent generator (replace rental use)

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Appendix A

Site Location Map

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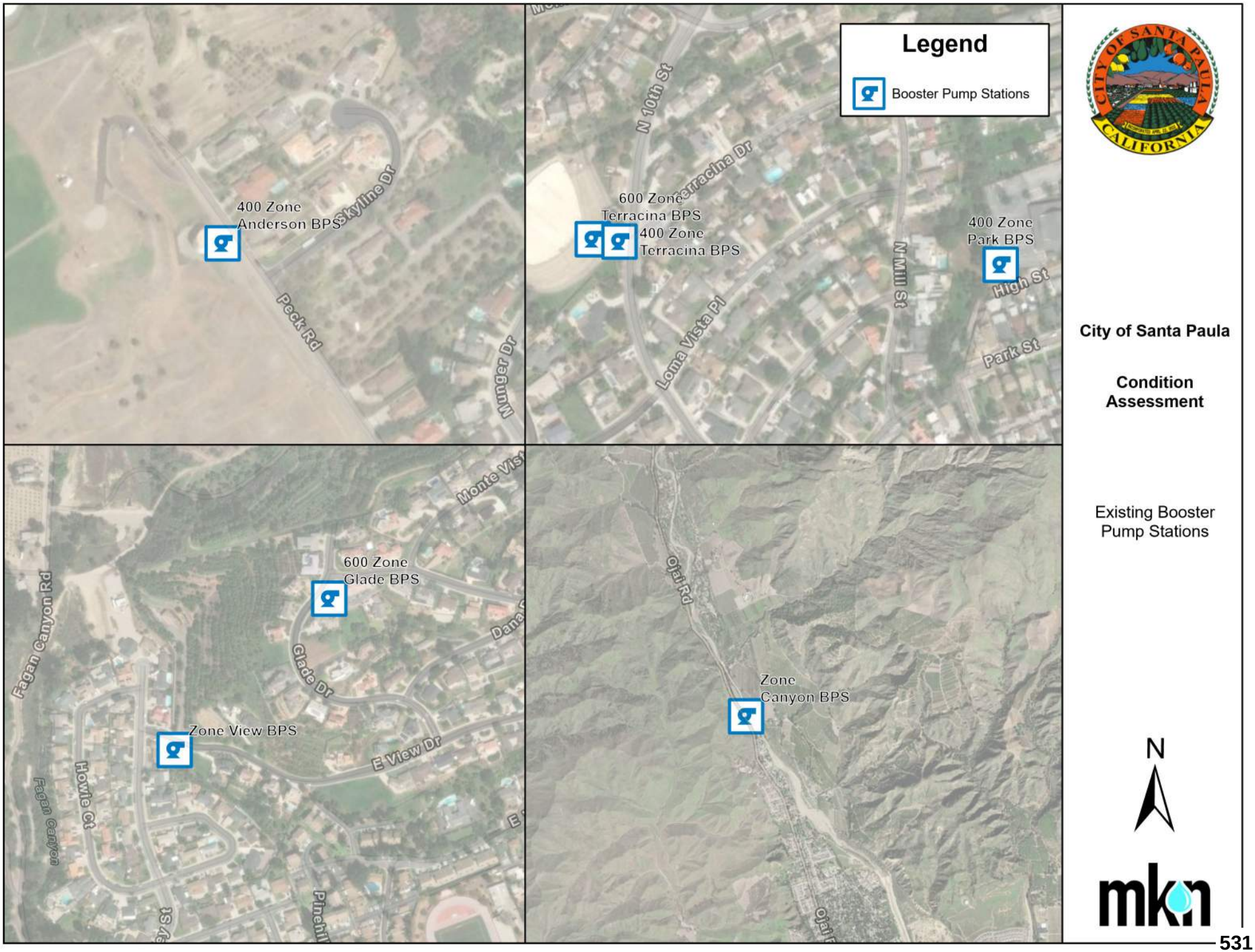
City of Santa Paula

Condition Assessment

Existing Groundwater Wells

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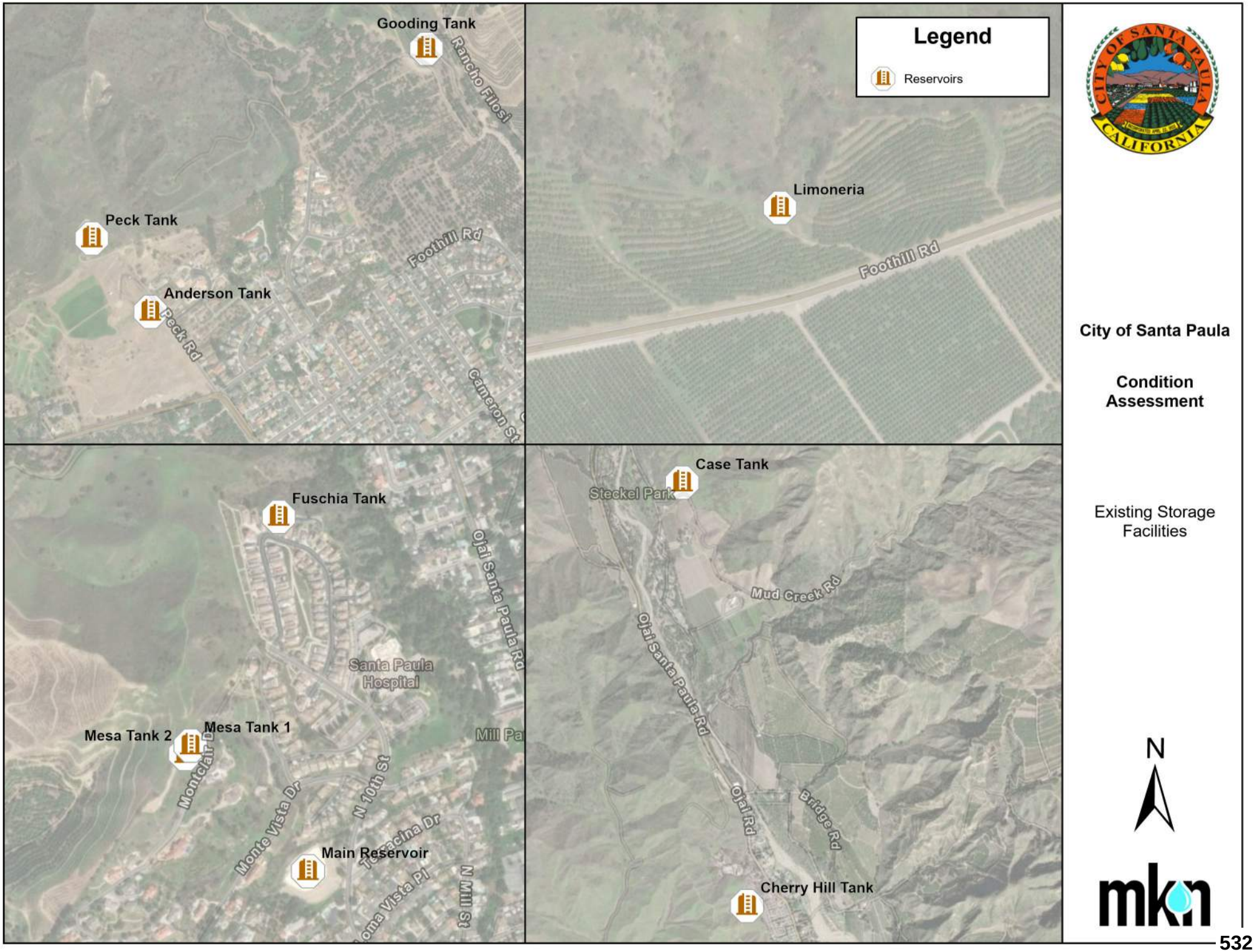


City of Santa Paula

Condition Assessment

Existing Booster Pump Stations

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Gooding Tank
Rancho Filosi
Peck Tank
Foothill Rd
Anderson Tank
Peck Rd
Cameron St
Limoneria
Foothill Rd
Legend
Reservoirs
Fuschia Tank
Ojai Santa Paula Rd
Santa Paula Hospital
Mesa Tank 2
Mesa Tank 1
Mill Pa
Montclair Dr
Monte Vista Dr
N 10th St
Terracina Dr
Main Reservoir
Loma Vista Pl
N Mill St
Case Tank
Steckel Park
Mud Creek Rd
Ojai Santa Paula Rd
Ojai Rd
Bridge Rd
Cherry Hill Tank
City of Santa Paula
Condition Assessment
Existing Storage Facilities
N
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Appendix B

Condition Assessment Forms

DRAFT

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Anderson Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1953**	
As-builts available?	**No**	
Reservoir Type	**Above-ground, welded steel tank**	
Reservoir Capacity	**0.62 MG**	
Diameter	**50'**	
Height	**42'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**YES**	
Security system, gate or intrusion alarm	**Gate only**	
Safety Tie-offs		
Railings	**Yes**	
Other Fall protection / Safety	**Yes**	

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**Poor drainage. Grading is up to side of the tank.**
Site Access (Road, Gates, etc.)		**Accessible by foot only, needs improvement, very poor**
Surface Improvements (landscape, bollards, etc.)		**Overgrown landscaping**
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		**Coating is poor**
Exterior Roof Condition		**Poor**
Inlet/Outlet Condition		**Poor condition. Drain valve partially buried.**
Foundation Condition		
Chime Condition		

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge	Yes	
Exterior Ladder and Cage	Yes	
Access Hatch	Yes	
Overflow	Yes	
Inlet/Outlet diameter (in)		10" goes to 12"
Roof Vent Condition		
Manway(s) Condition	OK	Only one present.
Seismic Anchorage		Not present

ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting		Not present
Communications		
Cathodic Protection		Not present

NOTES
No foundation on tank
Signs of burrowing animals
Thrust anchor cracked.
Piping in poor condition
Pipe coating poor - heavy chalking
Gunite failing
Box vents on roots

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: Anderson Tank
DATE: 7/9/2025

DESCRIPTION	
	Welded steel water storage tank located on N. Peck Rd. Tank is located on a hill and has shotcrete wall retaining soil around roughly 270-degrees of the tank.
YEAR CONSTRUCTED	1953
AS-BUILTS AVAILABLE	No
HEIGHT	42-feet
DIAMETER	50-feet
CAPACITY	0.62 - MG
OVERFLOW ELEVATION	41-feet (Assumed)
NUMBER OF SHELL COURSES	6
FOUNDATION TYPE	No foundation. Tank supported on soil.
ANCHORED OR UNANCHORED	Unanchored
MANWAY	1 - Bolted, No Hinge
LADDER	Single run with cage and security door. Safety climb system.
NAME PLATE	Illegible. Painted over.

CONDITION ASSESSMENT

FOUNDATION	No concrete foundation. Evidence of ground burrowing animals under tank edges. Grass and plants growing near tank bottom. Tank bottom is settling. The high side elevation is 2.8-inches and low side -0.8-inches.
EXTERIOR SHELL	Coating failure, flaking and peeling. Spot corrosion around bottom of tank shell and tank bottom. Rust staining.
EXTERIOR ROOF	Coating failure. Heavy presence of rusting and corrosion.
PIPE PENETRATIONS	Corrosion at sampling penetration. No flexible connection provided at outlet.
OVERFLOW	Corrosion on overflow pipe.
SITE AROUND TANK	Shotcrete walls have multiple cracks with plants growing at cracking.

APPERTANENCES	
EXTERIOR LADDER	Some corrosion exhibited on ladder.
MANWAY	A single bolted manway is provided for access at the east side of the tank. Coating has failed at the edges of the plate. There is corrosion at the bolts.
ROOF HATCH	A bolted roof hatch is provided near the ladder. The railing does not extend to the roof hatch. Roof hatch diameter doesn't meet current AWWA D100 requirements.
RAILING	Railing is galanized an appears to have been added after the orginal tank construction.
WATER LEVEL GAUGE	

ROOF VENT	4 roof vents are provided around the perimeter of the tank.All vents show signs of corrosion.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J exceeds 1.54 for a self-anchored tank. Recommend reducing operating level or adding ringwall footing and anchoring tank.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Case Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1966**	
As-builts available?	**No**	
Reservoir Type	**Above-ground, welded steel tank**	
Reservoir Capacity	**0.50 MG**	
Diameter	**60'**	
Height	**24'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	
Security system, gate or intrusion alarm	**None**	**Barbed wire fence - no chain link.**
Safety Tie-offs		
Railings	**Yes**	
Other Fall protection / Safety	**Yes**	

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**Poor, water drains to low point/back next to inlet/outlet piping. No outlet.Excavate regrade.**
Site Access (Road, Gates, etc.)		**Poor access due to landslide, no pavement, bank washed out 2 years ago. Can't access tank, have to walk.**
Surface Improvements (landscape, bollards, etc.)		**Needs landscaping, hills have eroded and buried ~1' of tank. Hill has slid down.**
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		**Poor coating with heavy chalking, some coating failures. Wind girder present.**
Exterior Roof Condition		
Inlet/Outlet Condition		**Fair/poor - outlet piping is not restrained and is exposed. Hose tap is not locked.**
Foundation Condition		**Rings supported by stakes. Dirt against edge of tank covering ring/gravel. - Estimate 1' deep @ NE side.**
Chime Condition		

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge		
Exterior Ladder and Cage		
Access Hatch		
Overflow		
Inlet/Outlet diameter (in)	12"	Outlet that should be buried is exposed.
Roof Vent Condition		
Manway(s) Condition		2 Mono bolt manways.
Seismic Anchorage		None
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting		None
Communications		
Cathodic Protection		Present but off

NOTES
Hose tap not locked and needs saddle tap.

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: Case Tank
DATE: 7/9/2025

DESCRIPTION	Welded steel water storage tank located off Mud Creek Rd. The tank is sited on a hill side. The roof is supported by 15 roof raffters which are visible from the roof vent. A wind girt is located near the top of the tank.
YEAR CONSTRUCTED	1966
AS-BUILTS AVAILABLE	No
HEIGHT	24-feet
DIAMETER	60-feet
CAPACITY	0.5 MG
OVERFLOW ELEVATION	Appears to be approximately 4-feet down from top of tank.
NUMBER OF SHELL COURSES	4
FOUNDATION TYPE	AWWA D100 Type 5 - Granular berm with steel retainer ring
ANCHORED OR UNANCHORED	Unanchored
MANWAY	2
LADDER	Single run with cage and security door. Galvanized.
NAME PLATE	Pittsburgh-Des Moines Steel Company, Contract No.: 36702-03

CONDITION ASSESSMENT

FOUNDATION	No concrete foundation. Around the perimeter of the tank there is soil and organic matter on the edge of the tank bttom. Some corrosion around the bottom of the shell at the tank bottom.
EXTERIOR SHELL	Rust staining in some locations on the shell and near the bottom of tank. Generally in good condition.
EXTERIOR ROOF	Minor spot corrosion. Generally in good condition.
PIPE PENETRATIONS	Appears in good condition. Penetraion is equiped with a seismic joint.
OVERFLOW	Good condition. Overflow stops above finish grade and is located on the exterior of the tank.
SITE AROUND TANK	

APPERTANENCES	
	A new galvanized ladder appears to have been added after the orginal tank construction.
EXTERIOR LADDER	Ladder was in good condition.
MANWAY	Two manways are provided for access.
ROOF HATCH	Two hinged roof hatches are provided. One is near the railing and ladder.
RAILING	Some railing is galanized an appears to have been added after the orginal tank construction. The rest of the railing appears to be original to the tank and is in good condition.
WATER LEVEL GAUGE	
ROOF VENT	Single center roof vent. Some corrosion, but overall in good condition.
SOLAR	A new solar panel was installed on the roof. It is attached to the roof with unistrut.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J exceeds 1.54 for a self-anchored tank. Recommend reducing operating level or adding ringwall footing and anchoring tank.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Cherry Hill Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1954**	**Tank retrofitted in 1985 - raised?**
As-builts available?	**No**	
Reservoir Type	**Above-ground, welded steel tank**	
Reservoir Capacity	**0.50 MG**	
Diameter	**66'**	
Height	**21'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	**Rodents got under.**
Security system, gate or intrusion alarm	**Gate**	**barbed wire OK**
Safety Tie-offs		
Railings	**Yes**	
Other Fall protection / Safety	**Yes**	

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading	OK	drainage has led to some ruts that may affect access.
Site Access (Road, Gates, etc.)	Poor	Very poor acccess road. Unpaved dirt road, super rutted, gate is not set back from the road.
Surface Improvements (landscape, bollards, etc.)		Could use bollards for piping, issues with rodents, overflow pipe causes erosion around footing.
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		Good, lower shell not uniform - 2 1/2 inches difference in height of bottom layer around tank (got bigger towards the back and smaller at the front)
Exterior Roof Condition		Good
Inlet/Outlet Condition		Good, needs lock on sample tap. Coating good.
Foundation Condition		Good
Chime Condition		Good

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge	Yes	
Exterior Ladder and Cage	Yes	Not safe to climb on ladder.
Access Hatch		
Overflow	Yes	
Inlet/Outlet diameter (in)	10"	
Roof Vent Condition		
Manway(s) Condition		
Seismic Anchorage		Not present
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting	No	
Communications	No	
Cathodic Protection	Yes	Present

NOTES
One rim vent covered but only weded on 3 sides.'
21' measured - 24' on gauge

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: Cherry Tank
DATE: 7/9/2025

DESCRIPTION	Welded steel water storage tank located off Cherry Hill Rd. The tank is sited on a hill side.
YEAR CONSTRUCTED	1954
SERIAL NUMBER	FC44976
AS-BUILTS AVAILABLE	No
HEIGHT	21-feet
DIAMETER	66-feet
CAPACITY	537,390 GAL
OVERFLOW ELEVATION	Appears to be approximately 1-feet down from top of tank.
NUMBER OF SHELL COURSES	5
FOUNDATION TYPE	AWWA D100 Type 5 - Granular berm with steel retainer ring
ANCHORED OR UNANCHORED	Unanchored
MANWAY	1 - Bolted
LADDER	Single run with cage and security door. Galvanized.
NAME PLATE	ARL Standard Tank - Graver Tank & MFG Co. Inc

CONDITION ASSESSMENT

FOUNDATION	No concrete foundation. Around the perimeter of the tank there is plant material growing between the steel retainer ring and shell. Some corrosion around the bottom of the shell at the tank bottom.
EXTERIOR SHELL	Generally in good condition. Minimal staining.
EXTERIOR ROOF	Many dents or pitting on tank roof. Minimal rust staining and corrosion.
PIPE PENETRATIONS	Appears in good condition. Penetraion is equiped with a seismic joint. Previous penetrations have been removed and reinforcing plate covered over openings.
OVERFLOW	Good condition. Overflow stops above finish grade and is located on the exterior of the tank.
SITE AROUND TANK	Flat with minimal plant growth.

APPERTANENCES

EXTERIOR LADDER	A new galvanized ladder appears to have been added after the orginal tank construction. Ladder was in good condition.
MANWAY	A single bolted manway is provided for access.
ROOF HATCH	A hinged roof hatch is provided near the railing and ladder.
RAILING	Some railing is galanized an appears to have been added after the orginal tank construction. The rest of the railing appears to be original to the tank and is in good condition.
WATER LEVEL GAUGE	
ROOF VENT	Center roof vent and a second vent near edge of tank. Some corrosion, but overall in good condition.
SOLAR	A new solar panel was installed on the roof. It is attached to the roof with unistrut.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J is within limits.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION	
Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Fuschia Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1955**	
As-builts available?	**No**	
Reservoir Type	**Above-ground, steel tank**	
Reservoir Capacity	**0.50 MG**	
Diameter	**60'**	
Height	**24'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes/No**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	**Security fencing is poor, rodents under the tank**
Security system, gate or intrusion alarm		**Poor barbed wire condition**
Safety Tie-offs		
Railings	**Yes**	
Other Fall protection / Safety	**Yes**	

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**OK**
Site Access (Road, Gates, etc.)		**Fair/Poor access, not a wide road around the tank**
Surface Improvements (landscape, bollards, etc.)		**Tree/plants cracking shotcrete, narrow road may call for bollards around inlet/outlet piping.**
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		**Good - slight elephant foot/buldge. Coating is good, minor chalking**
Exterior Roof Condition		**Rocks on roof**
Inlet/Outlet Condition		**Mild corrosion, altitude valve is leaking. Drainage should be evaluated to reduce rish of erosion.**
Foundation Condition		**Not present**
Chime Condition		**OK - minor corrosion at chime**

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge	Yes	
Exterior Ladder and Cage	Yes	
Access Hatch	Yes	
Overflow	Yes	
Inlet/Outlet diameter (in)	8"	
Roof Vent Condition		
Manway(s) Condition	OK	Two present
Seismic Anchorage		Not present
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting	None	
Communications		
Cathodic Protection	Yes	Present and appears to be okay.

NOTES
No fan

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: Fuscia Tank
DATE: 7/9/2025

DESCRIPTION

	Welded steel water storage tank located off Coronado Cir. The tank is sited on a hill and has shotcrete wall retaining soil around roughly 180-degrees of the tank.
YEAR CONSTRUCTED	1955
AS-BUILTS AVAILABLE	No
HEIGHT	24-feet
DIAMETER	60-feet
CAPACITY	0.50 - MG
OVERFLOW ELEVATION	23-feet (Assumed)
NUMBER OF SHELL COURSES	3
FOUNDATION TYPE	No foundation. Tank supported on soil.
ANCHORED OR UNANCHORED	Unanchored
MANWAY	1 - Bolted with Hinge
LADDER	Single run with cage and security door. Safety climb system.
NAME PLATE	Cosolidated Western, 1955

CONDITION ASSESSMENT

FOUNDATION	No concrete foundation. Evidence of ground burrowing animals under tank edges. Tank bottom is settling. The high side elevation is 0-inches and low side -2.2-inches. The tank is settling toward the uphill side.
EXTERIOR SHELL	Some deformation in the shell plate, possible elephants foot. Spot corrosion around bottom of tank shell and tank bottom. Rust staining.
EXTERIOR ROOF	Minor spot corrosion. Generally in good condition. Rocks through from a nearby walkway are scattered on the roof. A roof tie off is provided at the center of the tank.
PIPE PENETRATIONS	Corrosion at sampling penetration. No flexible connection provided at outlet.
OVERFLOW	Corrosion on overflow pipe.
SITE AROUND TANK	Shotcrete walls have multiple cracks that have been repaired with an unknown sealant.

APPERTANENCES

EXTERIOR LADDER	A new galvanized ladder appears to have been added after the orginal tank construction. Ladder was in good condition.
MANWAY	A single bolted manway is provided for access at the east side of the tank. Coating has failed at the edges of the plate. There is corrosion at the bolts.
ROOF HATCH	A hinged roof hatch is provided near the railing and ladder.

RAILING	Railing is galanized an appears to have been added after the orginal tank construction. Railing is in good condition.
WATER LEVEL GAUGE	Level gauge is operable.
ROOF VENT	4 roof vents are provided around the perimeter of the tank. Coating on vents is good.
SOLAR	A new solar panel was installed on the roof. It is ballusted with a weight.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J exceeds 1.54 for a self-anchored tank. Recommend reducing operating level or adding ringwall footing and anchoring tank.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Limoneira Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date		
As-builts available?	**No**	
Reservoir Type	**Above-ground, welded steel tank**	
Reservoir Capacity	**0.48 MG**	
Diameter	**50'**	
Height	**35' - 4"**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	
Security system, gate or intrusion alarm		**On private property**
Safety Tie-offs	**No**	
Railings	**No**	
Other Fall protection / Safety	**Yes**	**Poor ladder protection**

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		
Site Access (Road, Gates, etc.)		**Poor access, trees overgrowing easement. No rail.**
Surface Improvements (landscape, bollards, etc.)		
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		**Poor. Lap welds, not butt - on tank walls.**
Exterior Roof Condition		**Vent at top - no screen**
Inlet/Outlet Condition		**Fair/poor, coating failures.**
Foundation Condition		**Not present - unstable site & slope/erosion. No anchors.**
Chime Condition		

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge	No	Not present - uses pressure gauge.
Exterior Ladder and Cage	Yes	Poor
Access Hatch	Yes	
Overflow	Yes	
Inlet/Outlet diameter (in)	12"	
Roof Vent Condition		
Manway(s) Condition		
Seismic Anchorage		Not Present
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting	No	
Communications	No	
Cathodic Protection	No	Not present

NOTES
Tank is lap welded, not well built, this is a complete do-over
Not needed per Isaac, the Anderson tank is enough.
No foundation
Unstable subversion
No drainage

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: LimoneiraTank
DATE: 7/9/2025

DESCRIPTION	Welded steel water storage tank located off Foothill Rd. The tank is sited on a hill side.
YEAR CONSTRUCTED	
Serial Number	
AS-BUILTS AVAILABLE	No
HEIGHT	
DIAMETER	
CAPACITY	
OVERFLOW ELEVATION	Top of overflow is 3 inches from top of tank.
NUMBER OF SHELL COURSES	6
FOUNDATION TYPE	Tank bearing on soil
ANCHORED OR UNANCHORED	Unanchored
MANWAY	1 - Bolted
LADDER	Single run with cage and security door.
NAME PLATE	

CONDITION ASSESSMENT

FOUNDATION	No concrete foundation. Asphault ring around perimeter. Around the perimeter of the tank there is plant material growing near the tank bottom. Some corrosion around the bottom of the shell at the tank bottom.
EXTERIOR SHELL	Extensive staining, but is possibly runoff from water on the roof.
EXTERIOR ROOF	Extensive corrosion
PIPE PENETRATIONS	Appears in good condition. Penetraion is equiped with a seismic joint.
OVERFLOW	Extensive corrosion on overflow. Overflow does not extend below finish grade.
SITE AROUND TANK	Evidence of ground burrowing animals

APPERTANENCES	
EXTERIOR LADDER	Appears to be the original ladder equiped with cage and security door.
MANWAY	A single bolted manway is provided for access. Corrosion on bolts.
ROOF HATCH	No roof hatch.
RAILING	No railing tank roof.
WATER LEVEL GAUGE	
ROOF VENT	Pipe penetration with 180 degree elbow and screen at end of elbow.
SOLAR	A new solar panel was installed on the roof.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J exceeds 1.54 for a self-anchored tank. Recommend reducing operating level or adding ringwall footing and anchoring tank.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Main Reservoir
Site Address: 200 S Tenth St	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1896**	
As-builts available?	**No**	
Reservoir Type	**Constructed by earth embankments w/a concrete liner and has a non-symmetrical shape**	
Reservoir Capacity	**4.40 MG**	
Diameter		
Height	**30'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	
Security system, gate or intrusion alarm	**Yes**	**Needs barbed wire - main fence is new, live security**
Safety Tie-offs		**Tank is generally below grade**
Railings		**Tank is generally below grade**
Other Fall protection / Safety		**Tank is generally below grade**

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading	OK	
Site Access (Road, Gates, etc.)	OK	
Surface Improvements (landscape, bollards, etc.)	OK	Vegetation growing through shotcrete retaining walls
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		Buried
Exterior Roof Condition		OK, evidence of potential structural failure, ponding occurs on roof. TPO roof - fair condition, not too old. Drip rail not correct - should flash behind reglet.
Inlet/Outlet Condition		Buried
Foundation Condition		Buried
Chime Condition		Buried

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge		**Digital, accessed elsewhere. Hydroranger and SCADA.**
Exterior Ladder and Cage		**Buried**
Access Hatch		**Yes**
Overflow		
Inlet/Outlet diameter (in)		
Roof Vent Condition		**Poor**
Manway(s) Condition		**OK**
Seismic Anchorage		
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting		
Communications		
Cathodic Protection		

NOTES
Consider replacing wood strucutre with aluminum on steel?
Evaluate concrete?
Geotech evaluation of side walls?
Gunite in good condition
Drainage unclear - no DI observed, all sheet over side?
100 year old

RESERVOIR SITE VISIT NOTES

LOCATION: Main Reservoir
DATE: 7/9/2025

DESCRIPTION	The reservoir is an in ground concrete reservoir that is concrete lined on sloping soil. The roof consists of a wood framed roof supported by wood posts. The roof is extended above finish grade and the perimeter is wrapped with a mesh screen allowing venting of the reservoir. A V ditch is provided around the perimeter of the reservoir for drainage.
YEAR CONSTRUCTED	1896
AS-BUILTS AVAILABLE	No
HEIGHT	30-feet
LENGTH x WIDTH	270-feet x 175-feet
CAPACITY	4.40 - MG
OVERFLOW ELEVATION	Unknown
FOUNDATION TYPE	Concrete slab with sloping walls
ANCHORED OR UNANCHORED	Unanchored
MANWAY	2 - Hinged
LADDER	Single run with cage and security door. Safety climb system.

CONDITION ASSESSMENT

FOUNDATION	The reservoir was in service and the interior was not accessed.
ROOF	The roof has low spots and had some water ponding. Based on the observations it is expected that there may be some damaged rafters or columns.
WALLS/VENTS	The fascia board around the perimeter is in need of paint. Some screens have been repaired, but new screens are recommended.

APPERTANENCES

ROOF HATCH	Roof hatches are in good condition.
SITE AROUND TANK	Shotcrete walls have cracks with plants growing thorugh concrete. Minor amounts of plant debris in the V ditch around reservoir. Some cracks in the V ditch.

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION	
Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Peck Tank
Site Address:	
Assessor Name:	JH/SC

RESERVOIR CHARACTERISTICS MKN		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Installation Date	**1988**	
As-builts available?	**Yes***	***only have peck tank site rehab as-builts. No structural info in as-builts.**
Reservoir Type	**Above-ground, steel tank**	
Reservoir Capacity	**0.50 MG**	
Diameter	**60'**	
Height	**24'**	
Overflow Elevation (ft)		
Previous Dive Inspections?	**Yes**	
SAFETY FEATURES	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	
Security system, gate or intrusion alarm	**Gate**	**Poor - lots of graffiti**
Safety Tie-offs		
Railings	**Yes**	
Other Fall protection / Safety	**Yes**	

CITY OF SANTA PAULA
RESERVOIR CONDITION ASSESSMENT FORM

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**Poor asphalt**
Site Access (Road, Gates, etc.)		**Poor access, AC around tank is poor, severe ground settling at rear of tank (road)**
Surface Improvements (landscape, bollards, etc.)		**Needs landscaping, erosion, bollards are needed, overflow drains to surface, complete REDO of grading/drainage, tank drain is inadequate, several cracking systems**
EXTERIOR	**FIELD DATA**	**REVIEWER COMMENTS**
Exterior Shell Condition		**OK**
Exterior Roof Condition		**OK**
Inlet/Outlet Condition		**OK/Moderate corrosion**
Foundation Condition		**OK**
Chime Condition		**OK**

APPURTENANCES	FIELD DATA	REVIEWER COMMENTS
Level Gauge		OK
Exterior Ladder and Cage		OK
Access Hatch		OK
Overflow		OK - overflow draws to surface
Inlet/Outlet diameter (in)		10"
Roof Vent Condition		
Manway(s) Condition		OK - two of them
Seismic Anchorage		Not present
ELECTRICAL/INSTRUMENTATION		
ELECTRICAL	**FIELD DATA**	**REVIEWER COMMENTS**
Lighting		Not Present
Communications		
Cathodic Protection		

NOTES
Pipe supports not bolted
Flexible connection present

STEEL WATER STORAGE TANK SITE VISIT NOTES

LOCATION: Peck Tank
DATE: 7/9/2025

DESCRIPTION	Welded steel water storage tank located on N. Peck Rd. Tank is located on a hill and has shotcrete wall retaining soil around roughly 270-degrees of the tank. Tank is located on the hill above Anderson Tank.
YEAR CONSTRUCTED	1988
AS-BUILTS AVAILABLE	No
HEIGHT	24-feet
DIAMETER	60-feet
CAPACITY	0.50 - MG
OVERFLOW ELEVATION	23-feet (Assumed)
NUMBER OF SHELL COURSES	3
FOUNDATION TYPE	AWWA D100 Type 5 - Granular berm with steel retainer ring
ANCHORED OR UNANCHORED	Unanchored
MANWAY	2 - Bolted with Hinge
LADDER	Single run with cage and security door. Safety climb system.
NAME PLATE	Not found

CONDITION ASSESSMENT

FOUNDATION	
	Weeds are growing out of the granular berm near tank bottom. Tank bottom is settling unevenly. The high side elevation is 0-inches and low side -4.9-inches.
EXTERIOR SHELL	
	Spot coating failure, but no excessive signs of corrosion.
EXTERIOR ROOF	Spot coating failure, but no excessive signs of corrosion.
PIPE PENETRATIONS	Flexible connection is provided at the outlet.
OVERFLOW	Minor corrosion at the mesh screen cover.
SITE AROUND TANK	Shotcrete walls have multiple cracks with plants growing at cracking. The AC pavir
APPERTANENCES	
EXTERIOR LADDER	Galvanized ladder in good condition.
MANWAY	A single bolted manway is provided for access at the east side of the tank. Coating has failed at the edges of the plate. There is corrosion at the bolts.
ROOF HATCH	A bolted roof hatch is provided near the ladder. The railing does not extend to the roof hatch.
RAILING	Railing is galanized and is in good condition.
WATER LEVEL GAUGE	Gauge appears operable.
ROOF VENT	Single roof vent centered on tank. There is some minor corrosion at the screen and the frame.

SEISMIC ANALYSIS

OVERTURNING/ANCHORAGE	Overturning Ratio J exceeds 1.54 for a self-anchored tank. Recommend reducing operating level or adding ringwall footing and anchoring tank.
SHELL STRESSES	Shell stress for seismic loads exceeds allowable based on assumed material thicknesses for hydrostatic loading. Recommend UT testing shell to determine actual thickness.
FREEBOARD	Inadequate freeboard is provided. Recommend reducing Maximum Operating Level.
SLIDING	Sliding resistance is exceeded.

Pump Station Visual Inspection Checklist

Name of Observer: Shayne/Jon

Pump Station Name: __Anderson BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5): 200 S Tenth St Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			
Style (VT can, VT deck, Horiz., etc.)			VT
Pumps (number, capacity, make, model)			1+1 Config
Motors (size hP, make, model)			7.5HP and 15HP Motors
Series or Parallel Installation			Parallel
Pump Location - Outdoor / Indoor			Outdoor (pump below grade)
Electrical & Controls Location			Outdoors
VFDs (1, 2, etc. or all)			No
Suction Manifold - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			Above
Size & Material			Steel, 2-3"
Height Above/Below Grade			2'
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			None

Pump Station Visual Inspection Checklist

Name of Observer: Shayne/Jon

Pump Station Name: __Anderson BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			
Fencing and Gates			Yes - poor security and gap under fence
Alarms (buildings, gates, etc.)			
Lighting (standards, wall packs, etc.)			Yes
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			No
Signage			Yes
Labeling			Yes
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			
Pipe Supports (sufficiency, location, etc.)			Yes - Not bolted
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			
Generator Plug Panel			Generator recepticle
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Shayne/Jon

Pump Station Name: __Anderson BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			
Coatings:			
Pipe coatings-exposed			Yes
Valve coatings-exposed			Yes
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			

Pump Station Visual Inspection Checklist

Name of Observer: Shayne/Jon

Pump Station Name: __Anderson BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			Electrical is exposed and corroded (not covered)
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular	Y		
Maint. Equip. (i.e., chem., cranes, etc.)	Y		
Surfacing (paved, gravel)	Y, gravel		
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

PUMP STATION VISIT NOTES

LOCATION: Anderson Pump Station
DATE: 7/9/2025

STRUCTURE	**Pump Station**
DESCRIPTION	Fenced enclosure housing two pumps and electrical equipment located on hillside downhill from the Anderson Tank. Two sides have CMU retaining wall retaining 5-feet of soil maximum. Cantilever steel structure is supporting electcial equipment. Pump and piping is mounted on a concrete slab.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
SLAB ON GRADE	Minor cracking in slab on grade, particularly at penetrations. Generally OK condition.
CMU WALLS	Cracking in top of wall at the embedded fence post. Face of walls don't indicate any major cracking or stress.
ELECTRICAL EQUIPMENT SUPPORT	Steel structure has some coating failure and rust forming. No excessive steel section loss was exhibited.

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Canyon BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			**Complete Rehab/Replacement**
Style (VT can, VT deck, Horiz., etc.)	VT		
Pumps (number, capacity, make, model)			1 Pump
Motors (size hP, make, model)			15 HP
Series or Parallel Installation			
Pump Location - Outdoor / Indoor			
Electrical & Controls Location			
VFDs (1, 2, etc. or all)			
Suction Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Canyon BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			Landslide site - to be rehabilitated No security
Fencing and Gates			
Alarms (buildings, gates, etc.)			
Lighting (standards, wall packs, etc.)			
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			
Signage			
Labeling			
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			
Pipe Supports (sufficiency, location, etc.)			
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Canyon BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			
Coatings:			
Pipe coatings-exposed			
Valve coatings-exposed			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Canyon BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			No pavement
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Canyon BPS_____ Date: 7/9/25

NOTES:

Easement needed? - on county property not city property

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Glade BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			**210 TDH, 260 GPM**
Style (VT can, VT deck, Horiz., etc.)			VT
Pumps (number, capacity, make, model)			1 pump
Motors (size hP, make, model)			20 HP
Series or Parallel Installation			
Pump Location - Outdoor / Indoor			Outdoors
Electrical & Controls Location			Outdoors
VFDs (1, 2, etc. or all)			
Suction Manifold - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			Above
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			Above
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Glade BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			
Fencing and Gates	Y		No barbed wire, no security
Alarms (buildings, gates, etc.)			
Lighting (standards, wall packs, etc.)	Y		
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			
Signage			
Labeling			
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			6'
Pipe Supports (sufficiency, location, etc.)			OK - not bolted
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Glade BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			Wall failing
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			
Coatings:			
Pipe coatings-exposed			Y - fair
Valve coatings-exposed			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Glade BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Glade BPS_____ Date: 7/9/25

NOTES:

Inactive

Pumps from Zone 400 to zone 600 - terracina 2 now pumps from 200 to 600 zones and eliminates the need for Glade and View BPS

Wants to turn it into a PRV

PUMP STATION VISIT NOTES

LOCATION: Glade Booster Pump Station
DATE: 7/9/2025

STRUCTURE	**Pump Station**
DESCRIPTION	CMU enclosure housing pump. Inside the enclosure is a slab on grade. The enclosure is accessed with a swinging gate. The enclosure is mounted on a slope and the CMU walls are retaining soil. At the time of assessment the neigboring house was under construction. It appears that grading of the slopes near the enclosure walls had occured recently.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
SLAB ON GRADE	Minor cracking in slab on grade. Generally in good condition.
CMU WALLS	CMU walls appear in good condition. No major cracks were noted.
ELECTRICAL EQUIPMENT SUPPORT	The electrical equipment is mounted to the east wall.

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Park BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			
Style (VT can, VT deck, Horiz., etc.)			VT
Pumps (number, capacity, make, model)			2, but only 1 is used due to cracked support on P2
Motors (size hP, make, model)			40 HP
Series or Parallel Installation			Parallel
Pump Location - Outdoor / Indoor			Outdoor
Electrical & Controls Location			Outdoor
VFDs (1, 2, etc. or all)			No
Suction Manifold - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			Above
Size & Material			Steel
Height Above/Below Grade			3'
Isolation Valve			Yes
Metered			Yes
Indiv. Pump Discharge - above/buried			Above
Size & Material			Steel
Height Above/Below Grade			3'
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			Above
Size & Material			Steel ~8"
Height Above/Below Grade			3'
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			Broken/cracking supports, cans not bolted down, sole plates not bolted down

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Park BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			Security is poor
Fencing and Gates	Y		
Alarms (buildings, gates, etc.)			
Lighting (standards, wall packs, etc.)			
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			
Signage			
Labeling			
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			
Pipe Supports (sufficiency, location, etc.)			
Disassembly Points			
Seals Issues (leaks, drains, etc.)			Seals are leaking when pump is off
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			No generator
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Park BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			Fan on #2 is cracked
Coatings:			
Pipe coatings-exposed			
Valve coatings-exposed			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			Good

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Park BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Park BPS_____ Date: 7/9/25

NOTES:

Poor security

Seals are leaking when pump off

Pipe supports are good

PUMP STATION VISIT NOTES

LOCATION: Park St. Booster
DATE: 7/9/2025

STRUCTURE	**Pump Station**
DESCRIPTION	Outdoor pump station with fence enclosure.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
HOUSE KEEPING PADS	The slabs at pipe supports have extensive cracking. The pedestal pad at the pipe has exposed rebar and cracking. Pipe stands are anchored.
PUMP PADS	Pedestals for the pumps have cracking. The pump sole plate is not anchored to the pedestal.

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 1 BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			**To be converted to PRS**
Style (VT can, VT deck, Horiz., etc.)			
Pumps (number, capacity, make, model)			
Motors (size hP, make, model)			
Series or Parallel Installation			
Pump Location - Outdoor / Indoor			
Electrical & Controls Location			
VFDs (1, 2, etc. or all)			
Suction Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 1 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			
Fencing and Gates			
Alarms (buildings, gates, etc.)			
Lighting (standards, wall packs, etc.)			
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			
Signage			
Labeling			
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			
Pipe Supports (sufficiency, location, etc.)			
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 1 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			Roof in good condition
Walls (material)			
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			
Coatings:			
Pipe coatings-exposed			
Valve coatings-exposed			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			Coating on building is failing

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 1 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 1 BPS_____ Date: 7/9/25

NOTES:

Currently pumps from 400 to 600

May be considered to convert to PRV

Not been used in a while

PUMP STATION VISIT NOTES

LOCATION: Terracina Pump Station 1
DATE: 7/9/2025

STRUCTURE	**Pump Station**
DESCRIPTION	Small CMU building housing pump and electical equipment. Roof is comprised of a wood roof supported on block walls. The pumps are mounted to a concrete pads which sit above the slab on grade.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
SLAB ON GRADE	Minor cracking in slab on grade. Generally in good condition.
CMU WALLS	CMU walls show some signs of deterioration. There are some gaps in the head joints particulary in the walls over openings at the gable ends. The walls are not anchored to the roof.
WOOD ROOF	The rafters and collar ties appear to be in acceptable condition.
PUMP PADS	The concrete pads that are supporting the pumps are in poor condition exihbiting some spalling.

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 2 BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			**2pumps: 425 GPM; 350 TDH; 160 psi observed, 1pump: 1500 GPM; 350 TDH**
Style (VT can, VT deck, Horiz., etc.)			VT
Pumps (number, capacity, make, model)			3 pumps (1+1 + 1 FIRE)
Motors (size hP, make, model)			60 HP x 2 and 200 HP x 1
Series or Parallel Installation			Parallel
Pump Location - Outdoor / Indoor			Indoor
Electrical & Controls Location			
VFDs (1, 2, etc. or all)			Fire pump yes
Suction Manifold - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			Buried
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			Above
Size & Material			Steel
Height Above/Below Grade			3'
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			Above
Size & Material			Steel
Height Above/Below Grade			3'
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 2 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			
Fencing and Gates			Pump station is inside brick building
Alarms (buildings, gates, etc.)			Yes
Lighting (standards, wall packs, etc.)			Yes
Hatches			Roof hatches to remove pumps
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			Yes
Bollards			
Signage			Yes
Labeling			Yes
Maintenance Issues			
Spacing (access for personnel and tools)			Yes
Height of instruments			Yes
Pipe Supports (sufficiency, location, etc.)			Yes
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			Yes
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			Yes
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 2 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			Reinforced concrete
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			Good
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			Brick with sound proofing
Interior (ceiling or open, insulation)			
Lighting			Good
Doors (type, location, locks, emergency)			Good
Ventilation (fans, AC, etc.)			Good
Coatings:			
Pipe coatings-exposed			Good
Valve coatings-exposed			Good
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 2 BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular	Y		
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __Terracina No. 2 BPS_____ Date: 7/9/25

NOTES:

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __View Drive BPS_____ Date: 7/9/25

Location (Add Sketch Pg. 5):_____ Weather:_____

Personnel:_____

Surroundings (i.e., enclosure, lawn, street):_____

Year Built/Improved:_____

As-Builts Available: _____

Design Capacity:_____

Pump Maintenance:_____

Model #:_____

Serial #:_____

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Configuration / Pumps:			**Not in use**
Style (VT can, VT deck, Horiz., etc.)			Submersible
Pumps (number, capacity, make, model)			1 pump
Motors (size hP, make, model)			
Series or Parallel Installation			
Pump Location - Outdoor / Indoor			
Electrical & Controls Location			
VFDs (1, 2, etc. or all)			
Suction Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Inlet - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Indiv. Pump Discharge - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Disch. Manifold - above/buried			
Size & Material			
Height Above/Below Grade			
Isolation Valve			
Metered			
Pump Issues (heat, noise, leaks)			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __View Drive BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Safety Features:			
Fencing and Gates			Failing Brick walls no barbed wire
Alarms (buildings, gates, etc.)			Poor security
Lighting (standards, wall packs, etc.)			
Hatches			
Fall Protections (if applicable)			
Railing			
Ladders			
Eye wash (if applicable)			
Chemical storage			
Slippery surfaces			
Cameras			
Bollards			
Signage			
Labeling			
Maintenance Issues			
Spacing (access for personnel and tools)			
Height of instruments			
Pipe Supports (sufficiency, location, etc.)			No pipe supports - Cinderblocks for pipe supports :(
Disassembly Points			
Seals Issues (leaks, drains, etc.)			
Isolation for each Pumping Unit			
Hydro/Air Chamber			
Hydro/Air Chamber (isolatable - locking)			
Hydro/Air Chamber (compressor)			
Backup Power:			
Perm. Generator			Electrical equip was outside
Generator Plug Panel			
Type of fuel			
Automatic Transfer Switch			
Manual Transfer Switch			
Space for Temporary Gen.			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __View Drive BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Pump Structure (if applic.):			
Materials (reinforced concrete, metal, etc.)			
Exposed Rebar			
Lining (in pump well, etc.)			
Lighting			
HI improvements (fillets, splitters, etc.)			
Pump Mounts (cans, sole plates, etc.)			
Pump, Elec., Contr. Building (if applic.)			
Roof (flat, a-frame, metal, comp.,etc.)			
Walls (material)			
Interior (ceiling or open, insulation)			
Lighting			
Doors (type, location, locks, emergency)			
Ventilation (fans, AC, etc.)			
Coatings:			
Pipe coatings-exposed			Some corrosion
Valve coatings-exposed			
Pipe coatings-vault			
Valve coatings-vault			
Structure Coatings			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __View Drive BPS_____ Date: 7/9/25

Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Instrumentation:			
Level controls (type, location)			
Flow meter (make, model, location)			2 electric meters
Gauges			
Pressure switches			
SCADA/Telemtry			
Antennae			
Alarms (List)			
MCC Enclosure-style/condition			
Shade structure (Elec.)			
Shade structure (Instr.)			
Intrusion Alarms			
Item	Exist. (Y/N)	Oper. (Y/N)	Notes
Access:			
Vehicular			
Maint. Equip. (i.e., chem., cranes, etc.)			
Surfacing (paved, gravel)			No drainage
Ponding / Mud			
Site Features:			
Potable water			
On-site Equipment Storage			
Restrooms			
Lab			

Pump Station Visual Inspection Checklist

Name of Observer: Jon, Shayne

Pump Station Name: __View Drive BPS_____ Date: 7/9/25

NOTES:

Not in service
Francisco wants to convert to PRV
Backfeed for other zone
Neighbor might have used acting wall to mount meter
Pumps from Zone 200 to 400 - but Terracina 2 now pumps from 200 to 600 zones and eliminates need for Glade and View BPS
Wants to turn it into a PRV

PUMP STATION VISIT NOTES

LOCATION: View Booster Pump Station
DATE: 7/9/2025

STRUCTURE	**Pump Station**
DESCRIPTION	CMU enclosure housing pump. Inside the enclosure is a slab on grade. The enclosure is accessed with a swinging gate.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
SLAB ON GRADE	Minor cracking in slab on grade. Generally OK condition. Grass is growing in the joint between the CMU and slab on grade.
CMU WALLS	Some large cracks have formed in the south and east walls along the mortar joints. The walls are in poor condition and require remediation. A tree has started growing through the south-west corner of the block wall and requires removal.
ELECTRICAL EQUIPMENT SUPPORT	The electrical equipment is mounted to the south wall which requires remediation.
PIPE SUPPORTS	The pipes are supported on CMU and wood blocks. It is recommended to get steel pipe supports and replace the temporary blocks.\

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Well 1-B
Site Address:	
Assessor Name:	JH/SC

GENERAL		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Date Drilled		
Status	**Standby**	**Well produces rocks and sand. Used on East side of town. New wells are planned. Well is not used much due to the rocks and sand and may not be needed in future.**
As-builts available?	**Yes/No**	
Well Depth (ft)		
Casing Diameter (in)		
Casing Material		
Screen Type		
Screen Material		
Permanent Standby Generator	**Yes/No**	
Portable Generator Power Receptacle	**Yes/No**	
Site Piping	**Steel**	**Coating is ok, Bollards present. 10" diameter pipe.**
SECURITY	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Yes**	**Fencing present**
Security system, gate or intrusion alarm		

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading	**Good**	
Site Access (Road, Gates, etc.)	**Good**	
Surface Improvements (landscape, bollards, etc.)	**Good**	
STRUCTURES		
STRUCTURAL EVALUATION	**FIELD DATA**	**REVIEWER COMMENTS**
Roof		
Exterior Walls		
Interior Walls		
Floor/Slab		
Windows/Openings		
Doors		
Pipe Supports		
Large Equipment Anchorage (Generators, Pumps, etc.)		
Platforms (if present)		
MECHANICAL		
PUMP CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Pump Type		
Pump Manufacturer		
Pump Model #		
Impeller Code		
Pump Serial #		
Number of Stages		
Issues?		**Pump not bolted down**

PUMP PERFORMANCE FLOW	FIELD DATA	REVIEWER COMMENTS
Design Flowrate (gpm)	**1200 GPM**	
Observed Flowrate (gpm)		
Discharge Pressure (PSI)	**100psi+ (observed)**	
MOTOR CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Motor Type		
Model #		
Serial/Catalog #		
Total Horsepower (HP)	**150**	
Speed (rpm)	**1780**	
Phase/Voltage	**3**	
VFD?	**No**	
ELECTRICAL/INSTRUMENTATION		
GENERAL	**FIELD DATA**	**REVIEWER COMMENTS**
Disinfection/Treatment		**Chemicals stored in small wooden enclosure, double wall containment is present, eyewash is present. Sodium hypo injection tubing is not double contained and pressurized over 100 psi. Hypo line is exposed at injector. Aquadene is being used for iron manganese removal.**
List remote alarms		
List local annunciation alarms		
Manual or automatic transfer switch		
ELECTRICAL SAFETY	**FIELD DATA**	**REVIEWER COMMENTS**
Arc-flash labeling?		

ELECTRICAL EVALUATION	FIELD DATA	REVIEWER COMMENTS
Lighting	**Yes**	
Generator (if applicable)		
Main Electrical Panel		**Electrical is old. Electrical enclosures are at end of life.**
Communications		
PLC Controller		

NOTES

WELL SITE VISIT NOTES

LOCATION: Well 1-B
DATE: 7/9/2025

STRUCTURE	**Sodium Hypochlorite Shed**
DESCRIPTION	Wood framed walls and roof mounted to a concrete foundation.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	Existing slab has some spalling and damage. No large cracks were observed.
WALLS	Studs appear to be in good shape. Siding and trim is in need of paint and repair where there is some wood rot and termite damage.
ROOF	Roof framing condition is fair.

STRUCTURE	**Electrical Cabinet**
DESCRIPTION	The electrical cabinet is mounted to a 43-inch by 20-inch concrete pad. The cabinet is anchored with four 1/2-inch anchor bolts. Embedment is unknown. An additional cabinet was mounted to the back of the cabinet on the housekeeping pad and fitted with angles that bear on top of the concrete slab.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	The concrete has some spalling and cracking and generally is not in good condition.

STRUCTURE	**Pump**
DESCRIPTION	The pump is mounted to a 47-inch by 47-inch concrete pad.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	The concrete has some spalling and cracking and generally is in OK condition. Anchors for the pump were not visible.

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Well 11
Site Address:	
Assessor Name:	JH/SC

GENERAL		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Date Drilled		
Status	**Active**	
As-builts available?	**Yes/No**	
Well Depth (ft)		
Casing Diameter (in)		
Casing Material		
Screen Type		
Screen Material		
Permanent Standby Generator	**Yes/No**	
Portable Generator Power Receptacle	**Yes/No**	
Site Piping	**Steel**	**Minor corrosion, pipe supports not bolted/moderate corrosion. Pipe coatings mediocre/poor.**
SECURITY	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing	**Poor**	**Poor fencing. Roller gate is broken, barbed wire is broken.**
Security system, gate or intrusion alarm	**Need bollards to protect fence. Hypochlorite building not very secure - AC goes up side of wall and the roots are rotting. Weeds coming through AC.**	

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**Poor surface drainage, needs repaving.**
Site Access (Road, Gates, etc.)		
Surface Improvements (landscape, bollards, etc.)		
STRUCTURES		
STRUCTURAL EVALUATION	**FIELD DATA**	**REVIEWER COMMENTS**
Roof		
Exterior Walls		
Interior Walls		
Floor/Slab		
Windows/Openings		
Doors		
Pipe Supports		**Not bolted or touching pipe.**
Large Equipment Anchorage (Generators, Pumps, etc.)		
Platforms (if present)		
MECHANICAL		
PUMP CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Pump Type		**Pump is old**
Pump Manufacturer		
Pump Model #		
Impeller Code		
Pump Serial #		
Number of Stages		
Issues?		**Motor not bolted down.**

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

PUMP PERFORMANCE FLOW	FIELD DATA	REVIEWER COMMENTS
Design Flowrate (gpm)	**1200 GPM**	
Observed Flowrate (gpm)		
Discharge Pressure (PSI)	**444' TDH**	**105 psi observed**
MOTOR CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Motor Type		
Model #		
Serial/Catalog #		
Total Horsepower (HP)	**150**	
Speed (rpm)	**1775**	
Phase/Voltage		
VFD?		
ELECTRICAL/INSTRUMENTATION		
GENERAL	**FIELD DATA**	**REVIEWER COMMENTS**
Disinfection/Treatment		**Exposed sodium hypochlorite tubing, containment conduit not secure. Surface drainage not adequate.**
List remote alarms		
List local annunciation alarms		
Manual or automatic transfer switch		
ELECTRICAL SAFETY	**FIELD DATA**	**REVIEWER COMMENTS**
Arc-flash labeling?		

ELECTRICAL EVALUATION	FIELD DATA	REVIEWER COMMENTS
Lighting		
Generator (if applicable)		**Generator connections could use replacement**
Main Electrical Panel		**Electrical appears to be outdated.**
Communications		
PLC Controller		

NOTES

WELL SITE VISIT NOTES

LOCATION: Well 11
DATE: 7/9/2025

STRUCTURE	**Sodium Hypochlorite Shed**
DESCRIPTION	Prefabricated FRP
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	Slab not visible as containment is covering the slab. Anchorage not visible. The chemical storage tank is not anchored.
WALLS	The walls have some small cracks and deterioration. Condition is generally
ROOF	Roof has some deterioration.

STRUCTURE	**Electrical Cabinet**
DESCRIPTION	The electrical equipment is mounted to a galvanized steel structure and concrete slab that is flush with the AC pavement.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	The concrete slab is in good condition. The larger cabinets are anchored to the slab with 1/2-inch anchor bolts.

STRUCTURE	**Pump**
DESCRIPTION	The pump is mounted to a 60-inch by 60-inch concrete pad. The cabinet is anchored with four 1/2-inch anchor bolts. Embedment is unknown.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	The concrete is in good condition. The pump is not anchored to the concrete pad. Some corrosion in the pump mounting plate. Some corrosion in the pipe stands.

SITE ELEMENTS	
CONDITION ASSESSMENT	The rolling gate is not easily opened. Weeds are growing in the cracks in the pavement and joints between concrete and AC pavement. Tree outside of the site wall is overgrowing the fence. Some security wire at the tops of the fences are missing. The drain into the creek is eroding the creek bank.

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Well 12
Site Address:	
Assessor Name:	JH/SC

GENERAL		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Date Drilled	**1994**	
Status	**Active/Standby**	
As-builts available?	**Yes/No**	
Well Depth (ft)		
Casing Diameter (in)		
Casing Material		
Screen Type		
Screen Material		
Permanent Standby Generator	**Yes/No**	
Portable Generator Power Receptacle	**Yes/No**	**Portable generator onsite**
Site Piping		**Some coating is poor**
SECURITY	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing		**Brick walls present, no barbed wire.**
Security system, gate or intrusion alarm		**Poor live security, signs of grafiti/vandalism.**

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		**Fair asphalt**
Site Access (Road, Gates, etc.)		**Good access**
Surface Improvements (landscape, bollards, etc.)		
STRUCTURES		
STRUCTURAL EVALUATION	**FIELD DATA**	**REVIEWER COMMENTS**
Roof		**Electrical building in poor condition**
Exterior Walls		
Interior Walls		
Floor/Slab		
Windows/Openings		
Doors		
Pipe Supports		
Large Equipment Anchorage (Generators, Pumps, etc.)		
Platforms (if present)		
MECHANICAL		
PUMP CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Pump Type	**VT**	
Pump Manufacturer		
Pump Model #		
Impeller Code		
Pump Serial #		
Number of Stages		
Issues?		

PUMP PERFORMANCE FLOW	FIELD DATA	REVIEWER COMMENTS
Design Flowrate (gpm)		
Observed Flowrate (gpm)	**1300**	
Discharge Pressure (PSI)		
MOTOR CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Motor Type		
Model #		
Serial/Catalog #		
Total Horsepower (HP)	**150**	
Speed (rpm)	**1800**	
Phase/Voltage	**3**	
VFD?		
ELECTRICAL/INSTRUMENTATION		
GENERAL	**FIELD DATA**	**REVIEWER COMMENTS**
Disinfection/Treatment		**Sodium Hypochlorite valve should be locked. Broken chemical containment tubing. Containment for hypo seems inadequate.**
List remote alarms		
List local annunciation alarms		
Manual or automatic transfer switch		
ELECTRICAL SAFETY	**FIELD DATA**	**REVIEWER COMMENTS**
Arc-flash labeling?		

ELECTRICAL EVALUATION	FIELD DATA	REVIEWER COMMENTS
Lighting		
Generator (if applicable)		**Portable Generator**
Main Electrical Panel		
Communications		
PLC Controller		

NOTES
Iron and Manganese Chemicals
Electrical building seems poor
Unsecured ball valves on side of tank
Level gauge broken
Tank anchored
Pavement - fair
3 filter + 1 surge - vessels

WELL SITE VISIT NOTES

LOCATION: Well 12
DATE: 7/9/2025

STRUCTURE	**Backwash tank (bolted), Treatment plant, Chemical Shed, Site retaining wall**
DESCRIPTION	
AS-BUILTS AVAILABLE	No
TANK	The backwash tank is an AWWA D103 bolted tank built in 1994 by Peabody TecTank. The capacity is 57,200-gallons and is 21-feet diameter and 22-feet tall. The tank is anchored to the foundation. The foundation type (ring wall vs. mat slab) is unknown.
WELL HEAD AND COVER	The well head is covered by a prefab structure with a wood roof mounted to a concrete slab.
PIPE RACK	The piping is supported on four steel frames. The frames consist of wide flange columns with base plates bolted to the foundation. Connecting the wide flanges and directly supporting the piping is unistrut.
TRUSCO TANK	Beyond the pipe racks are three Trusco Tanks which are on unbraced leg supports. The legs are anchored to the foundation.
CHEMICAL SHED	The chemical shed floor is elevated above grade. Access is by a small stair and catwalk.
SITE	A CMU retaining wall is located on the north side of the site along the side of the highway. The wall is retaining roughly 5-feet of sloping soil. On the other sides of the site are cantilevered CMU site walls.
CONDITION ASSESSMENT	
TANK	Some cracking in the concrete foundation. Tank shell in good condition. The external ladder is galvanized and in good condition.
WELL HEAD AND COVER	Deterioration in the wood framing. Cracks in well head pedestal. No visible anchorage of the well pump to the pedetal.
PIPE RACK	The steel, unistrut, and foundations appear in good condition.
TRUSCO TANK	The tanks and anchorage are in good condition.
CHEMICAL SHED	The tanks inside the shed are sitting on grating and are unanchored. The exterior of the shed has some deterioration and corrosion on the fascia.
SITE	The CMU retaining wall at the side of the site nearest the highway is in good condition.

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Well 13
Site Address: 250 Trinity Ln	
Assessor Name:	JH/SC

GENERAL		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Date Drilled		
Status	**Standby**	**Alternative for Well 14. Pump only runs on manual, but it should be able to run automated to tank level, but not working. Motor faults after 1 hour.**
As-builts available?	**Yes/No**	
Well Depth (ft)		
Casing Diameter (in)		
Casing Material		
Screen Type		
Screen Material		
Permanent Standby Generator	**No**	
Portable Generator Power Receptacle	**No**	
Site Piping		**Pipe supports are corroded, piping has minor corrosion. Coating is fair.**
SECURITY	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing		**Adequate fencing, pump stored in brick building.**
Security system, gate or intrusion alarm		**Poor/fair security - camera blocked by neighboring palm tree, lots of grafiti on building. Could use vandal proof locks. Vines covering the wall. Need barbed wire fencing.**

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading	OK	
Site Access (Road, Gates, etc.)	OK	
Surface Improvements (landscape, bollards, etc.)	OK	
STRUCTURES		
STRUCTURAL EVALUATION	**FIELD DATA**	**REVIEWER COMMENTS**
Roof		
Exterior Walls		
Interior Walls		
Floor/Slab		
Windows/Openings		
Doors		
Pipe Supports		
Large Equipment Anchorage (Generators, Pumps, etc.)		
Platforms (if present)		
MECHANICAL		
PUMP CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Pump Type		
Pump Manufacturer		
Pump Model #		
Impeller Code		
Pump Serial #		
Number of Stages		
Issues?		

PUMP PERFORMANCE FLOW	FIELD DATA	REVIEWER COMMENTS
Design Flowrate (gpm)	**1800 GPM**	
Observed Flowrate (gpm)		
Discharge Pressure (PSI)	**~100 PSI**	
MOTOR CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Motor Type		
Model #		
Serial/Catalog #		
Total Horsepower (HP)		
Speed (rpm)		
Phase/Voltage		
VFD?		
ELECTRICAL/INSTRUMENTATION		
GENERAL	**FIELD DATA**	**REVIEWER COMMENTS**
Disinfection/Treatment		**Unprotected chem tubing, chem storage building grate is not rigid, exhaust fan in sodium hypo building appears to be broken. Coated walls in good condition. 200 gallon hypo tank. Exhaust fan not working.**
List remote alarms		
List local annunciation alarms		
Manual or automatic transfer switch		
ELECTRICAL SAFETY	**FIELD DATA**	**REVIEWER COMMENTS**
Arc-flash labeling?		

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

ELECTRICAL EVALUATION	FIELD DATA	REVIEWER COMMENTS
Lighting	**OK**	
Generator (if applicable)		
Main Electrical Panel		
Communications		
PLC Controller		

NOTES
Turn tremie tube elbow down

WELL SITE VISIT NOTES

LOCATION: Well 13
DATE: 7/9/2025

STRUCTURE	**CMU Chemical Storage, Electrical Room, and Pump Room**
DESCRIPTION	The structure housing the chemical storage, electrical equipment, and pump is a 12.67-feet building with exterior and interior CMU walls. The roof framing over the electrical and chemical storage rooms was not visible. The roof over the pump room has a steel framed roof that is removeable.
AS-BUILTS AVAILABLE	No
CONDITION ASSESSMENT	
FOUNDATION	Generally the slab is in good condition. There are some small cracks.
WALLS	The CMU walls are in good condition. There are some minor cracks in the exterior wall near the large opening at the pump room. Some graffiti was sprayed on the large door into the pump room.
ROOF	The roof framing was not visible.
CHEMICAL STORAGE ROOM	The chemical storage room smelled strongly of sodium hypochlorite. The exhaust fan did not appear to be functioning during the site visit.
ELECTRICAL ROOM	The wall in the electrical room had some efflorescence.
PUMP ROOM	The 50-inch square pad supporting the pump has some large cracks. The pump was anchored. The fascia on the removeable roof has some rot and damage.
PIPING AND PIPE SUPPORTS	The piping and supports have minor corrosion and coating failure.

SITE ELEMENTS	
CONDITION ASSESSMENT	The neighbor's ivy is growing over the CMU site wall

CITY OF SANTA PAULA
WELL CONDITION ASSESSMENT FORM

FACILITY AND REVIEWING INFORMATION

Date/Time of Assessment:	7/9/2025
Site Name/ Facility ID:	Well 14/Treatment Building
Site Address: 532 W Main St	
Assessor Name:	JH/SC

GENERAL		
GENERAL INFORMATION	**FIELD DATA**	**REVIEWER COMMENTS**
Date Drilled		
Status	**Active**	
As-builts available?	**Yes/No**	
Well Depth (ft)		
Casing Diameter (in)		
Casing Material		
Screen Type		
Screen Material		
Permanent Standby Generator	**No**	
Portable Generator Power Receptacle	**Yes**	
Site Piping	**Steel**	**Coating is worn for well, ok in the treatment building**
SECURITY	**FIELD DATA**	**REVIEWER COMMENTS**
Fencing		**Infrastructure is enclosed in building.**
Security system, gate or intrusion alarm		**Infrastructure is enclosed in building.**

SITE ACCESS/FEATURES	FIELD DATA	REVIEWER COMMENTS
Site Grading		
Site Access (Road, Gates, etc.)		
Surface Improvements (landscape, bollards, etc.)		
STRUCTURES		
STRUCTURAL EVALUATION	**FIELD DATA**	**REVIEWER COMMENTS**
Roof		
Exterior Walls		**Hole in wall is for generator cable.**
Interior Walls		**Sound damping material on walls.**
Floor/Slab		
Windows/Openings		
Doors		
Pipe Supports		
Large Equipment Anchorage (Generators, Pumps, etc.)		**Pump is not bolted.**
Platforms (if present)		
MECHANICAL		
PUMP CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Pump Type		
Pump Manufacturer		
Pump Model #		
Impeller Code		
Pump Serial #		
Number of Stages		**Pump appears to be worn. Operates at appropriate flow rate of 3,200 GPM, but significantly lower TDH than rated.**
Issues?		**Electrical is in the same room as water. Seal is leaking. Pump does not appear bolted.**

PUMP PERFORMANCE FLOW	FIELD DATA	REVIEWER COMMENTS
Design Flowrate (gpm)	**3200**	
Observed Flowrate (gpm)	**3200**	
Discharge Pressure (PSI)	**412'**	**(~231' observed) - pump may be worn or trimmed impellers**
MOTOR CHARACTERISTICS	**FIELD DATA**	**REVIEWER COMMENTS**
Motor Type	**VT**	
Model #		
Serial/Catalog #		
Total Horsepower (HP)	**500**	
Speed (rpm)	**1795**	
Phase/Voltage	**3/460**	
VFD?	**Yes**	
ELECTRICAL/INSTRUMENTATION		
GENERAL	**FIELD DATA**	**REVIEWER COMMENTS**
Disinfection/Treatment		
List remote alarms		
List local annunciation alarms		
Manual or automatic transfer switch		
ELECTRICAL SAFETY	**FIELD DATA**	**REVIEWER COMMENTS**
Arc-flash labeling?		

ELECTRICAL EVALUATION	FIELD DATA	REVIEWER COMMENTS
Lighting		
Generator (if applicable)		**Portable generator on-site, planned future permanent generator. Hole in walll for the generator cable.**
Main Electrical Panel		
Communications		
PLC Controller		

NOTES

Corrosion and cracking on flex couplings in the treatment building, vessel coatings at hatches is poor, general clutter throughout treatment building, grating in treatment building needs to be fixed - tripping hazard.
Backwash @ 50 hours to sump
Generally good condition.
AC was recently built.

Appendix C

Tank Maintenance Matrix and Dive Inspection Reports

DRAFT

City of Santa Paula

Tank Maintenance Plan

	Tank Name	Origin District	Last Dive Year	Next Dive	Overall Condition Rank	Interior Priority	Exterior Priority	Interior Scope	Exterior Scope	Year Built	Capacity	Dia.	Height	Interior Relining Estimated Cost	Exterior Paint Estimated Cost*	Current Dive Report
1	Anderson	Santa Paula	2025	2030	30	1	3	Reline	R/R	1980's	0.62 MG	48	42	$200,868	$56,972	Anderson
2	Peck	Santa Paula	2025	2030	40	1	5	Reline	NW	1980's	0.50 MG	60	24	$217,206	$51,433	Peck
3	Limoneria	Santa Paula	2025	2030	40	2	2	Reline	R/R	1950's	1MG	60	36	$257,901	$67,259	Limoneria
4	Case	Santa Paula	2025	2030	85	4	5	Reline	S/OC	1968	0.50 MG	60	24	$217,206	$51,433	Case
5	Cherry Hill	Santa Paula	2025	2030	85	4	5	Reline	S/OC	1954	0.53 MG	66	21	$242,676	$54,401	Cherry Hill
6	Fuchsia	Santa Paula	2025	2030	100	5	5	Reline	S	1955	0.50 MG	60	24	$217,206	$15,000	Fuchsia

Prioritization Key	
Priority 1 –	Work required as soon as possible
Priority 2 –	Work required in 1-3 years
Priority 3 –	Work required in 3-5 years
Priority 4 –	Work required in 5-7 years
Priority 5 –	No work required for 7-10+ years
WarRep -	Warranty Repairs Required

Abbreviation Legend	
NW	No work required (Priority 5)
S	Spot Repair
OC	Overcoat
S/OC	Spot Repair & Overcoat
R/L	Next dive will be a warranty
R/R	Remove and Replace

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www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

October 21, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Anderson Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Anderson Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 21, 2025

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Attachments

- **Field Notes**
- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Anderson Reservoir located at 675 N Peck Rd, Santa Paula CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 19, 2023 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 16 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The ~40 year old paint system on the tank is in overall poor condition with widespread and pervasive corrosion at the roof. The exterior paint system is severely weathered and has poor adhesion, making overcoating strategies risky. The existing paint system is believed to be the original system applied and potentially has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed. The paint system should be tested to identify the concentrations of heavy metals before any work takes place.

The original coal tar epoxy and coal tar enamel lining within the tank is in an overall unsatisfactory condition with widespread rust and blistering. The majority of the corrosion is within the MWL elevations of the tank shell and includes dark rust, pitting, exfoliation and the beginning stages of structural loss. The existing conditions dictate that the interior lining system should be removed and replaced within the next year to prevent further metal loss, necessitating the repair or replacement of steel elements when a relining is all that is required at this time.

Background

The Anderson Reservoir is a Welded Steel on grade structure that was constructed in the 1980's. The tank is approximately 48 feet in diameter by 42 feet high providing a nominal capacity of 620,000 gallons and is located at 675 N Peck Rd, Santa Paula CA. It is the only tank at this hillside site.

The tank shell has six courses that are connected to a roof with rafters, girders and one center column. The tank has six perimeter roof vents, one center stub vent, one roof hatch, and two shell manways. There is NO interior ladder and one exterior ladder. The exterior ladder has fall protection and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a mechanical water level indicator.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with a coal tar epoxy system while the tank shell, floor, and appurtenances are coated with a hot applied coal tar enamel. The exterior roof, shell, and appurtenances are painted with what appears to be an Alkyd system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in

accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in poor condition with moderate chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than ten percent of the overall surface area and rated a 4 in accordance with ASTM D610. At the shell, the exterior paint system is in good condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. The paint thicknesses were found to range from 9.0 to 10.0 mils on the roof and 14.0 to 15.0 mils on the shell. The paint system was estimated to exhibit poor adhesion (ASTM D6677, 3A).

Some of the specific data collected follows:

Exterior Paint			Overall Condition		Fair							
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Poor		Exterior		Good		Exterior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	4	4	4	4	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	6	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. Spot peeling and cracking was observed throughout, leading to lamellar or exfoliation corrosion (CSI Corrosion Grades 2, 4). The total amount of corrosion on the roof was rated to be approximately 1 percent of the total surface area (ASTM D610, 6), and there was a moderate amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in poor condition with areas of dark rust, pitting and lamellar exfoliation (CSI Corrosion Grades 2, 3, 4), especially within the mean water level segment of the shell. The total amount of corrosion on the shell was rated to be one-third of the total surface (ASTM D610, 2) with rust nodules and pitting observed. Widespread groupings of intact, medium dense blisters were observed (ASTM 714, 4/Dense).

The floor had a large amount of sediment upon it, but spot checks revealed a hot applied enamel system that was estimated to be in good condition, (ASTM D610, 9) with localized large blisters (ASTM 714, 4/Dense).

The data collected from the inspection follows:

Interior Paint	Above Water Condition		Poor		Below Water Condition		Good					
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Poor		Interior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	6	6	6	6	2	2	2	2	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2,4	2,4	2,4	2,4	2,3,4	2,3,4	2,3,4	2,3,4	2	2	2	2
Rust staining	Minor	Minor										
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling												
Delamination					Moderate	Moderate	Moderate	Moderate				
Cracking (ASTM D661)	2	2	2	2	2	2	2	2				
Blistering (ASTM 714) Size/Density					4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/rADmiKBxCrXi5Xn4A

Discussion

The paint system on the exterior was found to be relatively thin and in poor condition on the roof but in good condition on the shell. All surfaces of the roof have isolated spot rust and areas of peeling and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the vents have heavy corrosion up to and including some metal loss.

Peeling or delaminating coating is a symptom of an adhesion problem between the coating and substrate or from within layers of coating system. Adhesion is a function of a coating system's strength. Peeling is often a result of coated over contamination, incompatibility between coats, or from an undercoat being coated after its recoat window had closed. Catalyzed coatings, such as epoxies and urethanes continue to dry and then cure to a point to where they become too hard for topcoats to chemically adhere. Once the window for a chemical bond is closed, special procedures such as scarification are required to allow for a mechanical bond.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which

results in the paint no longer providing enough barrier protection from corrosion.

Cracking is the result of some form of stress within the coating system that extends through a complete layer of coating. The stress is often a result of some internal coating pressure or from some form of structural movement. The internal pressures can result from a shrinking film when it is applied too thick or if coating a coating does not have the elongation properties required to bridge existing breaks. Checking is related to cracking, but the coating breaks do not extend through the entire system.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior roof paint system be removed and replaced within the next 3 to 5 years before any additional significant metal loss develops. The existing paint system at the shell appears to be a suitable candidate for overcoating strategies, therefore, a spot repair and overcoat could be performed there in conjunction with the work being performed at the roof.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to the areas of the shell within the MWL. Some rafter flanges exhibit some minor section loss due to corrosion. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel, the process initiates itself as light-colored orange surface rust. As the corrosion process continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simple a result some areas not being completely sealed by coatings.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the

remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion. As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The original coal tar epoxy and hot applied enamel system within the tank cannot be spot repaired and the characteristics of the coating defects indicates that the lining failed many years ago. It is recommended that the lining be removed and replaced within the next 1 to 2 years.

During an earthquake, there is the potential for the tank bottom to move at a different rate than the below grade piping. Past seismic events have resulted in piping connections being sheared or cracked, which resulted in a loss of water capacity during times when it was most needed during the emergency. Retrofitting tank piping to include flexible connections for inlet/outlets is a better design when considering this issue.

The tank ventilation was found to have screening installed with gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next three to five years, remove and replace the exterior coating. This work should include the following:

1) Remove and replace the exterior paint system. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 6, "Commercial Blast Cleaning" (SSPC SP-6) followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

As soon as possible, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for structural repairs (welding, grinding, etc.)

6) Consider retrofitting the tank piping to include flexible couplings and the relocation of tank bottom connections to the lower shell.

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

P.O. Box 801357, Santa Clarita, CA 91380
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Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/19/25		Tuesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Andreson	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	N Peck Rd
Tank Location	675 N Peck Rd, Santa Paula CA
GPS Coordinates	34.35073, -119.09437
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	I Beam	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate	
Connections	Bolted	
Overflow Design	A Lower Funnel	
Inlet Interior Design	Stub	
Lining Type/Original	Epoxy	Yes

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	No	N/A		
CP System/Type	No	N/A		
Water Depth	16 ft			
Water Agitator	No	None		
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	620,000	
Diameter (feet)	48	
Height (feet)	42	
Erection Year	Unknown (80's)	
Contract No.	Unknown	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Six	
Height of Each Course	Mixed	
Roof Design	Pitched Roof with Drip Ring	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Unibolt	
Diameter of Manways	20 in	
No. Roof Hatches/Location	Two	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Round Hood	
Construction Co.	Unknown	

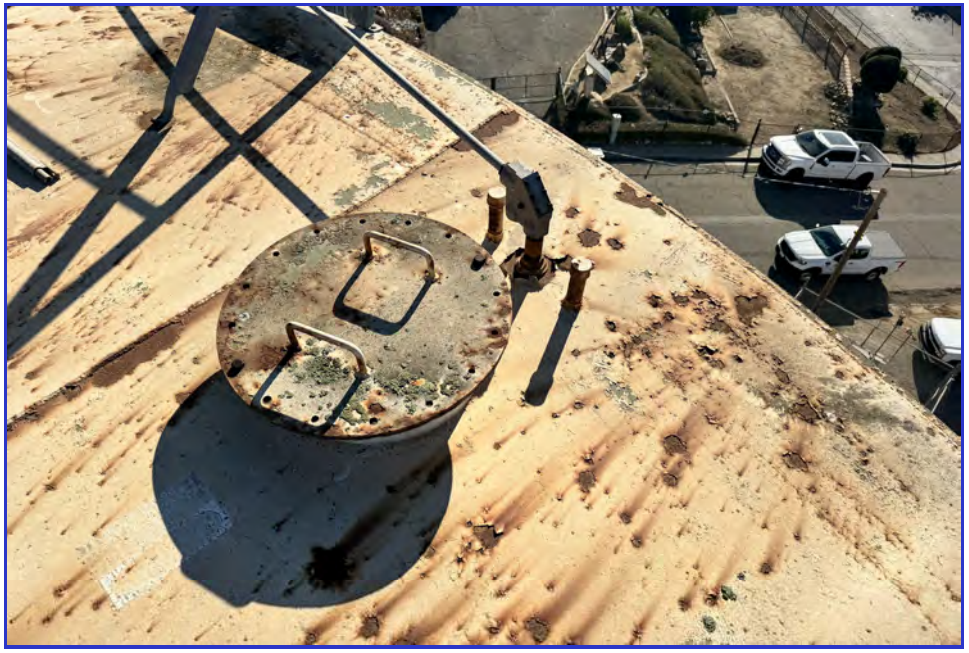
Item	Data		
Center Roof Vent Size	20 in		
Roof Vent Sealed	Yes	N/A	
Roof Rail System	Yes	N/A	
Roof Rail Satisfactory	Yes	N/A	
Rail Location	At Hatch		
No. & Type Roof Access	One	Ladder	
Exterior Vandal Deterrent	Yes		
Ext Ladder Satisfactory	One	Yes	
Ext Ladder Fall Prevent	Yes		
Roof Tie-Off Present	Yes		
Tank Piping	Shell Inlet and Outlet		
Inlet Diameter	12 in		
Outlet Diameter	12 in		
Flexible Pipe Coupling	No		
Overflow Pipe Diameter	12 in		
Overflow Exterior Design	Screen Air Gap		
Drain Location	Shell		
Tank Foundation	Gravel		
Water Level Indicator	YEs		
Tank Type	Potable		
Lining Type/Original	Polyurethane	No	

Miscellaneous Notes

The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -002



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -003



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -004



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -005



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -006



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -007



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -008



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -009



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -010



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -011



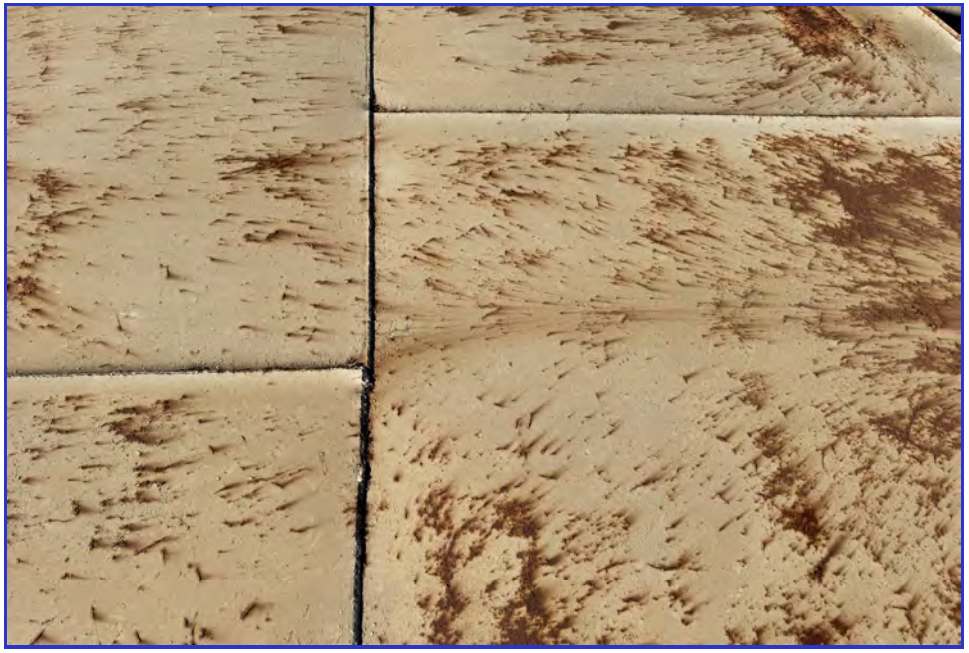
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -013



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -014



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -015



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -016



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -017



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -018



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -019



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -020



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -021



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -022



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -023



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -024



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -025



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -026



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -027



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -028



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -029



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -030



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -031



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -032



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -033



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -034



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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -037



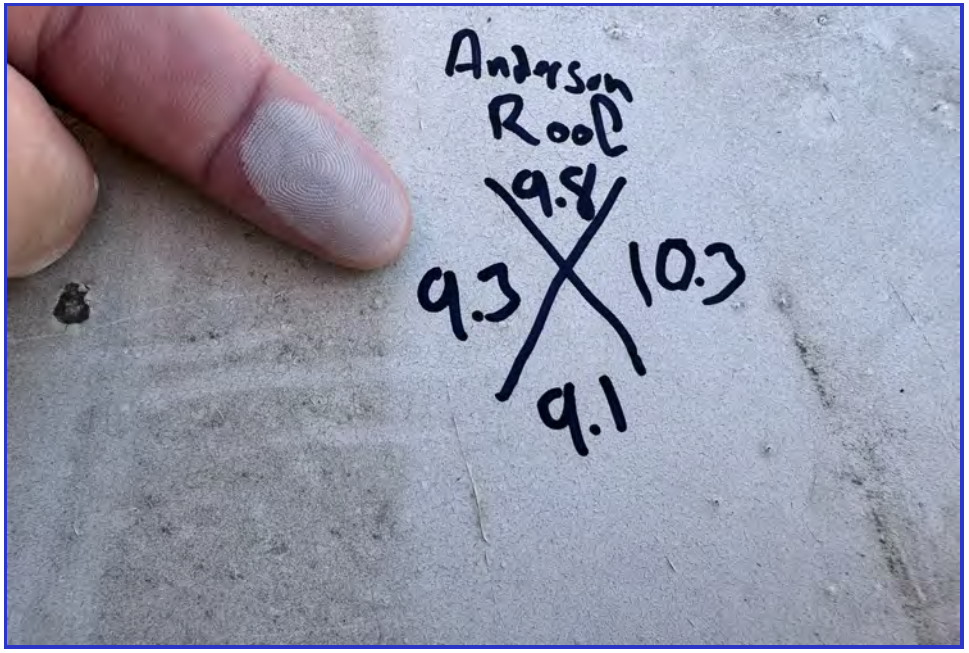
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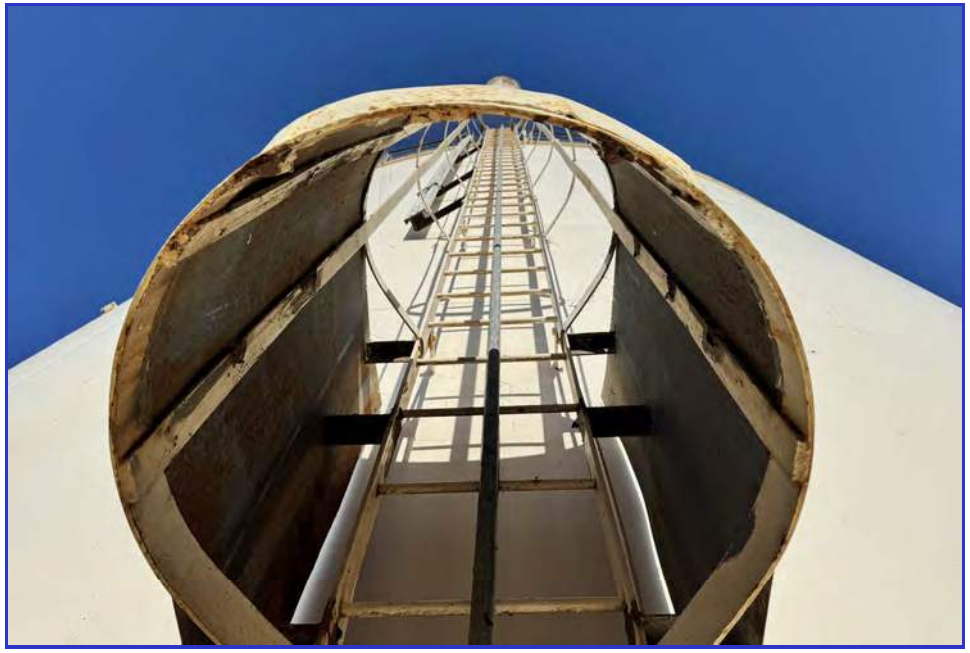
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -040



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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -043



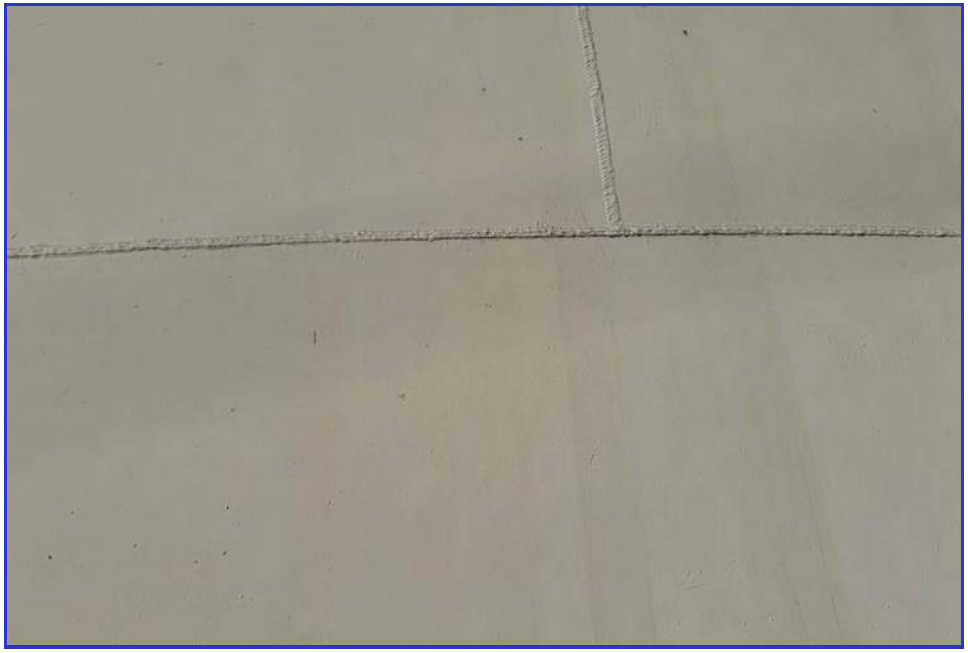
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -046



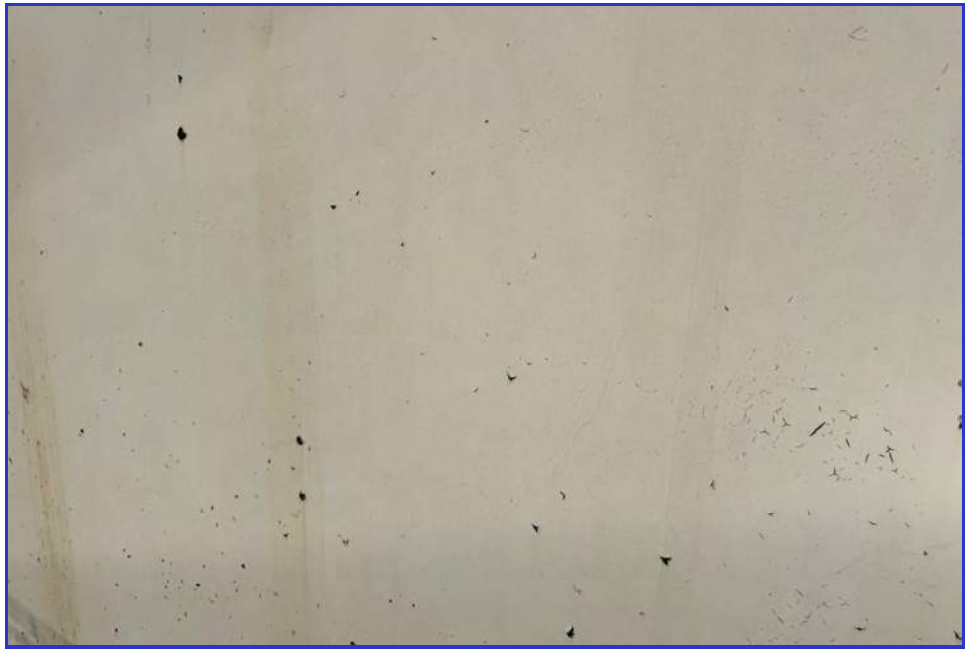
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -048



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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -051



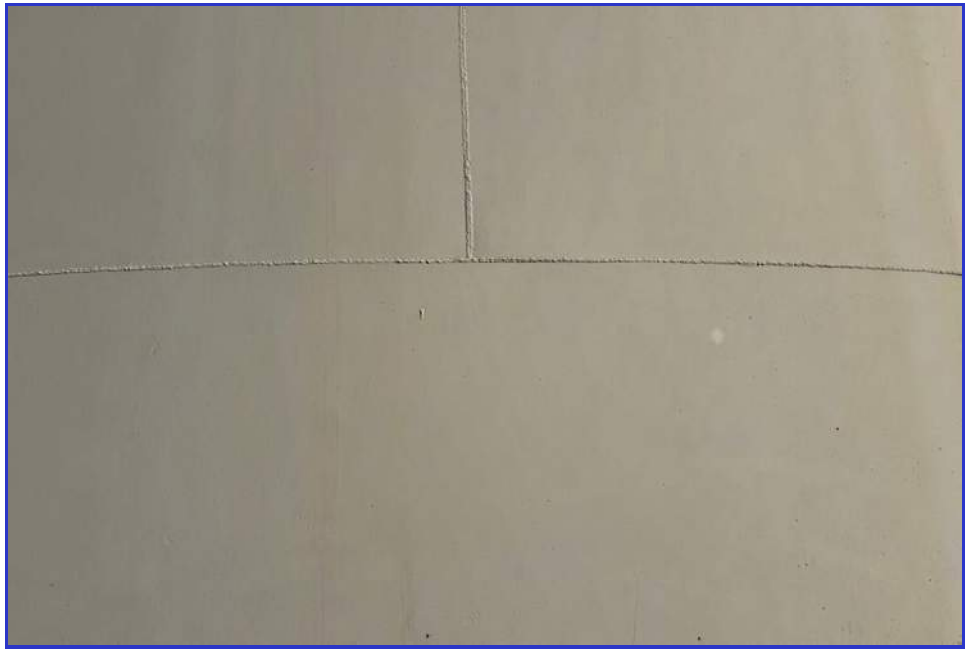
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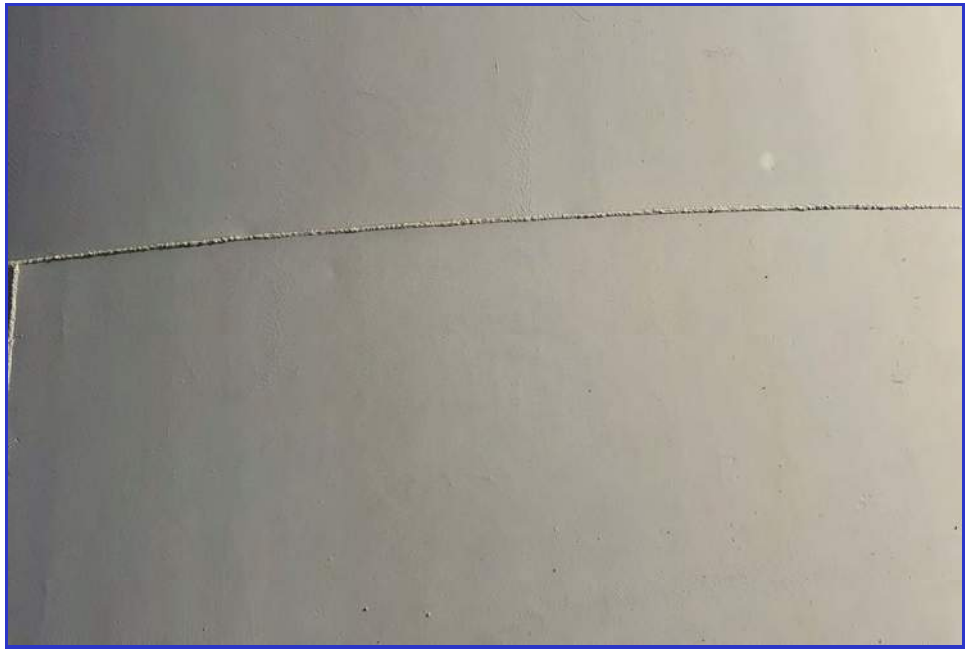
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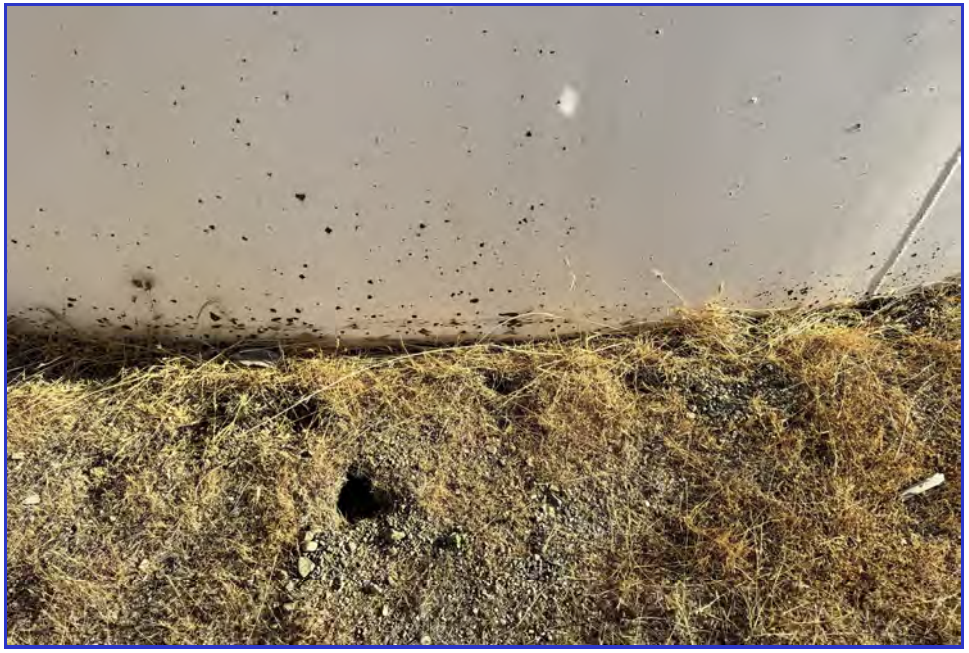
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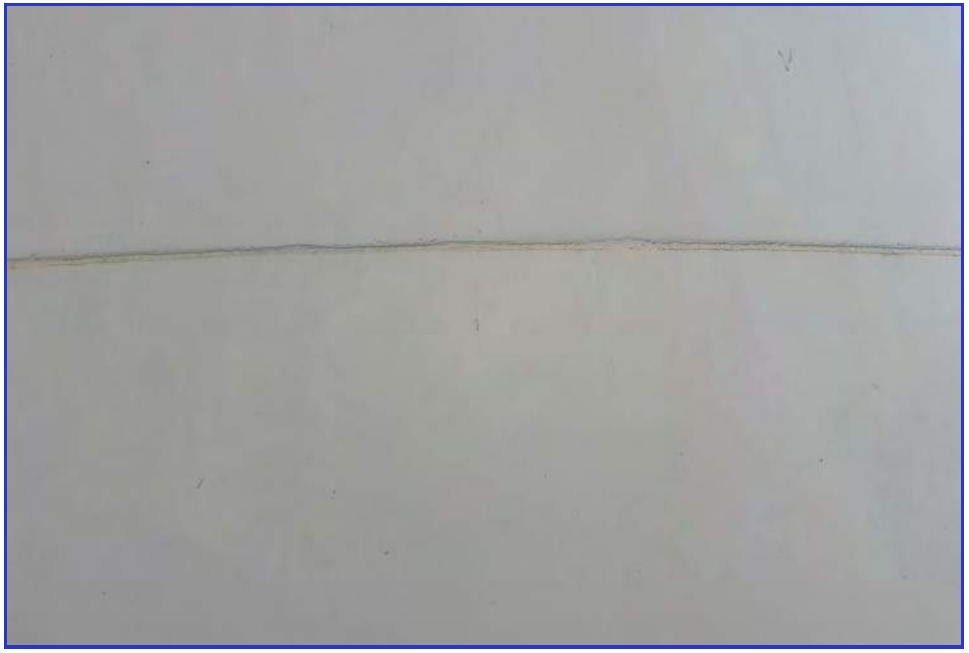
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -060



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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -063



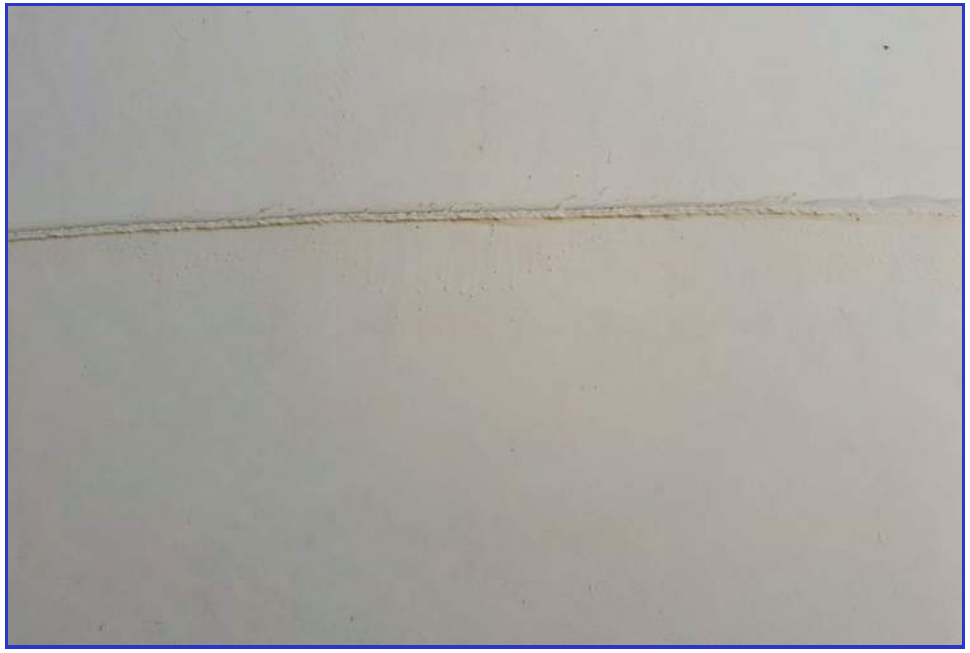
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -065



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -066



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -067



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -068



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -069



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -070



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -071



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -072



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -073



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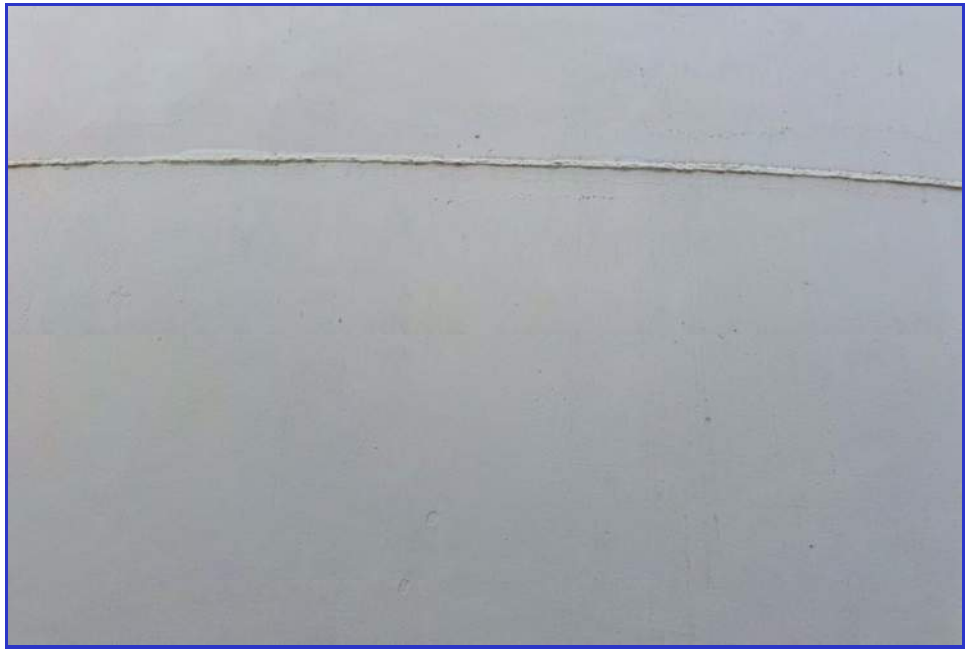
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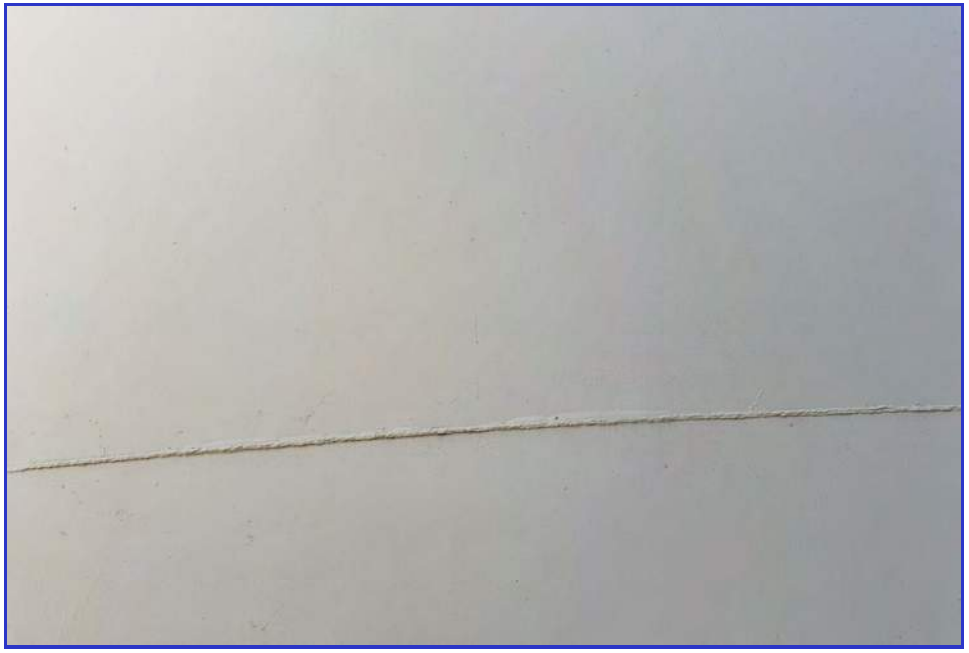
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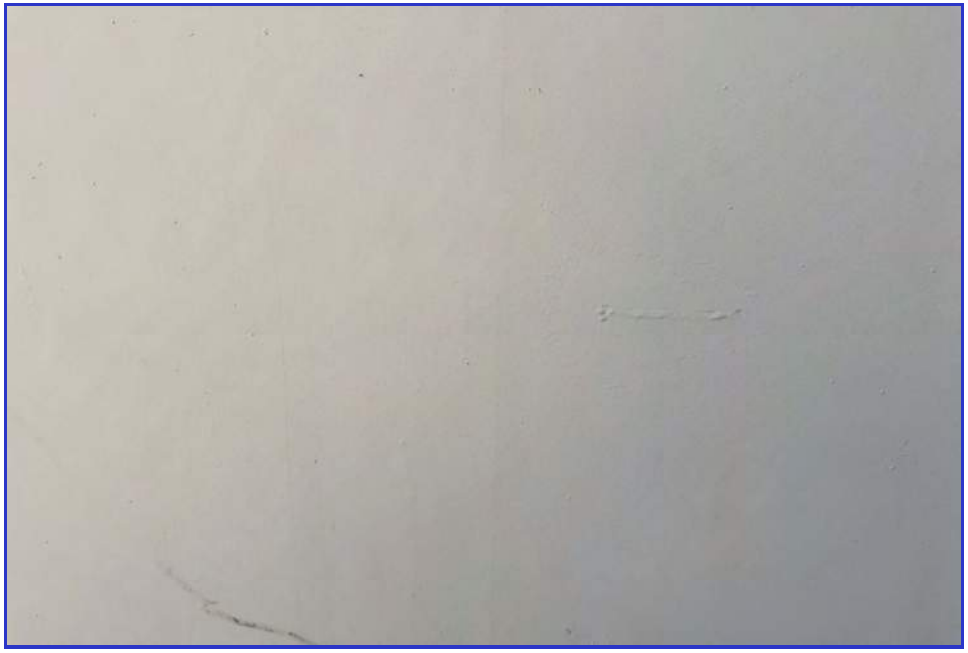
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -087



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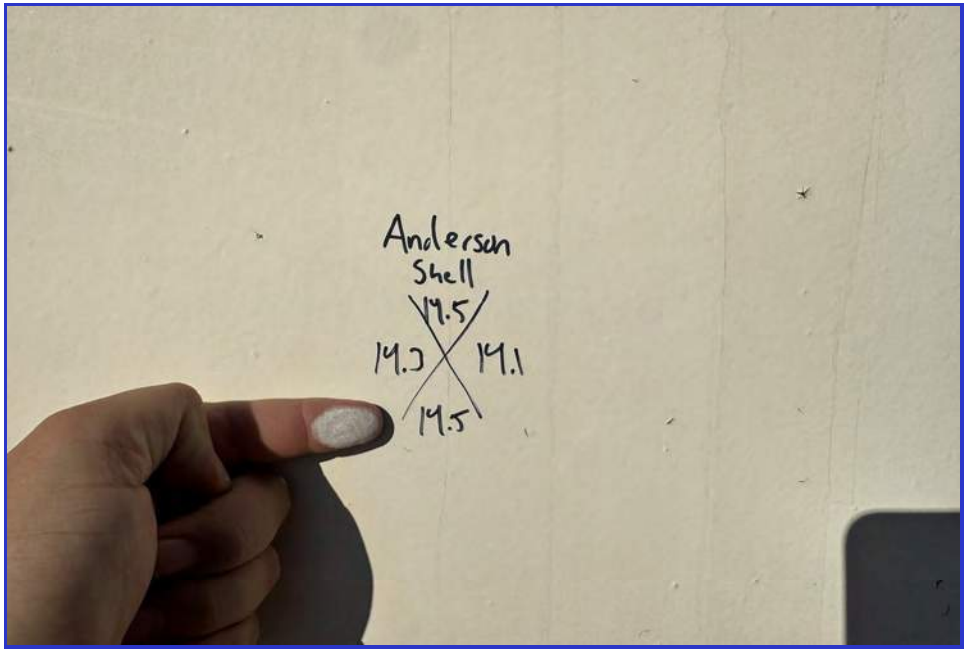
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EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -092



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -093



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -094



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -095



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -096



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -097



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -098



EXTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -099



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -001



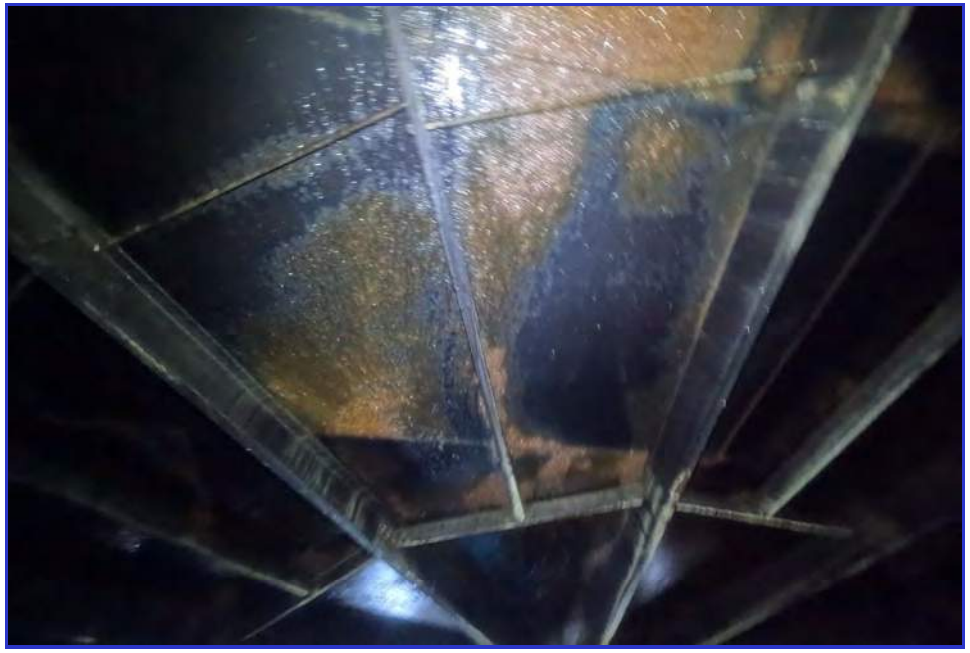
INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -002



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -003



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -004



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -005



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -006



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -007



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -008



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -009



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -010



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -011



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -012



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -013



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -014



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -015



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -016



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -017



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -018



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -019



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -020



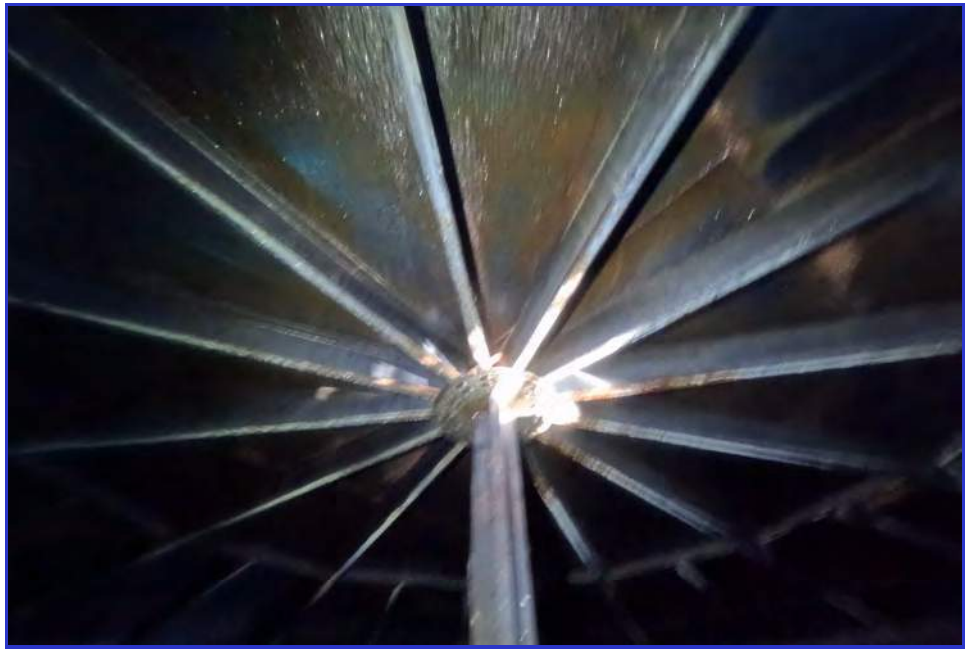
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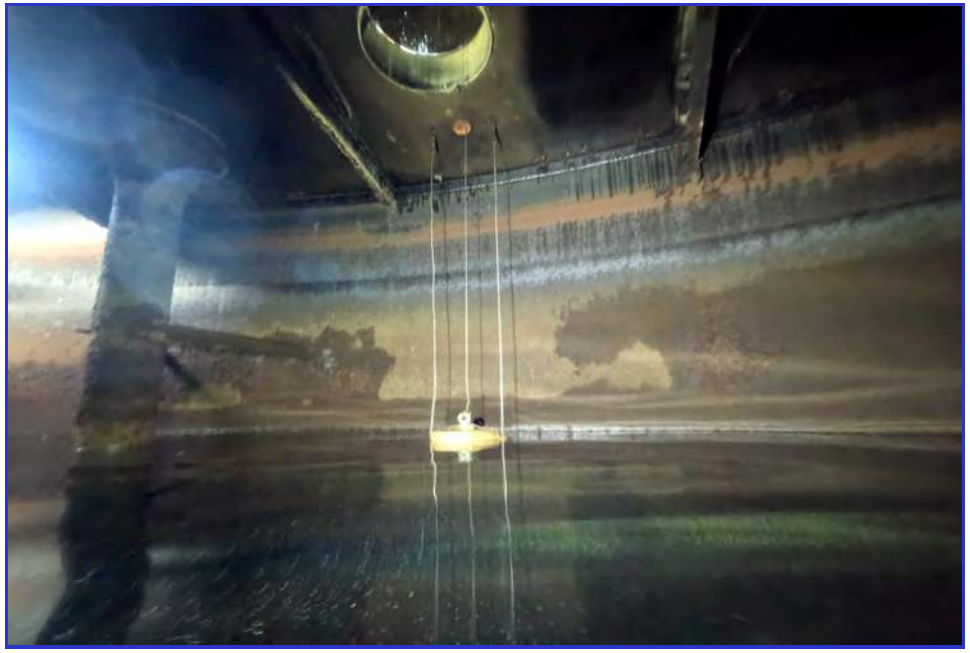
INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -022



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -023



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -024



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -025



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -026



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -027



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -028



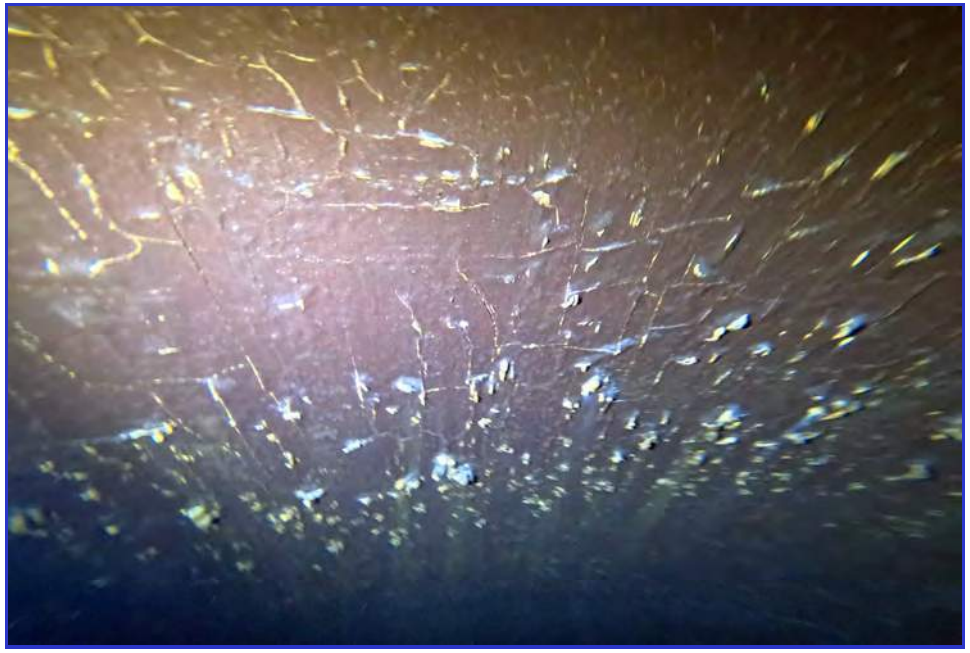
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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -030



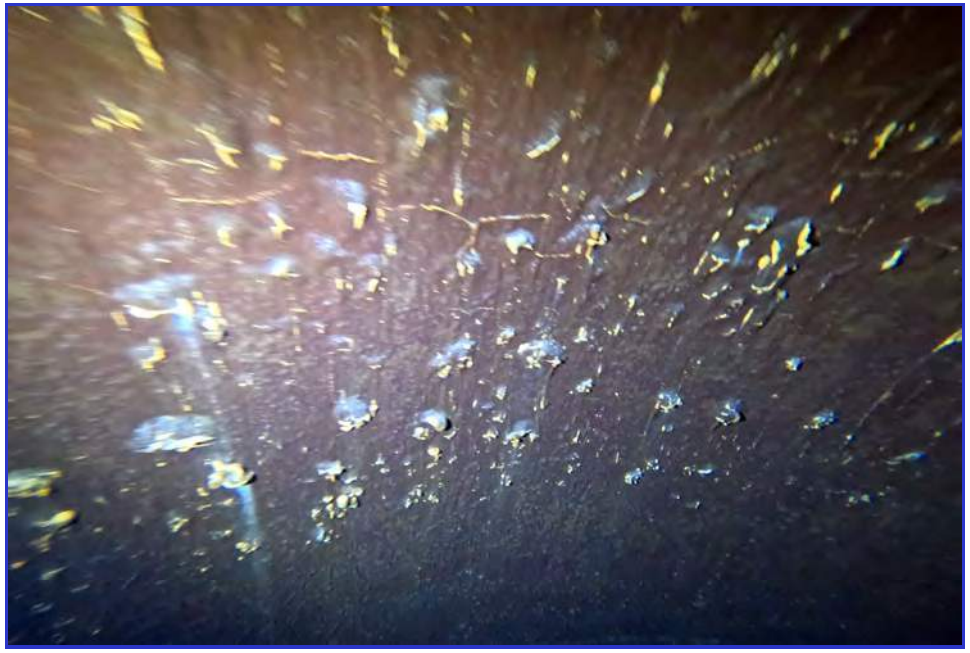
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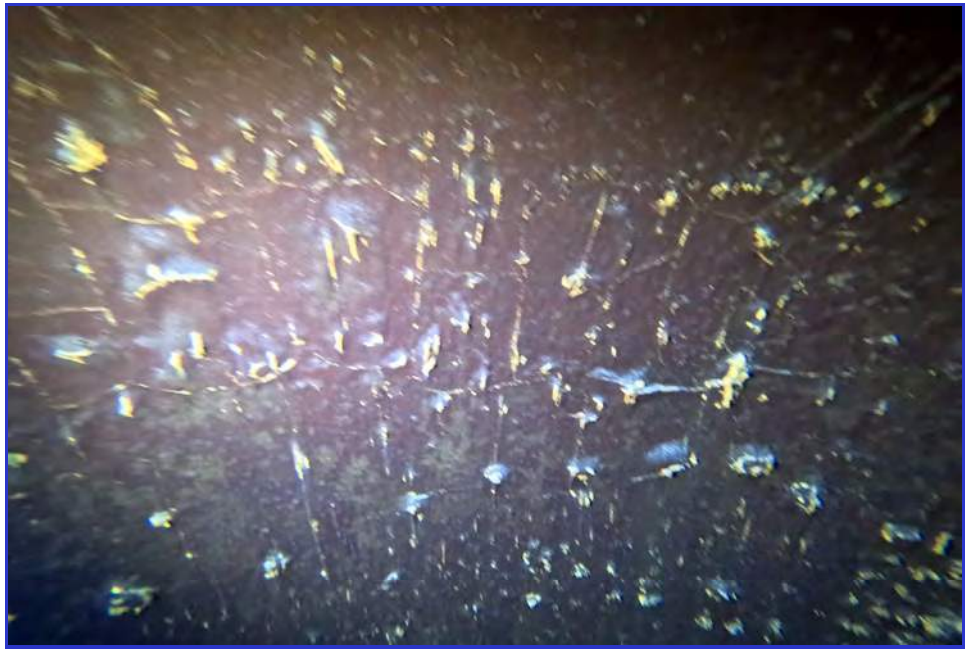
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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -033



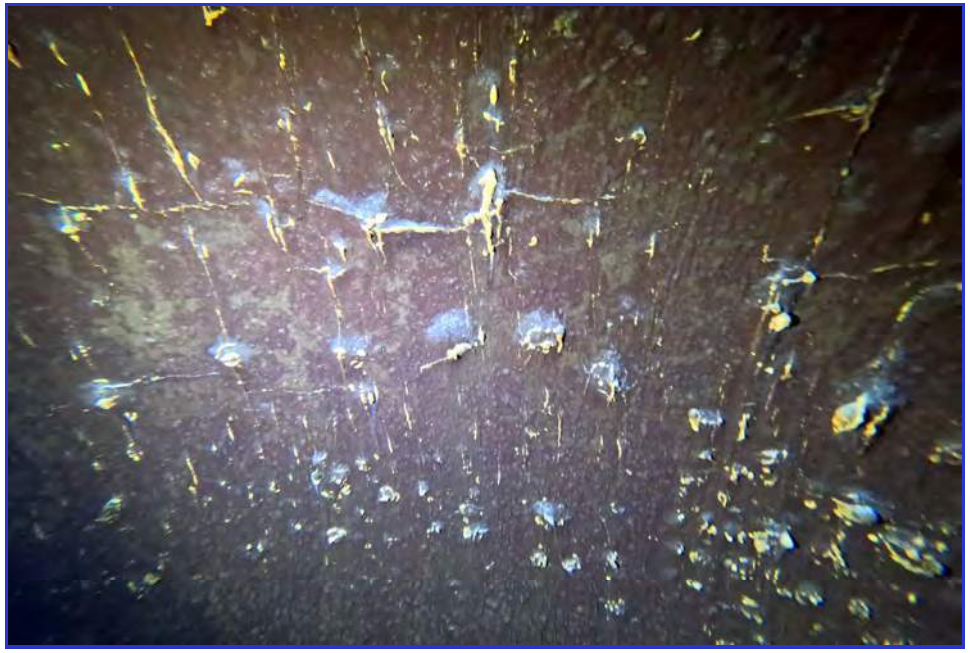
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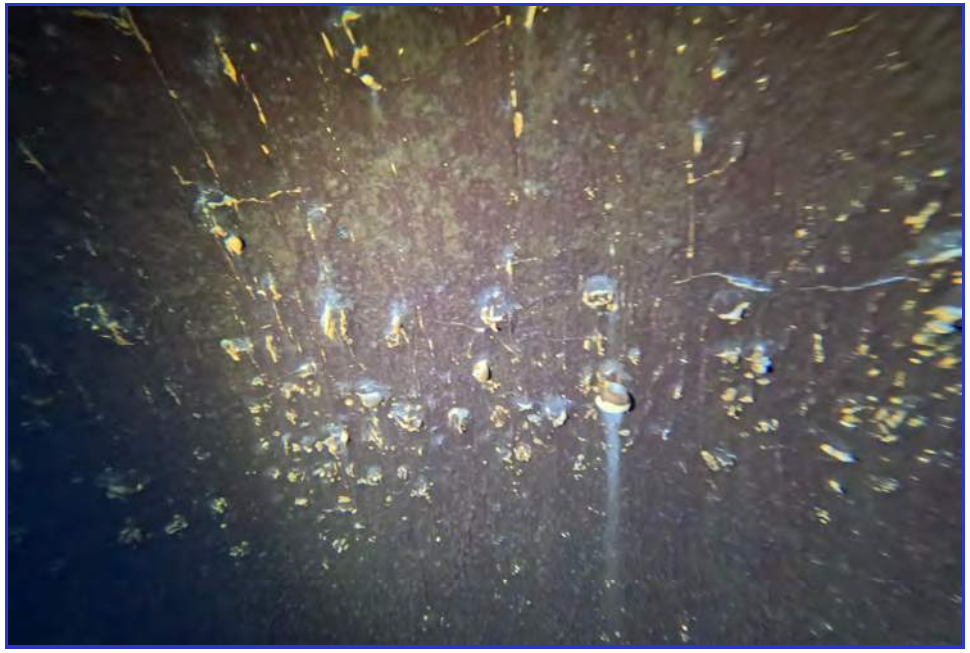
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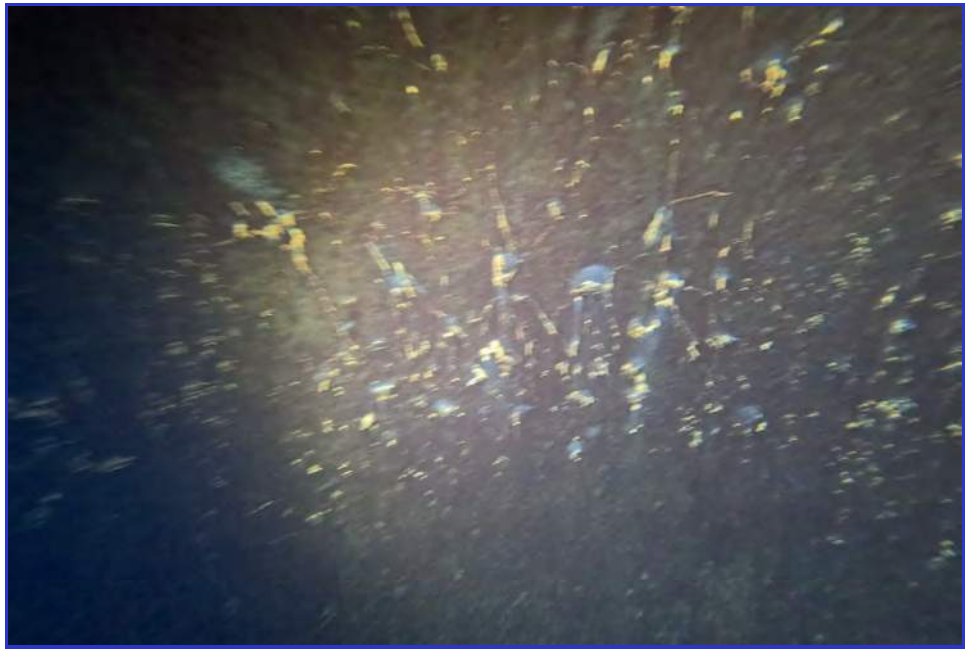
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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -037



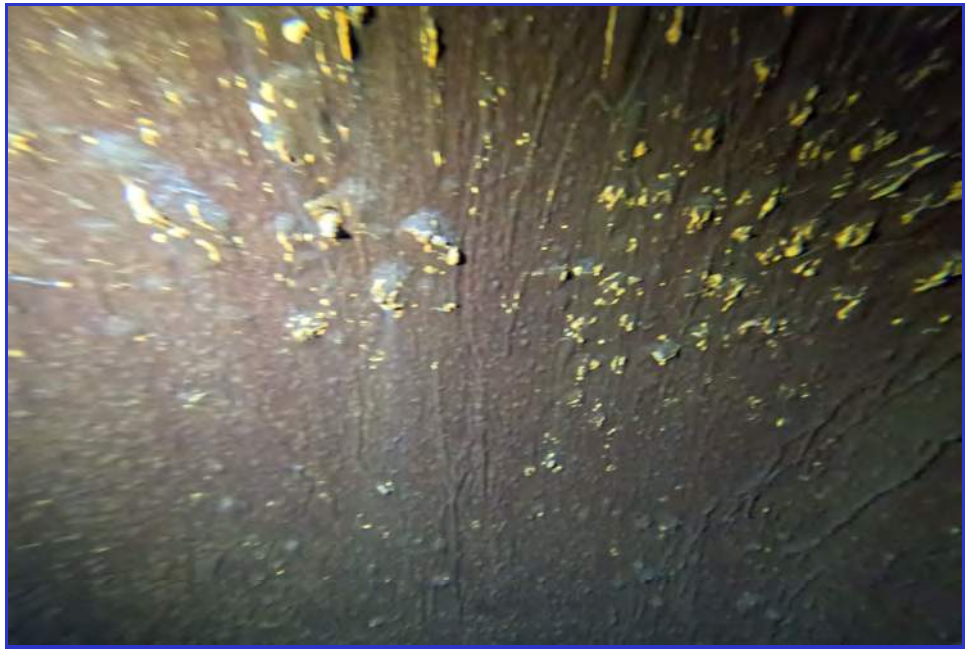
INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -038



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -039



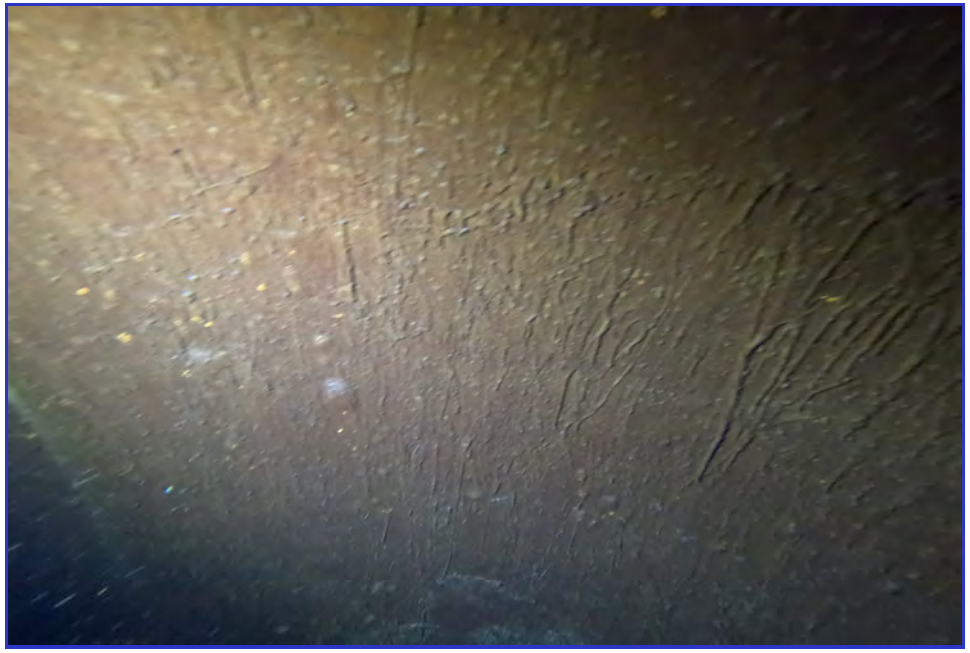
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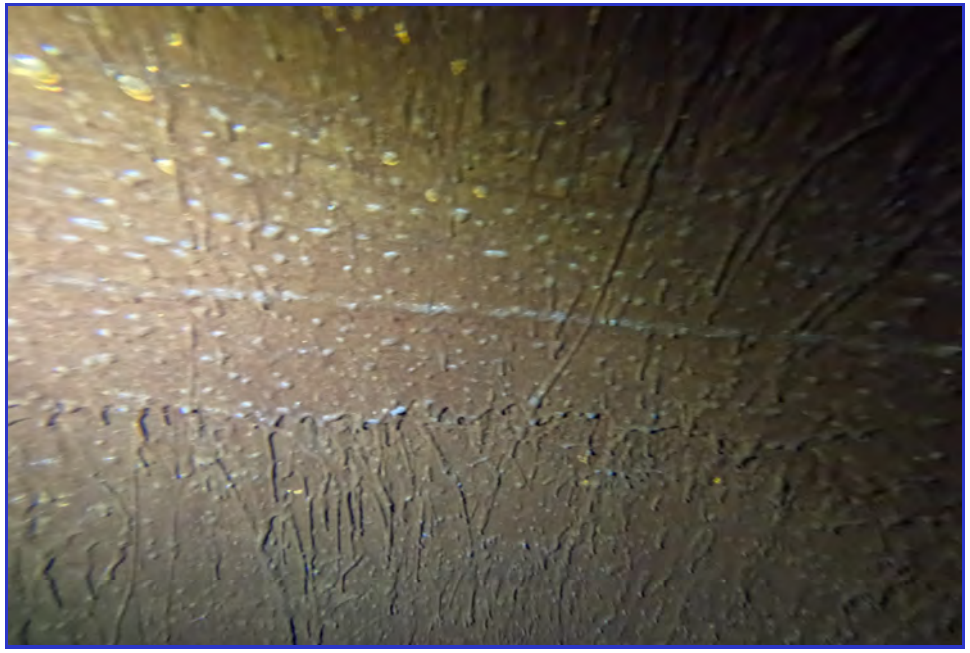
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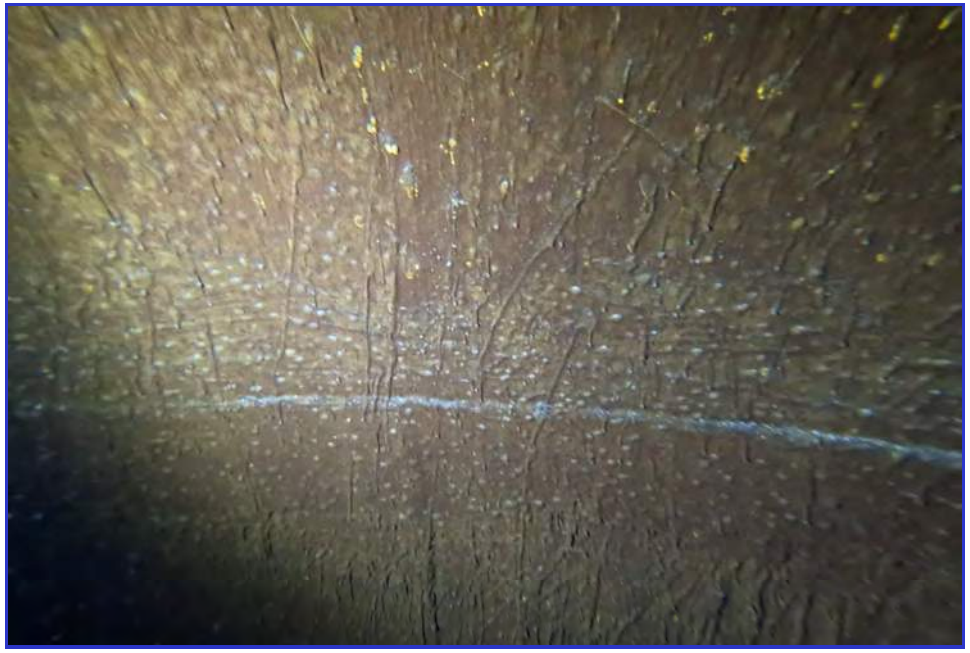
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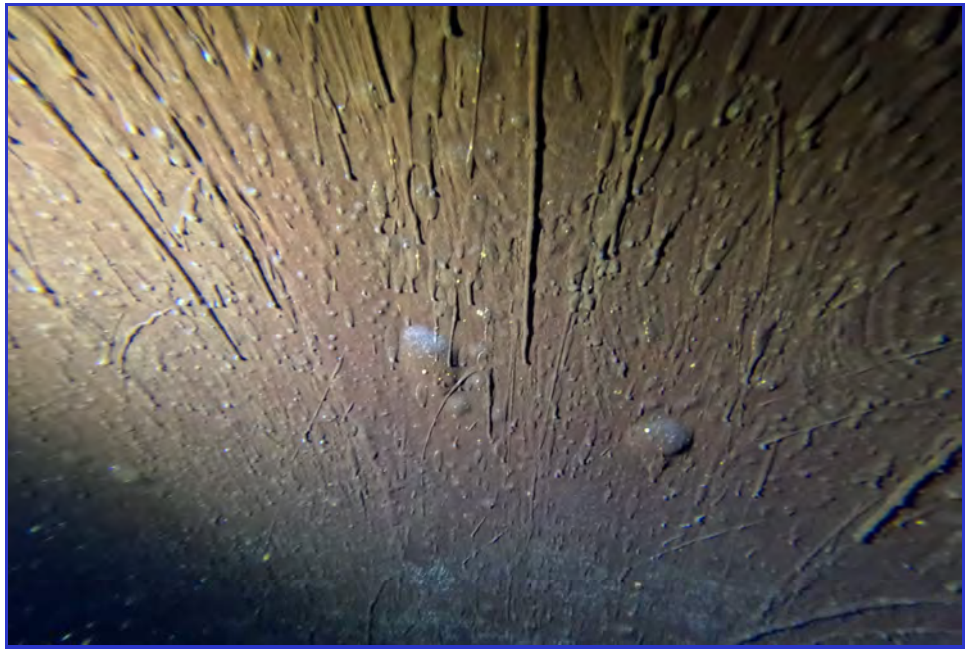
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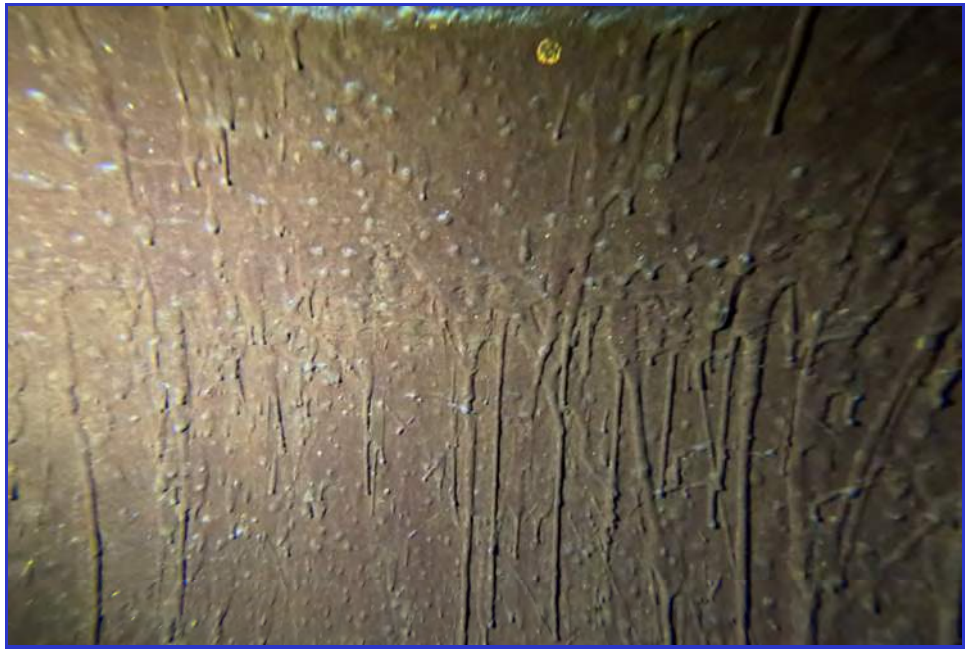
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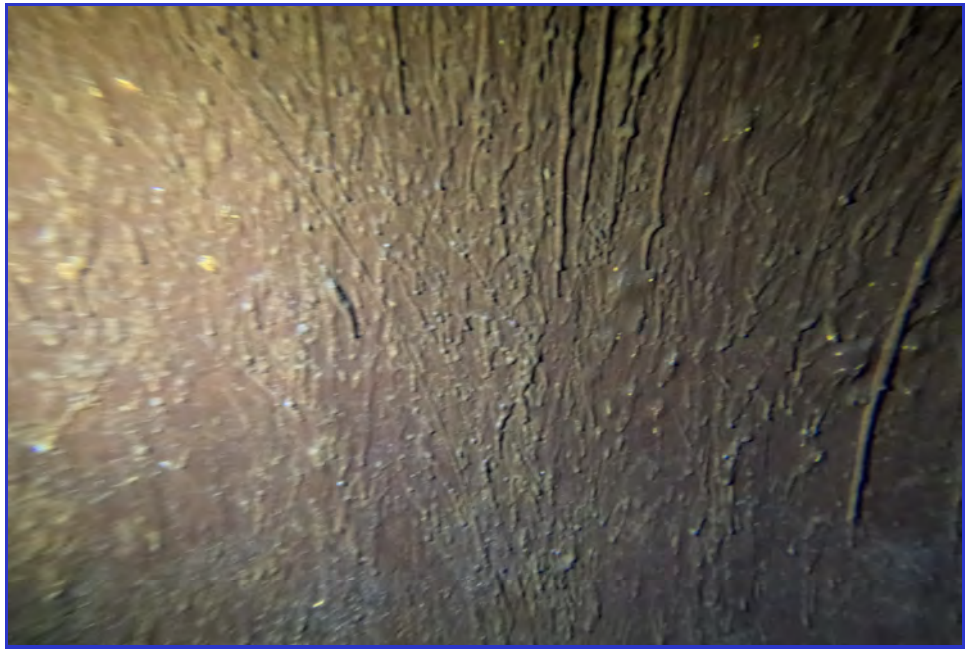
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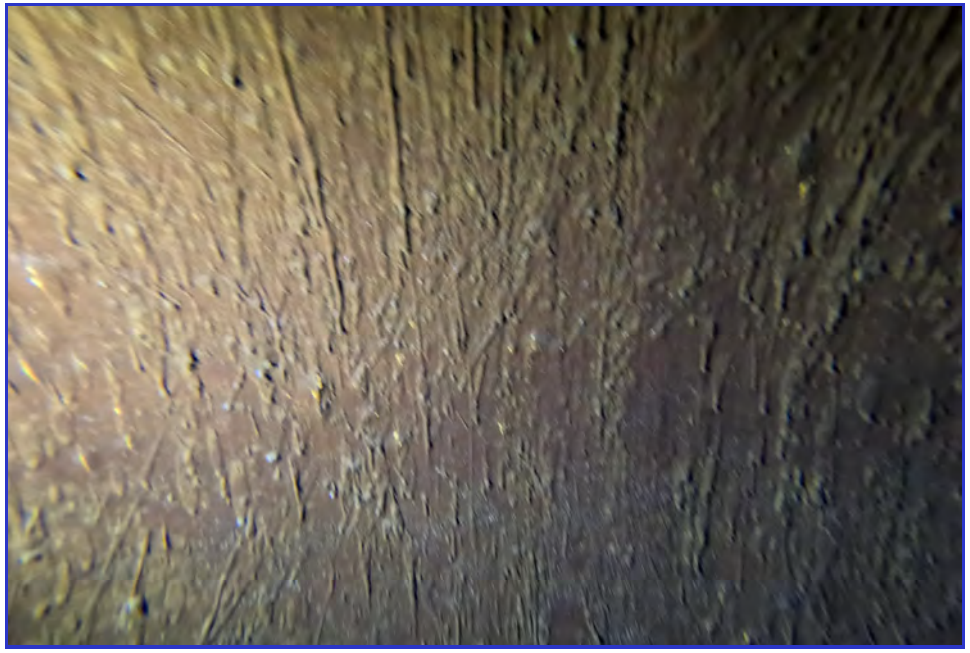
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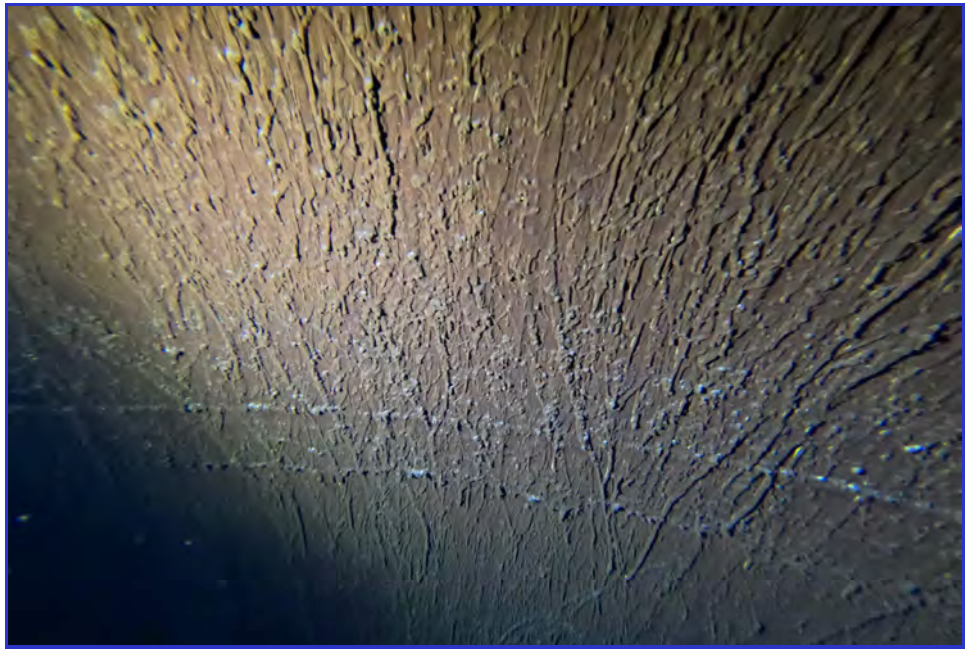
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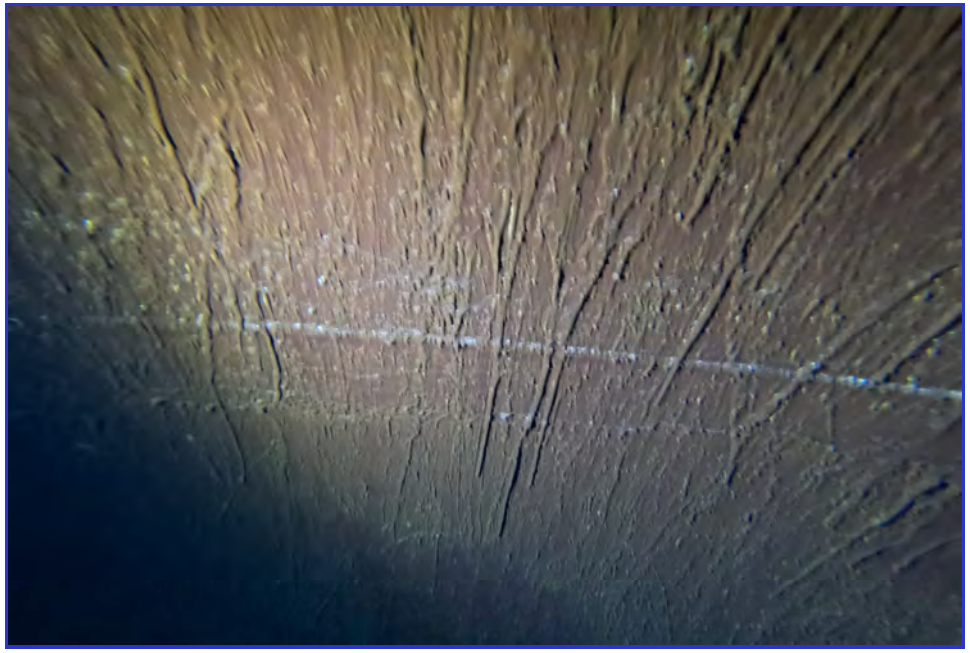
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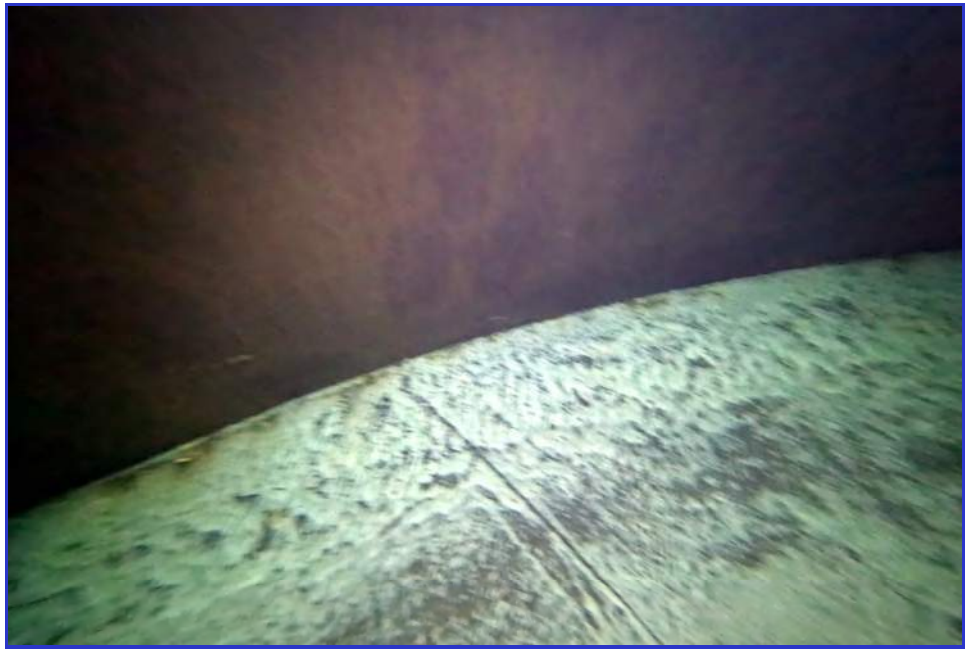
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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -056



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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -058



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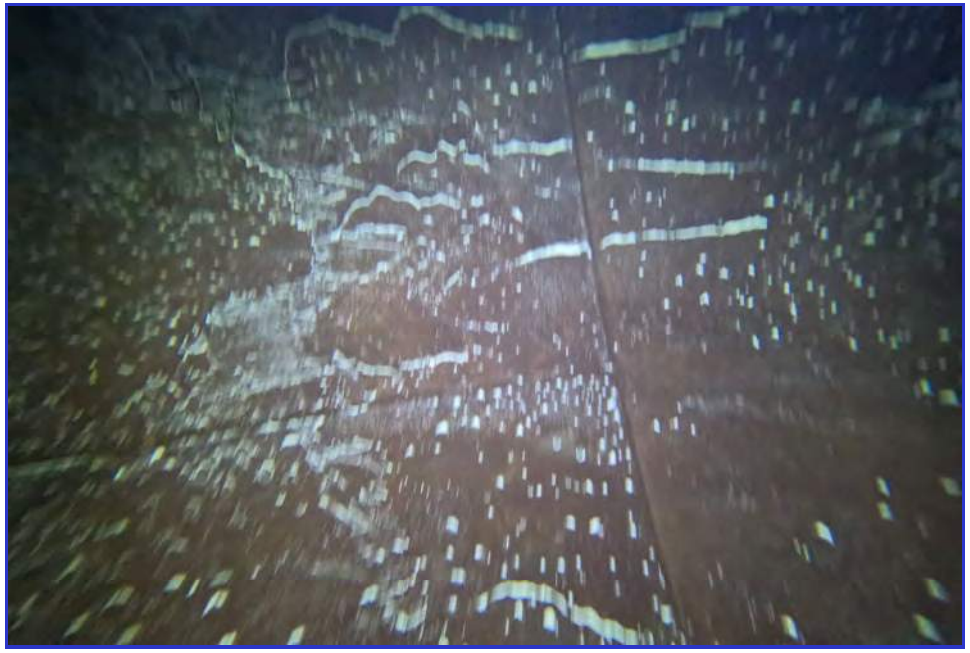
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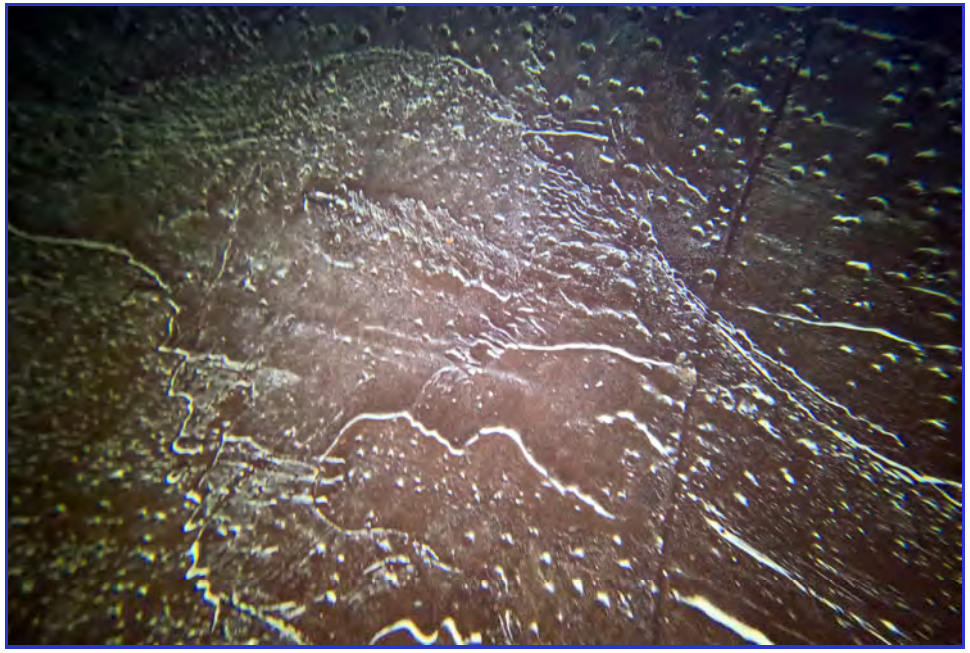
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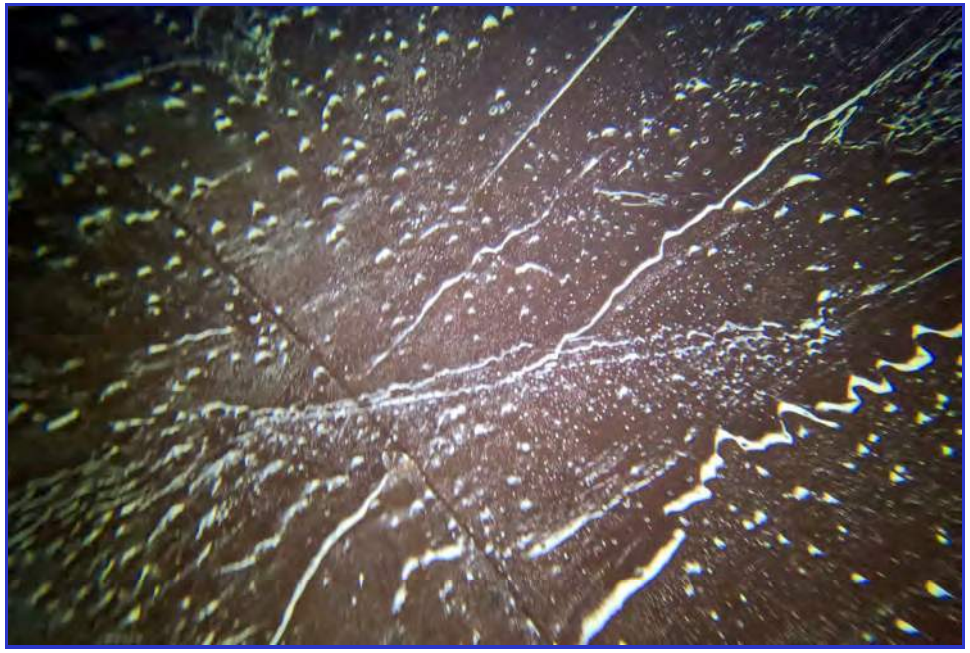
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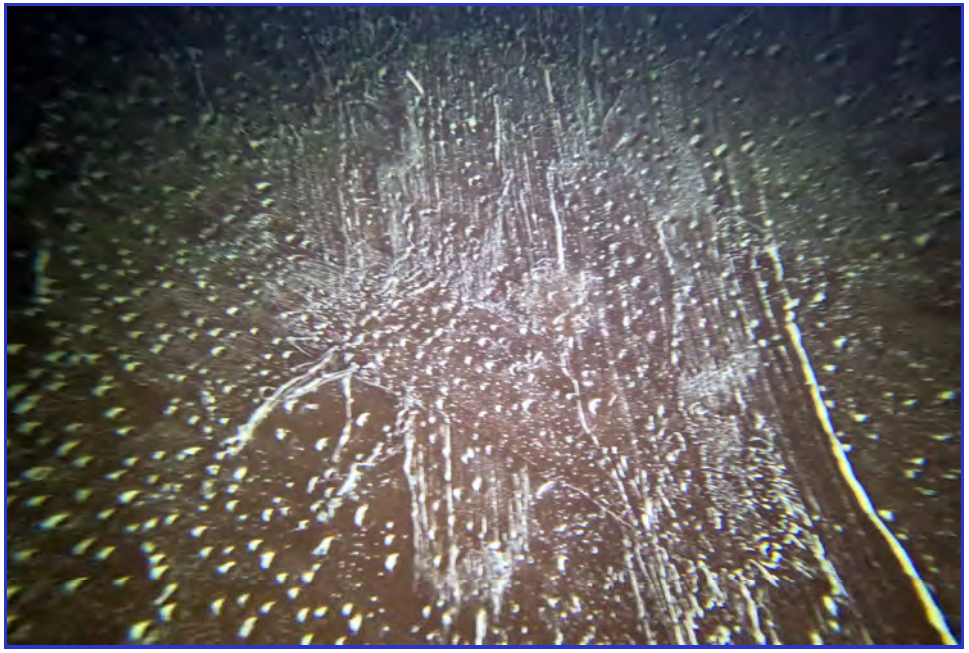
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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -071



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INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -073



INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -074



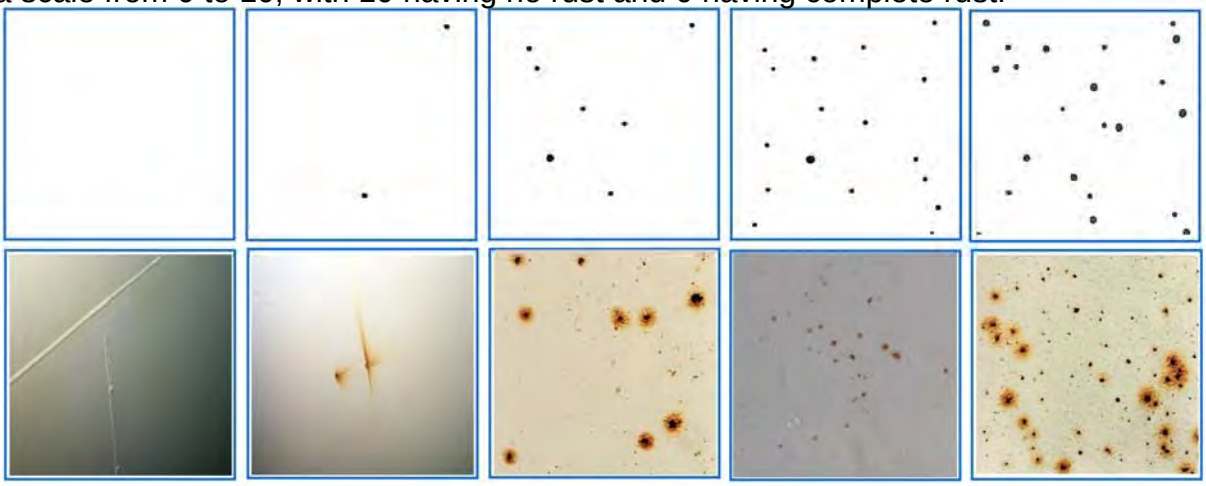
INTERIOR - City of Santa Paula - Anderson - Maintenance Inspection -075

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

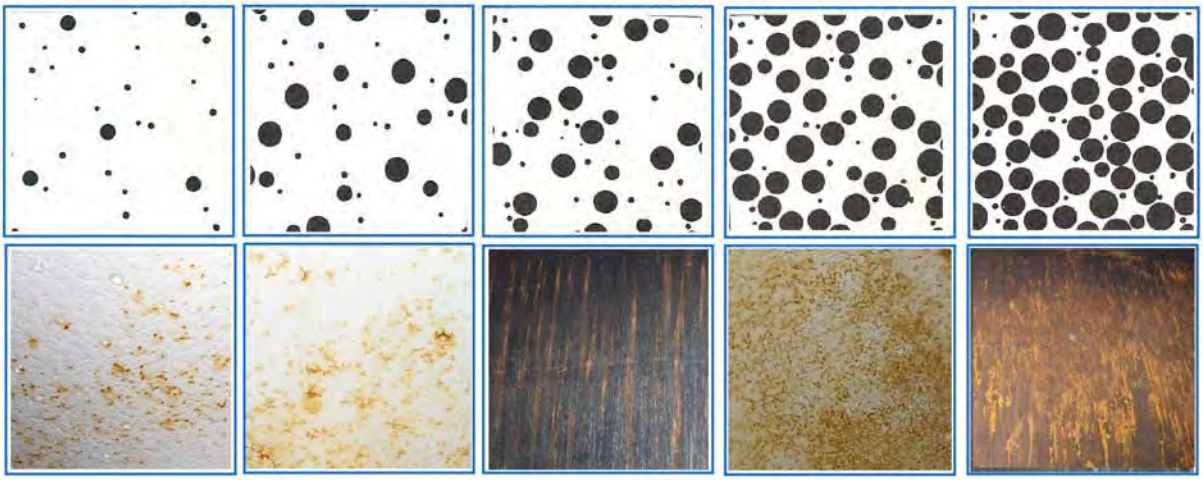
Rating	General Description of Conditions	
	Maintenance Inspection	Warranty Inspection
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

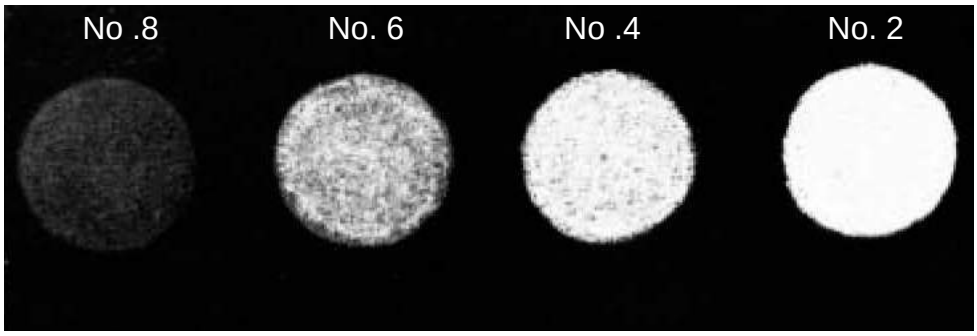
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

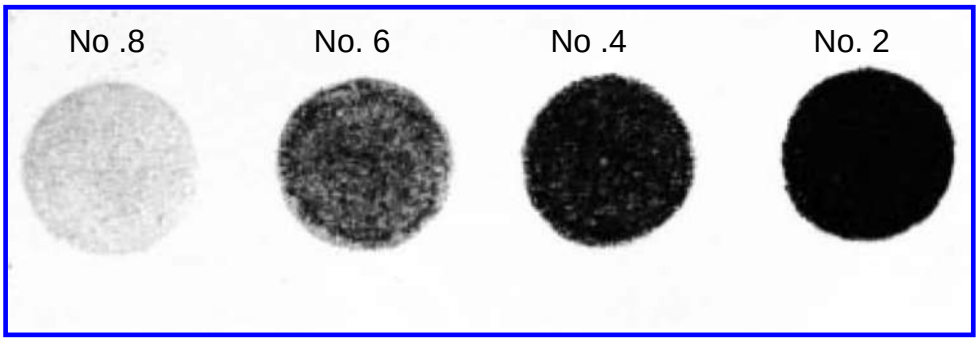
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

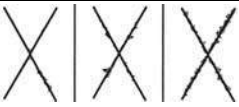
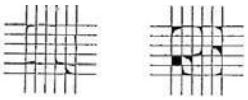
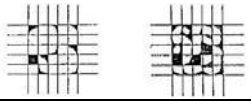
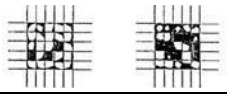


Dark Colored Paints



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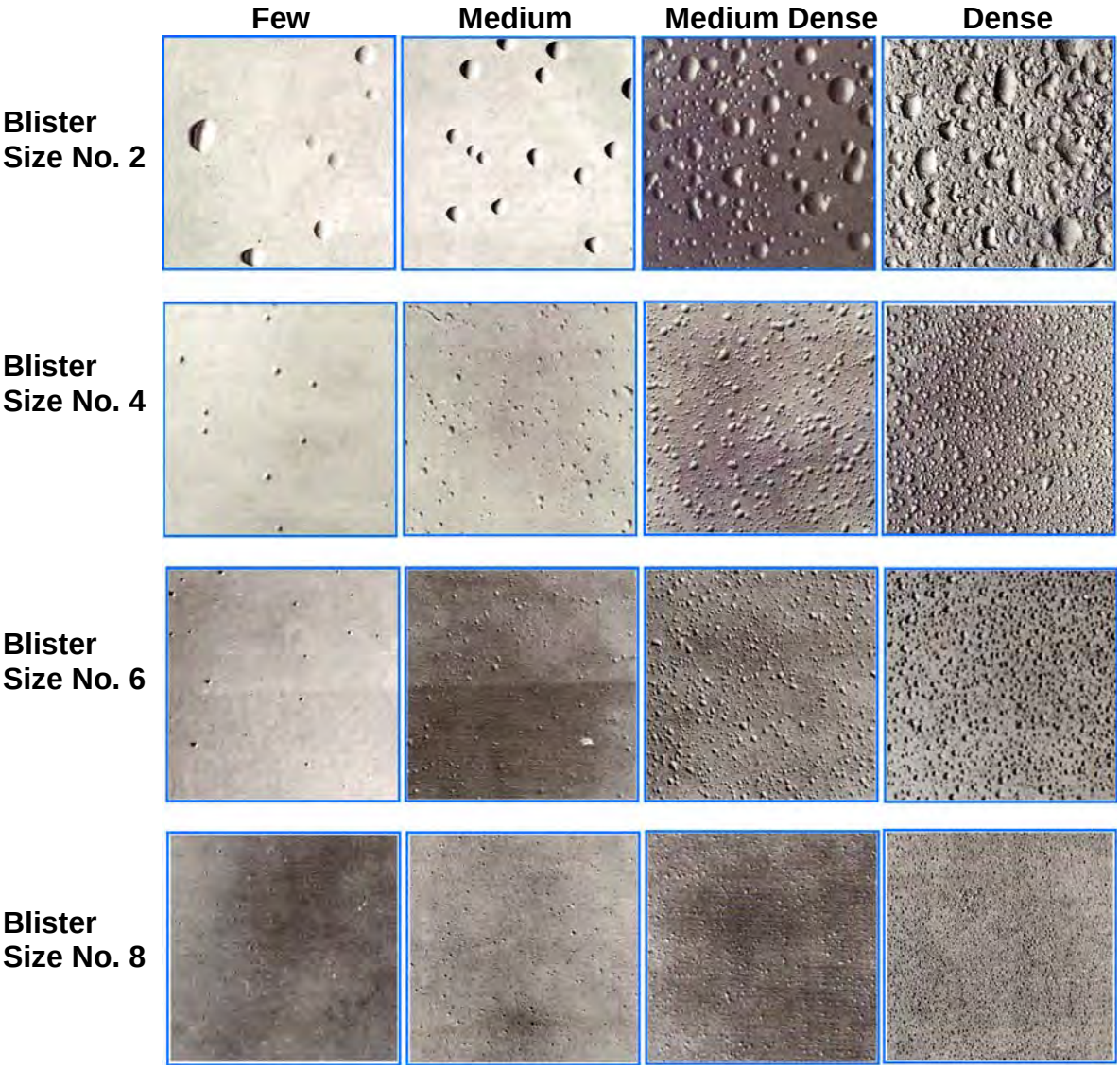
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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Providing Quality Technical Services to the Coating Industry

October 21, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Case Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Case Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 21, 2025

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- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Case Reservoir located near 8200 Pine Grove Rd, Santa Paula CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 19, 2023 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 16 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The paint system on the exterior was found to be relatively thin and in fair condition overall. The exterior surfaces have only isolated spot rust and the paint was found to have significantly weathered from chalking. However, the overall film thickness of the paint system and its general satisfactory adhesion makes it an ideal candidate for future overcoating strategies. Currently, it is recommended that the existing paint system be spot repaired and overcoated within the next 5 to 7 years to prevent further degradation and corrosion.

The 2nd generation aromatic polyurethane hybrid (Likely Polibrid 705) lining within the tank is in an overall fair condition with widespread rust and delaminations, however, the sacrificial anode CP system is preventing more advanced forms of corrosion from developing below the HWL and while the existing lining is nearing the end of its lifespan, the eventual relining project can be postponed for perhaps 4 to 6 years.

Background

The Case Reservoir is a welded steel on grade structure that was constructed in 1968. The tank is approximately 60 feet in diameter by 24 feet high providing a nominal capacity of 620,000 gallons and is located at 8200 Pine Grove Rd, Santa Paula CA. It is the only tank at this hillside site.

The tank shell has four courses that are connected to a roof with rafters and one center column. The tank has numerous perimeter roof vents, one center stub vent, one roof hatch, and two shell manways. There is an interior ladder and one exterior ladder. The exterior ladder has fall a protection device and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band. There is an internal sacrificial anode cathodic protection (CP) system associated with this tank. The tank has a mechanical, half-travel, water level indicator and there is a painter's rail both inside an out, just below the elevation of the roof/shell intersection.

It is believed that the interior lining is a 2nd generation system. The interior steel surfaces, including the roof and roof support members, are coated with a high-build aromatic hybrid polyurethane. The exterior roof, shell, and appurtenances are painted with what appears to be a polyurethane system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2).

Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in fair condition with moderate chalking (ASTM D4214, No. 6). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than 0.03 percent of the overall surface area and rated a 9 in accordance with ASTM D610. At the shell, the exterior paint system is in fair condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. The paint thicknesses were found to range from 7.0 to 9.0 mils on the roof and 5.0 to 6.0 mils on the shell. The paint system was estimated to exhibit moderate adhesion (ASTM D6677, 3A) at the shell and satisfactory adhesion (ASTM D6677, 5A) at the roof.

Some of the specific data collected follows:

Exterior Paint			Overall Condition		Fair							
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Fair		Exterior		Fair		Exterior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	6	6	6	6	6	6	6	6	6	6	6	6

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking was observed throughout with dark corrosion (CSI Corrosion Grades 2) appearing from undercutting. The total amount of corrosion on the roof was rated to be approximately 0.03 percent of the total surface area (ASTM D610, 9), and there was a minor amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in fair condition with areas of dark rust (CSI Corrosion Grades 2), especially within tank accessories and edges. The total amount of corrosion on the shell was rated to be 0.03 percent of the total surface (ASTM D610, 9) with rust nodules and pitting observed. The most prominent defect were areas of full lining release from the substrate. These areas were in close proximity to the upper shell vents and the defects exist in almost all locations, just below these vents. At this juncture, these defects do not appear to expose the substrate to corrosion and are merely very large blisters with intact caps.

The floor had a large amount of sediment upon it, but spot checks revealed the lining at the tank bottom was in good condition, (ASTM D610, 9) with no notable defects.

The data collected from the inspection follows:

Interior Paint	Above Water Condition		Fair		Below Water Condition		Good					
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Good		Interior		Fair		Interior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2	2	2	2	2		2					
Rust staining												
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling	Yes	Yes	Yes	Yes								
Delamination	Moderate		Moderate		Moderate		Moderate					
Cracking (ASTM D661)												
Blistering (ASTM 714) Size/Density												
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/e9LSzP2i1tJ5f8PT7

Discussion

In general, the exterior paint system on the tank is aged, relatively thin, and exhibits moderate chalking with satisfactory adhesion between the finish coat and the primer in all areas tested. There are few areas of pinpoint and spot rusting within the paint system upon the roof, primarily at plate depressions where water tends to pond and immerse the paint system for long periods of time. Although the shell surfaces have some isolated spot rust, the paint system was providing general corrosion protection, at this time. The paint will likely continue to provide protection of the steel for a few more years, but it will continue to oxidize and degrade.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel,

the process initiates itself as light colored orange surface rust. As the corrosion process continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

The tank roof has localized areas where atmospheric water tends to collect to develop ponds at plate depressions. The paint applied to the exterior of the tank was not designed for immersion service. As a result, the paint in many of these areas has degraded to form flaking and corrosion.

Generally speaking, there are four possible approaches to maintenance painting. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best painting approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If the paint film is too thick or has poor adhesion, the tension from the curing stresses and/or weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what painting approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals (i.e. lead, cadmium, and chromium). The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that spot repair, with or without overcoat, makes sense with up to 10 percent of the surface area requiring repairs. With more than 10% in disrepair, making spot repairs and overcoating becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is excellent. Once the amount of surface area in need of repair exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, and due to the satisfactory adhesion observed at the roof and shell, the tank exterior paint should be spot repaired and overcoated within the next 5 to 7 years.

Overall, the tank interior coatings are in good condition in the area above the highest water level (HWL), and in fair condition below the HWL. The lining on the underwater areas of the tank is mostly free of widespread corrosion, but there are localized areas of spot rust, including the beginning stages of exfoliation at irregular surfaces such as the ladder, dollar plate, rafter flanges, shell penetrations for accessories, and rough welds.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simply a result of some areas not being completely sealed by coatings.

The design and fabrication of a water storage tank is critical relative to the performance of the lining. For instance, tank and vessel internal surfaces to be lined should not be marred by gouges, handling marks, deep scratches, metal stamp marks, slivered steel, or other surface flaws. All rough welds should be ground to remove sharp edges and weld spatter removed. Flaws should be repaired by welding or grinding, as appropriate.

The corrosion at edges is likely simply a result of the coating not having enough barrier protection at the edges. All coatings tend to thin at edges, which often results in these locations showing signs of rust years before the barrier protection breaks down on flat surfaces. Surface tension results in coatings separating away from edges as they are applied. It is not clear if the installation of the coating system involved special brush work at the roof edges (i.e. strip coat), but strip coating would have helped prevent this type of defect.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

The tank ventilation was found to have screening installed without gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior:

1) No coatings work is required at this time. Plan on a future spot repair and overcoat of the paint system in conjunction with the future relining to best amortize costs.

Interior:

2) Within the next 4 to 6 years, remove and replace the lining system.

   a) This work should include abrasive blast cleaning all surfaces to SSPC SP-10, “Near White Blast Cleaning” followed by three coats of an ANSI/NSF certified epoxy at 4 to 6 mils per coat.

   b) Consider removal of the interior painter’s rail for a more monolithic lining application.

3) Engage the services of a cathodic protection systems professional to evaluate the operation of the impressed current CP system.

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

P.O. Box 801357, Santa Clarita, CA 91380
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Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/20/25		Wednesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Case	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Pine Grove Rd
Tank Location	8200 Pine Grove Rd, Santa Paula CA
GPS Coordinates	34.40955, -119.07742
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate with Clips	
Connections	Bolted	
Overflow Design	An Upper Funnel	
Inlet Interior Design	Stub	
Lining Type/Original	Epoxy	No

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	Yes	One		
CP System/Type	Yes	Sacraficial Annode		
Water Depth	16 ft			
Water Agitator	No	None		
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	500,000	
Diameter (feet)	60	
Height (feet)	24	
Erection Year	1968	
Contract No.	36702-03	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Four	
Height of Each Course	Multipule	
Roof Design	Pitched Roof with Drip Ring	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Unibolt	
Diameter of Manways	20 in	
No. Roof Hatches/Location	Two	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Round Hood	
Construction Co.	Pitt Des Moines	

Item	Data	
Center Roof Vent Size	30 in	
Roof Vent Sealed	Yes	N/A
Roof Rail System	Yes	N/A
Roof Rail Satisfactory	Yes	N/A
Rail Location	At Hatch	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Shell Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	No	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	Screen Air Gap	
Drain Location	Shell	
Tank Foundation	Gravel	
Water Level Indicator	YEs	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.
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EXTERIOR - City of Santa Paula - Case - Maintenance Inspection



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EXTERIOR - City of Santa Paula - Case - Maintenance Inspection-002



EXTERIOR - City of Santa Paula - Case - Maintenance Inspection-003



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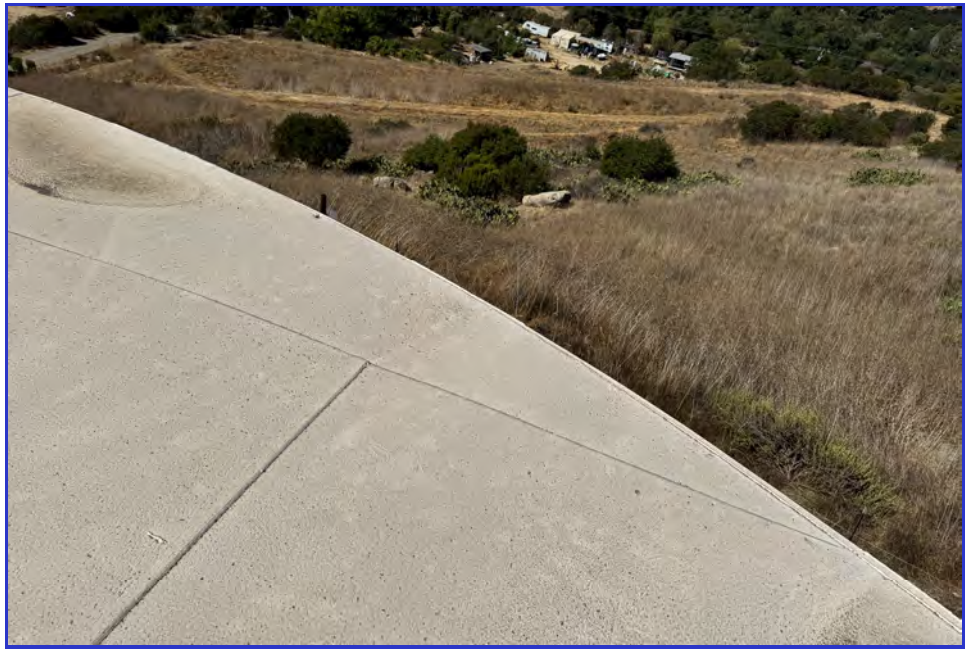
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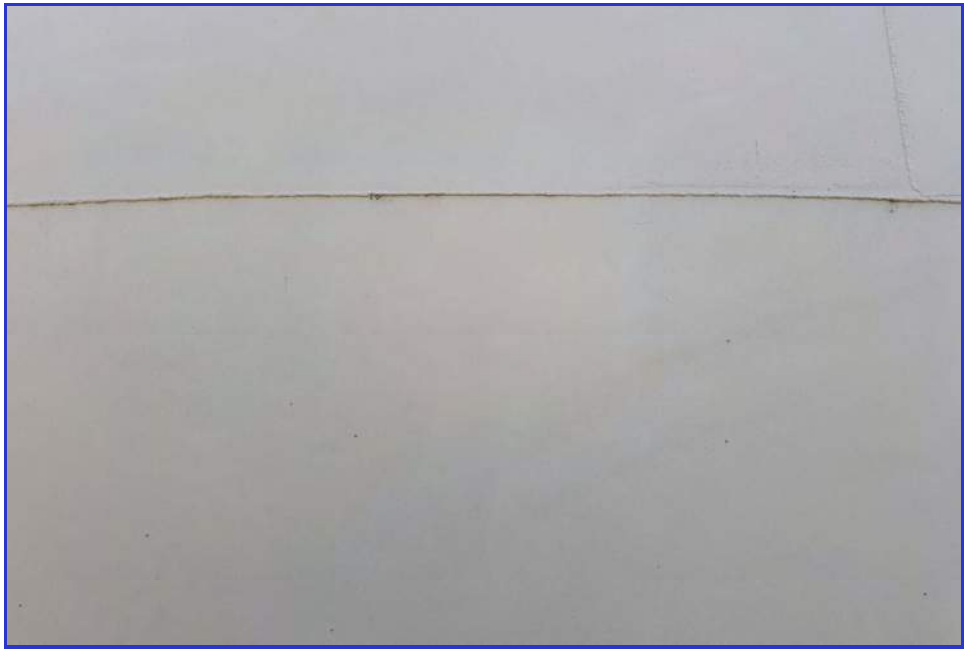
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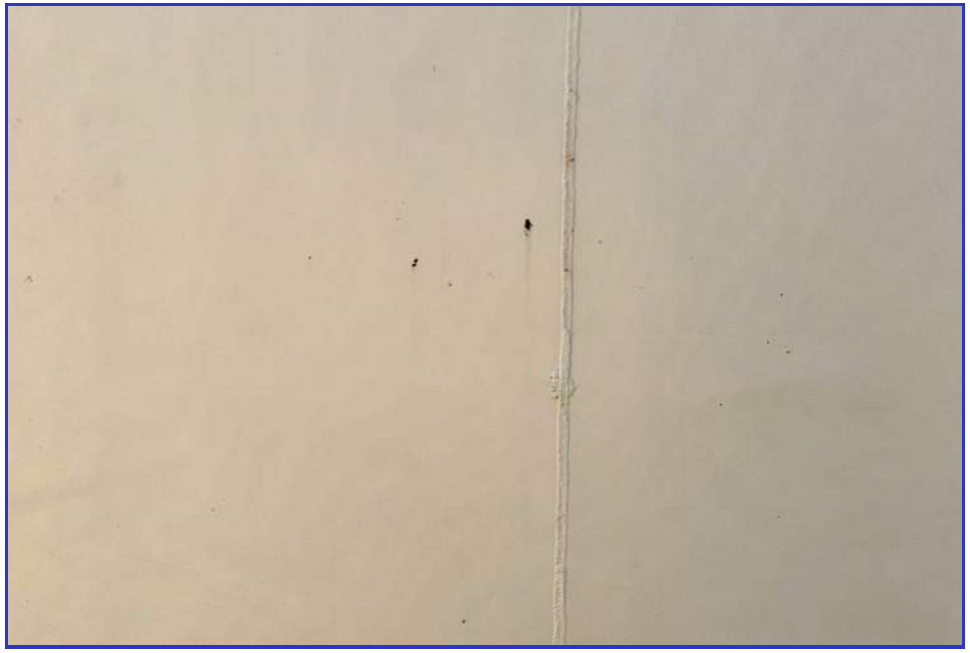
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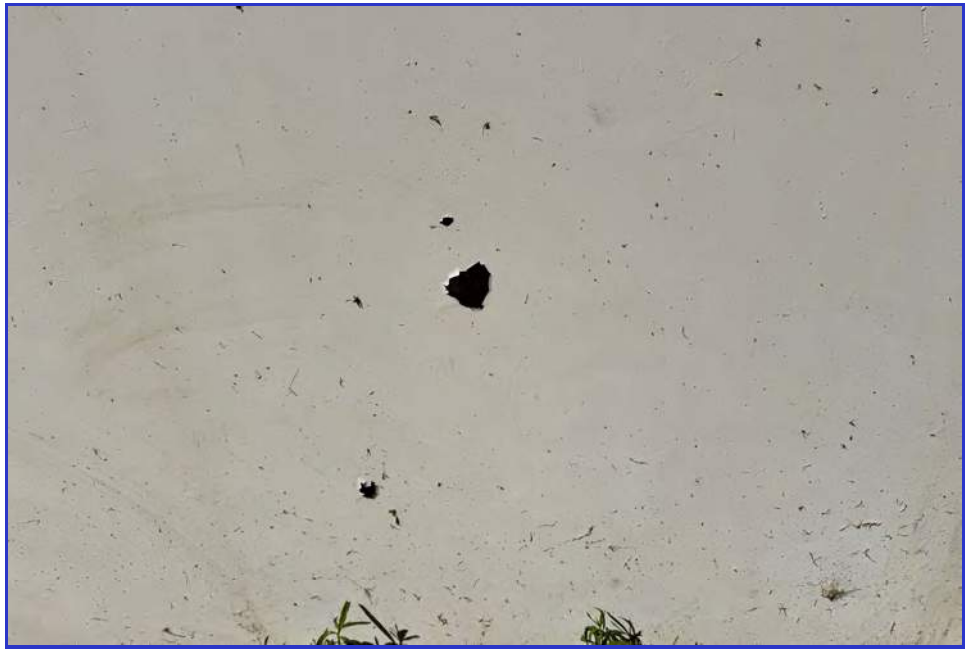
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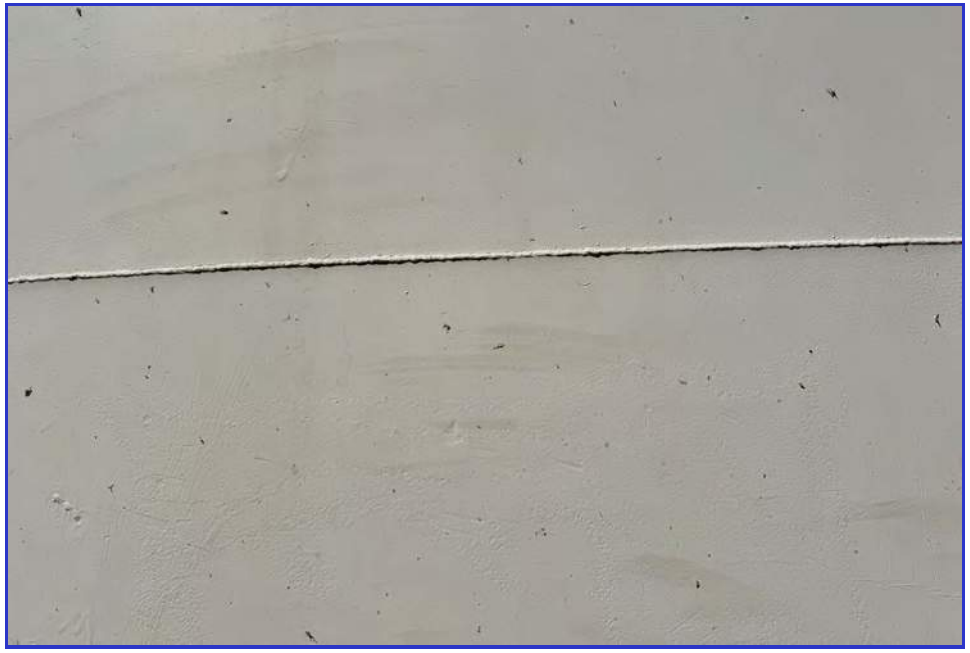
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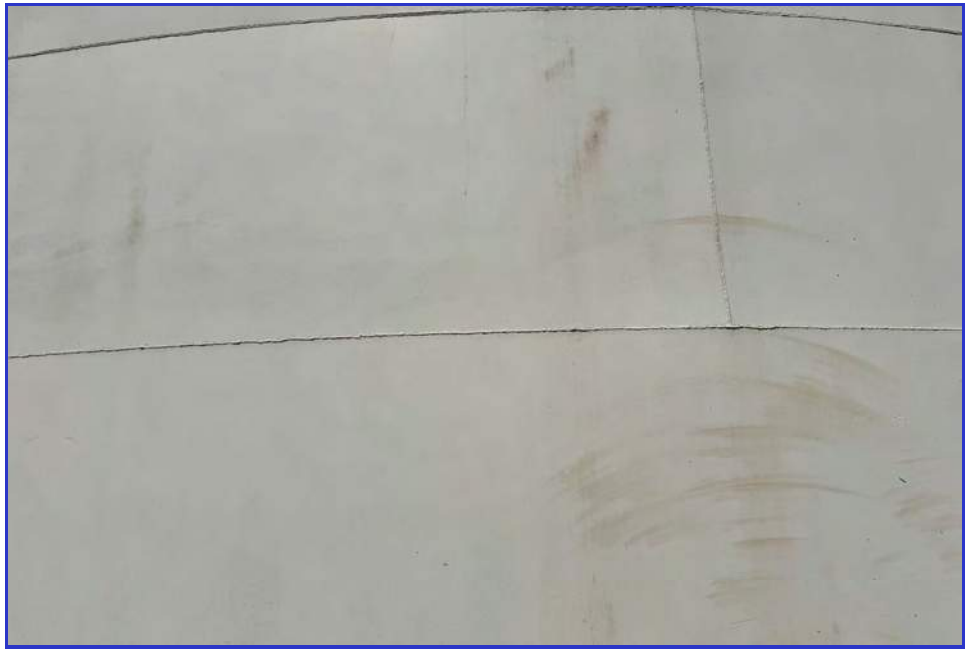
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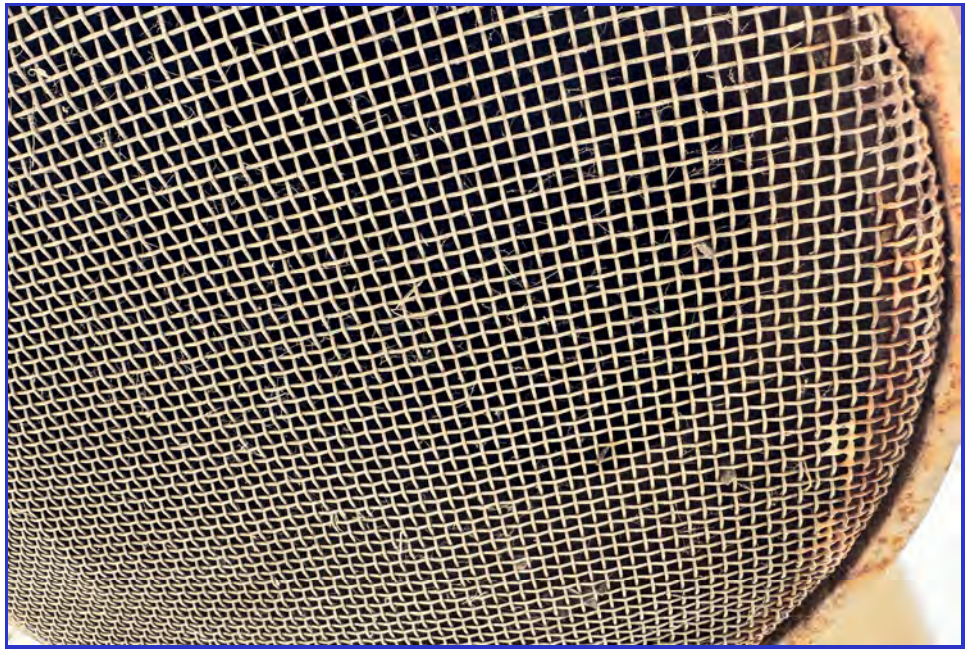
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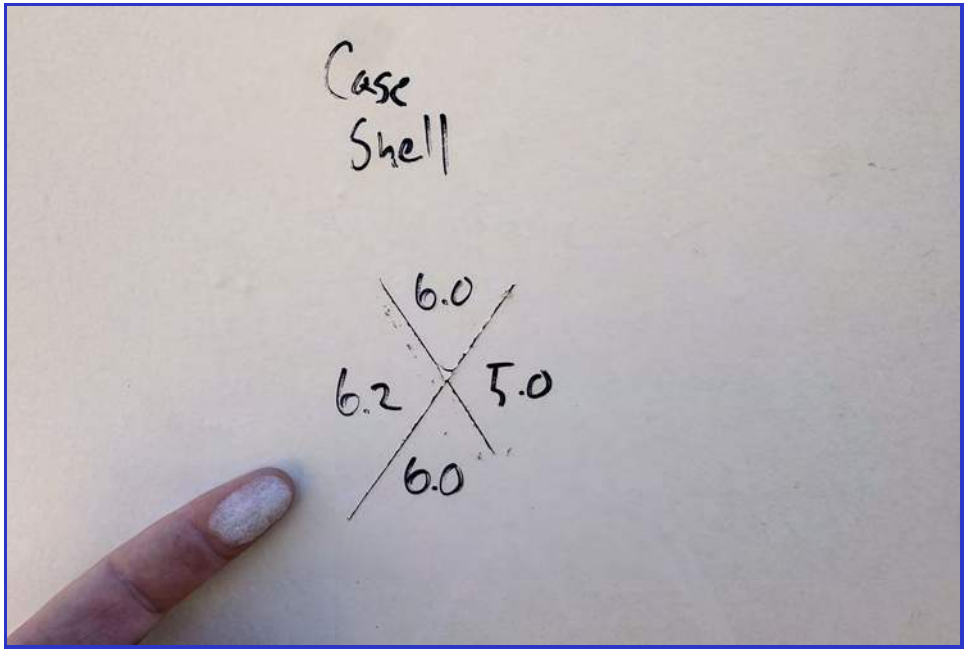
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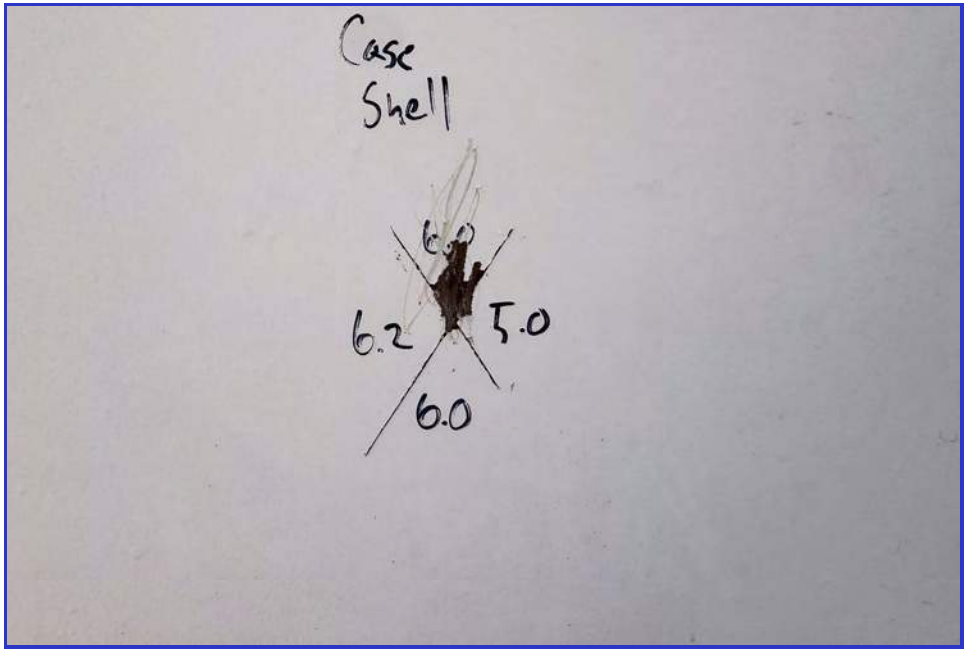
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INTERIOR - City of Santa Paula - Case - Maintenace Inspection



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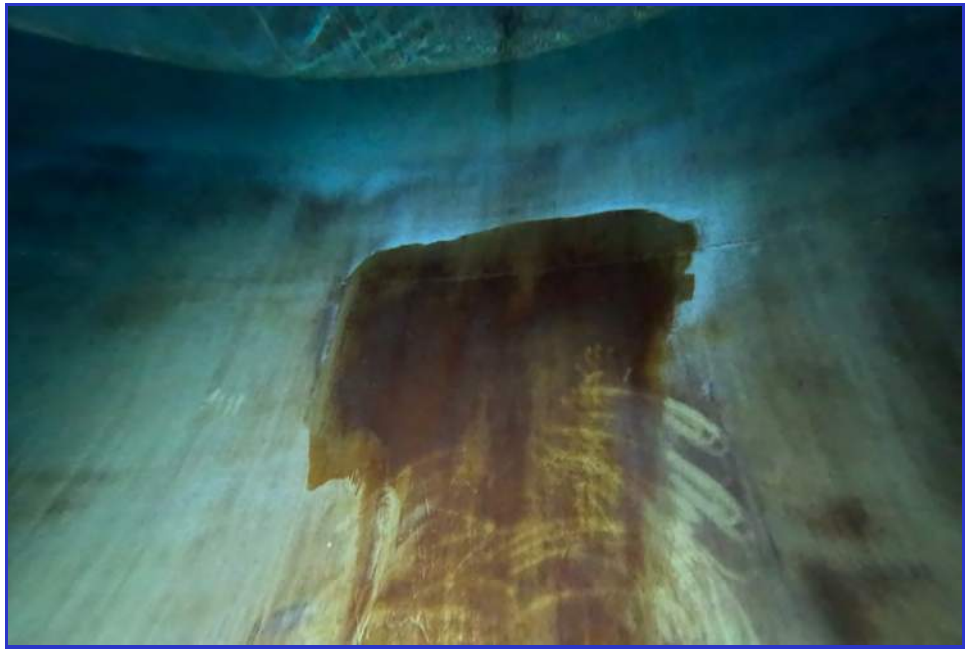
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INTERIOR - City of Santa Paula - Case - Maintenace Inspection -054



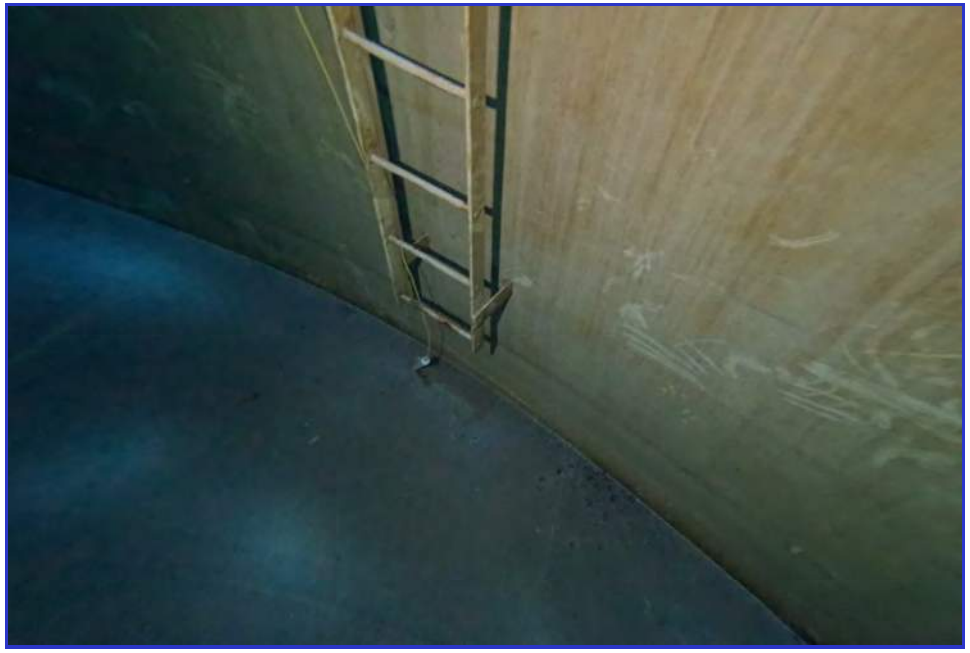
INTERIOR - City of Santa Paula - Case - Maintenace Inspection -055



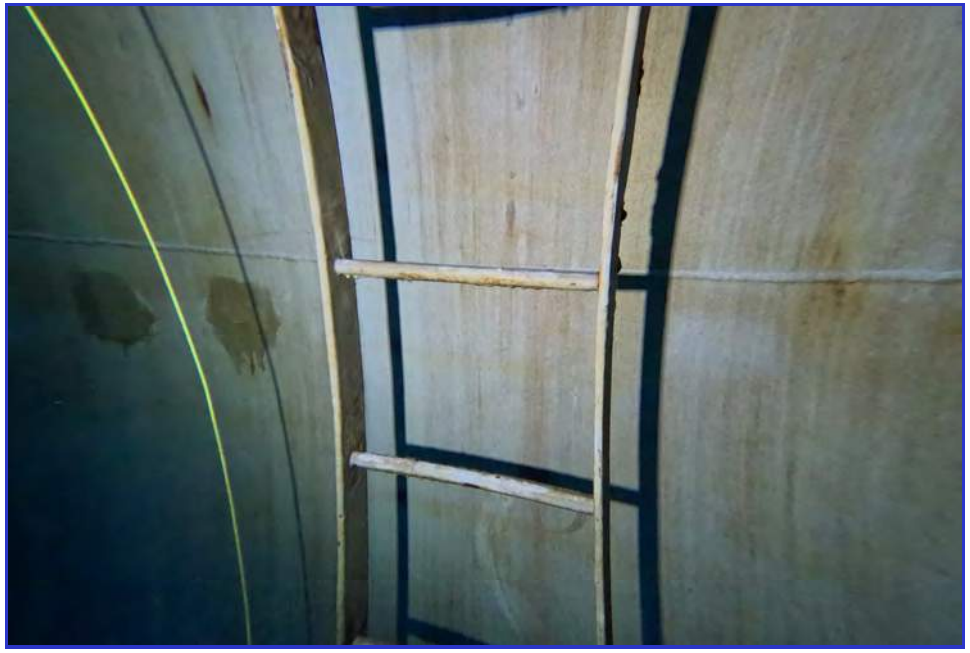
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INTERIOR - City of Santa Paula - Case - Maintenace Inspection -060



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -061



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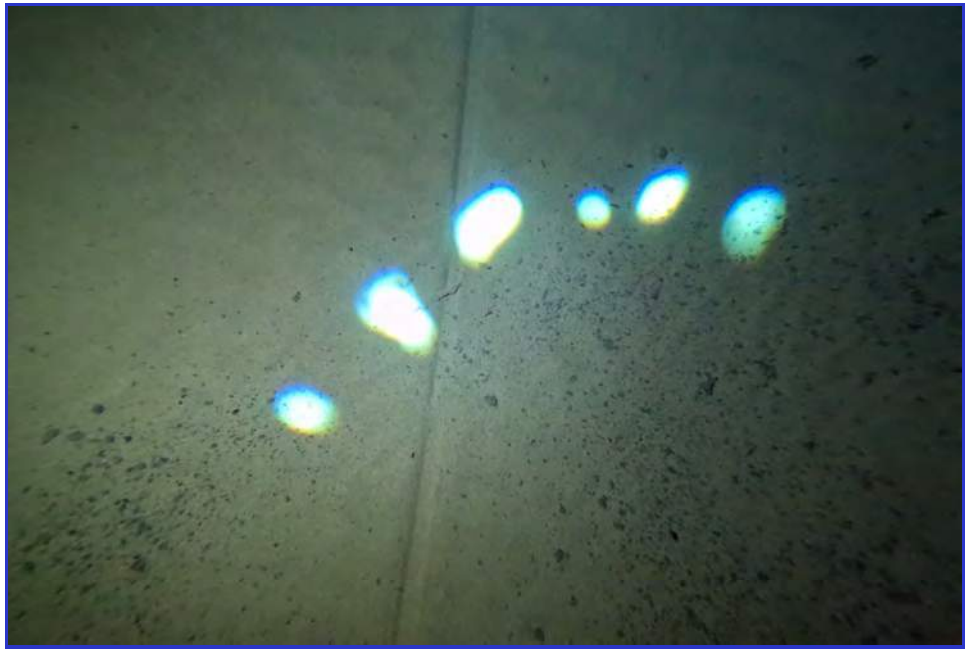
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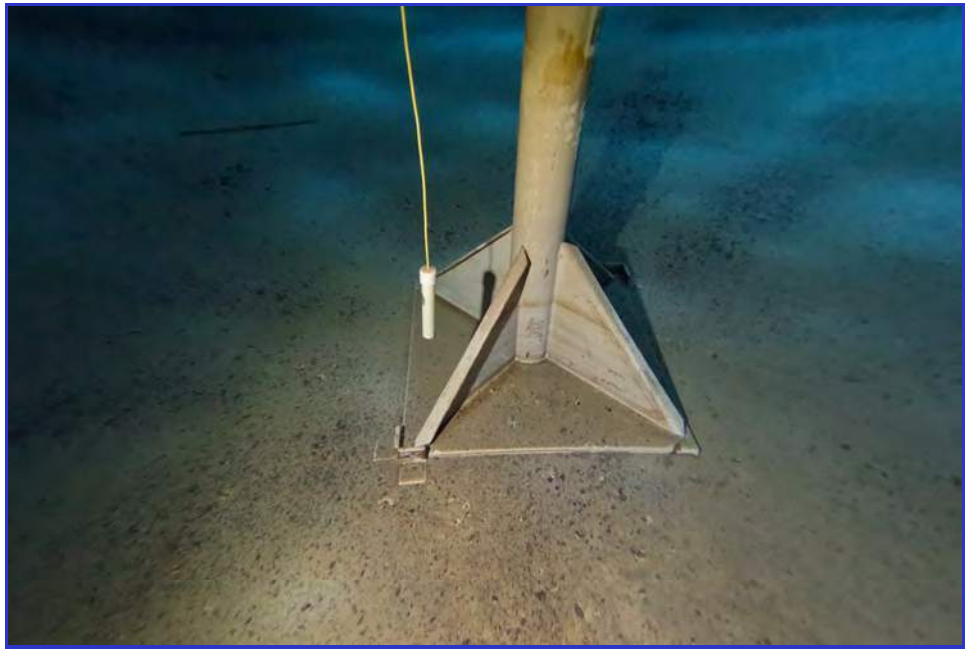
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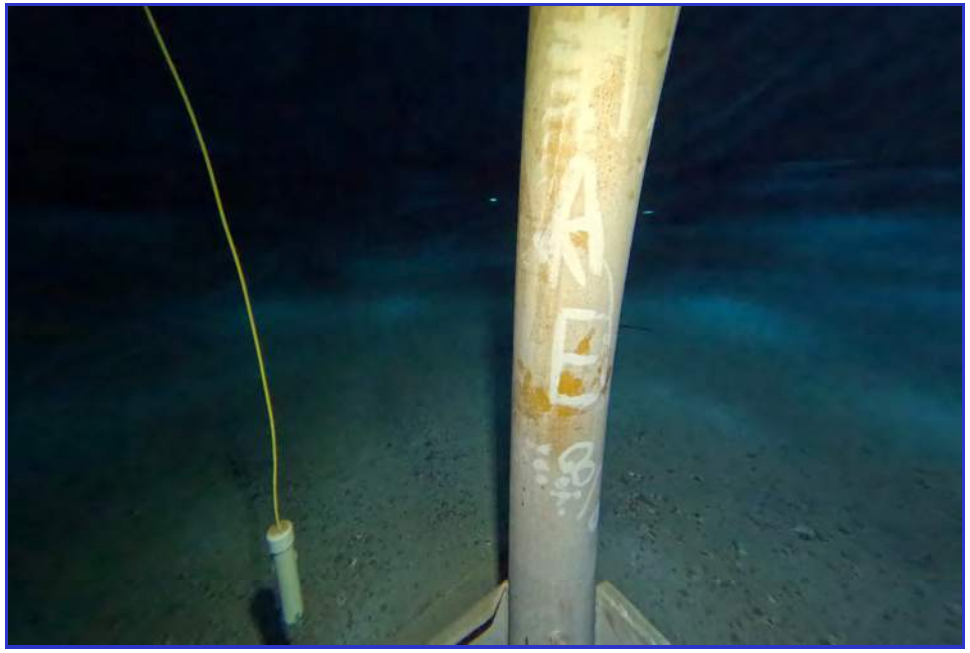
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INTERIOR - City of Santa Paula - Case - Maintenace Inspection -080



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -081



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -082



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -083



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -084



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -085



INTERIOR - City of Santa Paula - Case - Maintenace Inspection -086



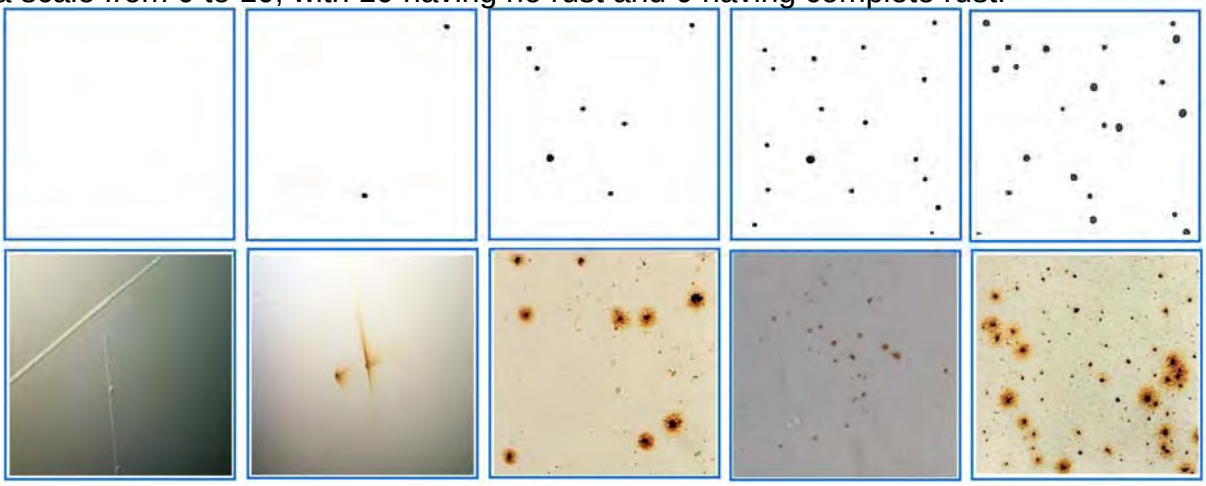
INTERIOR - City of Santa Paula - Case - Maintenace Inspection -087

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

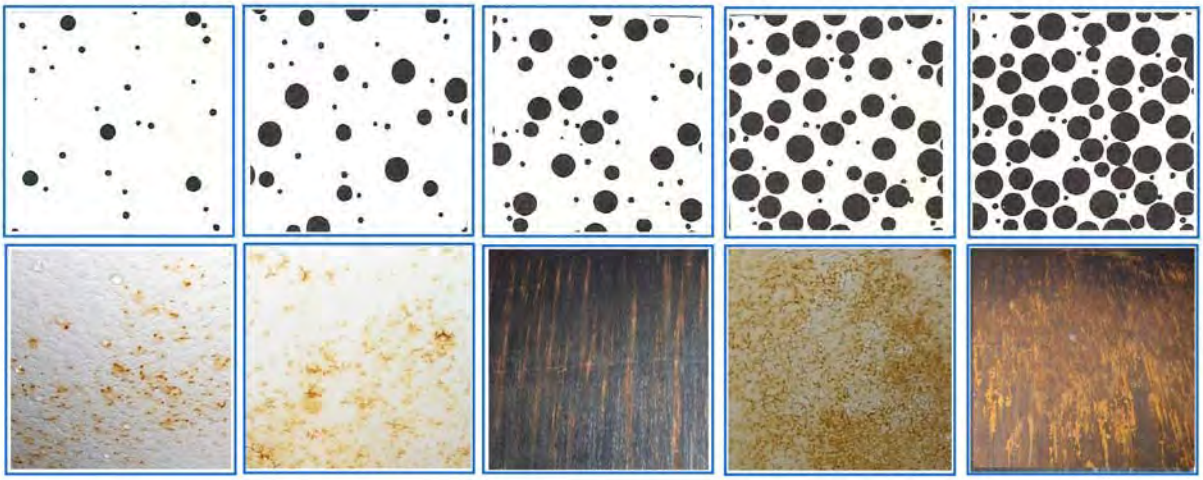
Rating	General Description of Conditions	
	Maintenance Inspection	Warranty Inspection
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

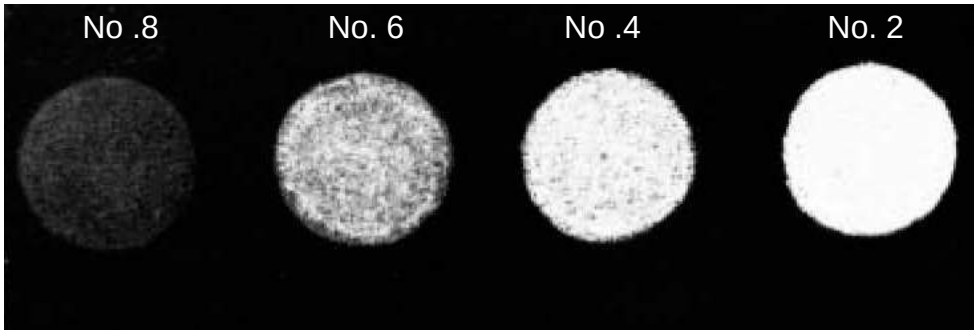
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

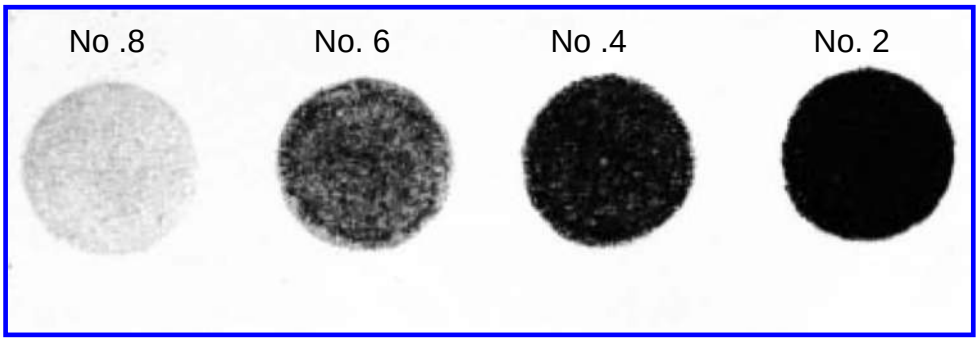
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

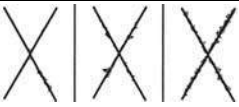
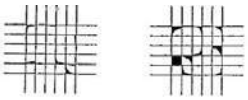
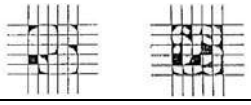
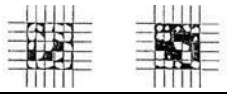


Dark Colored Paints



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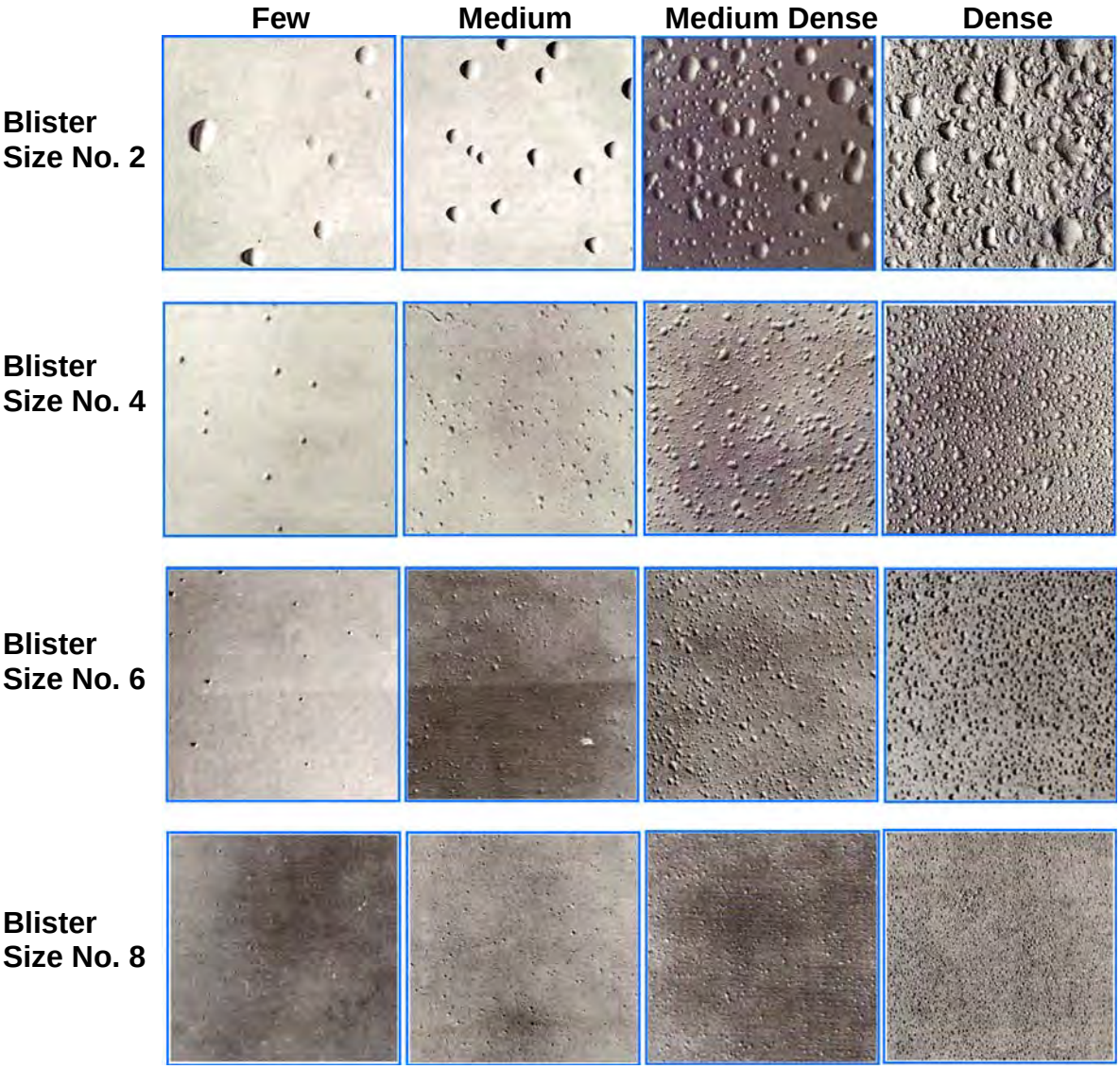
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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Providing Quality Technical Services to the Coating Industry

October 31, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Cherry Hill Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Cherry Hill Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 31, 2025

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- **Field Notes**
- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Cherry Hill Reservoir located near 6461-6339 Pine Grove Rd, Santa Paula, CA 93060. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 20, 2025 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 16 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and Anthony Jackson was the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The paint system on the exterior was found to be relatively thin and in good condition overall. The exterior surfaces have only isolated spot rust and the paint was found to have weathered from chalking, however, the overall film thickness of the paint system and its general satisfactory adhesion makes it an ideal candidate for future overcoating strategies. Currently, it is recommended that the existing paint system be spot repaired at the next maintenance interval to prevent further degradation of the system and suspend any active corrosion.

The interior lining appears to be a thick-film aromatic polyurethane hybrid (Likely Polibrid 705) in an overall fair condition with widespread rust, delaminations, and numerous application defects including very large sags and runs. However, the sacrificial anode CP system is preventing more advanced forms of corrosion from developing below the HWL and while the existing lining is nearing the end of its lifespan, the eventual relining project can be likely be postponed perhaps beyond 2030.

Background

The Cherry Hill Reservoir is a welded steel on grade structure that was constructed in 1954. The tank is approximately 66 feet in diameter by 21 feet high providing a nominal capacity of 535,164 gallons and is located near 6461-6339 Pine Grove Rd, Santa Paula, CA 93060. It is the only tank at this hillside site.

The tank shell has four courses that are connected to a conical roof with rafters and one center column. The tank has one center vent, one roof hatch, and two monobolt shell manways. There is an interior ladder and one exterior ladder. The exterior ladder has fall a protection device and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band. There is an internal sacrificial anode cathodic protection (CP) system associated with this tank. The tank has a mechanical, half-travel, water level indicator that improperly gauges the tank's height at 24 feet.

It is believed that the interior lining is a 3rd generation system. The interior steel surfaces, including the roof and roof support members, are coated with a high-build aromatic hybrid polyurethane and a multicoat thin-film epoxy. The exterior roof, shell, and appurtenances are painted with what appears to be a polyurethane system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video are included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in

accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in good condition with minimal chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than 0.03 percent of the overall surface area and rated a 9 in accordance with ASTM D610. At the shell, the exterior paint system is in good condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. The paint thicknesses were found to range from 12 to 15 mils on the roof and 12 to 14 mils on the shell. The paint system was estimated to exhibit moderate adhesion (ASTM D6677) at the shell and satisfactory adhesion (ASTM D6677, 5A) at the roof.

Some of the specific data collected follows:

Exterior Paint			Overall Condition		Good							
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Good		Exterior		Good		Exterior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout with dark corrosion (CSI Corrosion Grades 2) appearing from undercutting. The total amount of corrosion on the roof was rated to be approximately 0.03 percent of the total surface area (ASTM D610, 9), and there was a minor amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure. The most prominent defect observed at the roof where the gross application defects associated with some recent plural component spray application of an unknown material.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in fair condition with areas of dark rust (CSI Corrosion Grades 2), especially within tank accessories and edges. The total amount of corrosion on the shell was rated to be 0.03 percent of the total surface (ASTM D610, 9) with some rust nodules and minor pitting observed. Groupings of blisters were observed and rated 2/Few in accordance with ASTM 714.

The floor had a large amount of sediment upon it, but spot checks revealed the lining at the tank bottom was in good condition, (ASTM D610, 9) with the same patterning of blisters observed at the shell (2/Few). The vast majority of the blisters retain their blister caps.

The data collected from the inspection follows:

Interior Paint	Above Water Condition		Fair		Below Water Condition		Fair					
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Good		Interior		Fair		Interior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2	2	2	2	2		2					
Rust staining												
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling	Yes	Yes	Yes	Yes								
Delamination	Moderate		Moderate		Moderate		Moderate					
Cracking (ASTM D661)												
Blistering (ASTM 714) Size/Density					2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few	2/Few
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/vo2AV9Ku2yugo5tK6

Discussion

In general, the exterior paint system on the tank is aged, relatively thin, and exhibits moderate chalking with satisfactory adhesion between the finish coat and the primer in all areas tested. There are few areas of pinpoint and spot rusting within the paint system upon the roof, primarily at plate depressions where water tends to pond and immerse the paint system for long periods of time. Although the shell surfaces have some isolated spot rust, the paint system was providing general corrosion protection, at this time. The paint will likely continue to provide protection of the steel for a few more years, but it will continue to oxidize and degrade.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel,

the process initiates itself as light colored orange surface rust. As the corrosion process continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

The tank roof has localized areas where atmospheric water tends to collect to develop ponds at plate depressions. The paint applied to the exterior of the tank was not designed for immersion service. As a result, the paint in many of these areas has degraded to form flaking and corrosion.

Generally speaking, there are four possible approaches to maintenance painting. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best painting approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If the paint film is too thick or has poor adhesion, the tension from the curing stresses and/or weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what painting approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals (i.e. lead, cadmium, and chromium). The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that spot repair, with or without overcoat, makes sense with up to 10 percent of the surface area requiring repairs. With more than 10% in disrepair, making spot repairs and overcoating becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is excellent. Once the amount of surface area in need of repair exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, and due to the satisfactory adhesion observed at the roof and shell, the tank exterior paint should be spot repaired at the next maintenance interval.

Overall, the tank interior coatings are in a fair condition in the area above the highest water level (HWL), and in fair condition below the HWL. The lining on the underwater areas of the tank is mostly free of widespread corrosion, but there are localized areas of spot rust, including the beginning stages of exfoliation at irregular surfaces such as the ladder, dollar plate, rafter flanges, shell penetrations for accessories, and rough welds.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simply a result of some areas not being completely sealed by coatings.

The design and fabrication of a water storage tank is critical relative to the performance of the lining. For instance, tank and vessel internal surfaces to be lined should not be marred by gouges, handling marks, deep scratches, metal stamp marks, slivered steel, or other surface flaws. All rough welds should be ground to remove sharp edges and weld spatter removed. Flaws should be repaired by welding or grinding, as appropriate.

The corrosion at edges is likely simply a result of the coating not having enough barrier protection at the edges. All coatings tend to thin at edges, which often results in these locations showing signs of rust years before the barrier protection breaks down on flat surfaces. Surface tension results in coatings separating away from edges as they are applied. It is not clear if the installation of the coating system involved special brush work at the roof edges (i.e. strip coat), but strip coating would have helped prevent this type of defect.

It is not clear what caused the blisters to develop, but their locations and pattern is similar to coating symptoms that would be seen from with an improperly functioning cathodic protection (CP) system. The tell-tale sign of an over energized CP system are circular patches of blisters in areas adjacent to the CP anodes. This indicates that the CP system may not be properly operating and may be damaging the coating. This defect from cathodic disbondment can result in blistering as the over-energized CP generates hydrogen under the coating, creating blisters. No significant corrosion is associated with the condition. As a result, the only recommendation with respect to the blistering issue is to evaluate the proper operation of the CP system to avoid the continued damage to the coating.

The tank ventilation was found to have screening installed without gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior:

1) No coatings work is required at this time. Plan on a future spot repair and overcoat of the paint system in conjunction with the future relining to best amortize costs.

Interior:

2) Within the next 5 to 7 years, remove and replace the lining system.

   a) This work should include abrasive blast cleaning all surfaces to SSPC SP-10, “Near White Blast Cleaning” followed by three coats of an ANSI/NSF certified epoxy at 4 to 6 mils per coat.

3) Engage the services of a cathodic protection systems professional to evaluate the operation of the sacrificial anode CP system.

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

P.O. Box 801357, Santa Clarita, CA 91380
Phone: 877.274.2422 (toll free)
Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/20/25		Wednesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Cherry Hill	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Pine Grove Rd
Tank Location	8200 Pine Grove Rd, Santa Paula CA
GPS Coordinates	34.40955, -119.07742
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate with Clips	
Connections	Bolted	
Overflow Design	Capped Stub	
Inlet Interior Design	Stub	
Lining Type/Original	Epoxy	No

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	Yes	One		
CP System/Type	Yes	Sacraficial Annode		
Water Depth	16 ft			
Water Agitator	No	None		
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	535,164	
Diameter (feet)	66	
Height (feet)	21	
Erection Year	1954	
Contract No.	FC44976	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Four	
Height of Each Course	Multipule	
Roof Design	Pitched Roof with Drip Ring	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Unibolt	
Diameter of Manways	20 in	
No. Roof Hatches/Location	Two	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	On Hatch
Roof Vent Design	Round Hood	
Construction Co.	ARL Standard Tank	

Item	Data	
Center Roof Vent Size	12 in	
Roof Vent Sealed	Yes	Satisfactory
Roof Rail System	Yes	Corral
Roof Rail Satisfactory	Yes	N/A
Rail Location	At Hatch	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Shell Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	No	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	Screen Air Gap	
Drain Location	Shell	
Tank Foundation	Gravel	
Water Level Indicator	YEs	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.
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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -002



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -003



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -004



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -005



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -006



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -007



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -008



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -009



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -010



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -011



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -012



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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -014



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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -041



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -042



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -043



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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -045



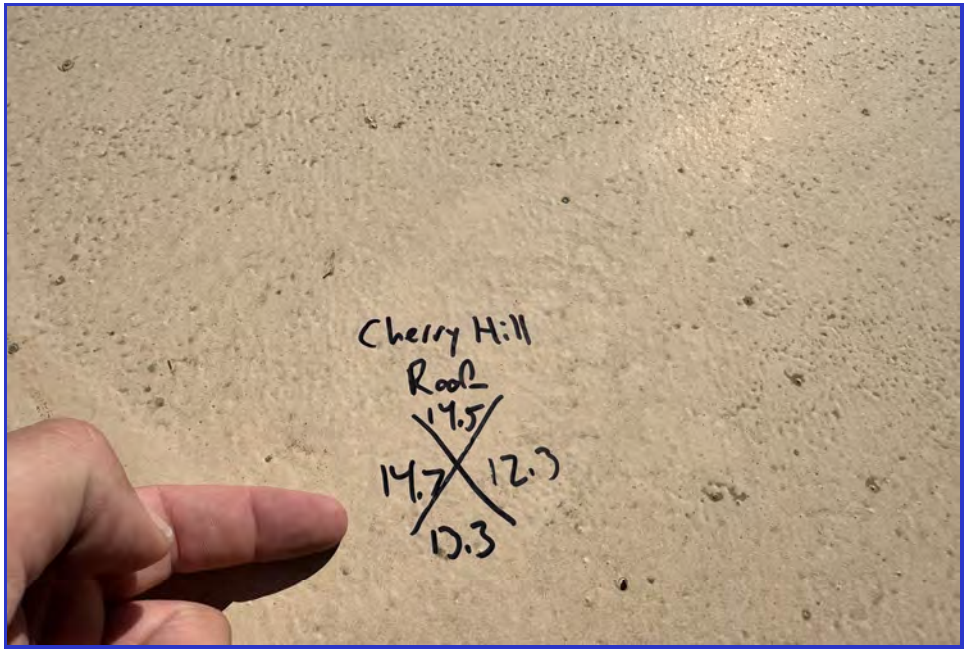
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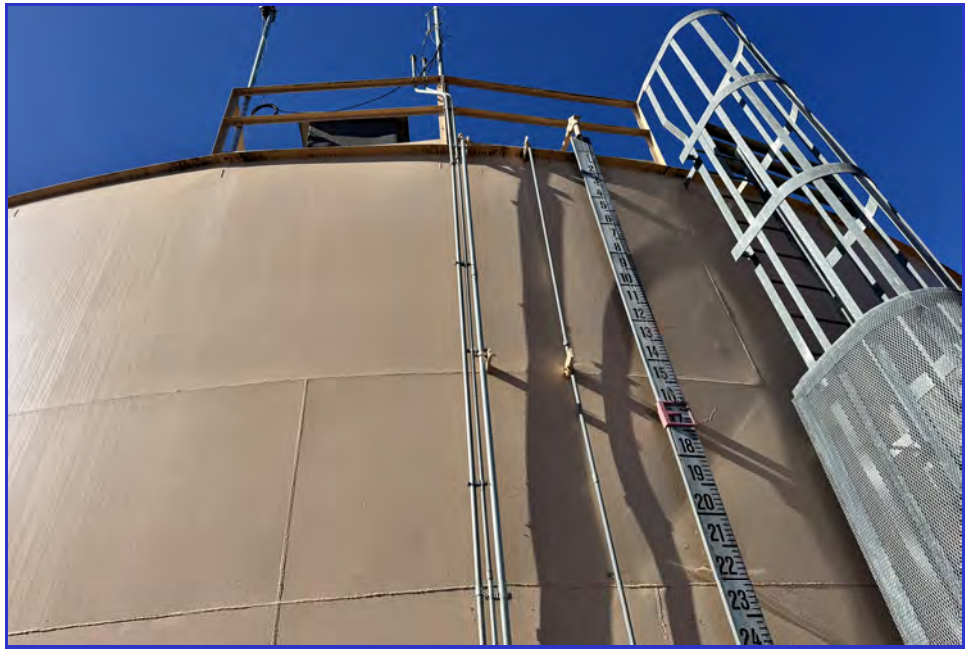
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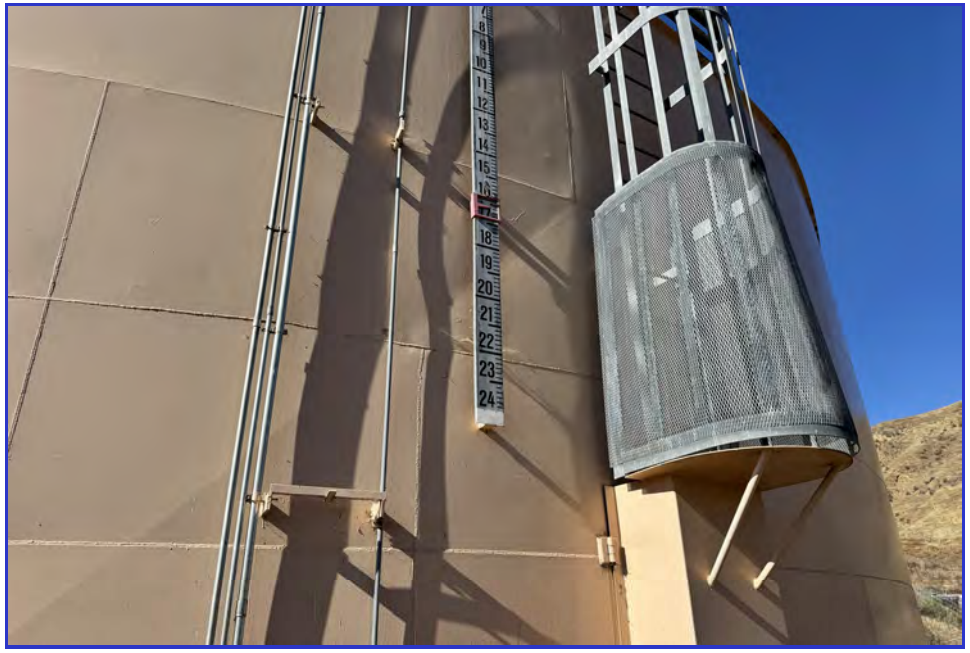
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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -052



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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -055



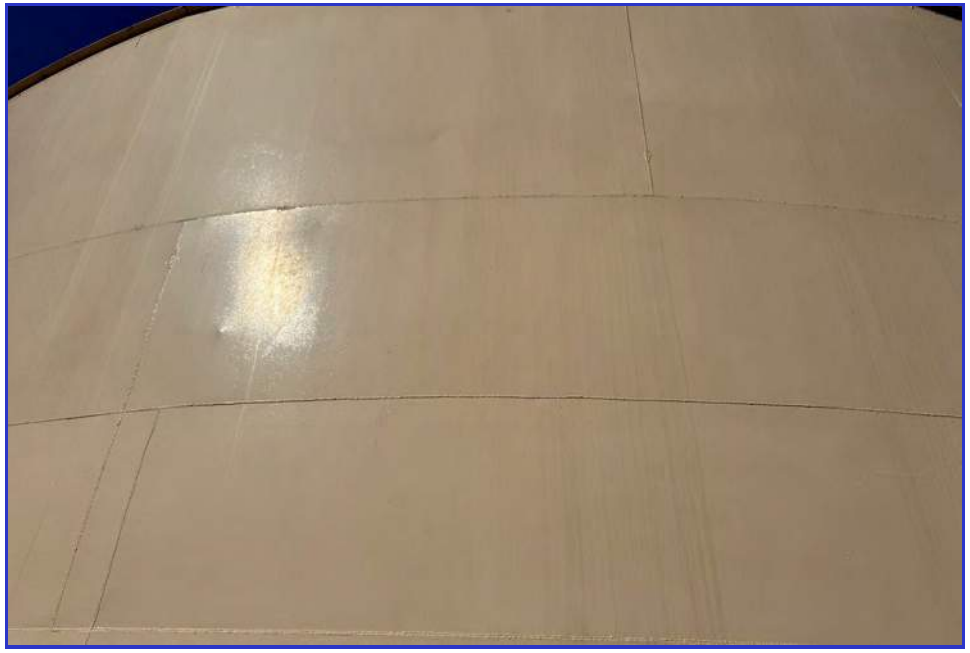
EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -056



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -057



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -058



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -059



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -060



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -061



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -062



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -063



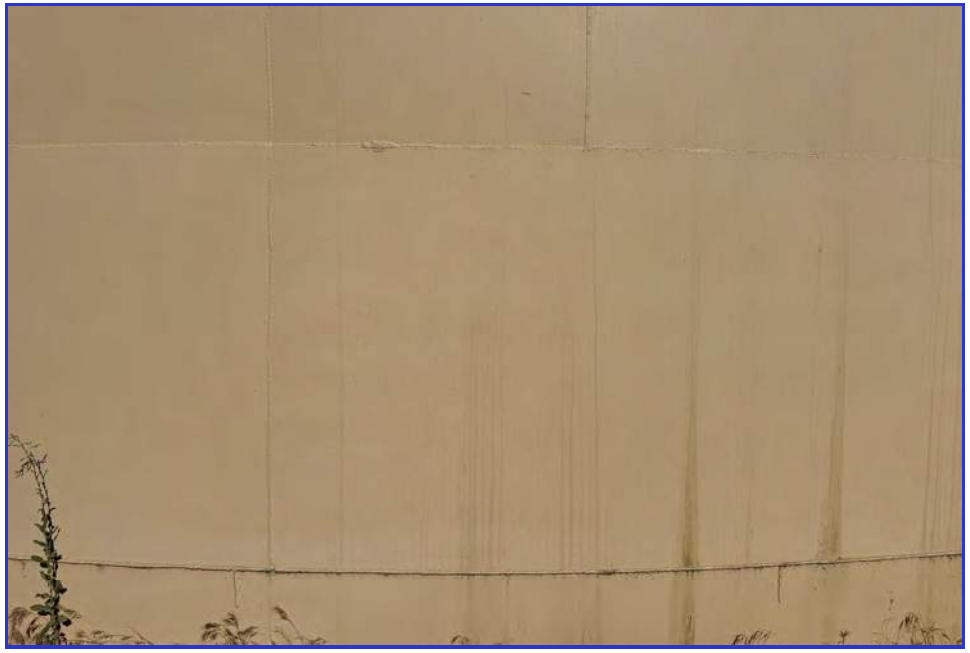
EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -064



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -065



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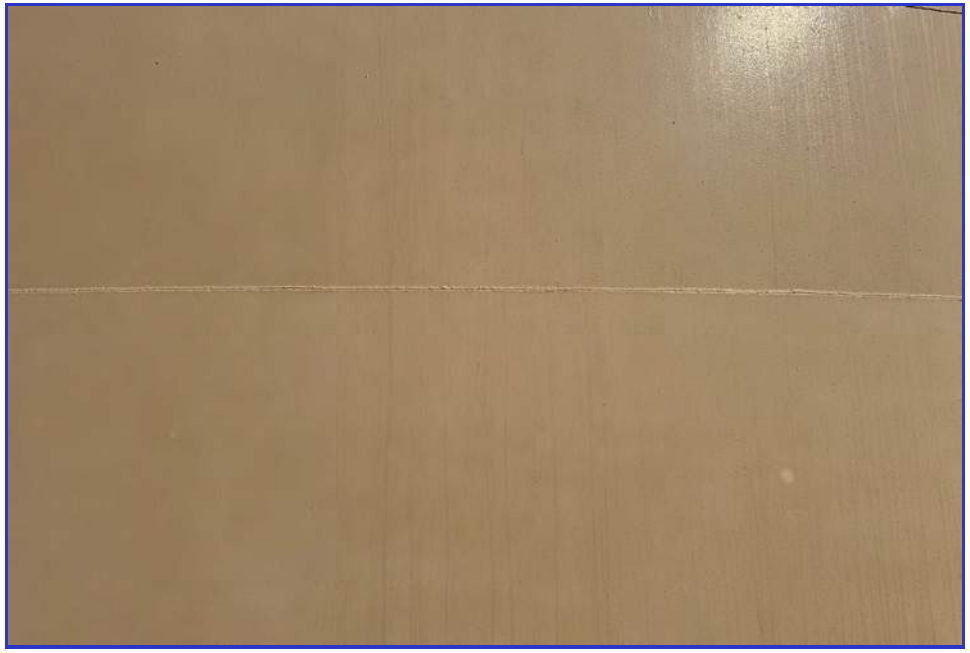
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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -069



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -070



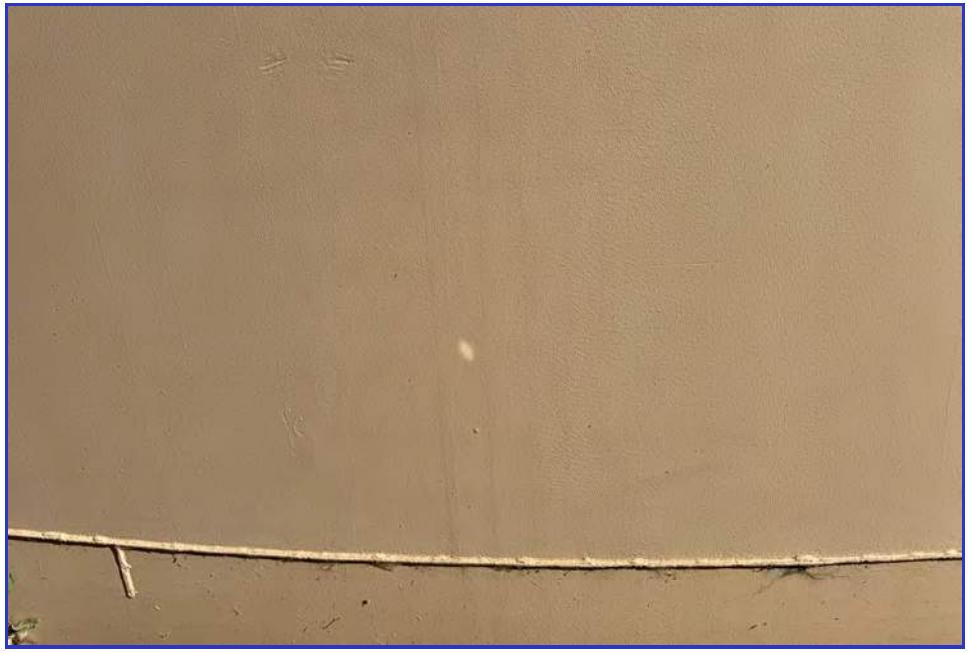
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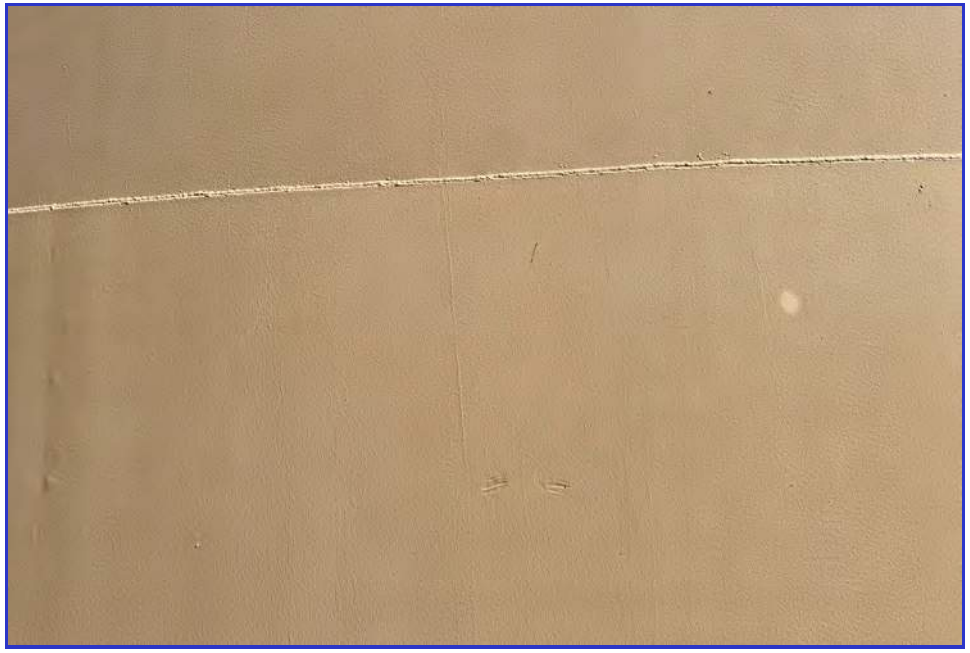
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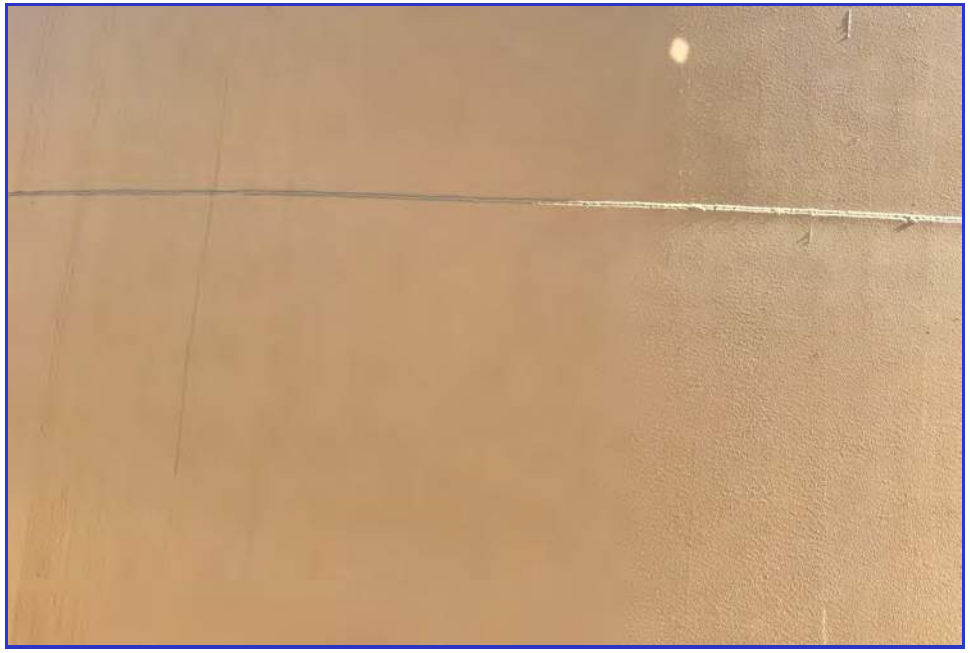
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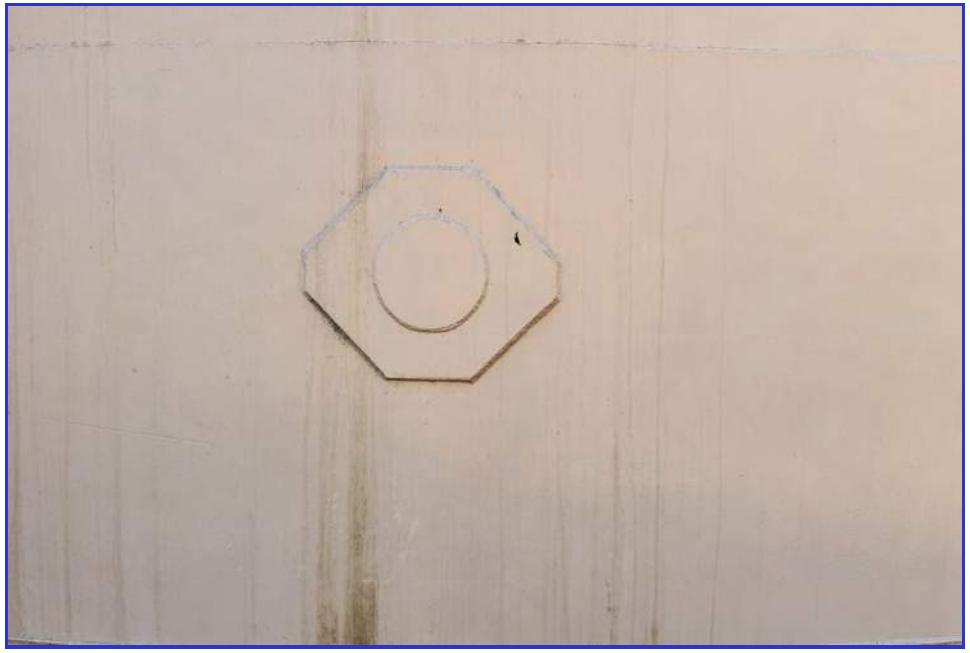
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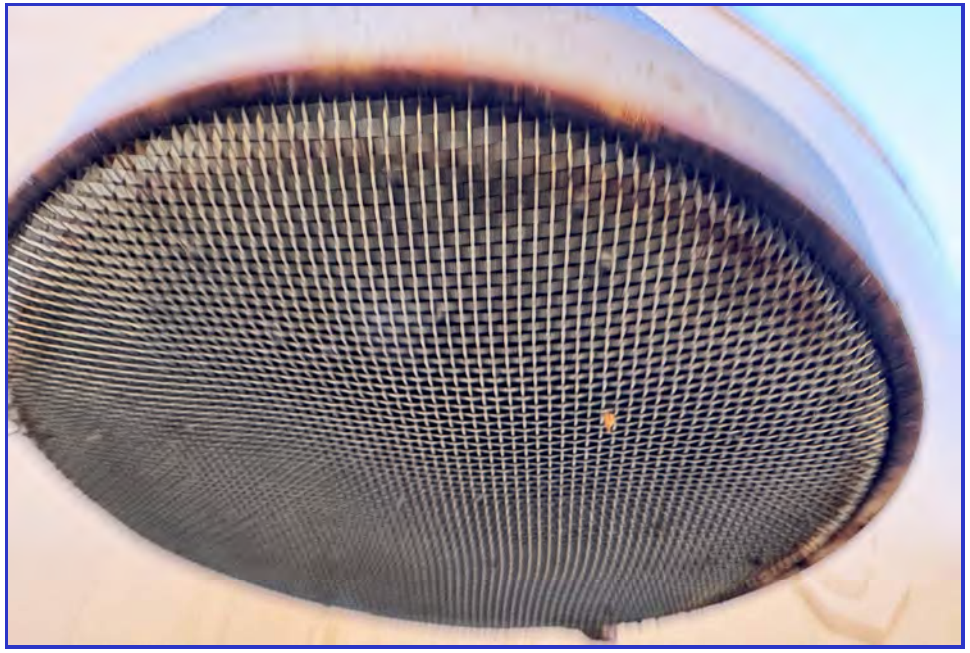
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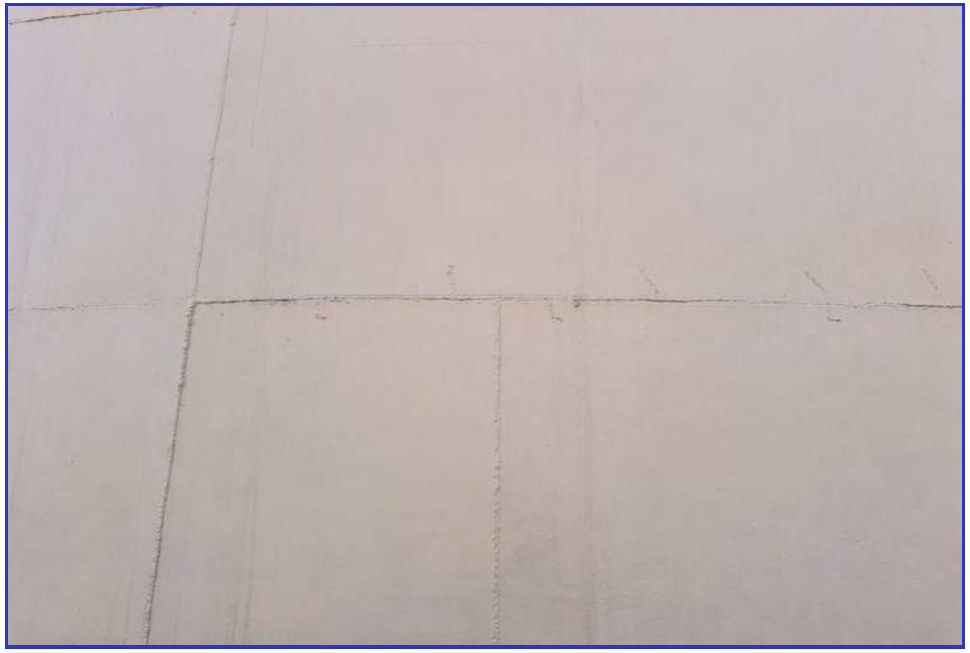
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EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -092



EXTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -093



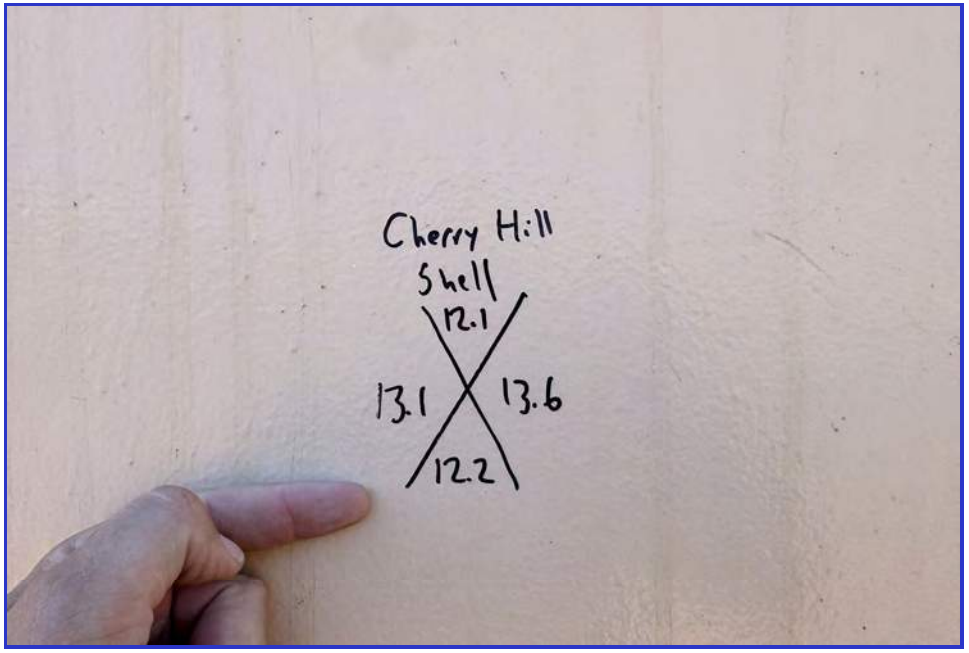
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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -001



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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -044



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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -046
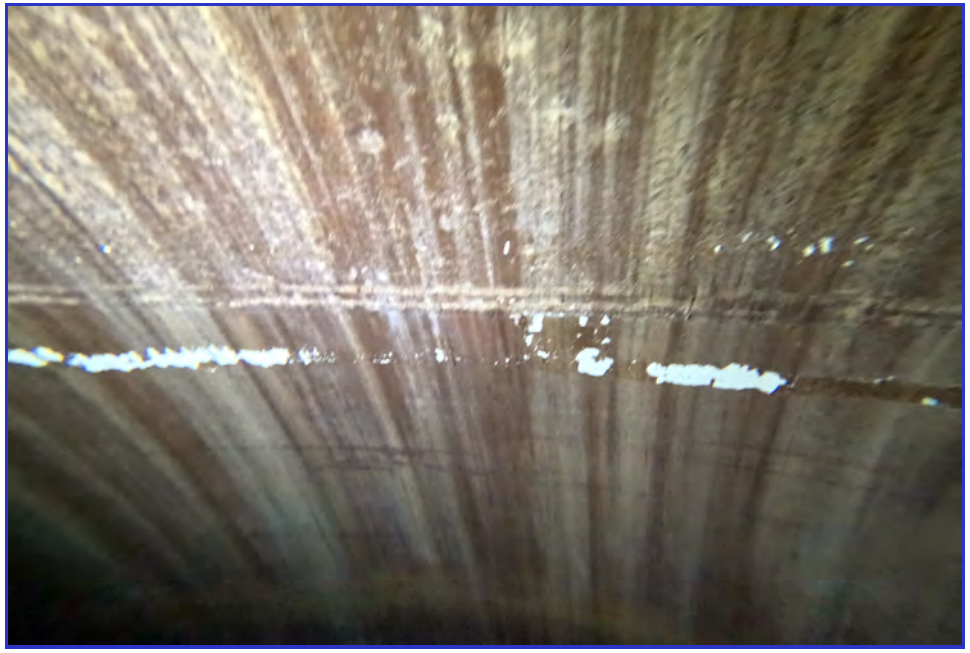


INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -047



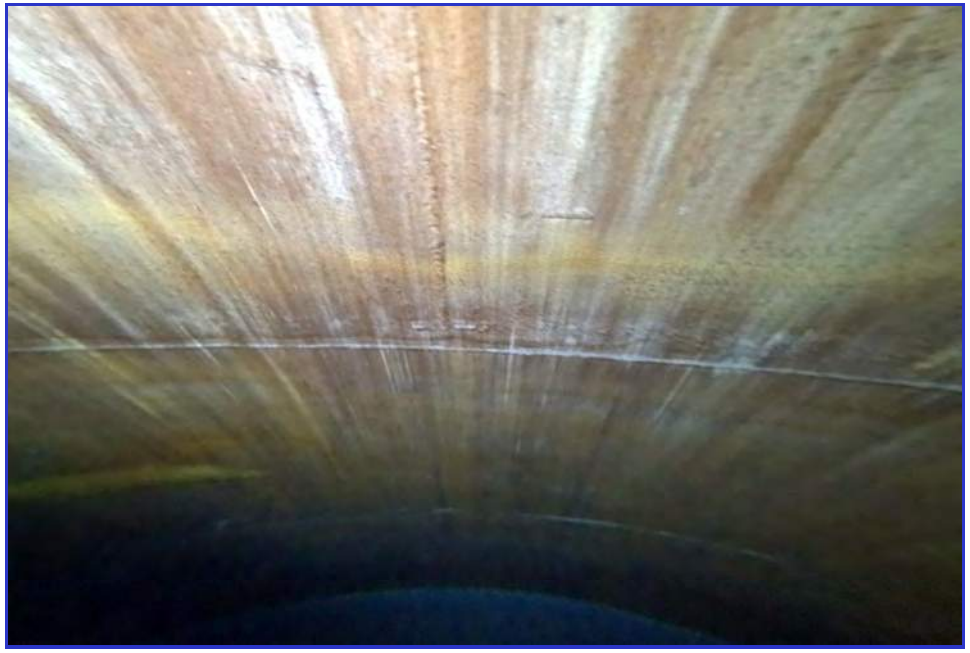
INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -048



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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -062



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -063



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -064



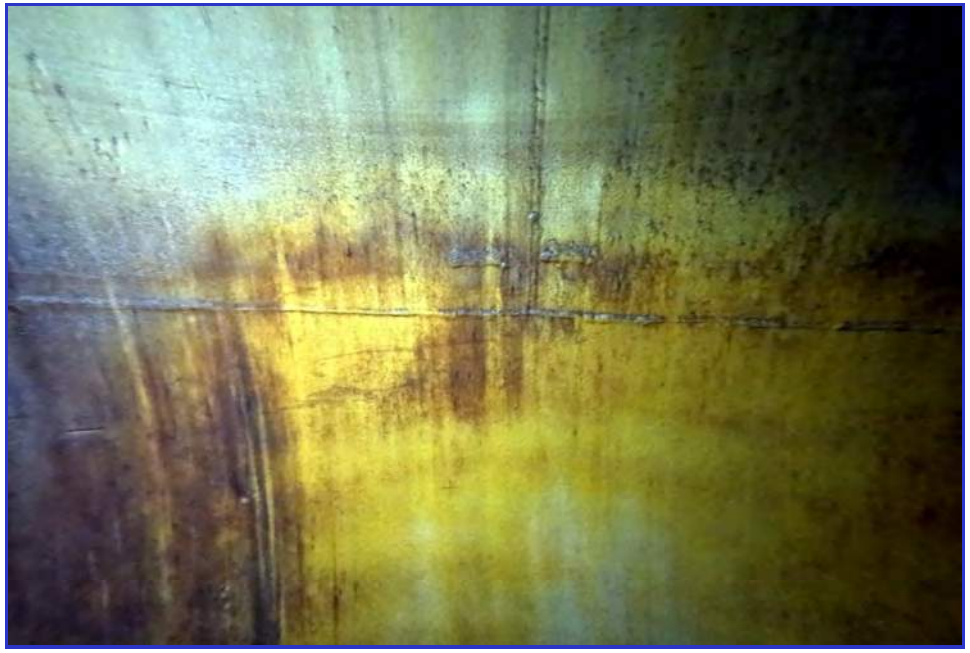
INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -065



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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -067



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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -070



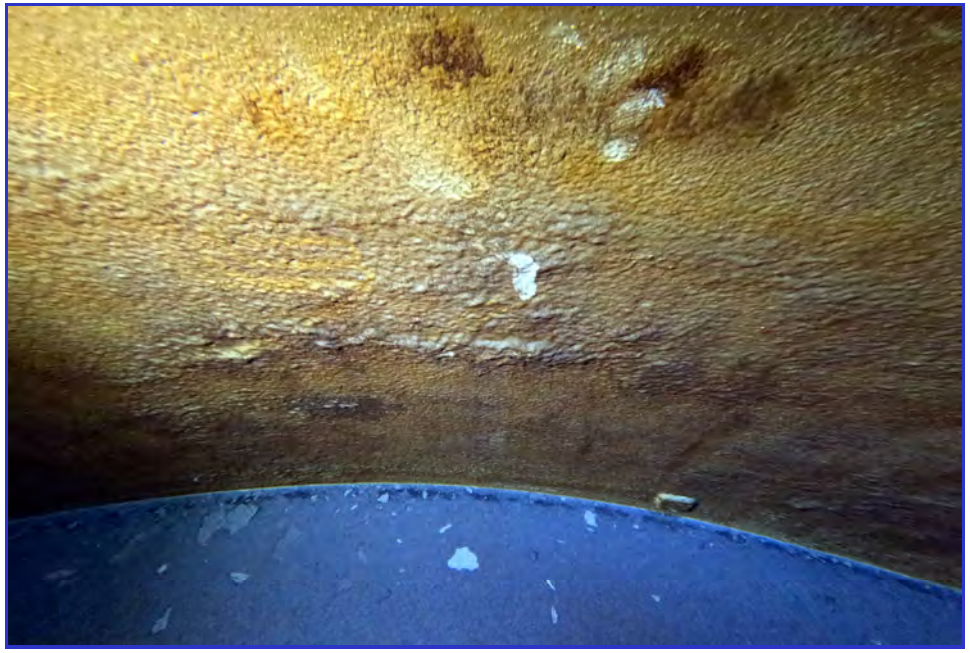
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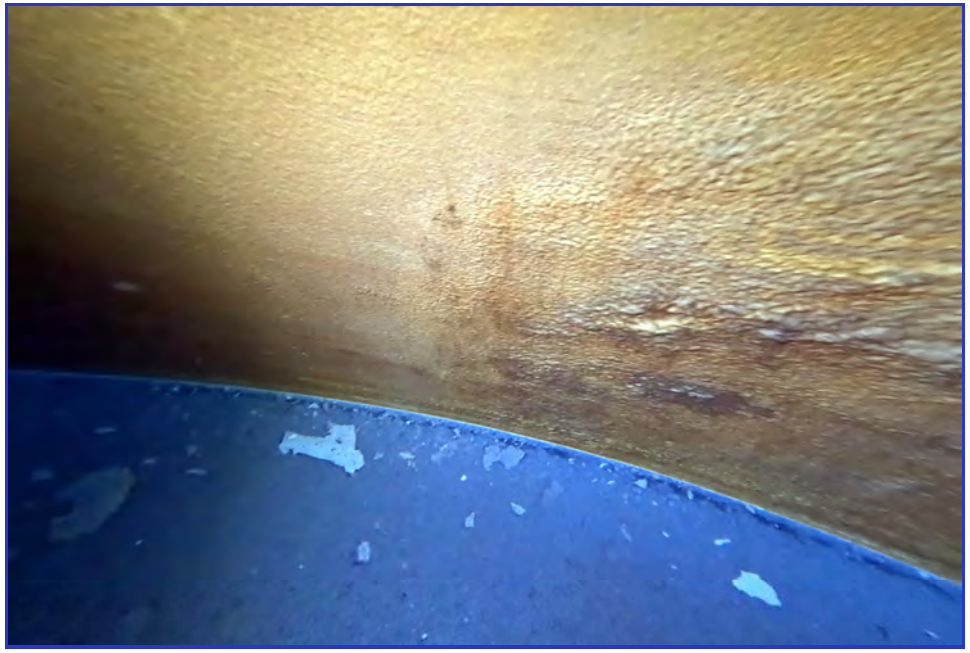
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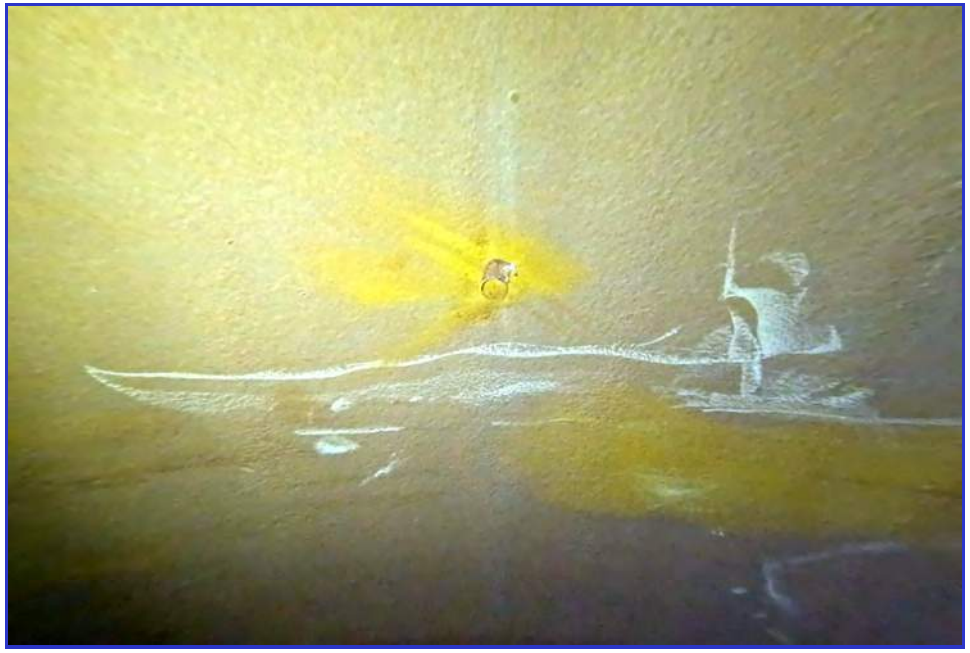
INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -073



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -074



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -075



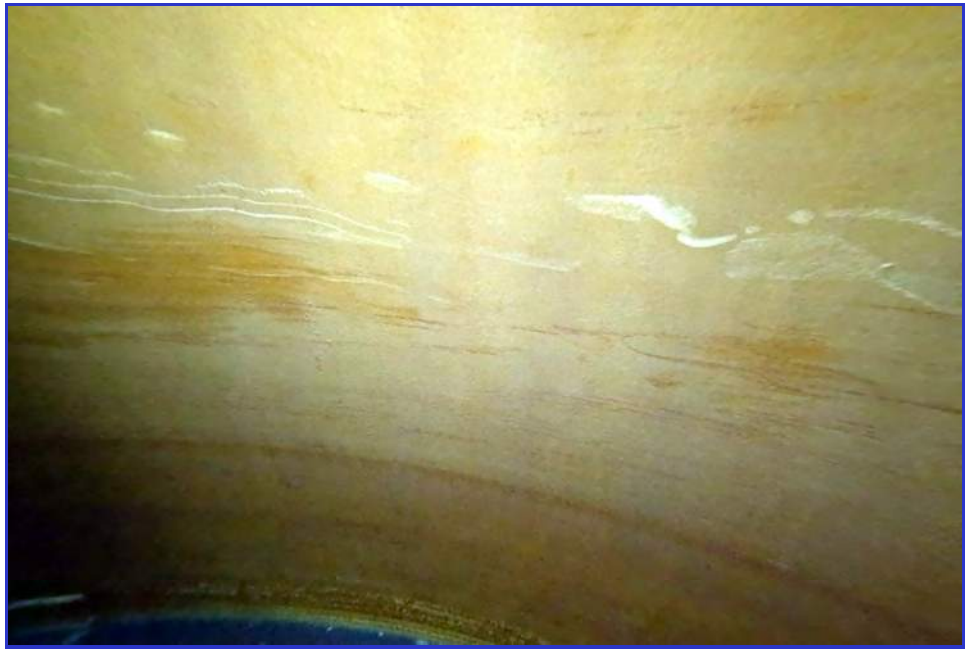
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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -080



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -081



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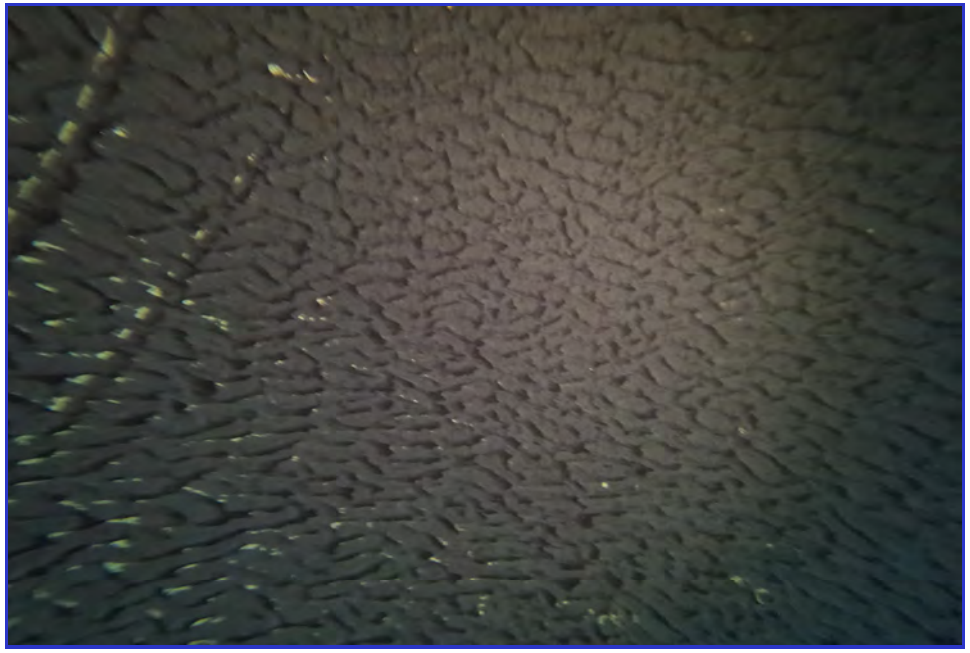
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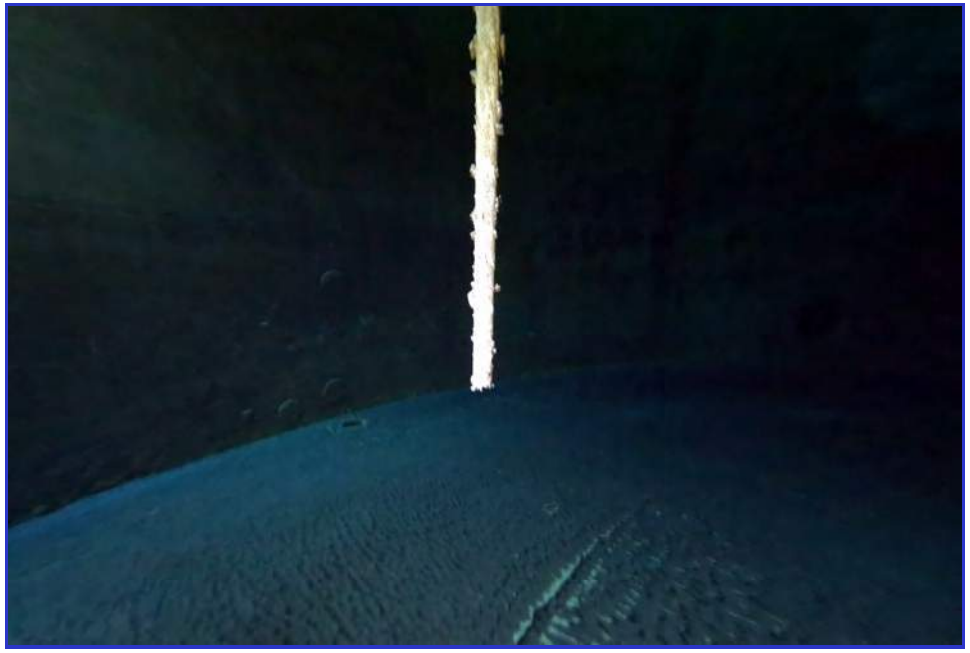
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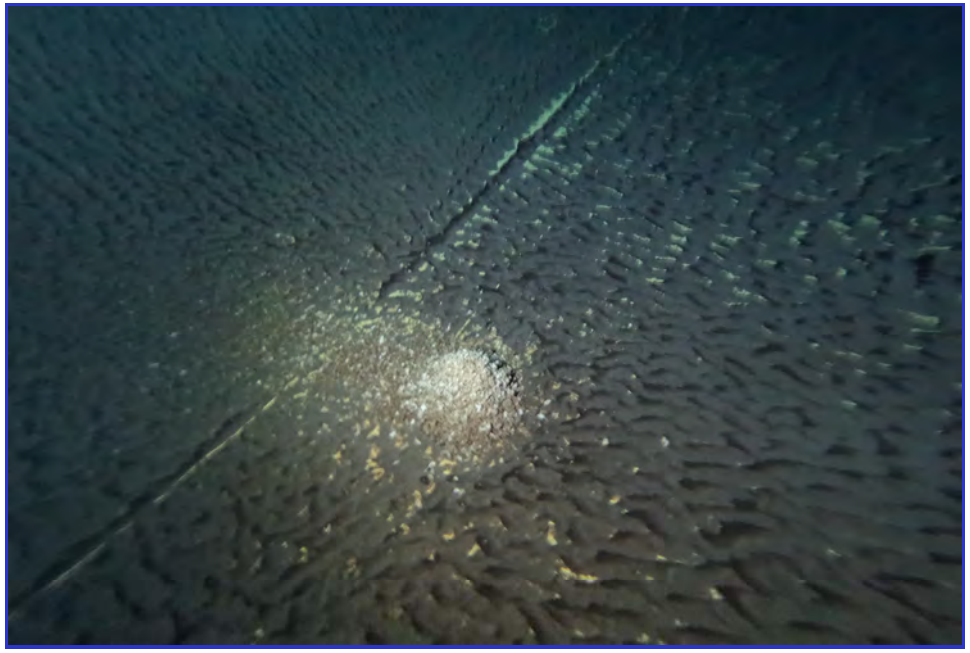
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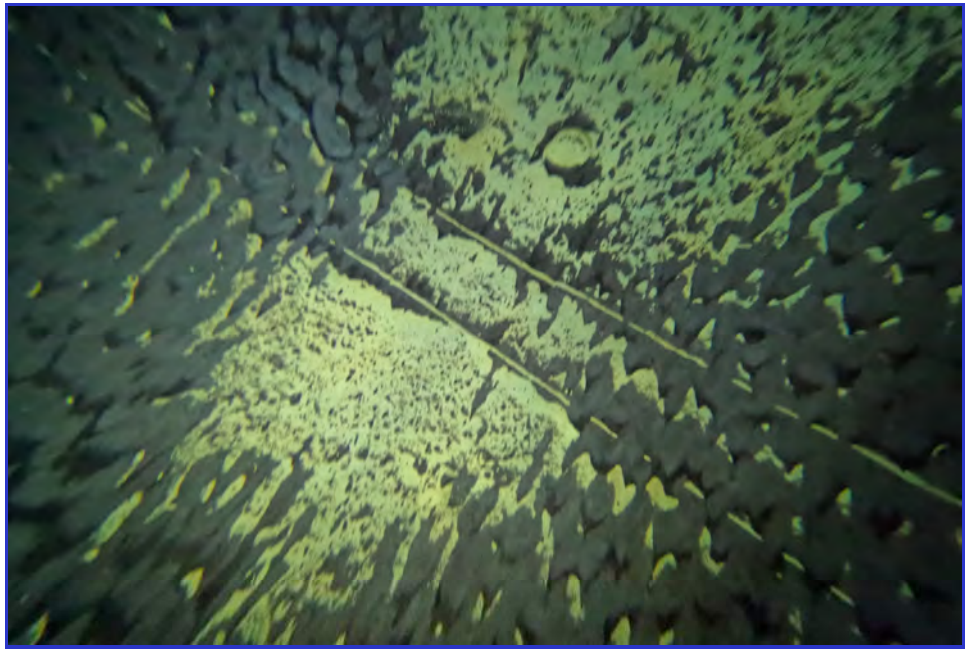
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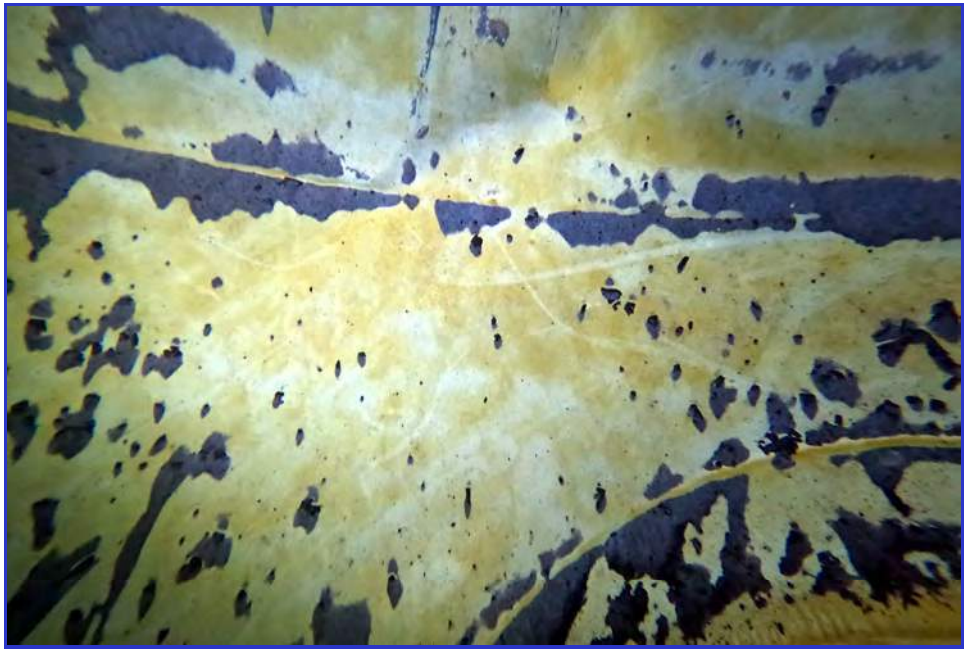
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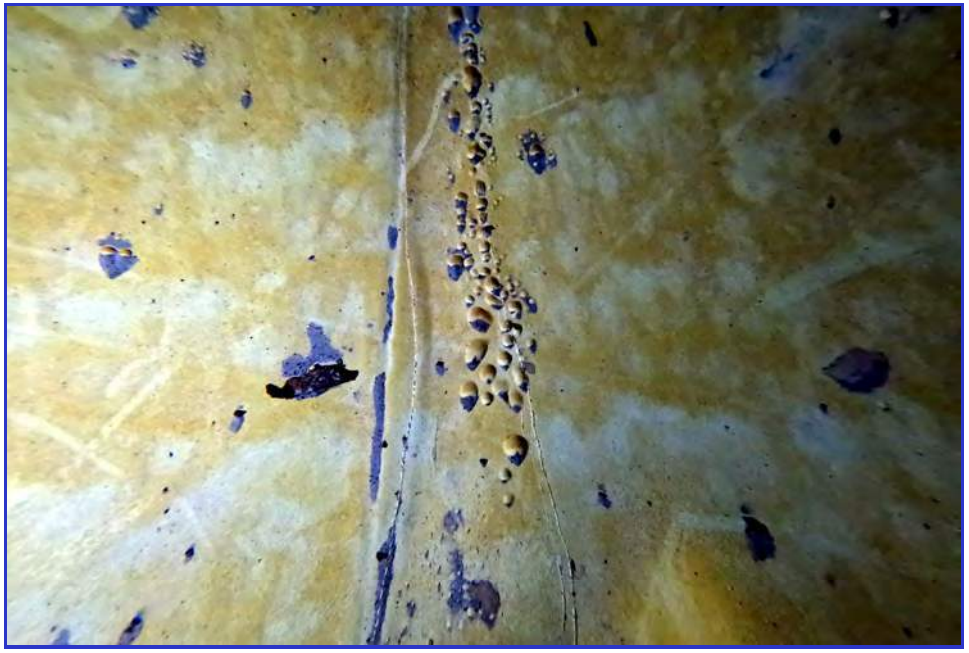
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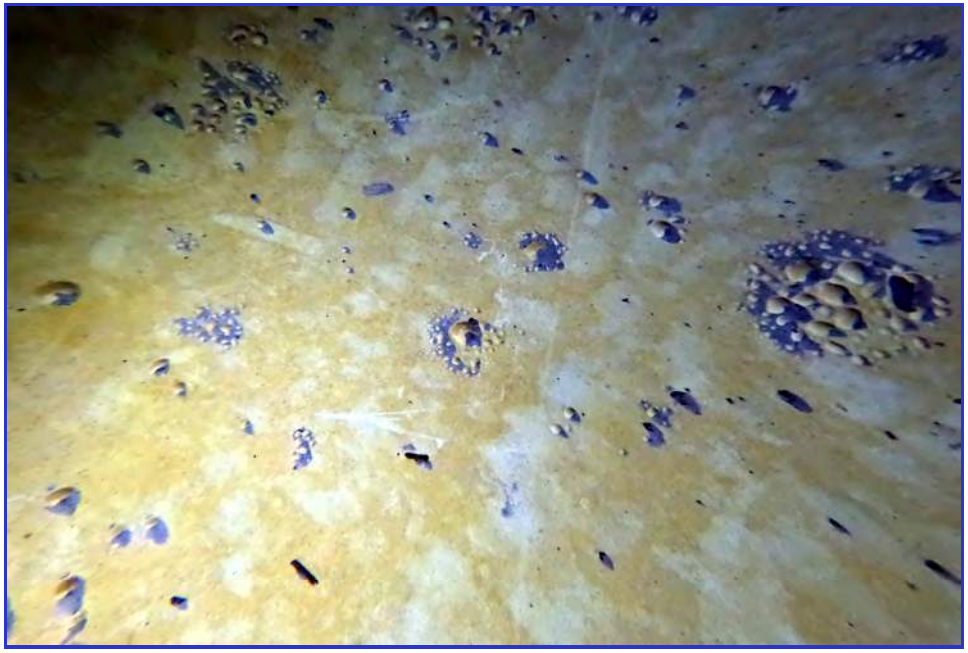
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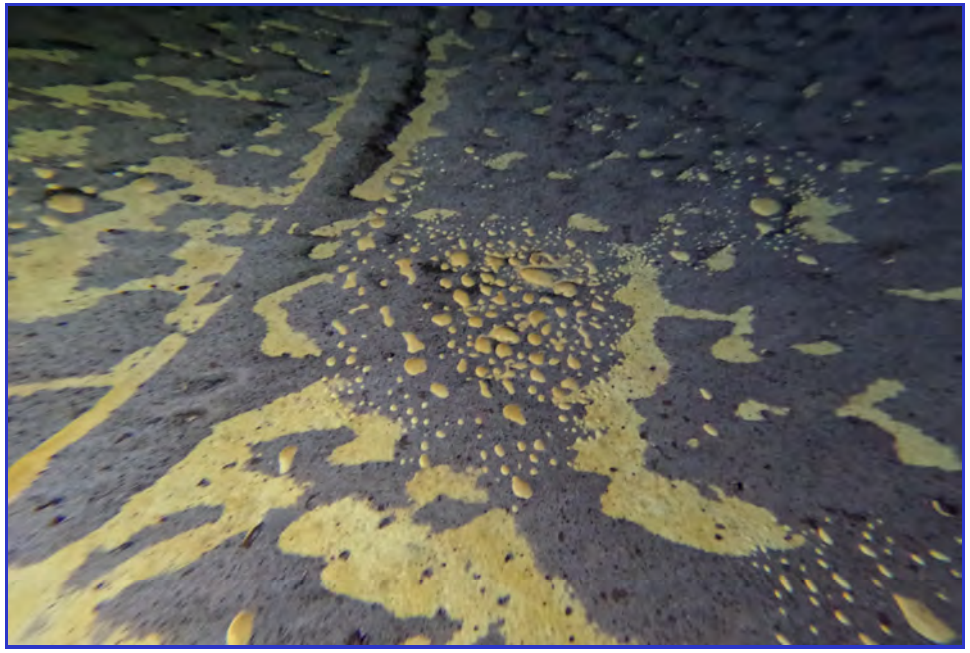
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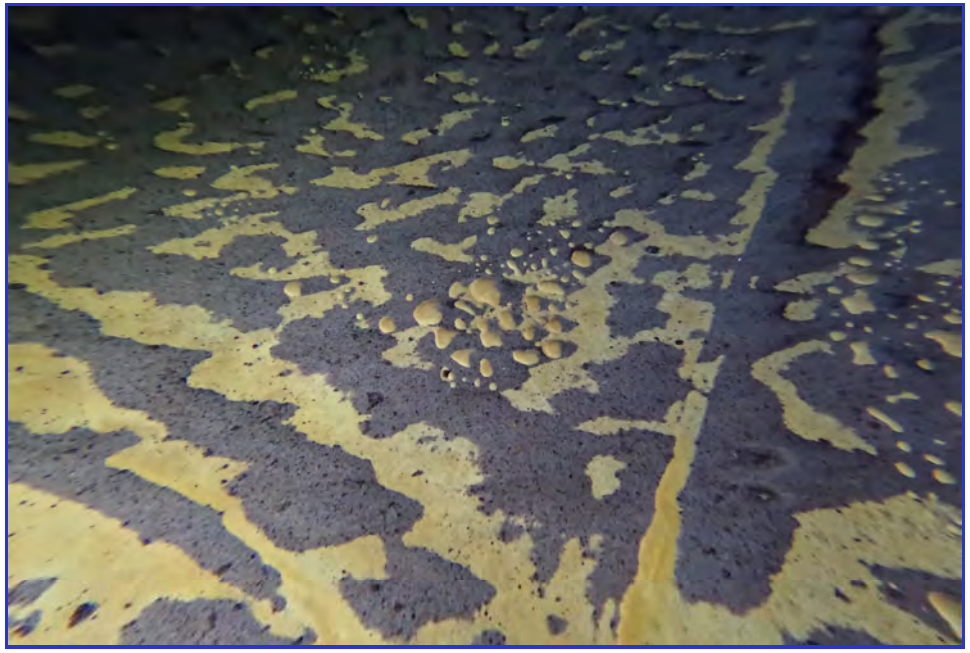
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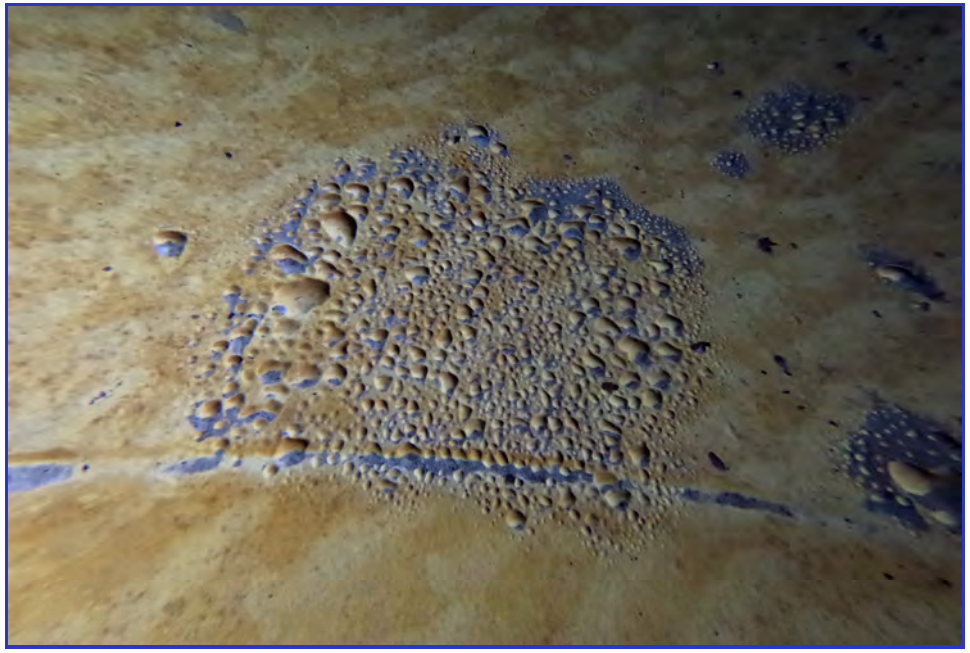
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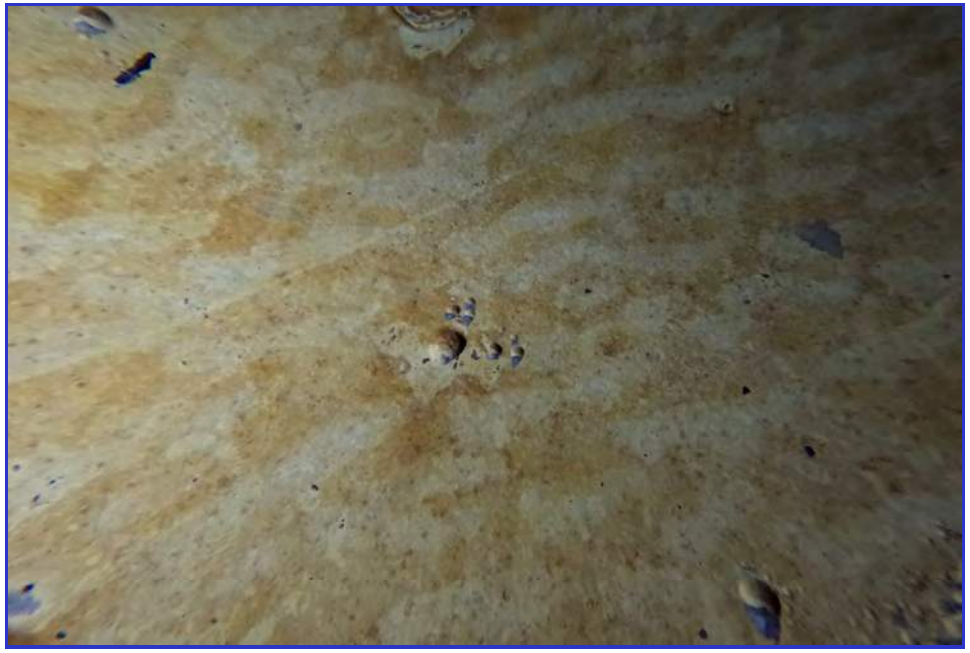
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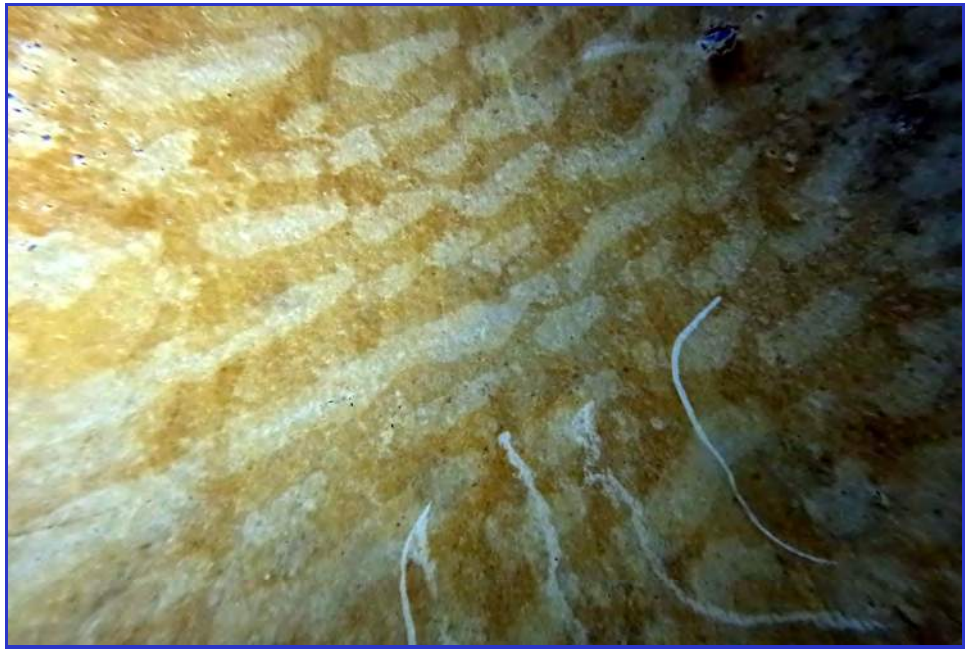
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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -104



INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -105



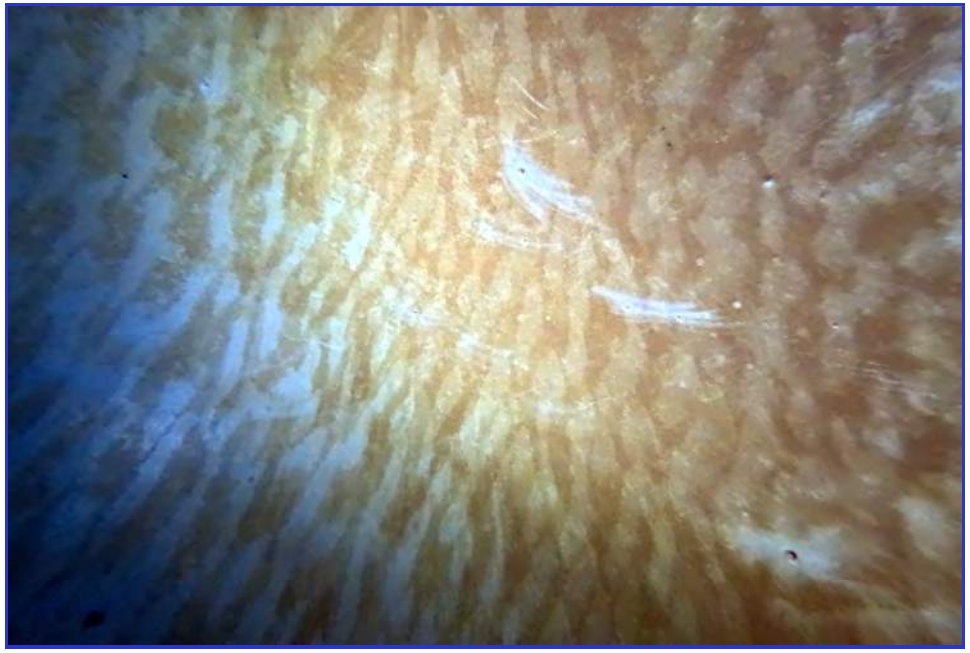
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INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -110



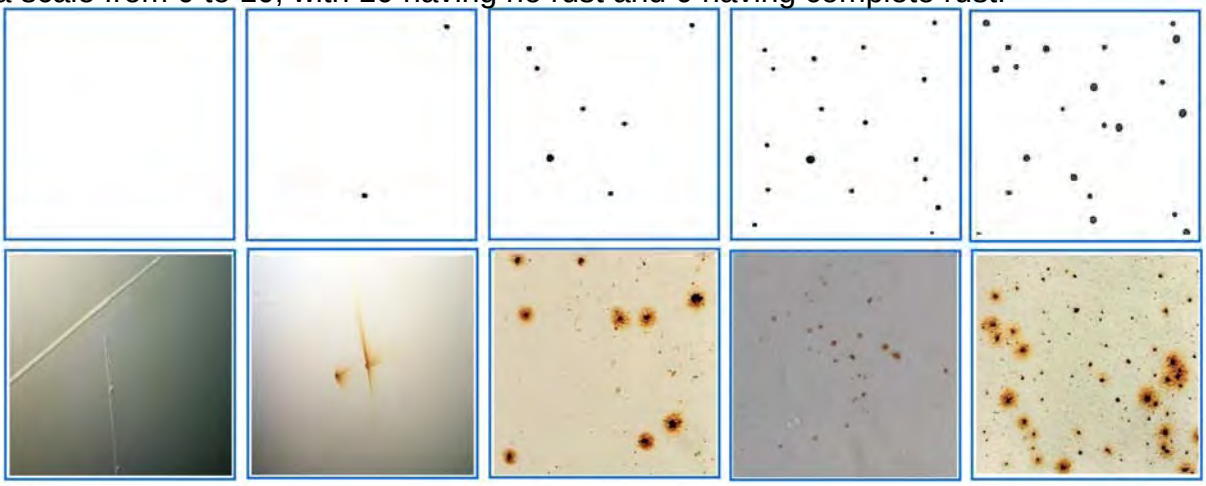
INTERIOR - City of Santa Paula - Cherry Hill - Maintenance Inspection -111

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

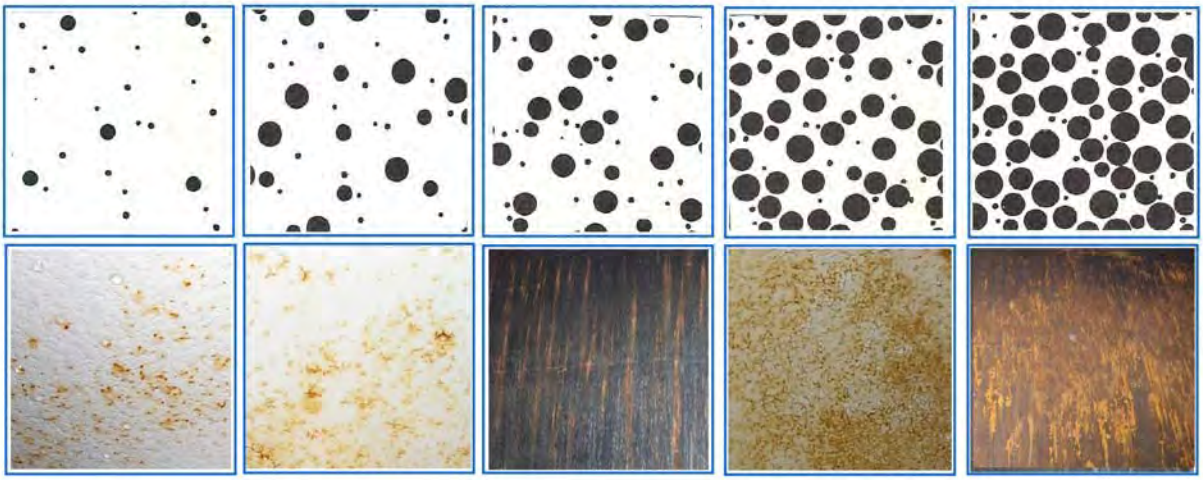
Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

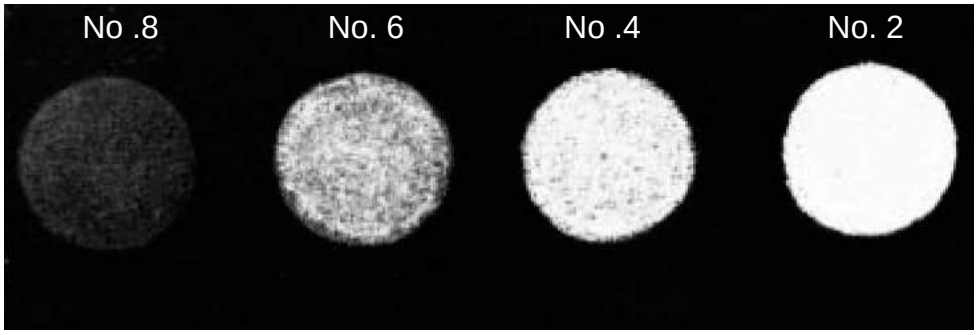
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

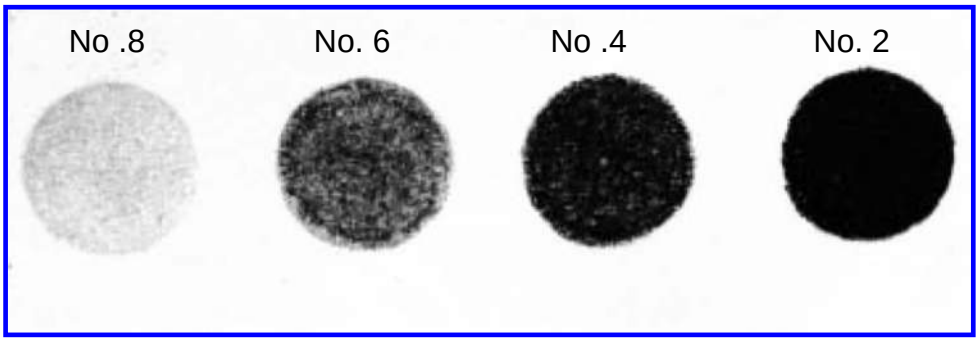
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

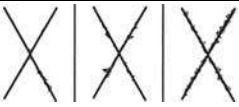
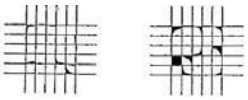
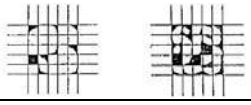
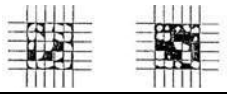


Dark Colored Paints



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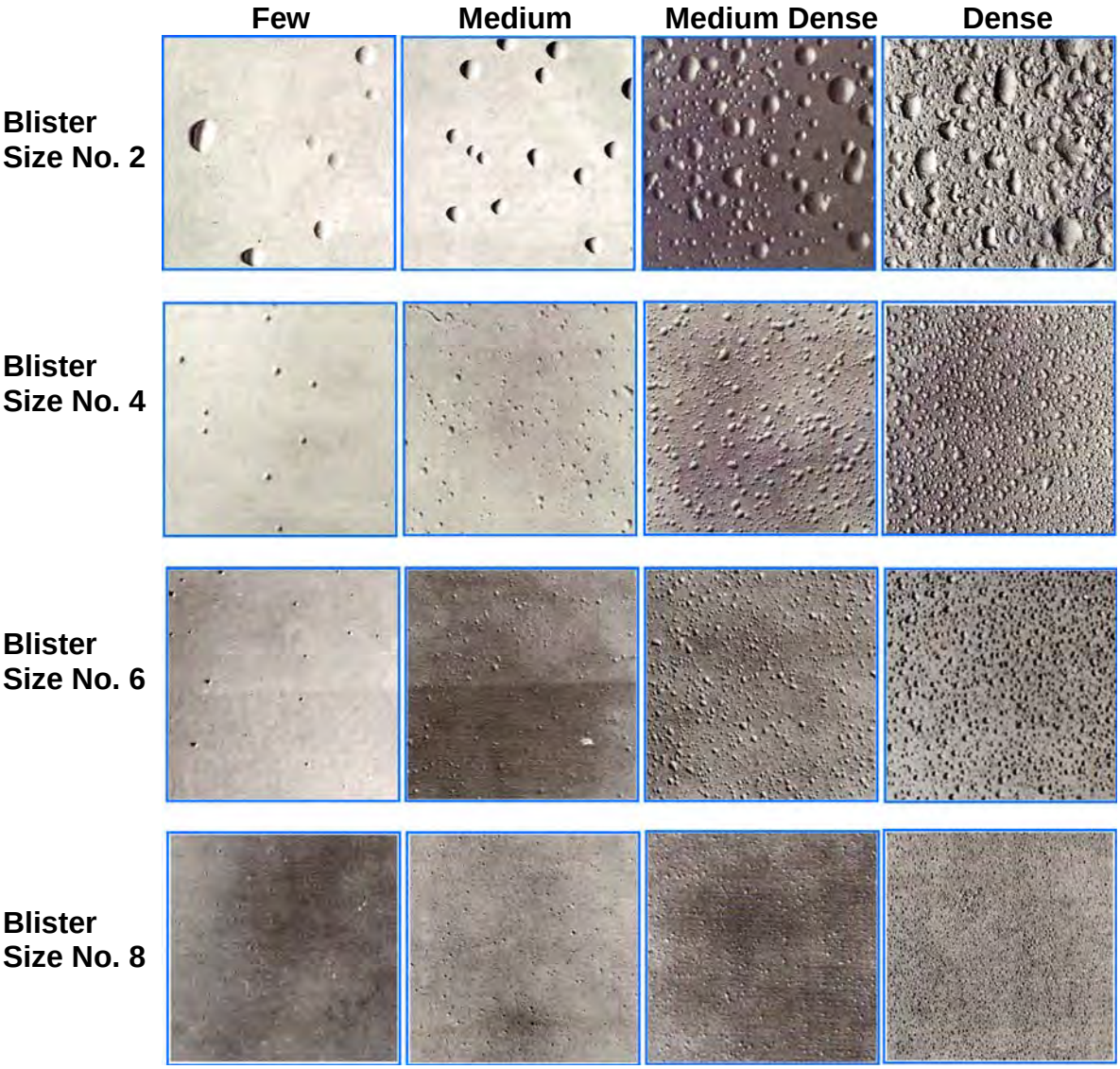
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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Fax: 661.775.7628
www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

October 31, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Fuchsia Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Fuchsia Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 31, 2025

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Attachments

- **Field Notes**
- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Fuchsia Reservoir located near 893 Coronado Cir, Santa Paula CA. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 20, 2025 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 16 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The paint system on the exterior was found to be relatively thin and in good condition overall. The exterior surfaces have only isolated spot rust and the paint was found to have weathered from chalking, however, the overall film thickness of the paint system and its general satisfactory adhesion makes it an ideal candidate for future overcoating strategies. Currently, it is recommended that the existing paint system be spot repaired at the next maintenance interval to prevent further degradation of the system and suspend any active corrosion.

The interior lining appears to be a somewhat recent multicoat, thin-film epoxy system that is in an overall good condition with no wholesale defects. The sacrificial anode CP system is preventing more advanced forms of corrosion from developing below the HWL. This tank should be placed back on a 3 to 5 year maintenance inspection schedule in accordance with AWWA and continue to perform patch repairs which will extend the overall lifespan of this lining.

Background

The Fuchsia Reservoir is a welded steel on grade structure that was constructed in 1955. The tank is approximately 60 feet in diameter by 24 feet high providing a nominal capacity of 500,000 gallons and is located near 893 Coronado Cir, Santa Paula CA. It is the only tank at this hillside site and is bordered by homes to the west.

The tank shell has three courses that are connected to a conical roof with rafters and one center column. The tank has one center vent, one roof hatch, and two multibolt shell manways. There is an interior ladder and one exterior ladder. The exterior ladder has fall a protection device and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band. There is an internal sacrificial anode cathodic protection (CP) system associated with this tank. The tank has a mechanical, half-travel, water level indicator that improperly gauges the tank's height at 24 feet.

It is believed that the interior lining is a 3rd generation system. The interior steel surfaces, including the roof and roof support members, are coated with a multicoat thin film epoxy. The exterior roof, shell, and appurtenances are painted with what appears to be a polyurethane system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video are included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking

was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in excellent condition with minimal chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than 0.03 percent of the overall surface area and rated a 9 in accordance with ASTM D610. At the shell, the exterior paint system is in excellent condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. The paint thicknesses were found to range from 9 to 10 mils on the roof and 14 to 15 mils on the shell. The paint system was estimated to exhibit moderate adhesion (ASTM D6677) at the shell and satisfactory adhesion (ASTM D6677, 5A) at the roof.

Some of the specific data collected follows:

Exterior Paint					Overall Condition			Excellent				
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Excellent		Exterior		Excellent		Exterior		Excellent	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Corrosion Grade												
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	8	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout with dark corrosion (CSI Corrosion Grades 2) appearing from undercutting. The total amount of corrosion on the roof was rated to be approximately 0.03 percent of the total surface area (ASTM D610, 9), and there was a minor amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in fair condition with areas of dark rust (CSI Corrosion Grades 2), especially within tank accessories and edges. The total amount of corrosion on the shell was rated to be 0.03 percent of the total surface (ASTM D610, 9) with some rust nodules and minor pitting observed. Groupings of blisters were observed and rated 2/Few in accordance with ASTM 714.

The floor had a large amount of sediment upon it, but spot checks revealed the lining at the tank bottom was in good condition, (ASTM D610, 9) with the same patterning of blisters observed at the shell (2/Few). The vast majority of the blisters retain their blister caps.

The data collected from the inspection follows:

Interior Paint	Above Water Condition		Good		Below Water Condition		Good					
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Good		Interior		Good		Interior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2	2	2	2	2		2					
Rust staining												
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling	Yes	Yes	Yes	Yes								
Delamination												
Cracking (ASTM D661)												
Blistering (ASTM 714) Size/Density												
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/vo2AV9Ku2yugo5tK6

Discussion

In general, the exterior paint system on the tank is relatively thin, and exhibits negligible chalking with satisfactory adhesion between the finish coat and the primer in all areas tested. There are few areas of pinpoint and spot rusting within the paint system upon the roof, primarily at plate depressions where water tends to pond and immerse the paint system for long periods of time. Although the shell surfaces have some isolated spot rust, the paint system was providing general corrosion protection, at this time. The paint will likely continue to provide protection of the steel for a few more years, but it will continue to oxidize and degrade.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel,

the process initiates itself as light colored orange surface rust. As the corrosion process continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

The tank roof has localized areas where atmospheric water tends to collect to develop ponds at plate depressions. The paint applied to the exterior of the tank was not designed for immersion service. As a result, the paint in many of these areas has degraded to form flaking and corrosion.

Generally speaking, there are four possible approaches to maintenance painting. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best painting approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If the paint film is too thick or has poor adhesion, the tension from the curing stresses and/or weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what painting approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals (i.e. lead, cadmium, and chromium). The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that spot repair, with or without overcoat, makes sense with up to 10 percent of the surface area requiring repairs. With more than 10% in disrepair, making spot repairs and overcoating becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is excellent. Once the amount of surface area in need of repair exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, and due to the satisfactory adhesion observed at the roof and shell, the tank exterior paint should be spot repaired at the next maintenance interval.

Overall, the tank interior coatings are in a fair condition in the area above the highest water level (HWL), and in fair condition below the HWL. The lining on the underwater areas of the tank is mostly free of widespread corrosion, but there are localized areas of spot rust, including the beginning stages of exfoliation at irregular surfaces such as the ladder, dollar plate, rafter flanges, shell penetrations for accessories, and rough welds.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simply a result of some areas not being completely sealed by coatings.

The design and fabrication of a water storage tank is critical relative to the performance of the lining. For instance, tank and vessel internal surfaces to be lined should not be marred by gouges, handling marks, deep scratches, metal stamp marks, slivered steel, or other surface flaws. All rough welds should be ground to remove sharp edges and weld spatter removed. Flaws should be repaired by welding or grinding, as appropriate.

The corrosion at edges is likely simply a result of the coating not having enough barrier protection at the edges. All coatings tend to thin at edges, which often results in these locations showing signs of rust years before the barrier protection breaks down on flat surfaces. Surface tension results in coatings separating away from edges as they are applied. It is not clear if the installation of the coating system involved special brush work at the roof edges (i.e. strip coat), but strip coating would have helped prevent this type of defect.

It is not clear what caused the blisters to develop, but their locations and pattern is similar to coating symptoms that would be seen from with an improperly functioning cathodic protection (CP) system. The tell-tale sign of an over energized CP system are circular patches of blisters in areas adjacent to the CP anodes. This indicates that the CP system may not be properly operating and may be damaging the coating. This defect from cathodic disbondment can result in blistering as the over-energized CP generates hydrogen under the coating, creating blisters. No significant corrosion is associated with the condition. As a result, the only recommendation with respect to the blistering issue is to evaluate the proper operation of the CP system to avoid the continued damage to the coating.

The tank ventilation was found to have screening installed without gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior:

1) No coatings work is required at this time. Spot repair the paint system at the next maintenance interval.

Interior:

2) No coatings work is required at this time. Place the tank back on a 3-to-5-year maintenance inspection schedule as recommended by AWWA and continue to make patch repairs which will extend the overall lifespan of the lining.

3) Engage the services of a cathodic protection systems professional to evaluate the operation of the sacrificial anode CP system.

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

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Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/20/25		Wednesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Fuchsia	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Fuchsia Ln
Tank Location	893 Coronado Cir, Santa Paula CA
GPS Coordinates	34.36879, -119.06714
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	I Beams	
Upper Center Column	Dollar Plate	
Column Base Design	Crows Foot	
Connections	Bolted	
Overflow Design	A Lower Funnel	
Inlet Interior Design	T Pipe with Duckbill	
Lining Type/Original	Epoxy	No

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	Yes	One		
CP System/Type	Yes	Sacraficial Annode		
Water Depth	16 ft			
Water Agitator	No			
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	1,000,000	
Diameter (feet)	60	
Height (feet)	24	
Erection Year	1955	
Contract No.	59312	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Three	
Height of Each Course	8 Ft	
Roof Design	Pitched Roof with Drip Ring	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circle	
Diameter of Manways	24 in	
No. Roof Hatches/Location	One	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	Five	Edge
Roof Vent Design	Round Hood and Slanted	
Construction Co.	Consolidated Western	

Item	Data	
Center Roof Vent Size	12x18 in	
Roof Vent Sealed	Yes	N/A
Roof Rail System	Yes	N/A
Roof Rail Satisfactory	Yes	N/A
Rail Location	At Hatch	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Shell Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	No	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	Screen Air Gap	
Drain Location	Shell	
Tank Foundation	Gravel	
Water Level Indicator	YEs	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

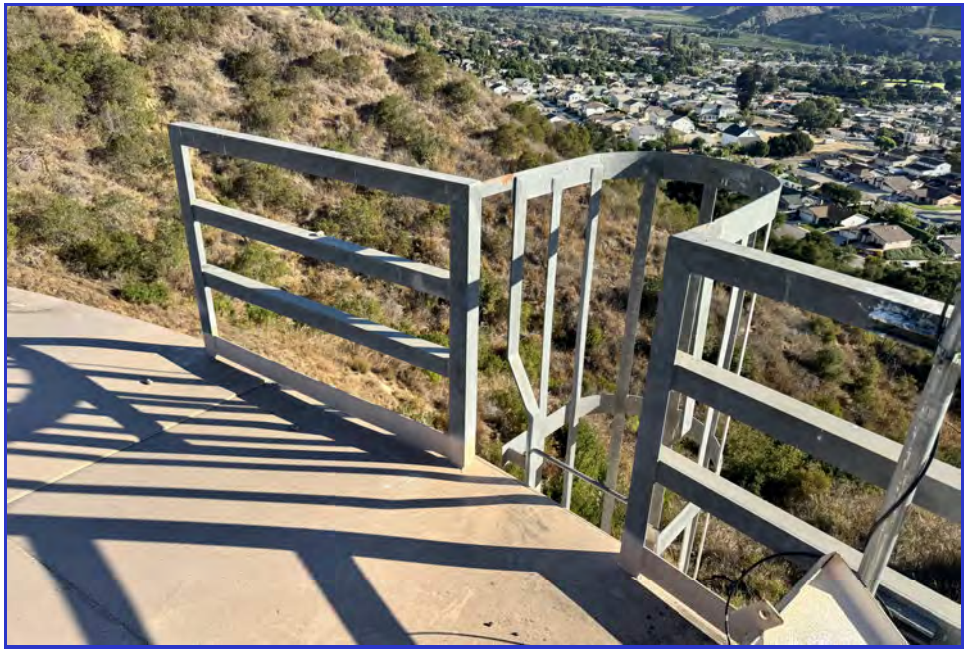
The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -002



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -003



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -004



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -005



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -006



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -007



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -008



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -009



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -010



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -011



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -012



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -013



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -014



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -015



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -016



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -017



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -018



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -019



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -020



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -021



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -022



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -023



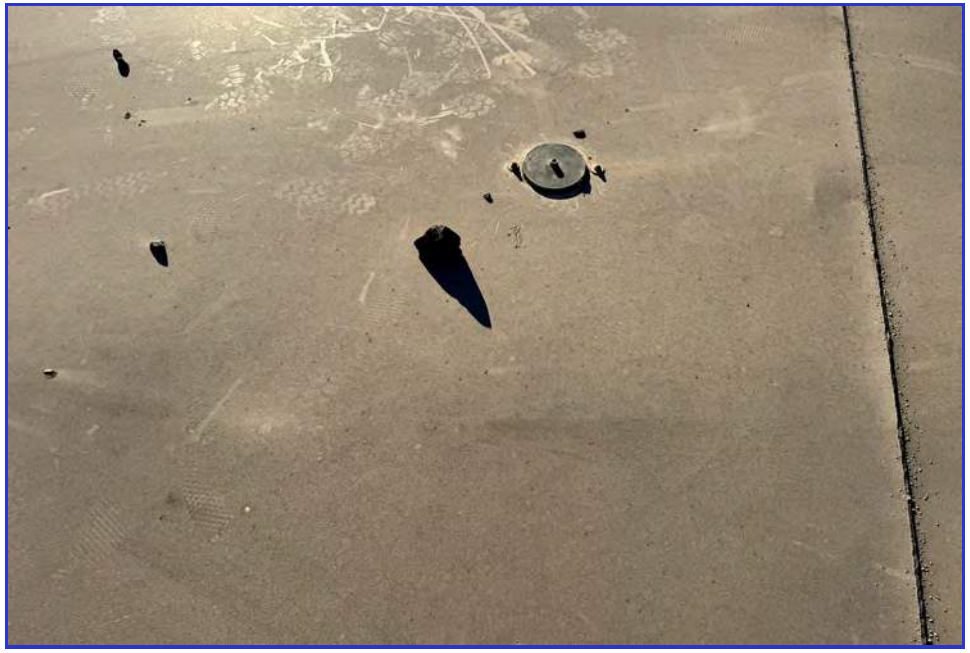
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -025



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -026



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -027



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -028



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -029



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -030



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -031



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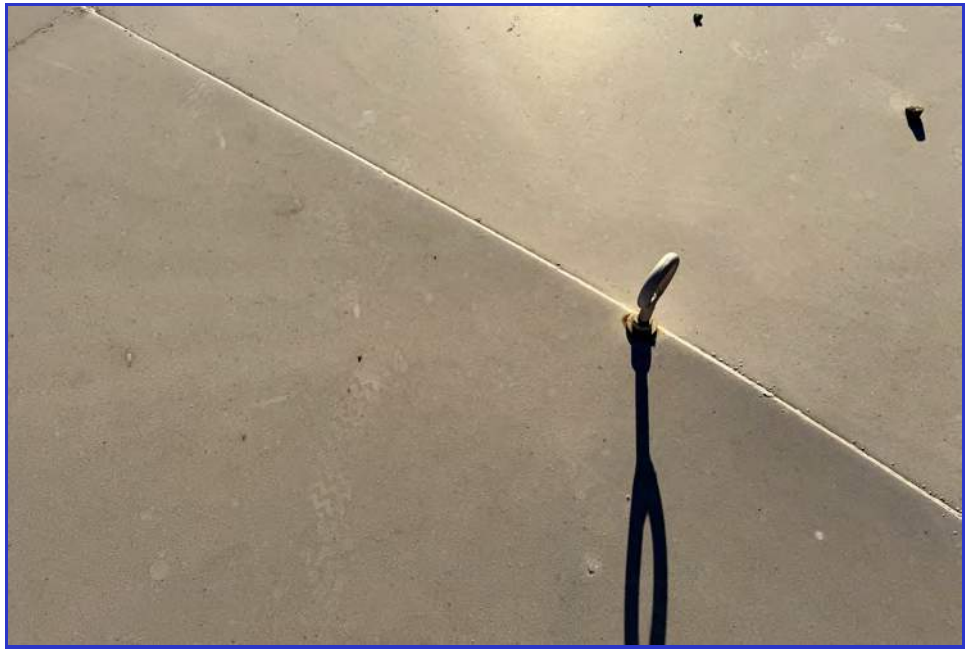
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -038



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -039



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -040



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -041



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -042



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -043



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -044



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -045



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -046



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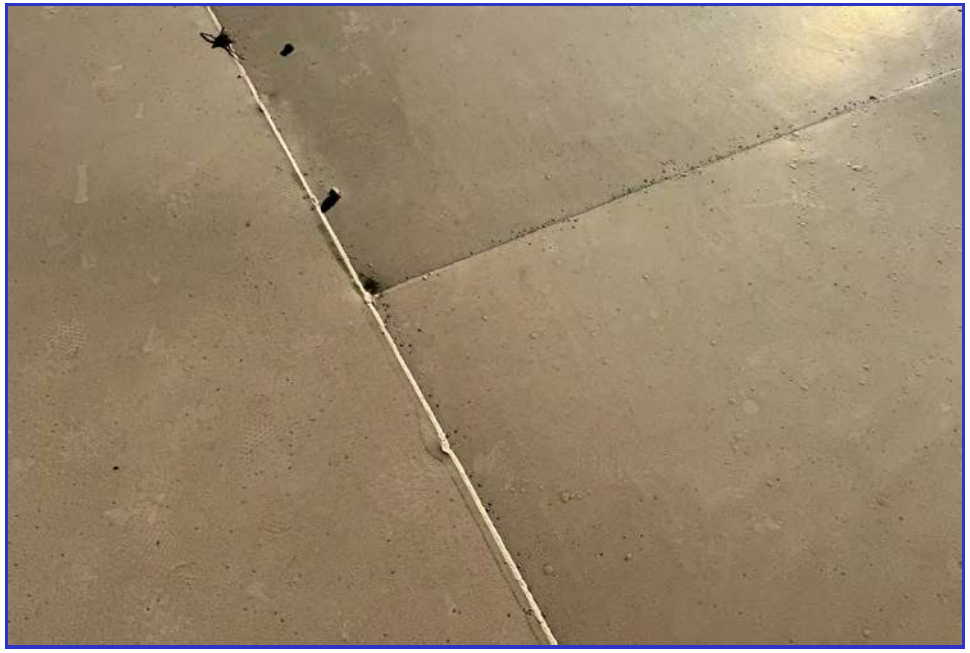
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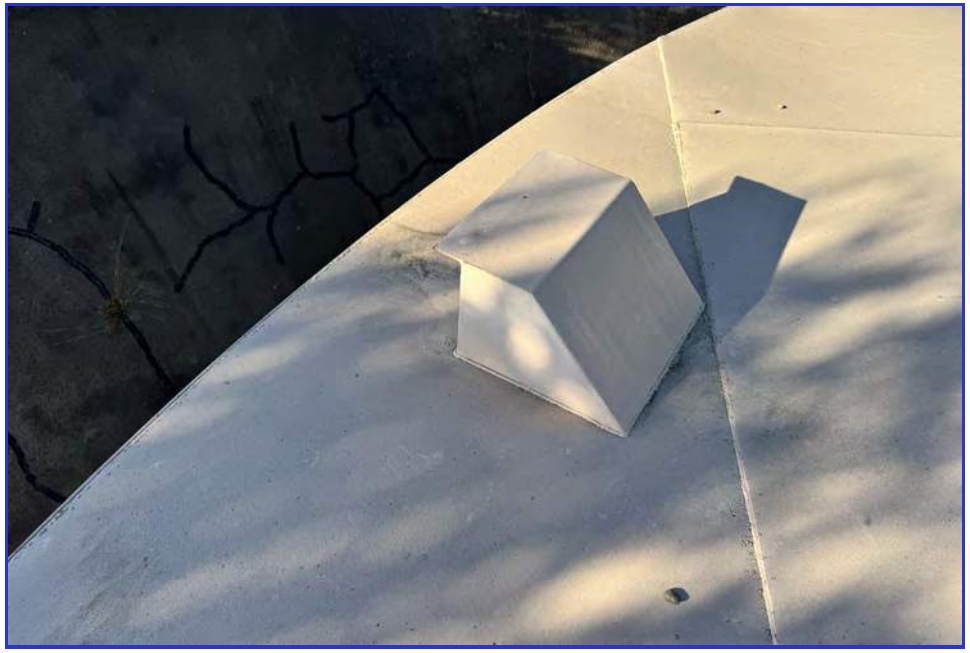
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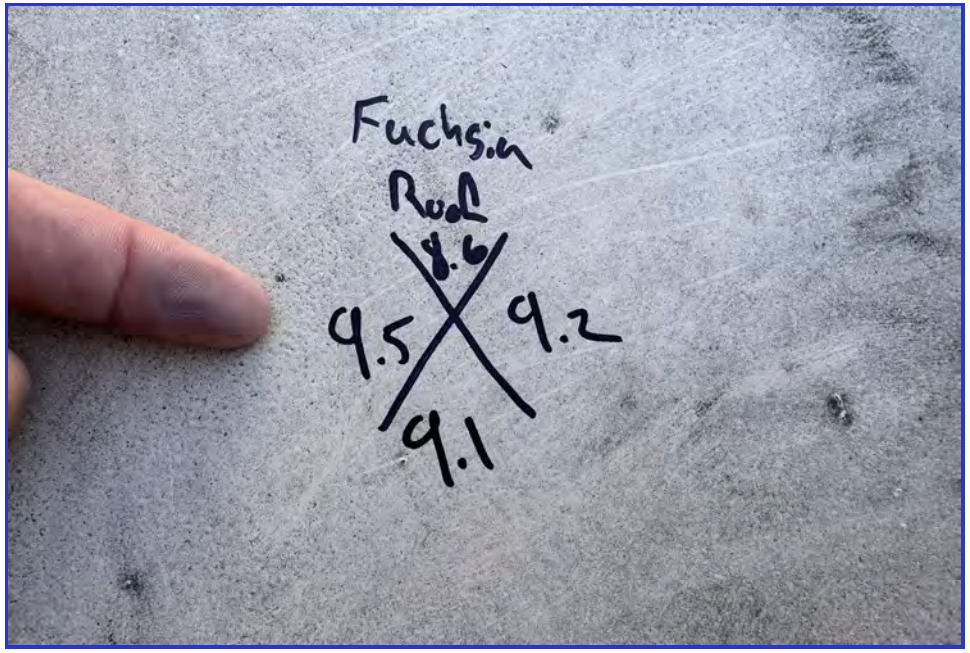
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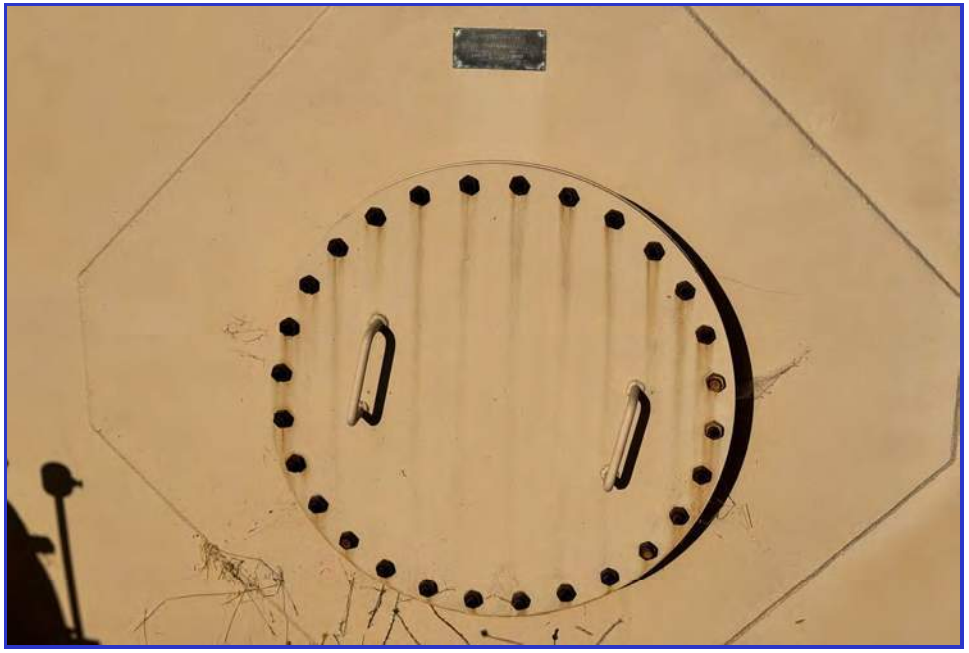
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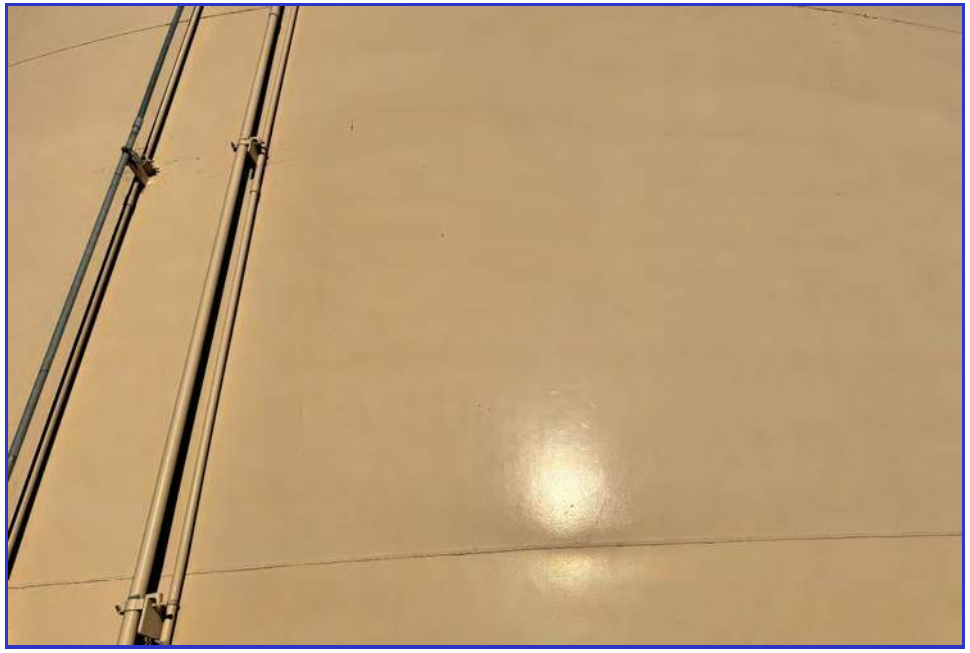
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -067



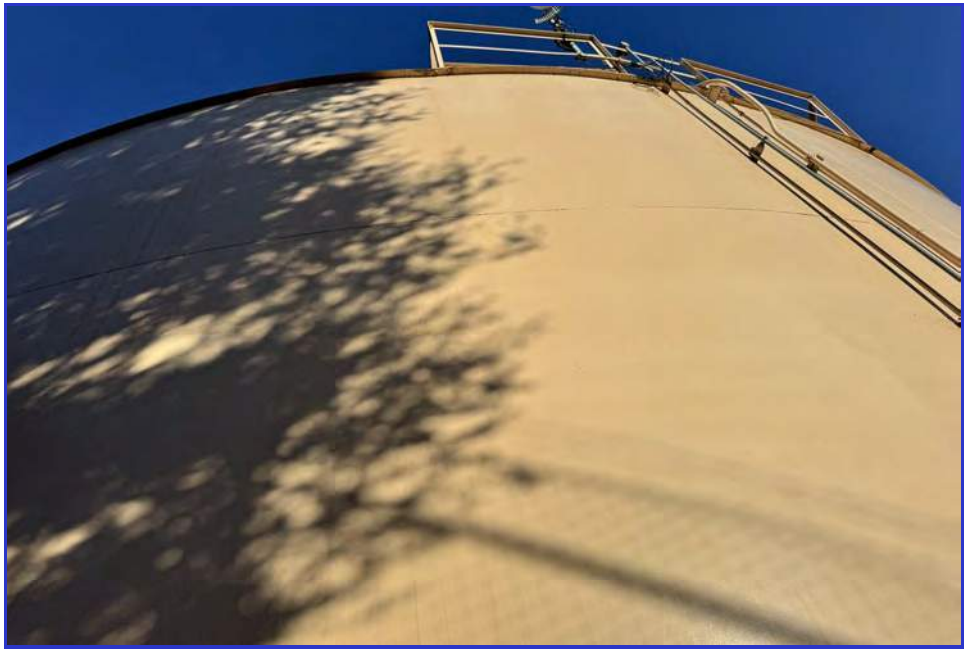
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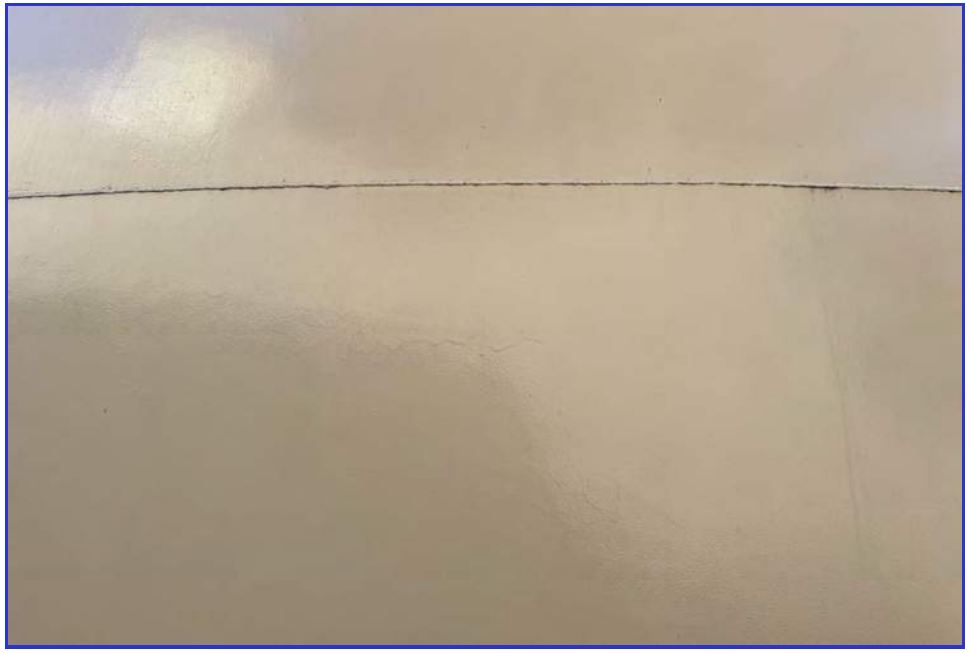
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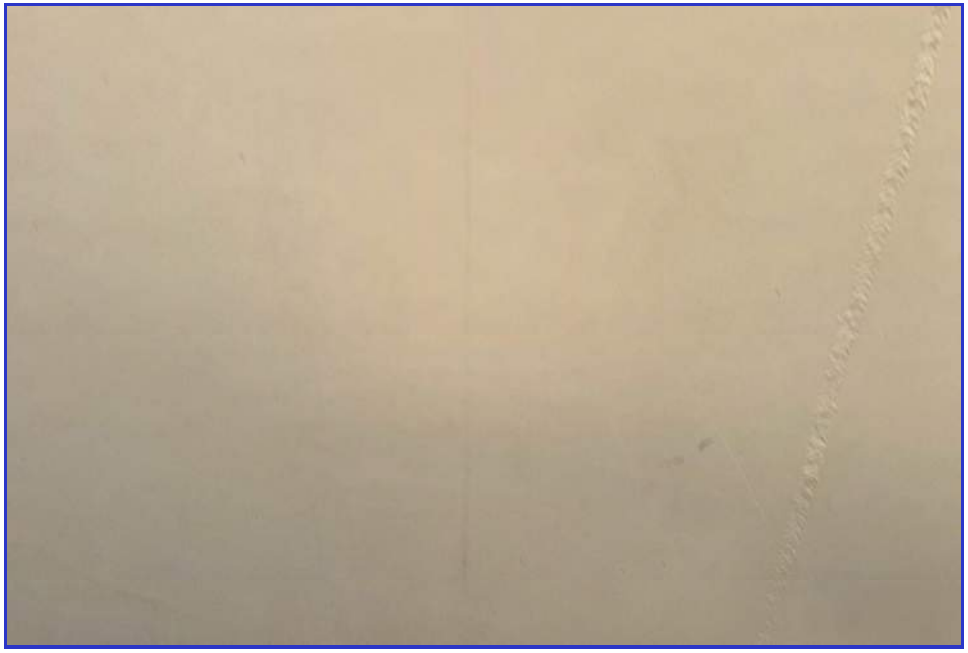
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -109



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -110



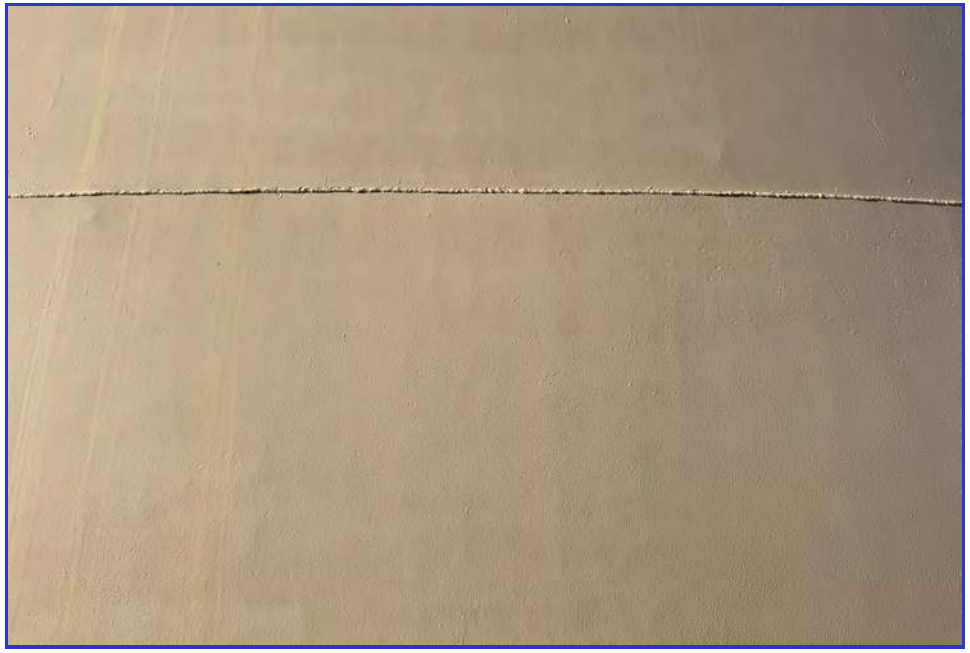
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -113



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -114



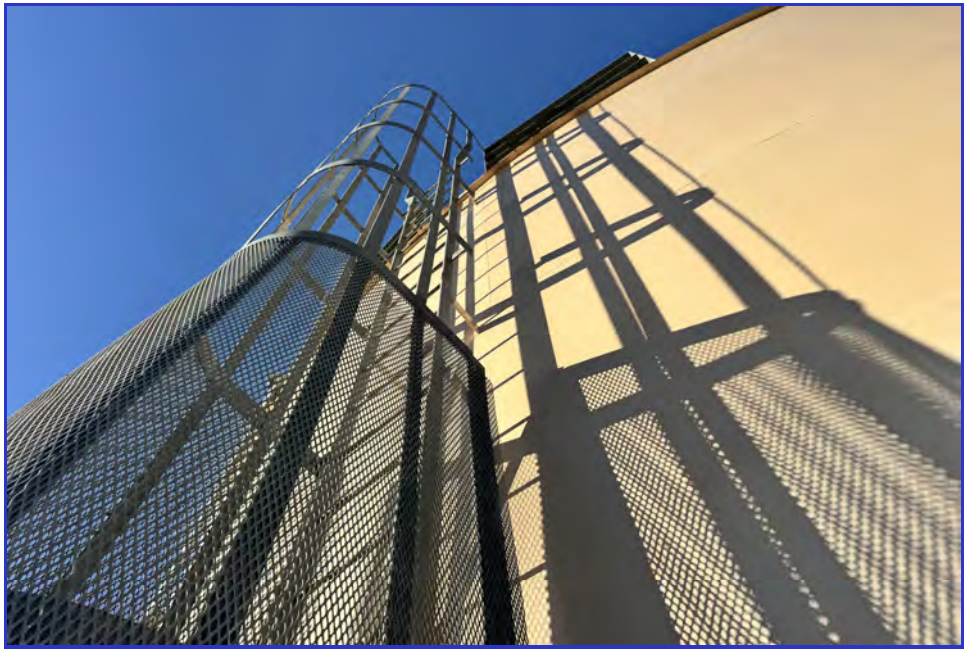
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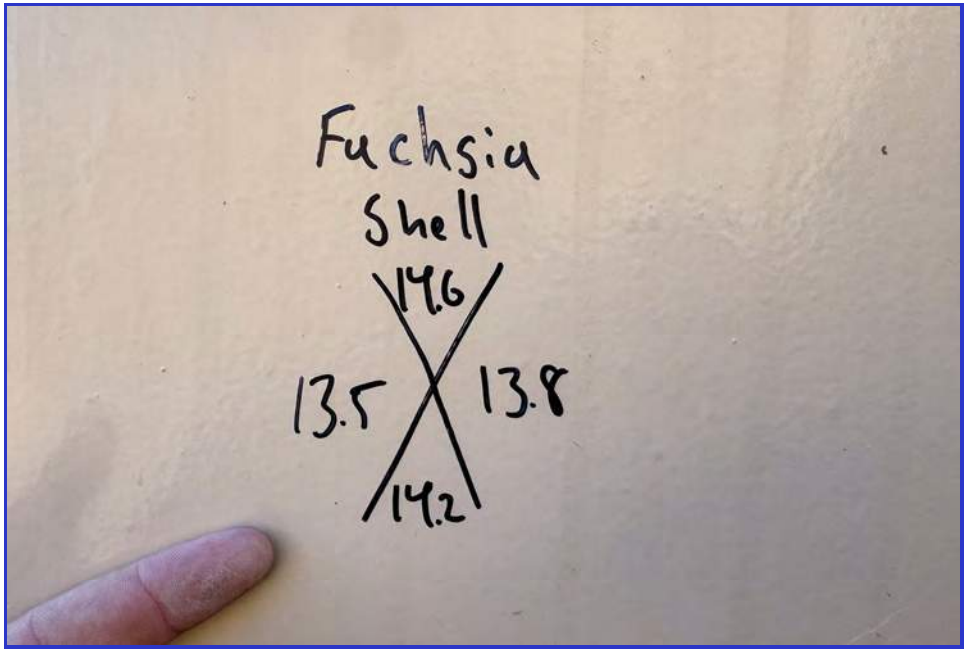
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EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -117



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -118



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -119



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -120



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -121



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -122



EXTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -123



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -001



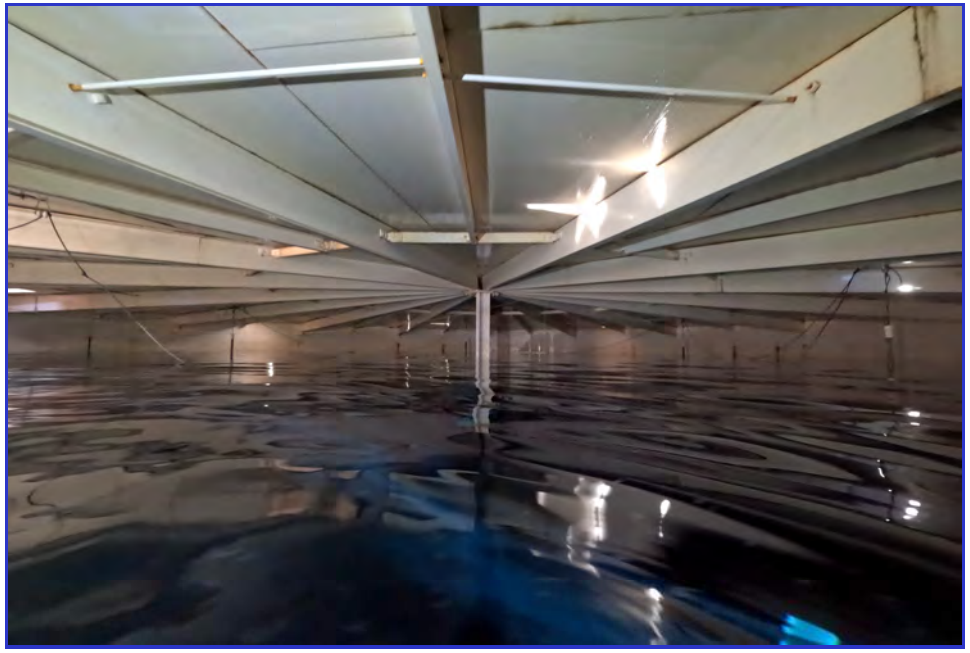
INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -002



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -003



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -004



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -005



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -006



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -007



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -008



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -009



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -010



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -011



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -012



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -013



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -014



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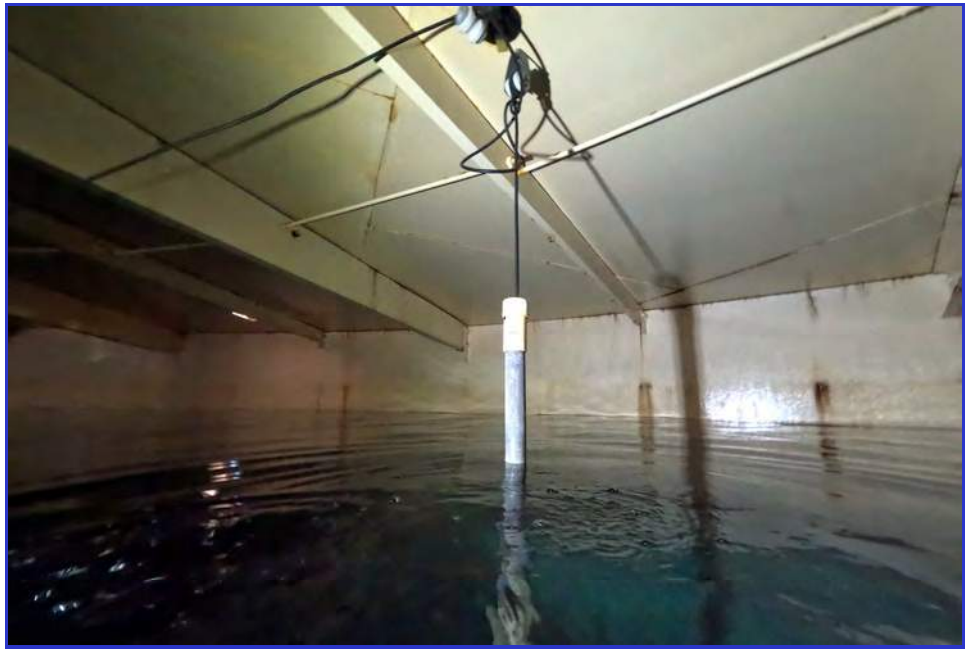
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INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -028



INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -029



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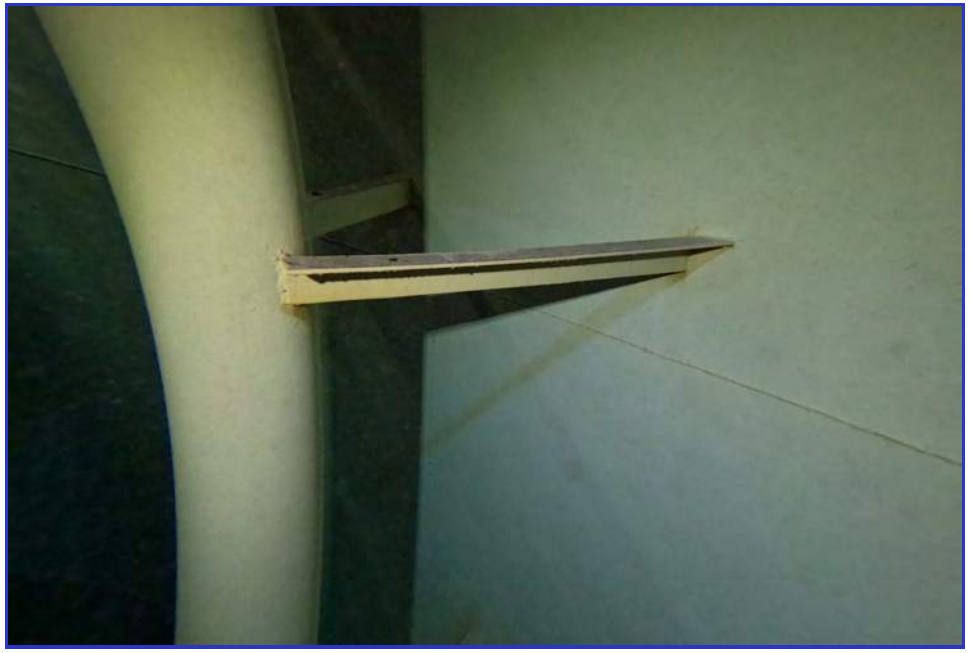
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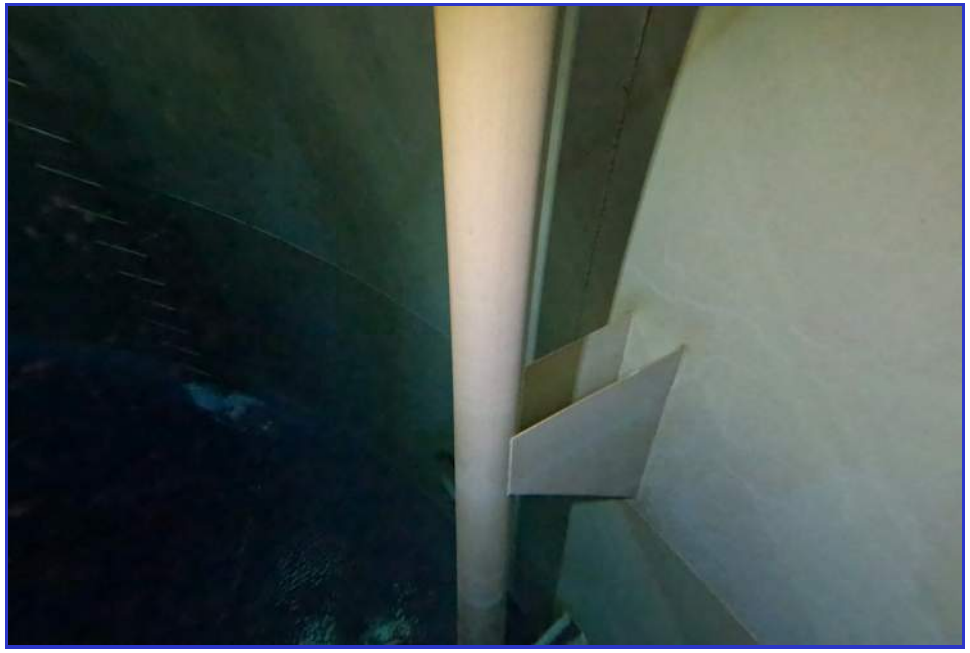
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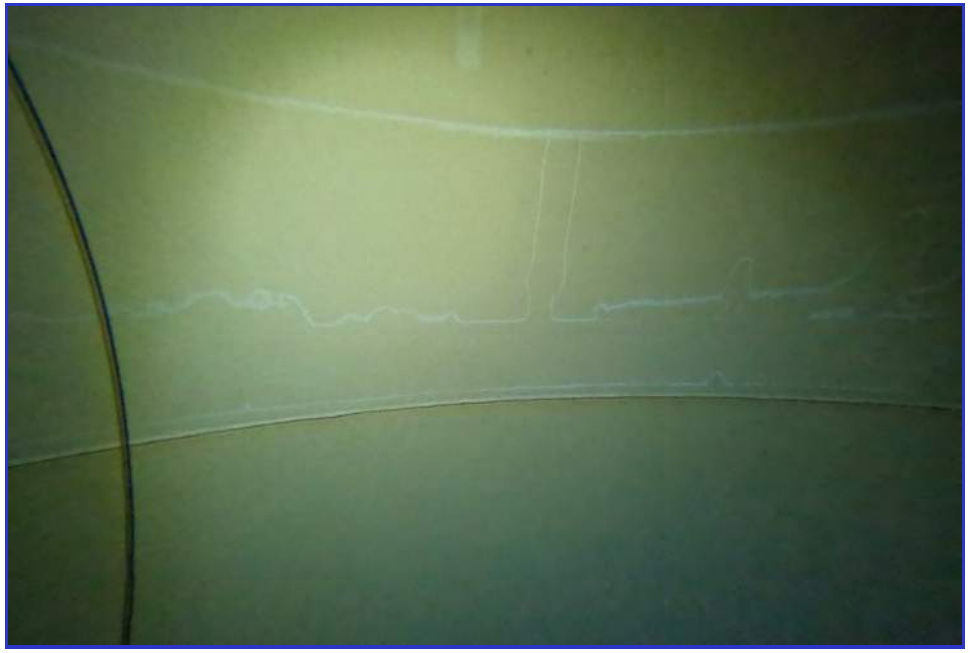
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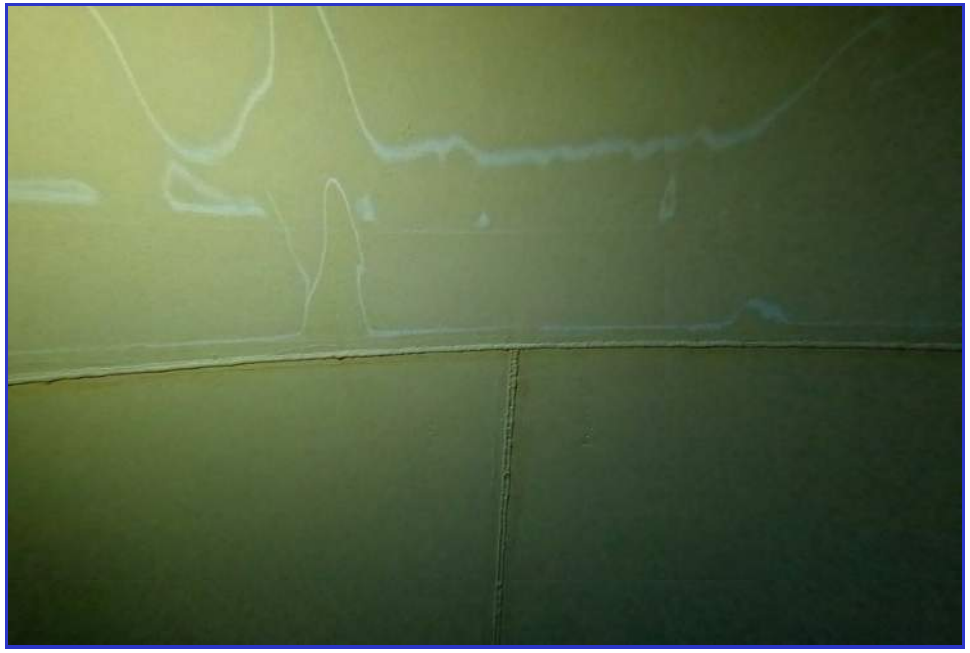
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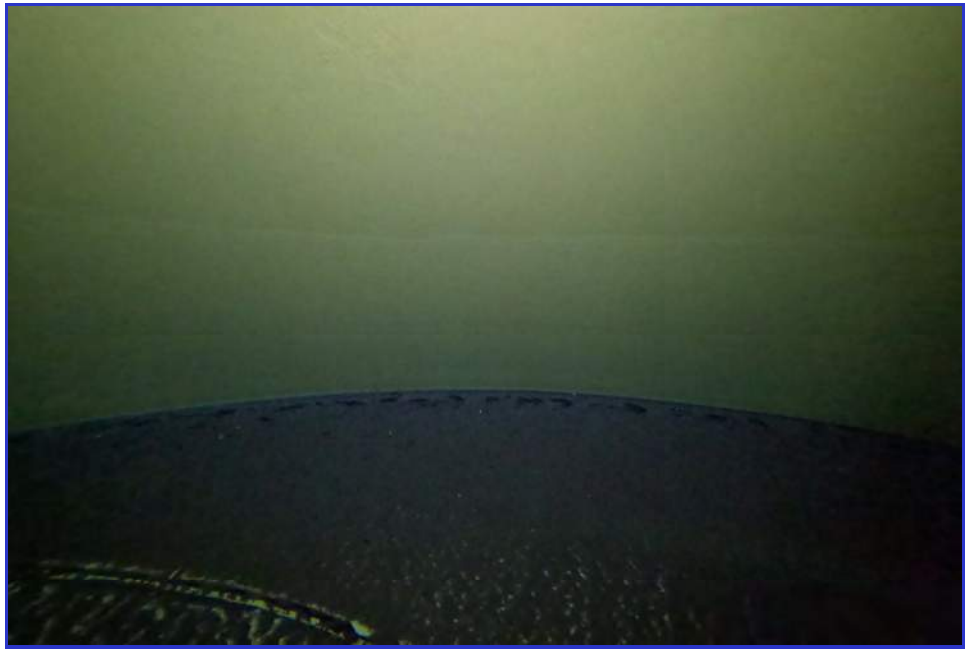
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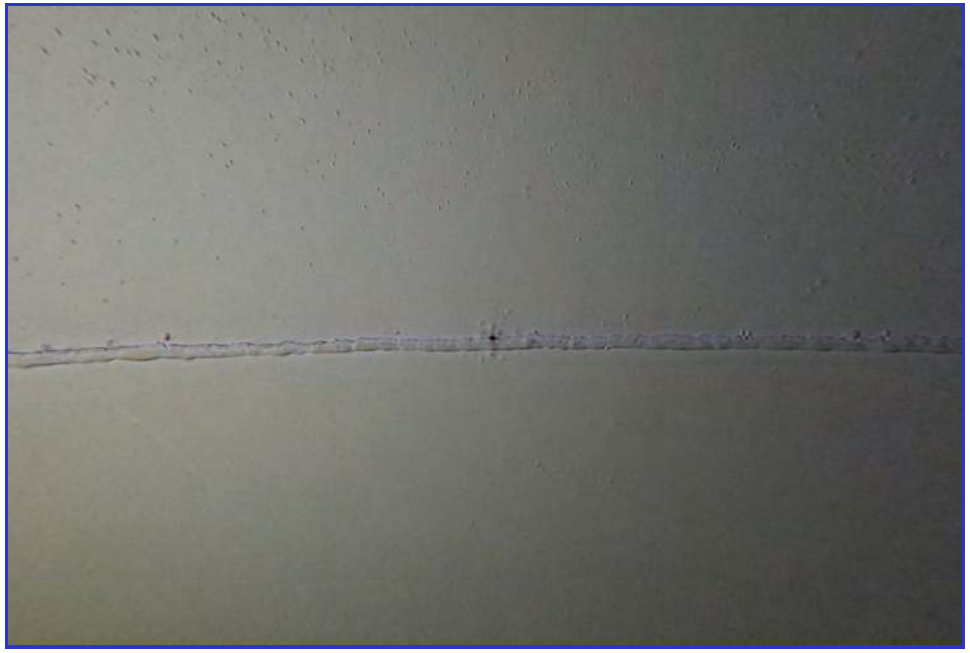
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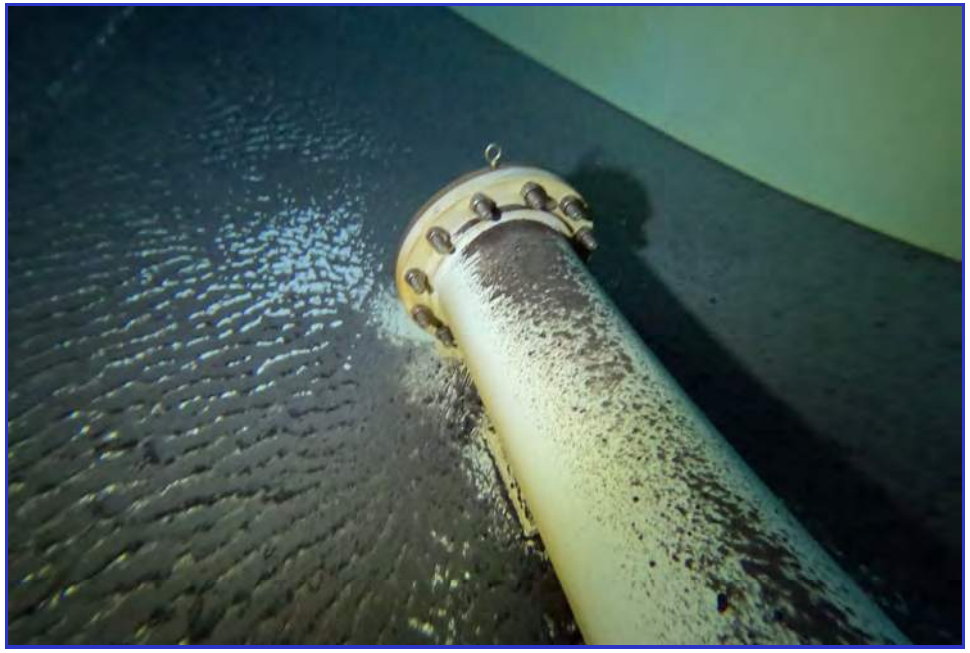
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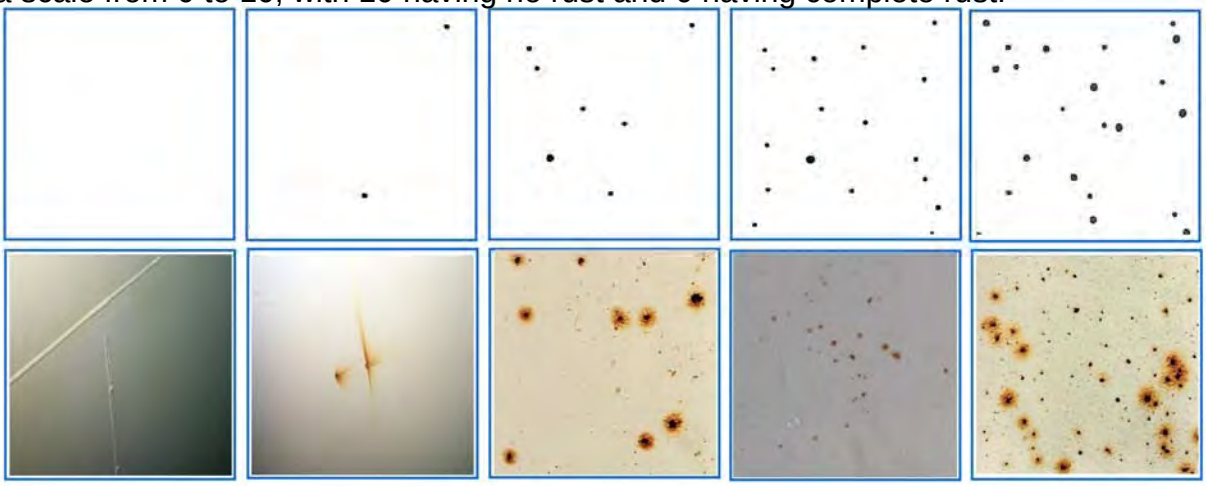
INTERIOR - City of Santa Paula - Fuchsia - Maintenance Inspection -091

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

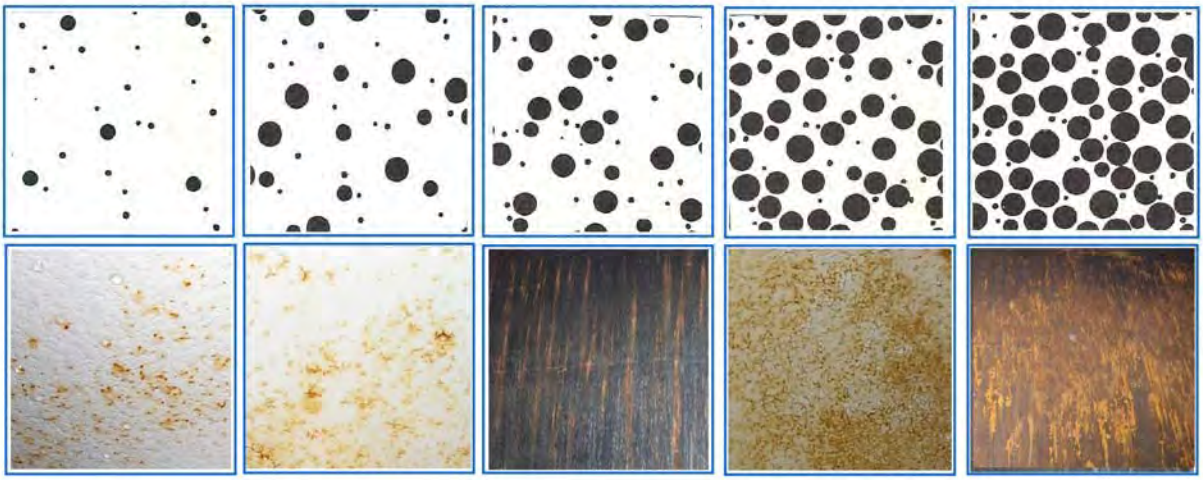
Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

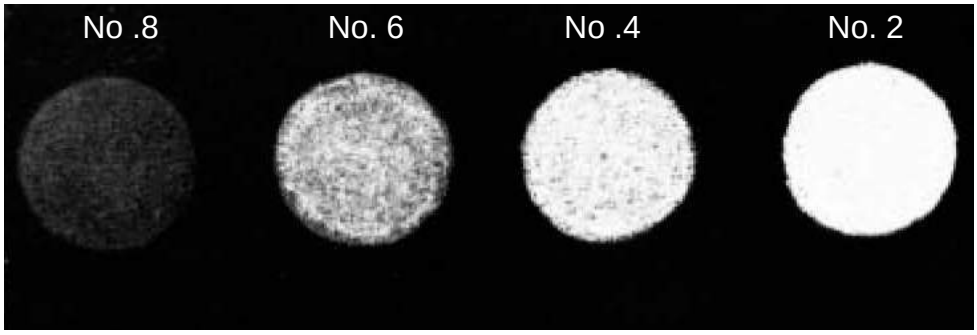
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

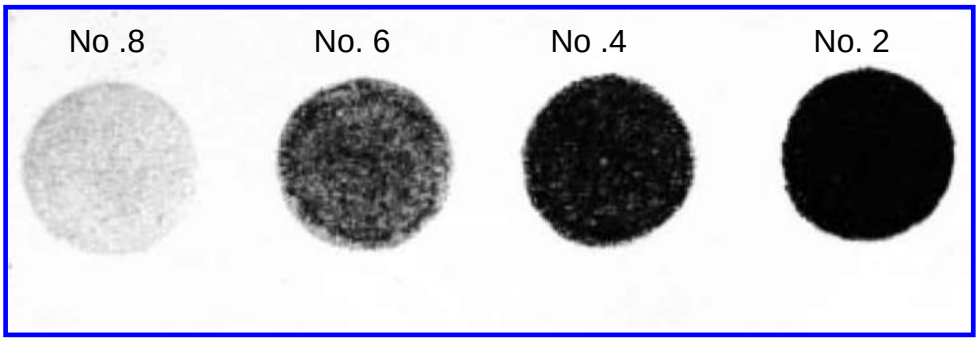
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

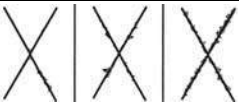
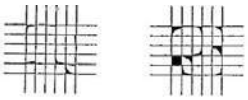
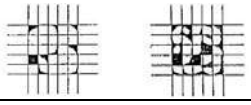
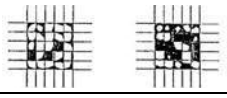


Dark Colored Paints



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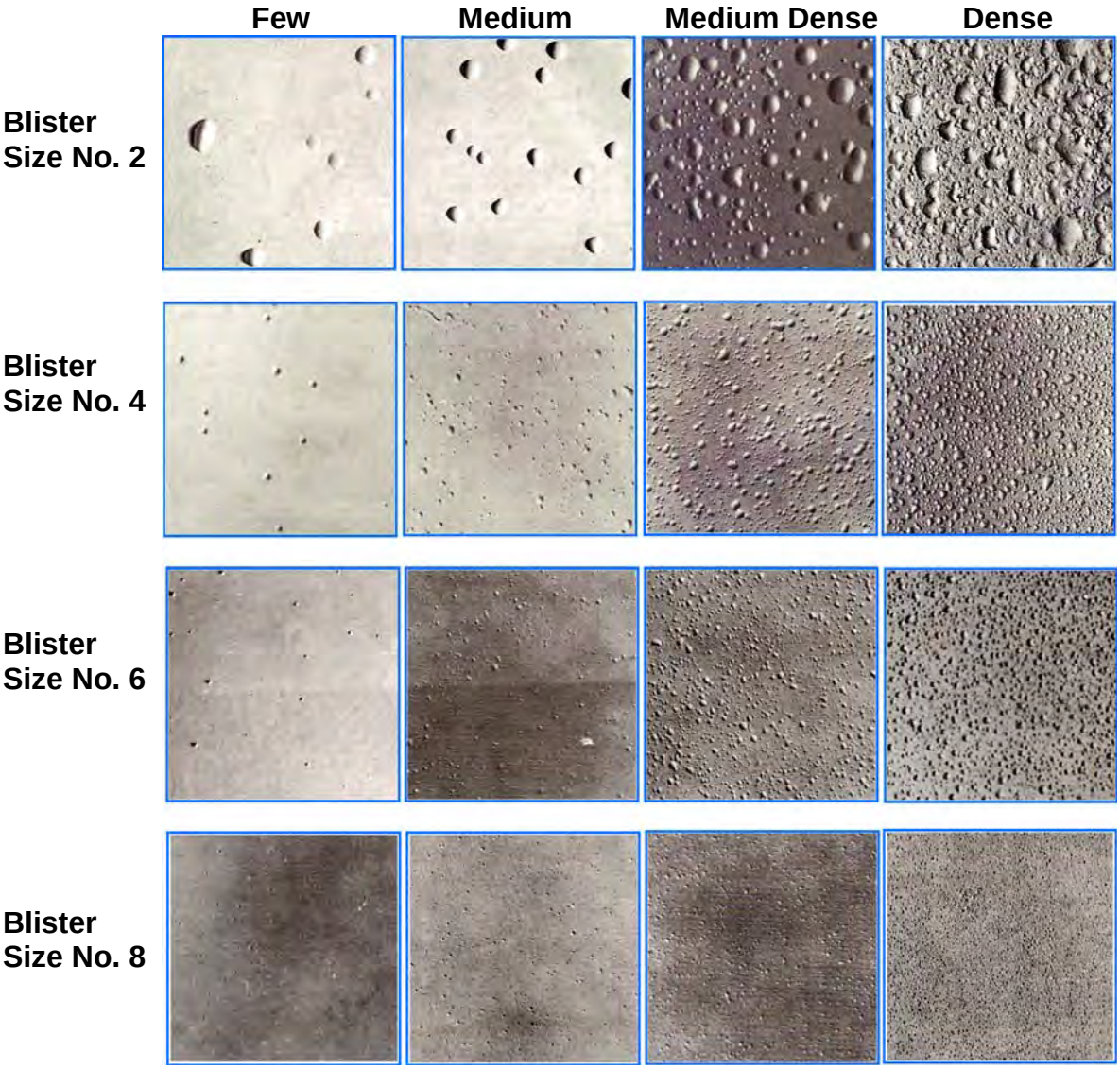
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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www.CSIServices.biz

Providing Quality Technical Services to the Coating Industry

October 21, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Limoneria Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Limoneria Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 21, 2025

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Attachments

- **Field Notes**
- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Limoneria Reservoir located near 13459-12899 Foothill Rd, Santa Paula, CA 93060. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 19, 2025 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 34 feet, but the diver was unable to physically enter the tank, however, the camera was lowered into the water and some information was obtained. Steve Metcalf was the site supervisor and the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The ~60 year old paint system on the tank is in overall poor condition with widespread and pervasive corrosion at the roof. The exterior paint system is severely weathered and has poor adhesion, making overcoating strategies risky. The existing paint system is believed to be the original system applied and potentially has high concentrations of heavy metals (e.g. lead, chromium, etc.) that will require special precautions to protect the workers and environment when it is disturbed. The paint system should be tested to identify the concentrations of heavy metals before any work takes place.

The original coal tar epoxy and coal tar enamel lining within the tank is in an overall unsatisfactory condition with widespread rust and blistering. The majority of the corrosion is within the MWL elevations of the tank shell and includes dark rust, pitting, exfoliation and the beginning stages of structural loss. The existing conditions dictate that the interior lining system should be removed and replaced within the next year to prevent further metal loss, necessitating the repair or replacement of steel elements when a relining is all that is required at this time.

Background

The Limoneria Reservoir is a Welded Steel on grade structure that was constructed in the 1950's. The tank is approximately 60 feet in diameter by 36 feet high providing a nominal capacity of 1,000,000 gallons and is located at near 13459-12899 Foothill Rd, Santa Paula, CA 93060. It is the only tank at this hillside site.

The tank shell has six courses that are connected to a conical roof with rafters, girders and one center column. The tank has one roof vent, one roof hatch, and two shell multibolt manways. There is NO interior ladder and one exterior ladder. The exterior ladder has fall protection and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band and is not seismically anchored. There is no internal or external cathodic protection (CP) system associated with this tank. The tank has a mechanical water level indicator.

It is believed that the interior linings are the original coatings applied. The interior steel surfaces, including the roof and roof support members are coated with a coal tar epoxy system while the tank shell, floor, and appurtenances are coated with a hot applied coal tar enamel. The exterior roof, shell, and appurtenances are painted with what appears to be the original Type IV, lead based, alkyd paint system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations, but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video is included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 "Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces" (Chart 2).

Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in poor condition with moderate chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than ten percent of the overall surface area and rated a 4 in accordance with ASTM D610. At the shell, the exterior paint system is in good condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. Chalking at the shell was heavy and rated a 6 (ASTM D4214, 6). The paint thicknesses were found to range from 3 to 5 mils on the roof and 3 to 4 mils on the shell. The paint system was estimated to exhibit poor adhesion (ASTM D6677, 3A).

Some of the specific data collected follows:

Exterior Paint			Overall Condition		Fair							
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Poor		Exterior		Good		Exterior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	4	4	4	4	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	6	6	6	6	6	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in poor condition with corrosion common to the edges of the support member flanges and roof plates. Spot peeling and cracking was observed throughout, leading to lamellar or exfoliation corrosion (CSI Corrosion Grades 2, 3, 4). The total amount of corrosion on the roof was rated to be approximately 1 percent of the total surface area (ASTM D610, 6), and there was a moderate amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure.

The shell surfaces are covered with a heavy sediment and the lining was found to be in poor condition with areas of dark rust, pitting and lamellar exfoliation (CSI Corrosion Grades 2, 3, 4), especially within the mean water level segment of the shell. The total amount of corrosion on the shell was rated to be less than 10 percent of the total surface (ASTM D610, 4) with rust nodules and pitting observed. Widespread groupings of intact, medium dense blisters were observed (ASTM 714, 4/Dense).

The floor had a large amount of sediment upon it, but spot checks revealed a hot applied enamel system that was estimated to be in good condition, (ASTM D610, 9) with localized large blisters (ASTM 714, 4/Dense).

The data collected from the inspection follows:

Interior Paint	Above Water Condition		Poor		Below Water Condition		Good					
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Poor		Interior		Poor		Interior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	6	6	6	6	6	6	6	6	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2,3,4	2,3,4	2,3,4	2,3,4	2,3	2,3	2,3	2,3				
Rust staining												
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling												
Delamination												
Cracking (ASTM D661)	2	2	2	2	2	2	2	2				
Blistering (ASTM 714) Size/Density					4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense	4/Dense
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/3QV1ETJaRjGvsaJD6

Discussion

The paint system on the exterior was found to be relatively thin, very weathered and in poor condition on the roof but in good condition on the shell. All surfaces of the roof have isolated spot rust and areas of peeling and the paint system was found to have significantly weathered from chalking. It was also noted that the underside of the vents have heavy corrosion up to and including some metal loss.

Peeling or delaminating coating is a symptom of an adhesion problem between the coating and substrate or from within layers of coating system. Adhesion is a function of a coating system's strength. Peeling is often a result of coated over contamination, incompatibility between coats, or from an undercoat being coated after its recoat window had closed. Catalyzed coatings, such as epoxies and urethanes continue to dry and then cure to a point to where they become too hard for topcoats to chemically adhere. Once the window for a chemical bond is closed, special procedures such as scarification are required to allow for a mechanical bond.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Cracking is the result of some form of stress within the coating system that extends through a complete layer of coating. The stress is often a result of some internal coating pressure or from some form of structural movement. The internal pressures can result from a shrinking film when it is applied too thick or if coating a coating does not have the elongation properties required to bridge existing breaks. Checking is related to cracking, but the coating breaks do not extend through the entire system.

Generally speaking, there are four possible approaches to maintenance coating work. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If a film is too thick or has poor adhesion, the tension from the curing stresses and/or the weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what maintenance coating approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals. The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that up to 10 percent of the surface area requiring repair is the point at which making spot repairs with overcoat becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is satisfactory. Once the amount of surface area exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, it is recommended that the tank exterior roof paint system be removed and replaced within the next 1 to 2 years before any additional significant metal loss develops. The existing paint system at the shell appears to NOT be a suitable candidate for overcoating strategies, therefore, a full removal and replacement of the paint system is in order.

At interior surfaces, the tank lining system was found to have widespread dark corrosion above the highest water level (HWL) with lamellar and/or exfoliation corrosion common to the areas of the shell within the MWL. Some rafter flanges exhibit some minor section loss due to corrosion. A significant amount of corrosion was found below HWL with pitting and medium dense patches of broken and unbroken blisters.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel, the process initiates itself as light-colored orange surface rust. As the corrosion process continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

Exfoliation corrosion is a form of intergranular corrosion which involves selective attack of a metal at or adjacent to grain boundaries. In this process, corrosion products force metal to move away from the body of the material, giving rise to a layered, laminar appearance. Exfoliation corrosion is also known as layer corrosion or lamellar corrosion.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simple a result some areas not being completely sealed by coatings.

Since all of the blisters were underwater and below the common water level, it is presumed that the blisters are a result of osmotic forces. Osmotic blistering is typically caused when coatings that are to be placed into immersion service are applied too thick, overcoated too soon, under colder weather conditions, and/or over contaminated surfaces. One form of osmotic blistering is solvent entrapment. Solvents are added to coatings to act as a vehicle during application. When coatings are applied too thick the coating solvents that were designed to be released during application are locked in-place when the catalyzed coating reaches a full chemical cure. Additionally, if coatings are applied under cold or cooler conditions, the solvents have a difficult time escaping from the film before it gets hard. Blisters that result from solvent entrapment tend to be localized to the coolest and lowest areas of a tank. Solvent vapors are typically heavier than air, and the lowest portion of a tank tends to become saturated with these gases without proper ventilation at the time of application. Coated over contamination creates a source for osmotic forces. This contamination attracts fluid that creates pressures that exceed the film's ability to bond, creating blisters.

Isolated corrosion pits can develop within a coating system that may have only a few small breaks that were not corrected through periodic maintenance repairs. If the remaining, adjacent coating has excellent adhesion, it will inhibit undercutting corrosion.

As a result, the corrosion forces will have a tendency to concentrate on the exposed bare metal, which results in pitting. Pitting can be critical in some instances. The maximum corrosion rate for steel in fresh water is typically no more than 30 mils per year (MPY). As a result, the pitting can develop into a perforation if not repaired. If a thru-hole develops within a tank bottom, the isolated issue can develop into a much larger corrosion problem. Corrosion requires oxygen to advance, and the underside of the tank bottoms are considered a dead-air space. As a result, the bottom of tank floors are typically not coated. A perforation or thru-hole with even a small trickle of water will reintroduce oxygen into the environment creating active corrosion that is difficult to identify until the steel floor plate requires replacement.

Industrial paint systems such as those applied to industrial facilities (i.e. piping, structural steel, storage tanks) typically have a life expectancy of 25 to 35 years before any spot maintenance coating repairs are required. The original coal tar epoxy and hot applied enamel system within the tank cannot be spot repaired and the characteristics of the coating defects indicates that the lining failed many years ago. It is recommended that the lining be removed and replaced within the next 1 to 2 years.

The tank ventilation was found to have screening installed with gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior

Within the next one to two years, remove and replace the exterior paint system.

1) This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 6, "Commercial Blast Cleaning" (SSPC SP-6) followed by 4-6 mils of an industrial epoxy primer and 3-5 mils of a polyurethane finish coat.

2) Test the paint system for heavy metals to determine if any special actions are required to protect workers and the environment during paint disturbance.

Interior

As soon as possible, remove and replace the interior lining. This work should include the following:

3) Remove and replace the lining system at all interior surfaces. This work should include cleaning all surfaces in accordance with SSPC's Surface Preparation Standard No. 10 "Near-White Metal Blast Cleaning" (SSPC-SP10) followed by three 4 to 6 mil coats of an NSF Certified epoxy lining.

4) Caulk all crevices in the tank such as roof lap seams.

5) Anticipate the need for structural repairs (welding, grinding, etc.)

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

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Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/19/25		Tuesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Limoneria	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	Foothill Rd
Tank Location	Santa Paula CA
GPS Coordinates	34.33722, -119.13180
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	I Beam	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate	
Connections	Bolted	
Overflow Design	Stubs	
Inlet Interior Design	Stub	
Lining Type/Original	Epoxy	Yes

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	No	N/A		
CP System/Type	No	N/A		
Water Depth	34			
Water Agitator	No			
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	1,000,000	
Diameter (feet)	60	
Height (feet)	36	
Erection Year	Unknown - Suspect 1950's	
Contract No.	Unknown	
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Six	
Height of Each Course	6	
Roof Design	Pitched Roof	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Bolted Circles	
Diameter of Manways	20 in	
No. Roof Hatches/Location	Two	Near Edge
Hatch Design	Vent	
Size of Roof Hatch	17 in	
No. Roof Vents/Location	One	Hatch
Roof Vent Design	Hatch	
Construction Co.	Unknown	

Item	Data	
Center Roof Vent Size	N/A	
Roof Vent Sealed	Yes	N/A
Roof Rail System	Yes	N/A
Roof Rail Satisfactory	Yes	N/A
Rail Location	Top of Ladder	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Shell Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	No	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	Screen Air Gap	
Drain Location	Shell	
Tank Foundation	Gravel	
Water Level Indicator	YEs	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.
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EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection



EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection -002



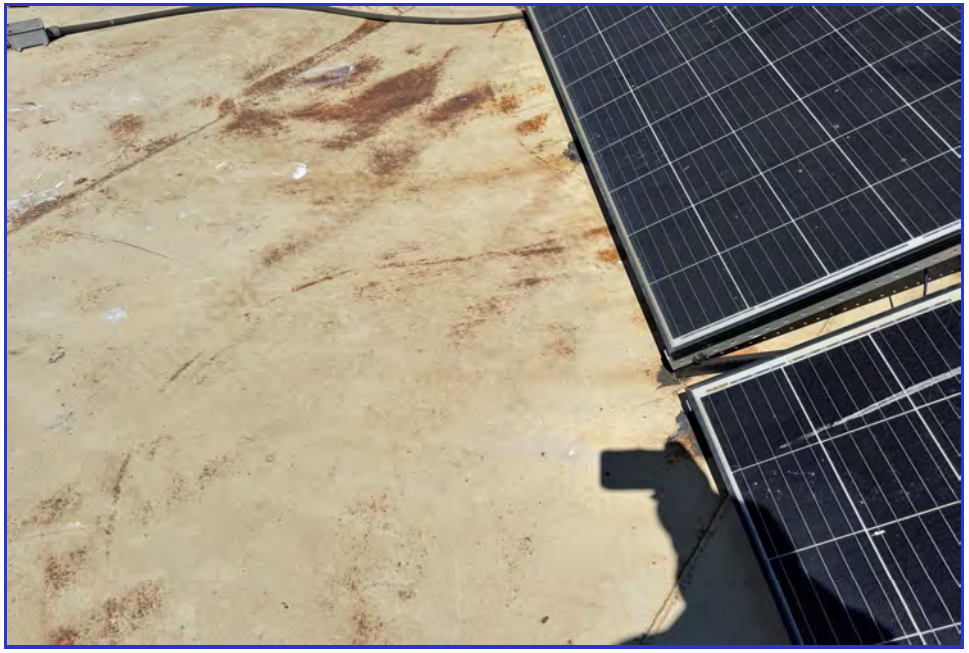
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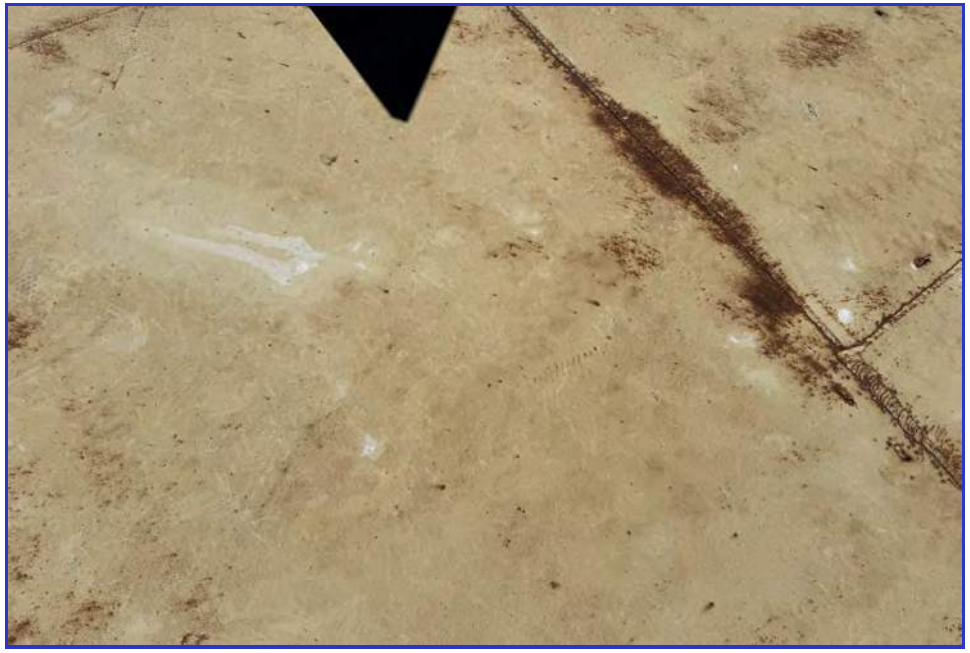
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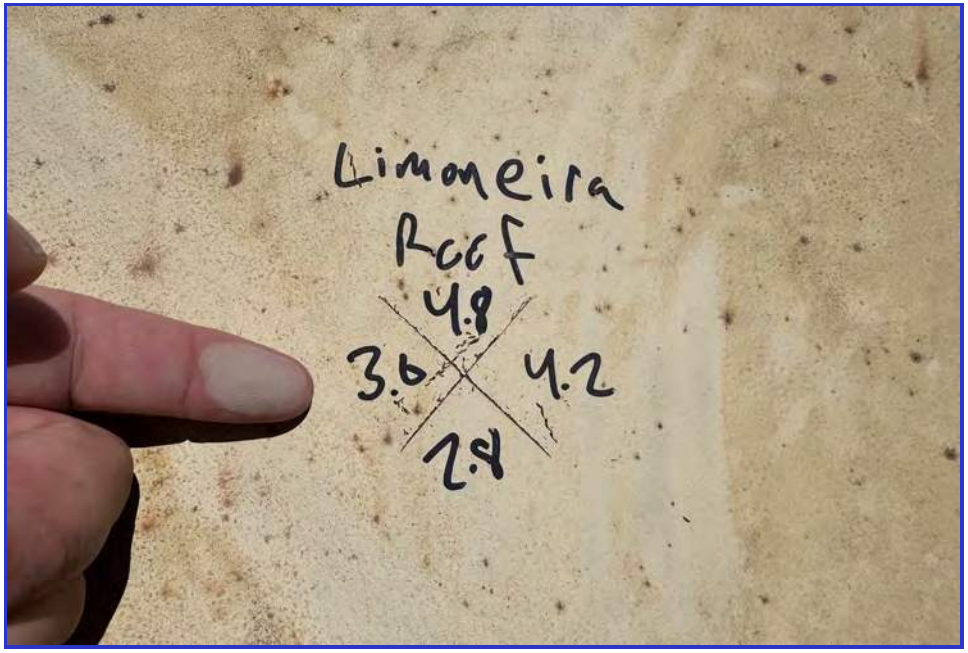
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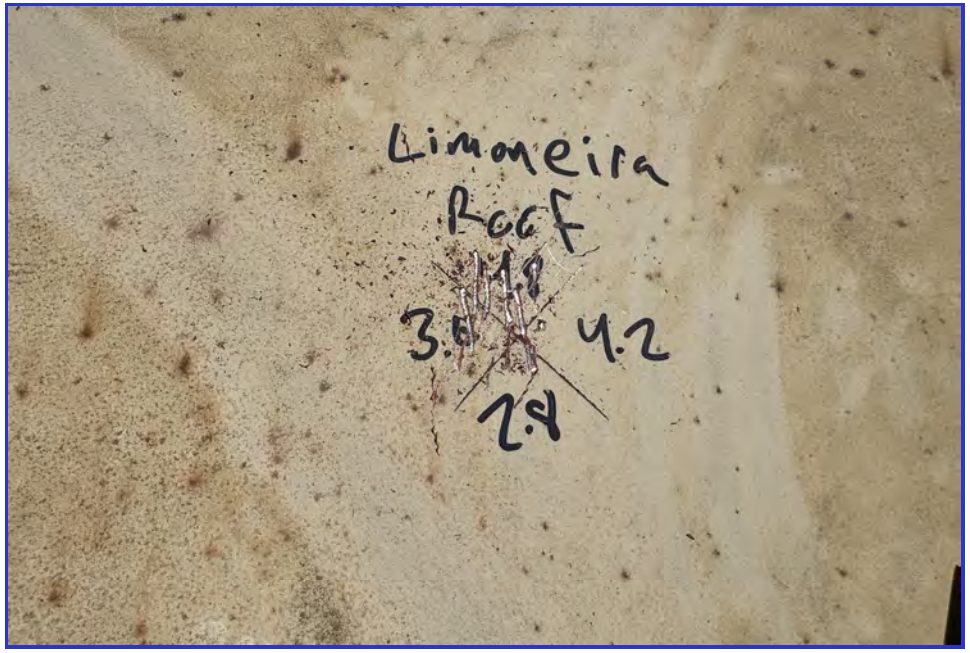
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EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection -046



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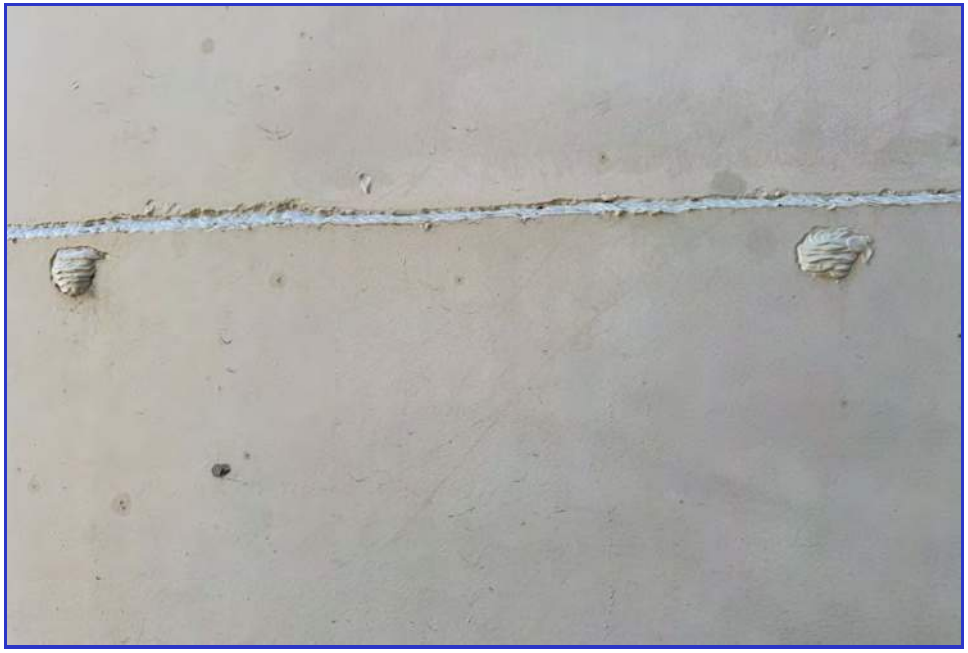
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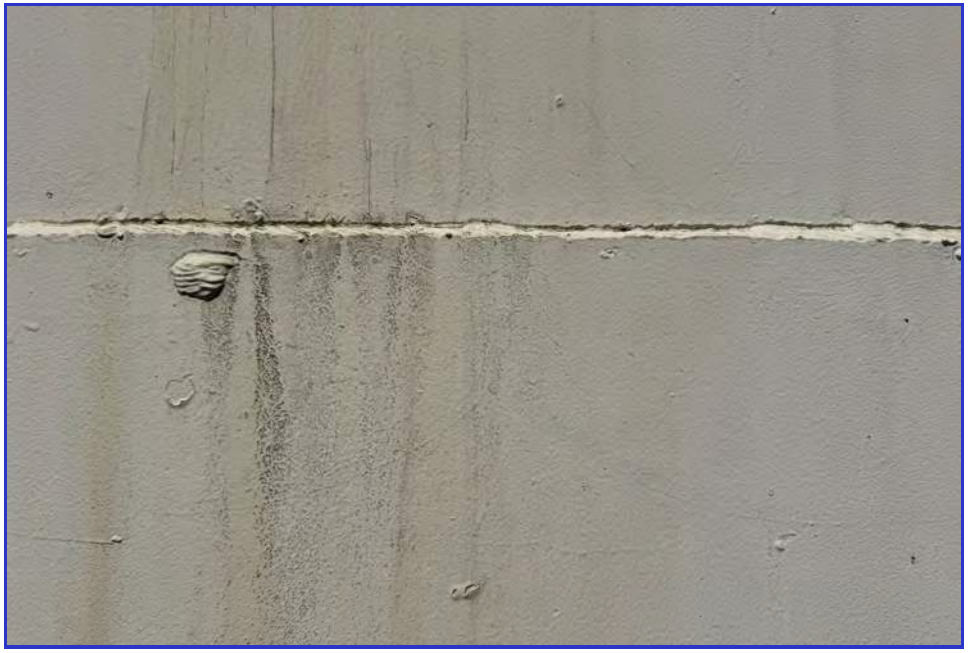
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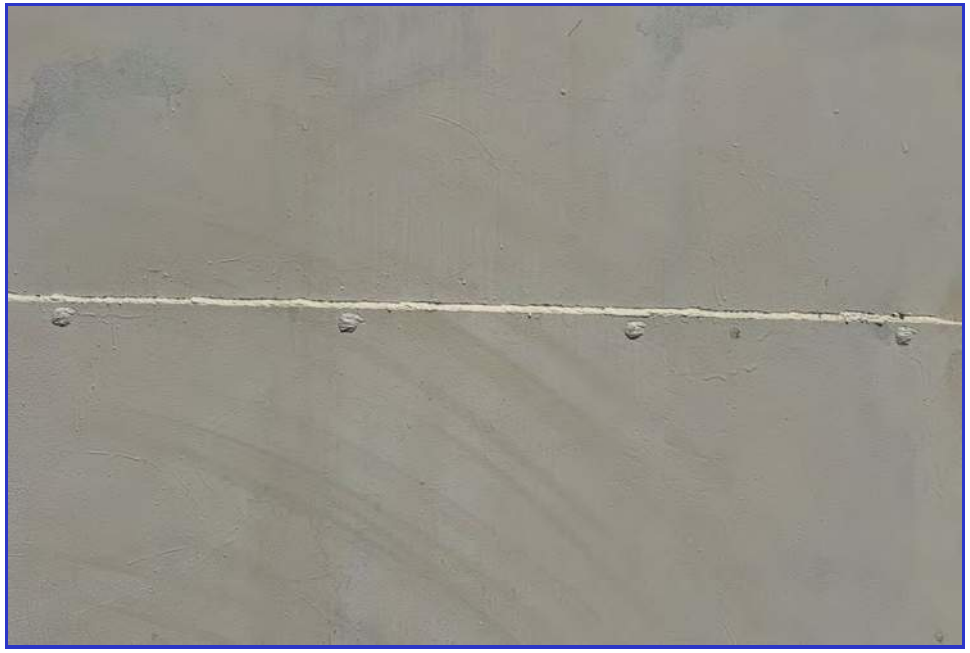
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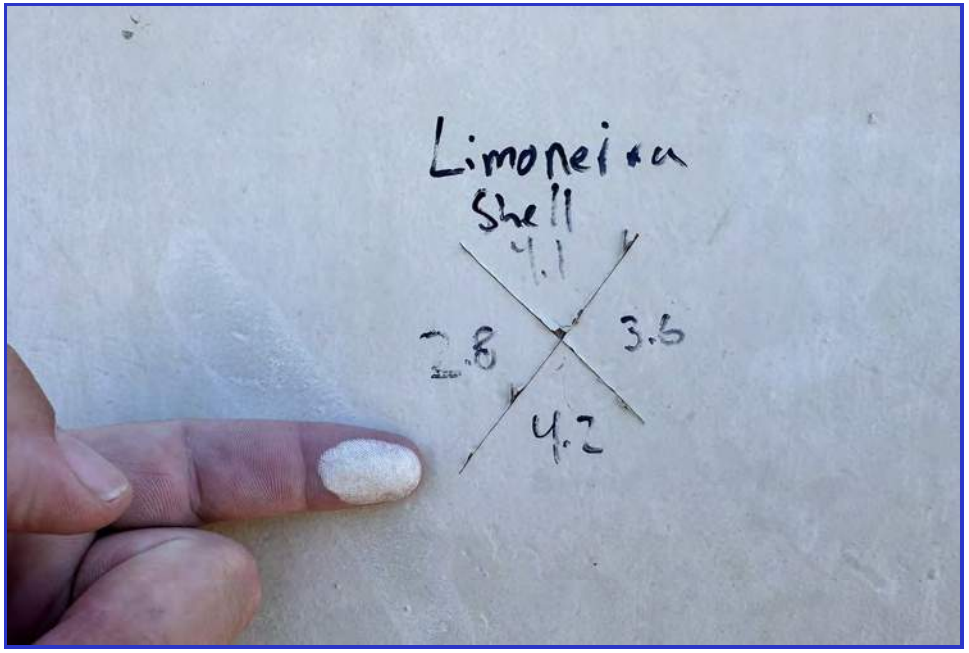
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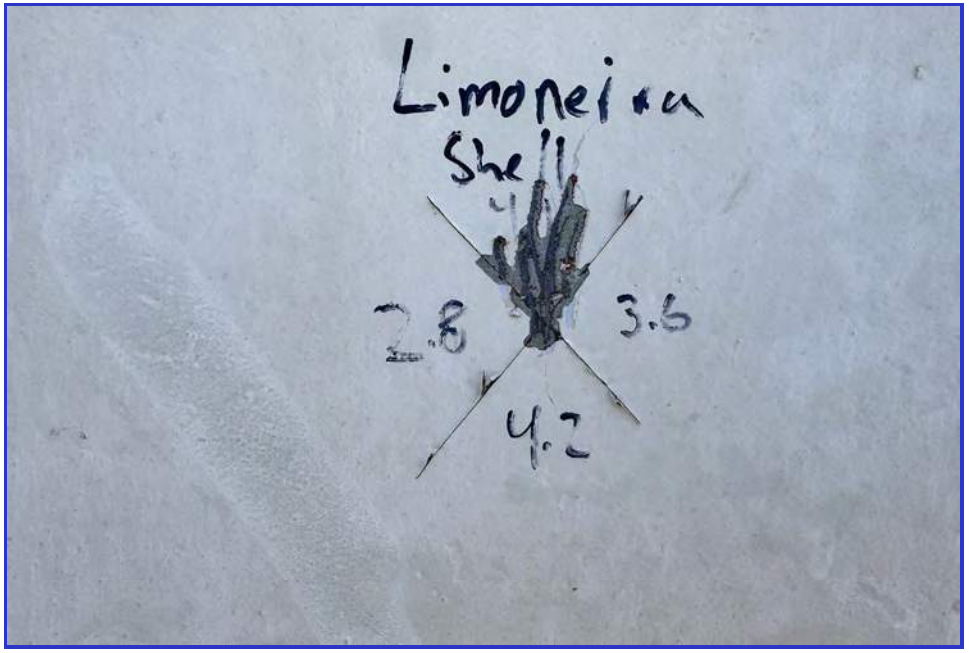
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EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection -106



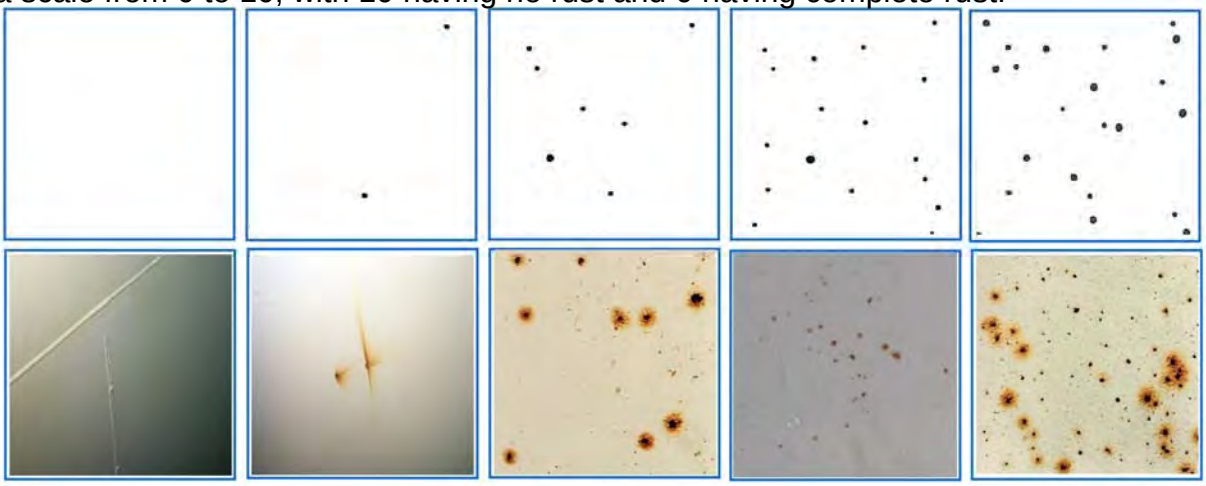
EXTERIOR - City of Santa Paula - Limoneria - Maintenance Inspection -107

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

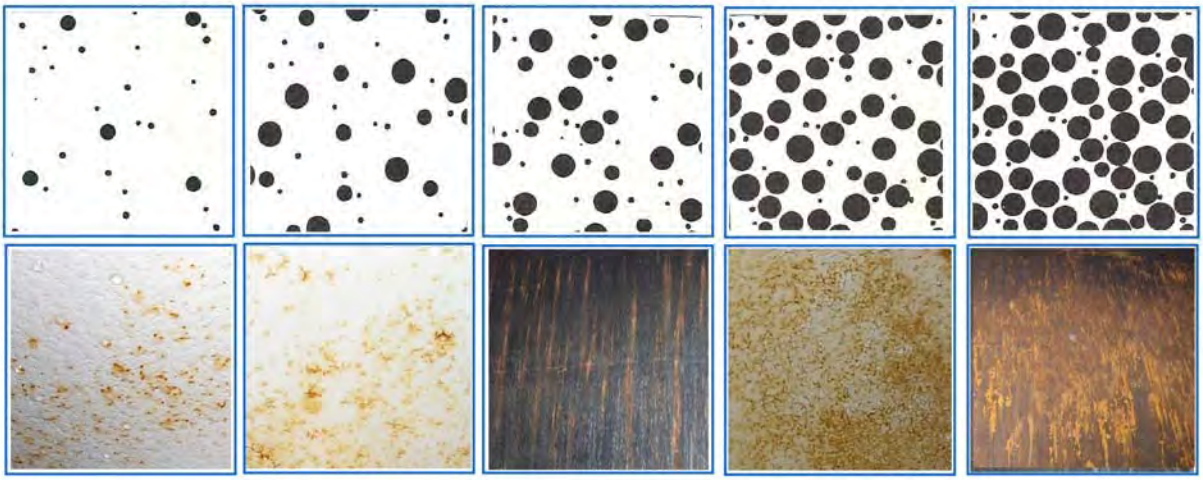
Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

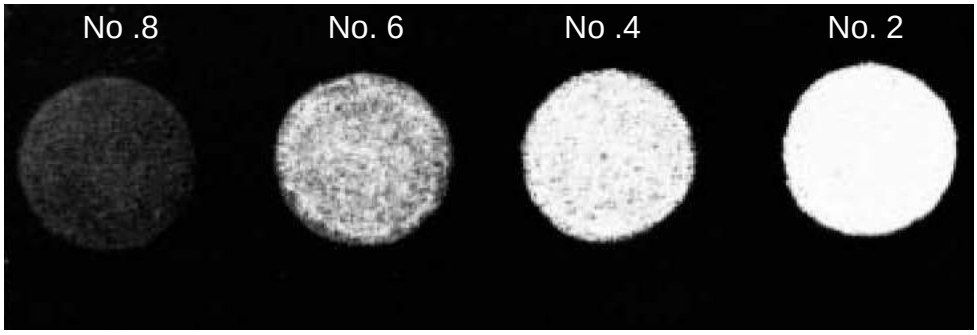
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

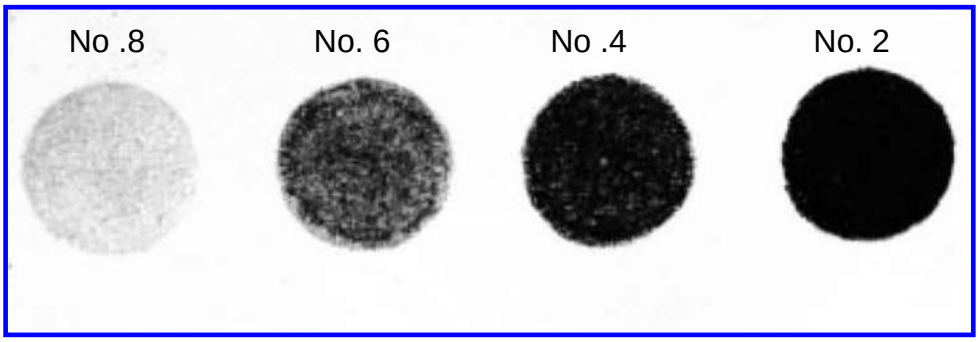
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

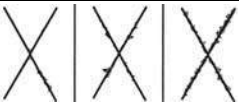
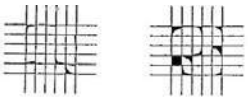
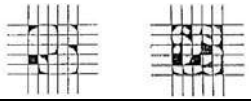
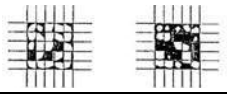


Dark Colored Paints



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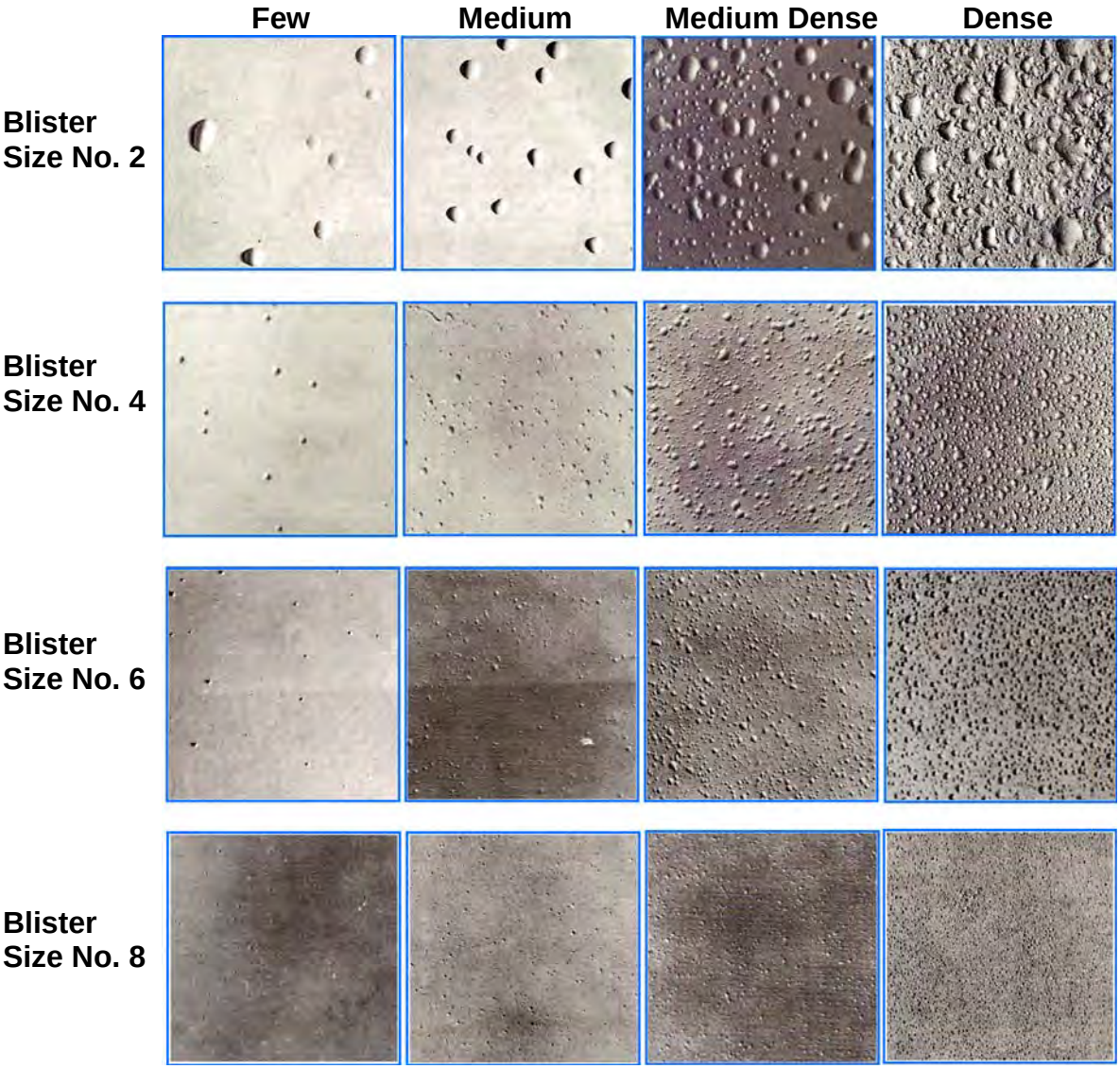
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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Providing Quality Technical Services to the Coating Industry

October 31, 2025 ***Via Email:*** lgarcia@mknassociates.us

Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Office: 805.266.8152

Subject: **Final Report - Maintenance Inspection**

Re: **Peck Reservoir, City of Santa Paula**

Dear Luis:

Please find attached the final report for the evaluation that was completed on the above referenced tank. Also attached is our invoice.

Thank you for your business and please let me know if you have any questions or comments about our findings. I can always be reached by cell at 951.609.6991 or by e-mail at rgordon@csiservices.biz.

Sincerely,
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

P. O. Box 801357, Santa Clarita, CA 91380 877.274.2422

Final Report
Maintenance Inspection
Peck Reservoir
City of Santa Paula



Prepared for:
Luis Garcia
MKN Associates
121 N. Fir Street, Unit G
Ventura, CA 93001

Prepared by:
CSI Services, Inc.

N. Randy Gordon, PCS
Technical Services Manager

PROTECTIVE COATING SPECIALIST
N. RANDY GORDON
No. 2018-621-011
Exp. 12-31-26
PCS
STATE OF CALIFORNIA

October 31, 2025

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Attachments

- **Field Notes**
- **Exterior Photos**
- **Interior Photos**
- **CSI Chart 1 – General Description of Conditions**
- **CSI Chart 2 – Rust Grade Criteria**
- **CSI Chart 3 – Corrosion Grade Criteria**
- **CSI Chart 4 – Coating Chalking Criteria**
- **CSI Chart 5 – Coating Adhesion Criteria**
- **CSI Chart 6 – Coating Blistering Criteria**

Introduction

MKN Associates authorized CSI Services, Inc. (CSI) to conduct a maintenance inspection on the City of Santa Paula's Peck Reservoir located near 601-699 N Peck Rd, Santa Paula, CA 93060. This report documents the findings of the inspection and services performed.

Any recommendations have been made in accordance with the applicable requirements of American Water Works Association's Standard (AWWA) D102 "Coating Steel Water Storage Tanks," AWWA Standard M42 "Steel Water Storage Tanks," and CSI's experience with evaluating over a thousand water storage facilities. A photo summary and narrated video are also included to document the condition of the tank.

The field-work was completed on August 19, 2025 by a team primarily comprised of Josh Severa, Steven Metcalf and Steven Metcalf Jr. The exterior shell observations were made mostly from grade level, while the exterior of the roof was examined close-up. The interior inspection was carried out with the tank's water level at approximately 16 feet using special underwater diving equipment and techniques. Steve Metcalf was the site supervisor and the lead diver. Mr. Randy Gordon, Technical Services Manager, reviewed the results of the field data and prepared recommendations for maintenance work. Mr. Gordon has over 35 years of experience through the evaluation of thousands of storage tanks and other industrial structures. He is certified as an SSPC Protective Coating Specialist (PCS) and NACE/SSPC Level 3 Coating Inspector.

Summary

The paint system on the exterior was found to be relatively thin and in good condition overall. The exterior surfaces have only isolated spot rust and the paint was found to have weathered from chalking, however, the overall film thickness of the paint system and its general satisfactory adhesion makes it an ideal candidate for future overcoating strategies. Currently, it is recommended that the existing paint system be spot repaired at the next maintenance interval to prevent further degradation of the system and suspend any active corrosion.

The interior lining is in good overall condition with no wholesale defects. The sacrificial anode CP system is preventing more advanced forms of corrosion from developing below the HWL. At this juncture, it is recommended that the tank be placed back on a 3 to 5 year maintenance inspection schedule as recommended by AWWA and continue to make patch repairs to the lining which will extend the overall lifespan if the system.

Background

The Peck Reservoir is a welded steel on grade structure that was constructed in 1954. The tank is approximately 60 feet in diameter by 24 feet high providing a nominal capacity of 500,000 gallons and is located near 601-699 N Peck Rd, Santa Paula, CA 93060. It is the only tank at this hillside site.

The tank shell has three courses that are connected to a conical roof with rafters and one center column. The tank has one center vent, one roof hatch, and two monobolt shell manways. There is an interior ladder and one exterior ladder. The exterior ladder has fall a protection device and a vandal deterrent screen. The tank rests on an oilsand foundation with a gravel grade band and is not seismically anchored. There is an internal sacrificial anode cathodic protection (CP) system associated with this tank. The tank has a water level sensor but no mechanical water level indicator.

It is believed that the interior lining is a 2nd generation system. The interior steel surfaces, including the roof and roof support members, are coated with a multicoat thin-film epoxy. The exterior roof, shell, and appurtenances are painted with what appears to be a polyurethane system. The internal roof lap seams are not caulked.

Field Evaluation

The purpose of this survey was to assess the condition of the existing coatings and recommend maintenance coating work, where needed. The evaluation mainly involved visual observations but also involved various testing procedures. Photographs and video were taken to document the field inspections, and a photo summary and narrated video are included within this report.

For survey purposes, the tank has been segmented into defined areas: exterior roof, exterior shell, interior roof, interior shell, and interior floor. The various appurtenances within each of these areas have also been evaluated. A rating system has been developed to quantify the condition of these various tank areas. Each of the rating criteria is found in the Attachments (Charts 1 through 6).

The condition of the coating systems was rated as being poor, fair, good, or excellent (Chart 1). The extent of any rust defects identified within each of the areas was generally determined using the guidelines set forth in ASTM D610 “Standard Test Method for Evaluating the Degree of Rusting of Painted Steel Surfaces” (Chart 2). Where applicable, the characteristic or stage of corrosion was determined in accordance with CSI Corrosion Grade criteria (Chart 3). The degree of paint chalking

was determined in accordance with ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Test Method D659, Method C (Chart 4). Coating adhesion was assessed in accordance with ASTM D3359 “Standard Test Method for Evaluating Adhesion by Tape Test, modified Method A and/or a modified version of ASTM D6677 “Standard Test Method for Evaluating Adhesion by Knife” (Chart 5). The modified version of ASTM D6677 was used in areas where destructive testing was not found to be practical. Any blistering that may have been present was rated in accordance with ASTM D714 “Standard Test Method for Evaluating the Degree of Blistering in Paints” (Chart 6), and the paint dry film thickness was measured with a Positector 6000FN3 Type II gage in accordance with the applicable guidelines set forth SSPC PA2. The visual observations and data collected from the various areas of the tank are found in the charts below:

Exterior

Close-up visual examination of the coating was limited to the first (lowest) shell course, upper shell areas adjacent to the ladder, and the roof. The exterior paint on the roof is in good condition with minimal chalking (ASTM D4214, No. 8). Dark rust (CSI Corrosion Grade 2) was present in areas that had been mechanically damaged from operations or vandalism and in areas where paint was peeling. The amount of rust on the roof was less than 0.03 percent of the overall surface area and rated a 9 in accordance with ASTM D610. At the shell, the exterior paint system is in good condition and was rated a 9 (ASTM D610) with less than 0.03 percent of the total surface area impacted by corrosion. The paint thicknesses were found to range from 5 to 6 mils on the roof and 7 to 8 mils on the shell. The paint system was estimated to exhibit satisfactory adhesion (ASTM D6677, 4A) at the shell and satisfactory adhesion (ASTM D6677, 5A) at the roof.

Some of the specific data collected follows:

Exterior Paint					Overall Condition		Fair					
Paint Defects	Roof Quadrant				Shell Quadrant				Tank Support			
	Exterior		Fair		Exterior		Fair		Exterior		Fair	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Corrosion Grade	2	2	2	2	2	2	2	2	2	2	2	2
Rusting at crevices												
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Checking (ASTM D660)												
Chemical staining												
Chalking	8	8	8	8	8	8	8	8	6	8	8	8

Interior

The roof area is defined as those surfaces above the highest water level (HWL). Close-up visual examinations were made to all areas below the waterline and all other areas were assessed from the water level. The coating on the underside of the roof plates and roof support structure is in good condition with corrosion common to the edges of the support member flanges and edges of roof plates. Minor instances of spot peeling and cracking were observed throughout with dark corrosion (CSI Corrosion Grades 2) appearing from undercutting. The total amount of corrosion on the roof was rated to be approximately 0.03 percent of the total surface area (ASTM D610, 9), and there was a minor amount of rust staining present at the upper shell course from the roof, emanating from the faying surfaces at the roof structure. The most prominent defect observed at the roof where the gross application defects associated with some recent plural component spray application of an unknown material.

The shell surfaces are covered with a dark sediment, but spot checking revealed the lining on the shell was found to be in fair condition with areas of dark rust (CSI Corrosion Grades 2), especially within tank accessories and edges. The total amount of corrosion on the shell was rated to be 0.03 percent of the total surface (ASTM D610, 9) with some rust nodules and minor pitting observed. Groupings of blisters were observed and rated 2/Few in accordance with ASTM 714.

The floor had a large amount of sediment upon it, but spot checks revealed the lining at the tank bottom was in good condition, (ASTM D610, 9) with the same patterning of blisters observed at the shell (2/Few). The vast majority of the blisters retain their blister caps.

The data collected from the inspection follows:

Interior Paint			Above Water Condition		Good		Below Water Condition		Good			
Paint Defects/Overall Grade	Roof Quadrant				Shell Quadrant				Floor Quadrant			
	Interior		Good		Interior		Good		Interior		Good	
	S	W	N	E	S	W	N	E	S	W	N	E
Rust spots (ASTM D610)	9	9	9	9	9	9	9	9	9	9	9	9
Rust areas (ASTM D610)												
Corrosion Grade	2	2	2	2	2		2					
Rust staining												
Rusting at crevices	Yes	Yes	Yes	Yes	Yes		Yes					
Spot peeling												
Delamination												
Cracking (ASTM D661)												
Blistering (ASTM 714) Size/Density												
Pitting (Estimated Amount)												
Pitting (Estimated Deepest Mils)												

Dive Inspection Video



Cut and paste the external link: https://photos.app.goo.gl/vo2AV9Ku2yugo5tK6

Discussion

In general, the exterior paint system on the tank is aged, relatively thin, and exhibits moderate chalking with satisfactory adhesion between the finish coat and the primer in all areas tested. There are few areas of pinpoint and spot rusting within the paint system upon the roof, primarily at plate depressions where water tends to pond and immerse the paint system for long periods of time. Although the shell surfaces have some isolated spot rust, the paint system was providing general corrosion protection, at this time. The paint will likely continue to provide protection of the steel for a few more years, but it will continue to oxidize and degrade.

Chalking is the term for the powdery characteristic of an aged coating that may also have a faded finish. Chalking is a result of the natural breakdown of a paint system's binder when it is exposed to sunlight. The binder (or resin) degrades in ultraviolet light, which leaves behind the unbound pigment or chalk. Aside from a faded appearance, chalking can result in corrosion as the film weathers (thins) away through cycles of wind and rain. As the paint endures years of direct sunlight, it begins to weather away, which results in the paint no longer providing enough barrier protection from corrosion.

Rust is a result of ferrous metal essentially converting itself back to its original state, iron ore. It takes a tremendous amount of energy to convert an ore into a usable metal. These metals then try to naturally release this energy through the development of rust. Corrosion is a more generic term for a condition that has resulted in a substrate that has reacted with its environment. With respect to the stages of the rust or corrosion of steel, the process initiates itself as light colored orange surface rust. As the corrosion process

continues, the rust becomes darker in color until it eventually results in advancing forms of metal loss. Metal loss can take the form of pitting, which is a localized corrosion cell that results in cavities or holes developing in the metal.

The tank roof has localized areas where atmospheric water tends to collect to develop ponds at plate depressions. The paint applied to the exterior of the tank was not designed for immersion service. As a result, the paint in many of these areas has degraded to form flaking and corrosion.

Generally speaking, there are four possible approaches to maintenance painting. The coatings can be either completely removed and replaced (repainted), spot repaired, spot repaired and overcoated, or simply overcoated. In evaluating the condition of a coating to determine the best painting approach there are a number of different factors to consider. The first set of factors includes the determination of the coating's ability to withstand the added stress of an additional coat(s). Attributes impacting this decision include film thickness and adhesion. If the paint film is too thick or has poor adhesion, the tension from the curing stresses and/or weight of the additional paint can cause the existing system to disbond. The second set of factors to consider when determining what painting approach to take is the amount of surface area requiring repair, the overall difficulty in providing access to the structure, and whether the coating system contains heavy metals (i.e. lead, cadmium, and chromium). The final factor is the condition of the substrate.

When considering whether a spot repair approach is a viable option, a good rule of thumb is that spot repair, with or without overcoat, makes sense with up to 10 percent of the surface area requiring repairs. With more than 10% in disrepair, making spot repairs and overcoating becomes a diminishing return. With 10 percent rusting, overcoating may be an option if the adhesion is better than fair. If there is more than 10 percent rusting and the substrate is free of mill scale, overcoating may be considered an option if the adhesion is excellent. Once the amount of surface area in need of repair exceeds this range, the cost of cleaning and coating the individual rust spots approaches (or exceeds) the total cost of removal and replacement.

On this basis, and due to the satisfactory adhesion observed at the roof and shell, the tank exterior paint should be spot repaired at the next maintenance interval.

Overall, the tank interior coatings are in good condition in the area above the highest water level (HWL), and in good condition below the HWL. The lining on the underwater areas of the tank is mostly free of widespread corrosion, but there are localized areas of spot rust, including the beginning stages of exfoliation at irregular surfaces such as the ladder, dollar plate, rafter flanges, shell penetrations for accessories, and rough welds.

A tank roof, including its roof support structure has many open, unsealed areas by design. These open areas are primarily at the inaccessible crevices that are between the top of the roof beam flanges and the roof plate. The cost of properly sealing these areas becomes a diminishing return, notably when one considers that small crevice areas often develop into dead-air space. The minor amount of rust staining is simply a result of some areas not being completely sealed by coatings.

The design and fabrication of a water storage tank is critical relative to the performance of the lining. For instance, tank and vessel internal surfaces to be lined should not be marred by gouges, handling marks, deep scratches, metal stamp marks, slivered steel, or other surface flaws. All rough welds should be ground to remove sharp edges and weld spatter removed. Flaws should be repaired by welding or grinding, as appropriate.

The corrosion at edges is likely simply a result of the coating not having enough barrier protection at the edges. All coatings tend to thin at edges, which often results in these locations showing signs of rust years before the barrier protection breaks down on flat surfaces. Surface tension results in coatings separating away from edges as they are applied. It is not clear if the installation of the coating system involved special brush work at the roof edges (i.e. strip coat), but strip coating would have helped prevent this type of defect.

It is not clear what caused the blisters to develop, but their locations and pattern is similar to coating symptoms that would be seen from with an improperly functioning cathodic protection (CP) system. The tell-tale sign of an over energized CP system are circular patches of blisters in areas adjacent to the CP anodes. This indicates that the CP system may not be properly operating and may be damaging the coating. This defect from cathodic disbondment can result in blistering as the over-energized CP generates hydrogen under the coating, creating blisters. No significant corrosion is associated with the condition. As a result, the only recommendation with respect to the blistering issue is to evaluate the proper operation of the CP system to avoid the continued damage to the coating.

The paint on the exterior satisfactory condition and should continue to provide proper performance for more than 5 years, and the only need for paint work at this time would be based on aesthetics. Likewise, the interior lining is also in satisfactory condition. The lining has negligible rusts spots in many areas of the tank, but these areas do not involve any significant corrosion that requires repair. It is recommended that the tank should be placed back on a 3 to 5-year maintenance inspection cycle as recommended by AWWA with a plan to also make some underwater maintenance repairs during that inspection.

The tank ventilation was found to have screening installed without gaps or penetrations.

Recommendations

The following activities are recommended for remedial work:

Exterior:

1) No coatings work is required at this time. Plan on a future spot repair and overcoat of the paint system in conjunction with any future relining to best amortize costs.

Interior:

2) No coatings work is required at this time. It is recommended that the tank should be placed back on a 3 to 5-year maintenance inspection cycle as recommended by AWWA with a plan to also make some underwater maintenance repairs during that inspection.

3) Engage the services of a cathodic protection systems professional to evaluate the operation of the sacrificial anode CP system.

NOTICE: This report represents the opinion of CSI Services, Inc. This report is issued in conformance with generally acceptable industry practices. While customary precautions were taken to ensure that the information gathered and presented is accurate, complete, and technically correct, it is based on the information, data, time, and materials obtained and does not guarantee a leak proof tank.

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Fax: 661.755.7628
www.CSIServices.biz

Page	1	of	1
Date	08/19/25		Tuesday
CSI Job No.	240243		
Completed By	Metcalf		

Field Water Tank Dive Inspection Report

Tank Name:	Peck	**Dive Supervisor:**	Steven Metcalf
Tank Owner/Client:	City of Santa Paula	**Dive Leader:**	Josh Servera
Client Contact:	Rob Lepore	**Dive Tender**	Steven Metcalf Jr

Scope Maintenance Inspection

Site Information

Item	Description
Cross Street	N Peck Rd
Tank Location	675 N Peck Rd, Santa Paula CA
GPS Coordinates	34.35232, -119.09596
Nearest Structures	N/A
Surrounding Site	Dirt

Item		Notes
Perimeter Fencing	Yes	
Site secured on arrival	Yes	
Overhead Power Lines	No	
Antenna on Tank	No	
Roof Accessible	Yes	

Interior Structural Characteristics

Item	Data	
Roof Structure	Rafters and Center Column	
Column Design	Pipe	
Upper Center Column	Dollar Plate	
Column Base Design	Free Plate	
Connections	Bolted	
Overflow Design	An Upper Funnel	
Inlet Interior Design	Stub	
Lining Type/Original	Epoxy	No

Item	Data			
Outlet Design	Stub			
No. Interior Ladder	Yes	One		
CP System/Type	Yes	Sacraficial Annode		
Water Depth	16 ft			
Water Agitator	No			
Barrier Walls	None			
No. of Columns	One Column			
Caulking	Roof	No	Columns	No

Exterior Structural Characteristics

Item	Data	
Capacity (gallons)	500,000	
Diameter (feet)	60	
Height (feet)	24	
Erection Year		
Contract No.		
Tank Type	Welded Steel	
Tank Profile	on grade	
Tank Geometry	Cylinder	
Number of Courses	Three	
Height of Each Course	8	
Roof Design	Pitched Roof with Drip Ring	
No. Shell Manways	Two Shell Manways	
Type of Manways	Round	
Manway Cover Design	Unibolt	
Diameter of Manways	20 in	
No. Roof Hatches/Location	Two	Near Edge
Hatch Design	Square Shoe Box	
Size of Roof Hatch	24 in	
No. Roof Vents/Location	One	Center
Roof Vent Design	Round Hood	
Construction Co.		

Item	Data	
Center Roof Vent Size	20 in	
Roof Vent Sealed	Yes	N/A
Roof Rail System	Yes	N/A
Roof Rail Satisfactory	Yes	N/A
Rail Location	At Hatch	
No. & Type Roof Access	One	Ladder
Exterior Vandal Deterrent	Yes	
Ext Ladder Satisfactory	One	Yes
Ext Ladder Fall Prevent	Yes	
Roof Tie-Off Present	Yes	
Tank Piping	Shell Inlet and Outlet	
Inlet Diameter	12 in	
Outlet Diameter	12 in	
Flexible Pipe Coupling	No	
Overflow Pipe Diameter	12 in	
Overflow Exterior Design	Screen Air Gap	
Drain Location	Shell	
Tank Foundation	Gravel	
Water Level Indicator	YEs	
Tank Type	Potable	
Lining Type/Original	Polyurethane	No

Miscellaneous Notes

The information reported was obtained using visual observations and testing believed to be accurate. The information reported represents the data obtained from the specific representative areas inspected, tested, and/or verified. This document shall only be produced in its entirety.

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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -002



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -003



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -004



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -005



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -006



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -007



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -008



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -009



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -010



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -011



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -012



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -013



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -014



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -015



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -016



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -017



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -018



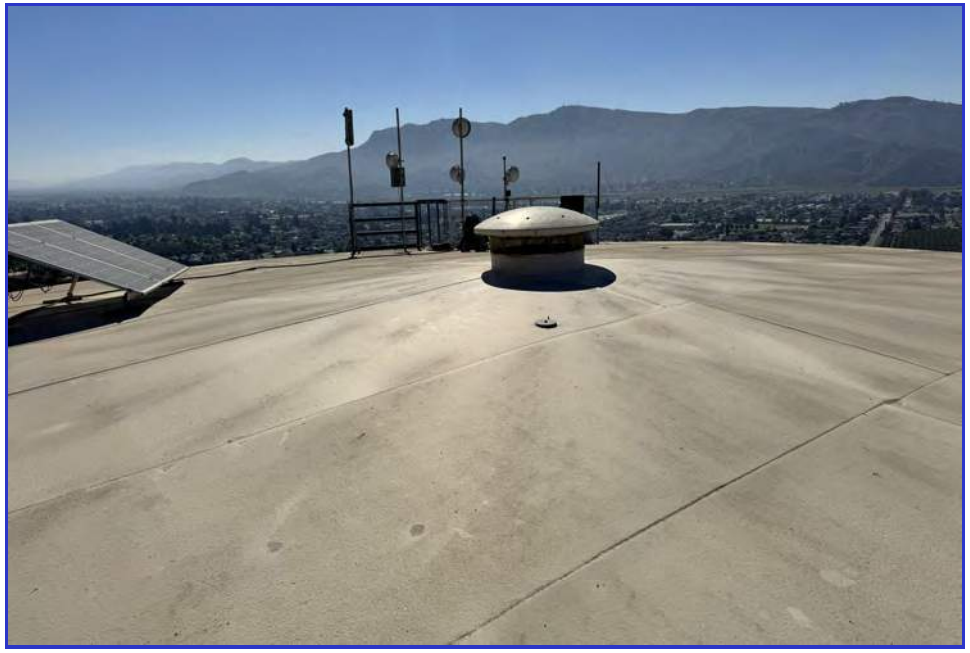
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -019



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -020



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -021



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -022



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -023



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -024



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -025



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -026



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -027



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -028



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -029



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -030



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -031



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -032



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -033



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -034



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -035



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -036



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -037



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -038



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -039



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -040



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -041



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -042



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -043



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -044



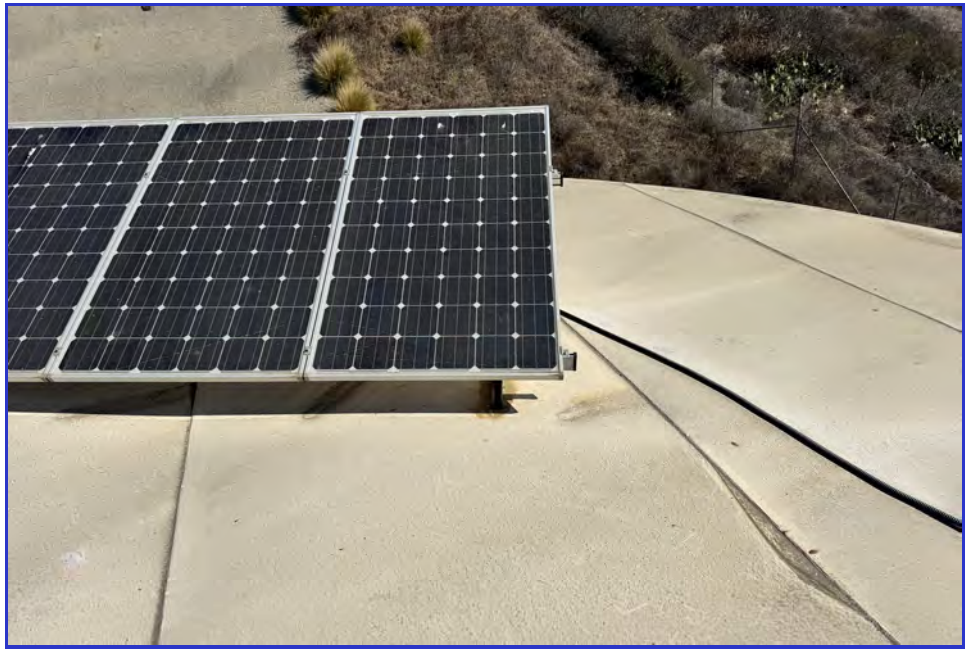
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -045



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -046



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -047



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -048



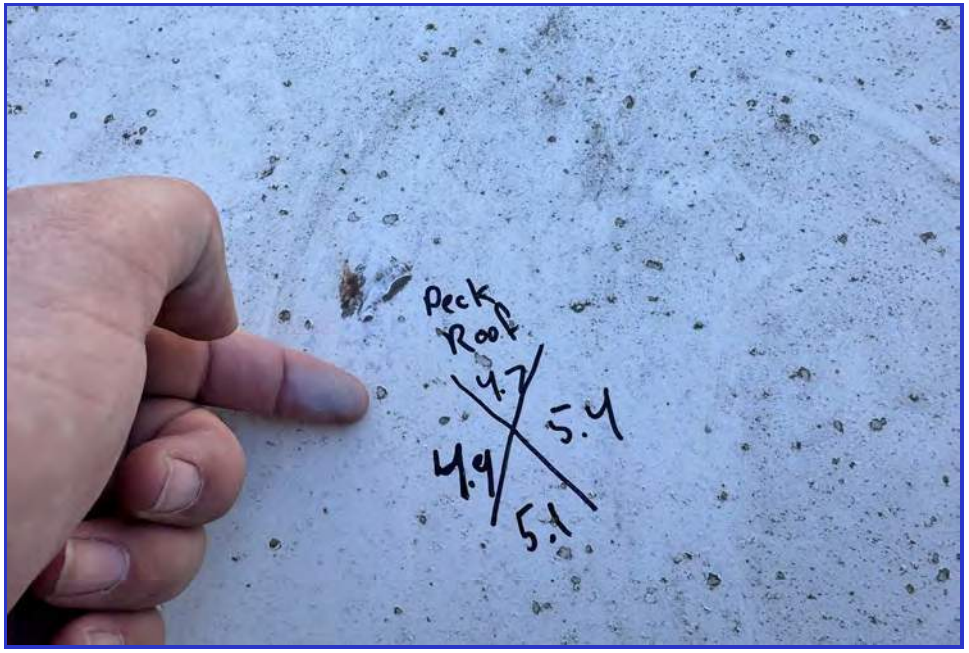
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -049



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -050



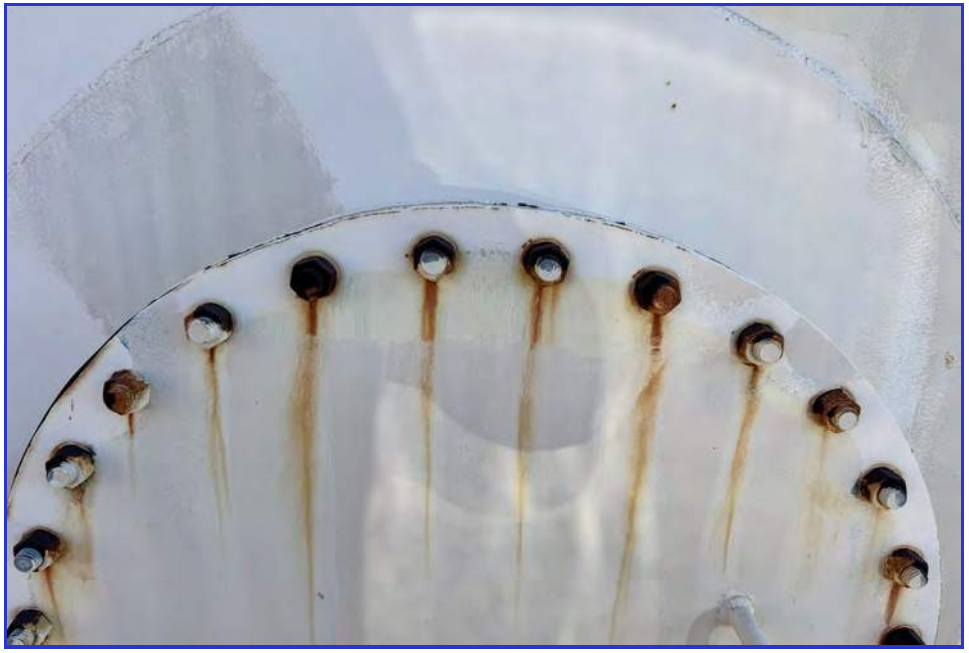
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -051



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -052



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -053



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -054



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -055



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -056



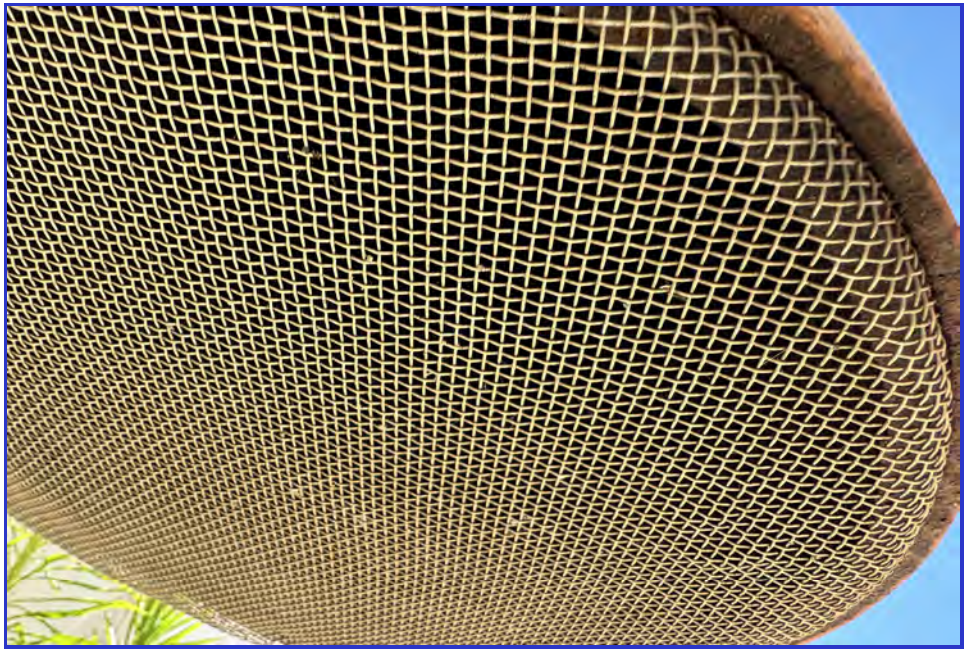
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -057



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -058



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -059



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -060



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -061



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -062



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -063



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -064



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -065



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -066



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -067



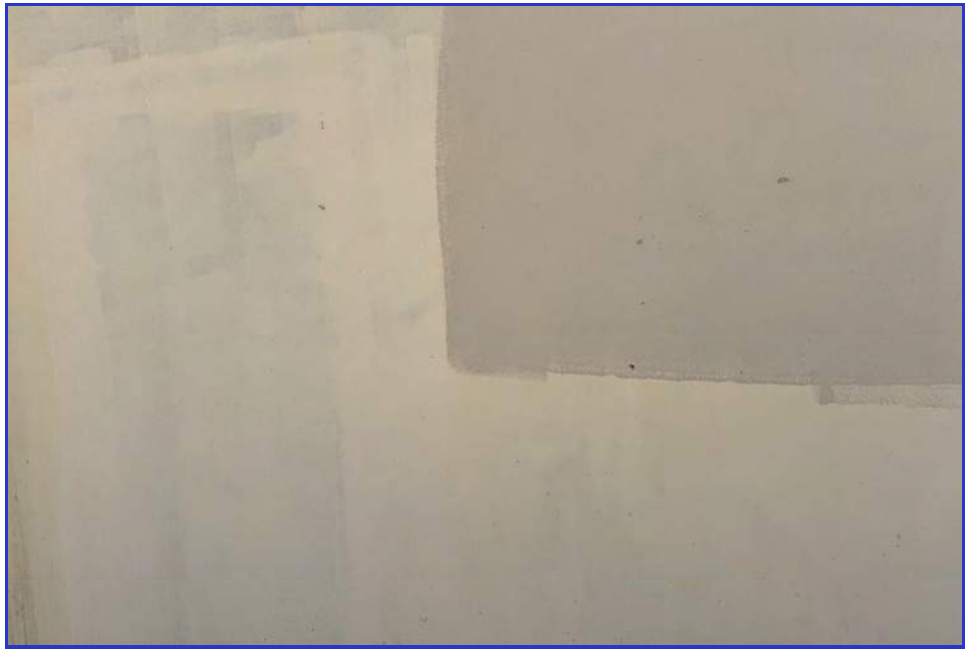
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -068



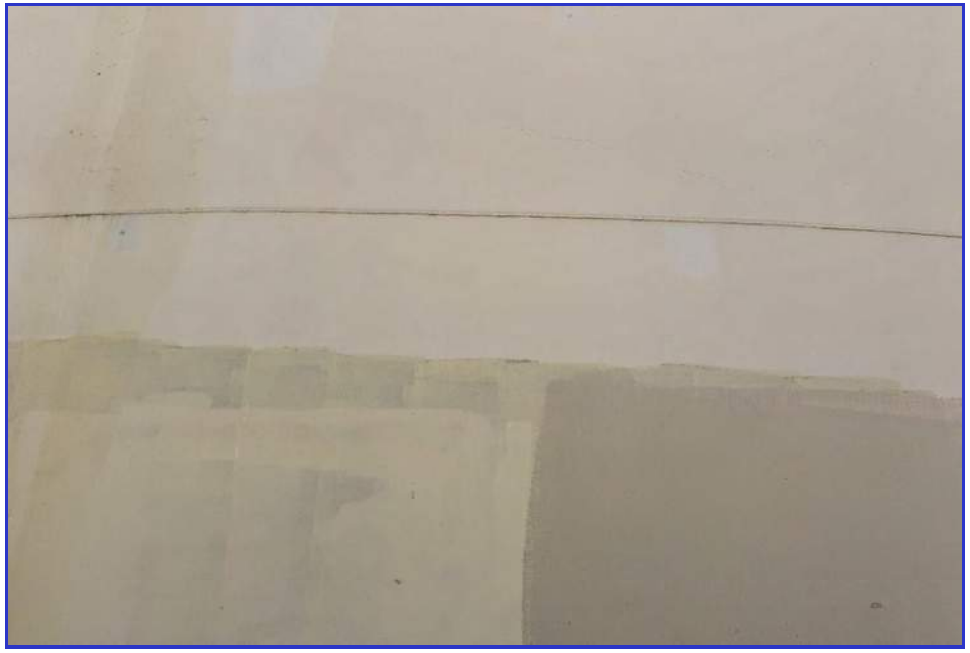
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -069



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -070



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -071



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -072



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -073



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -074



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -075



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -076



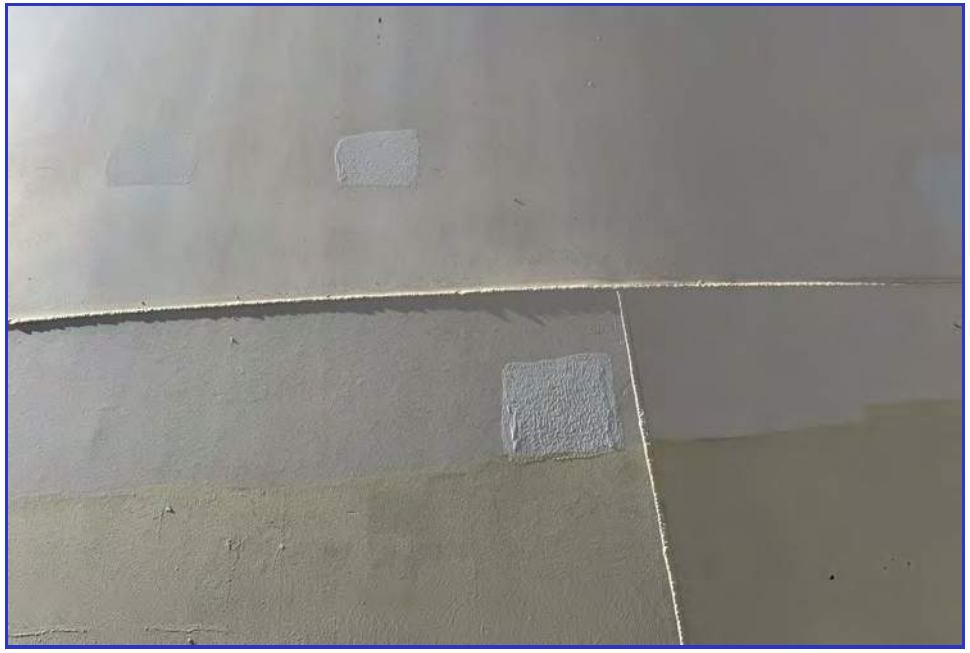
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -077



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -078



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -079



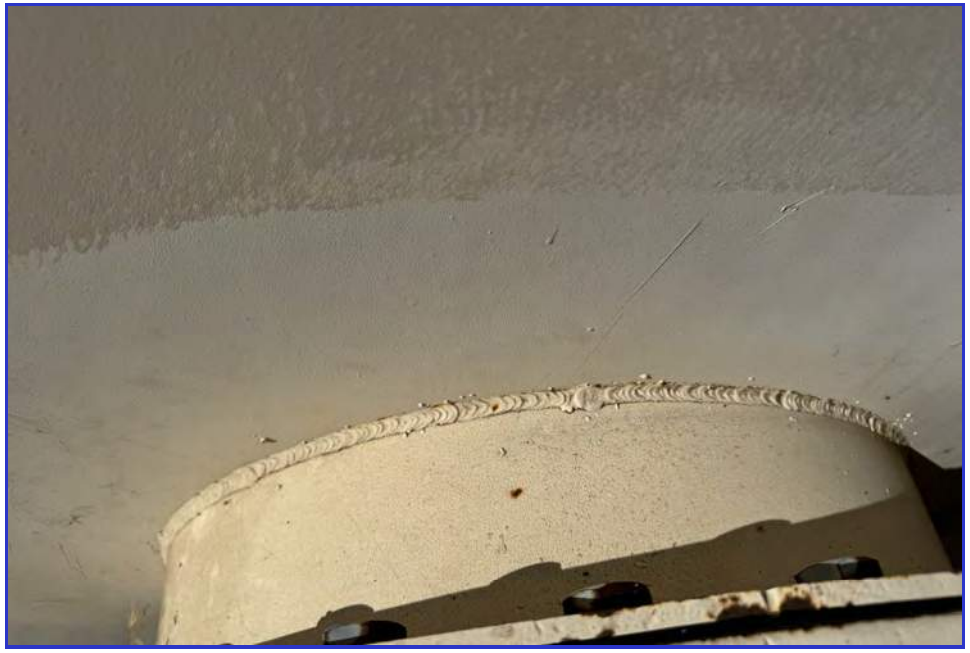
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -080



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -081



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -082



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -083



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -084



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -085



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -086



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -087



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -088



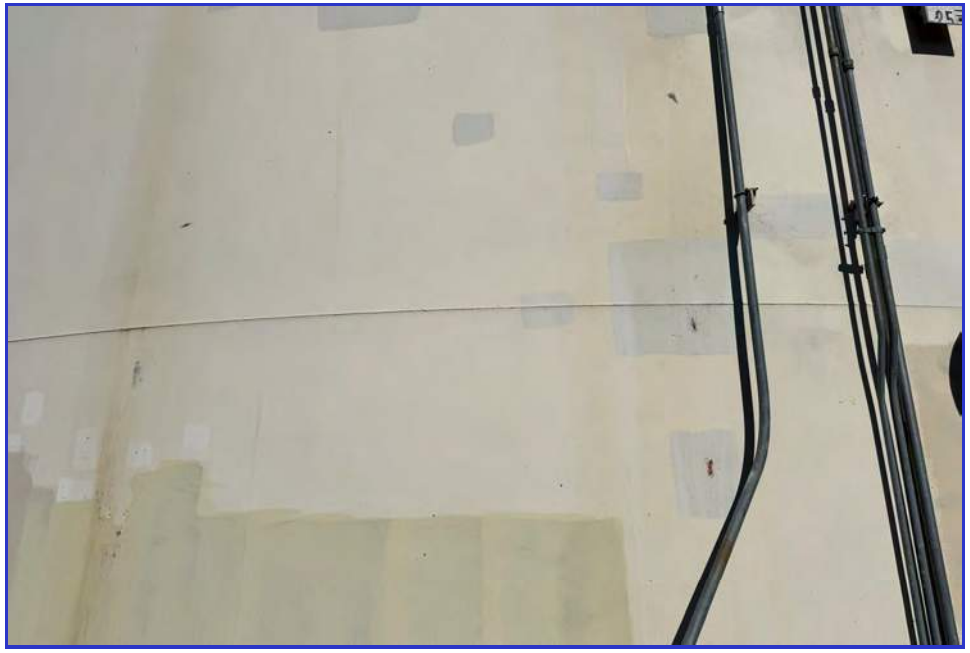
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -089



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -090



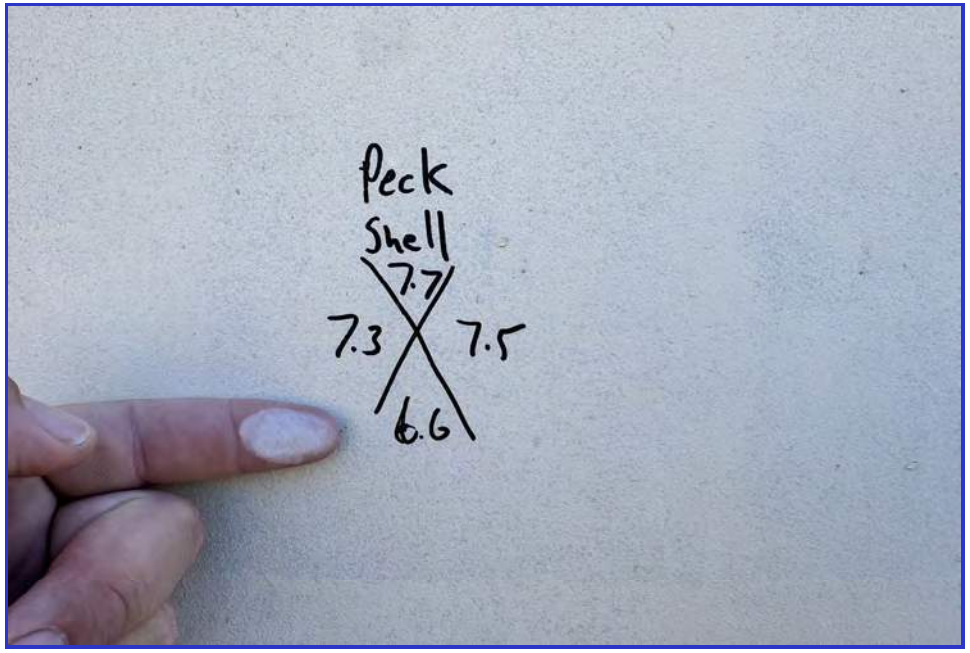
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -091



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -092



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -093



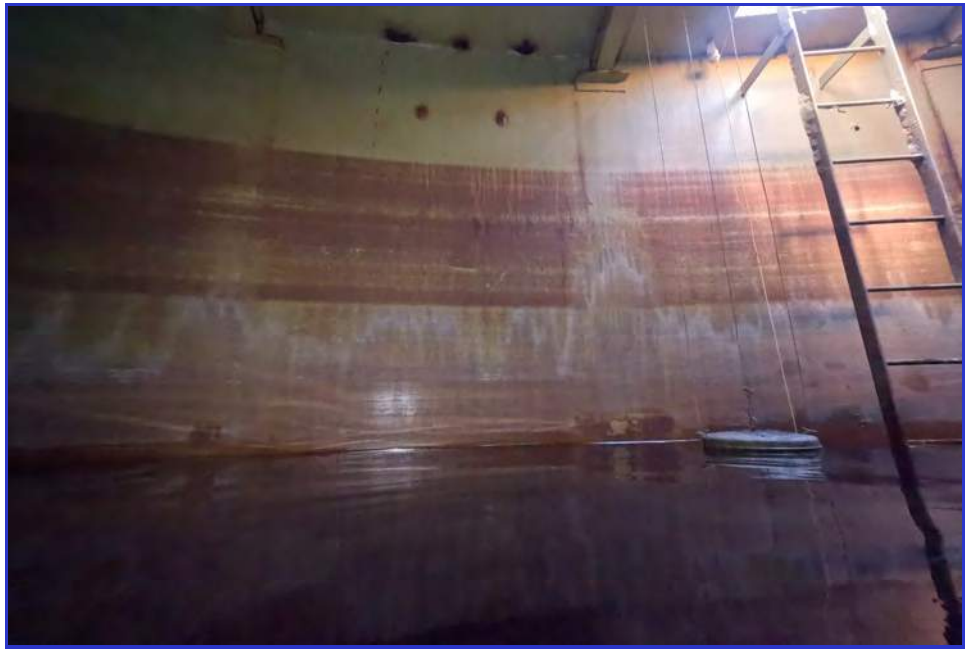
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -094



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -095



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -001



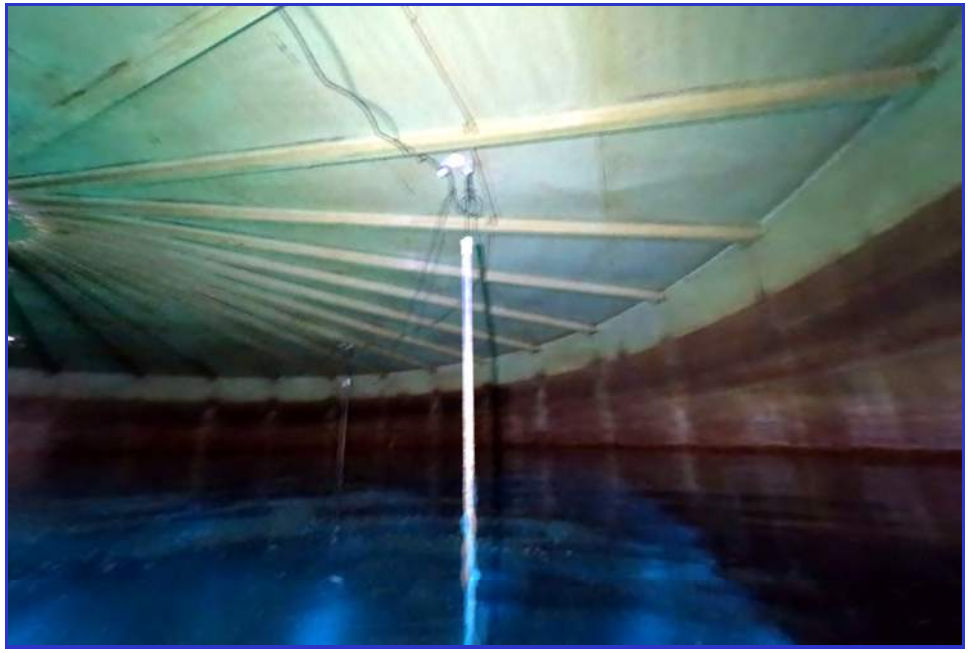
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -002



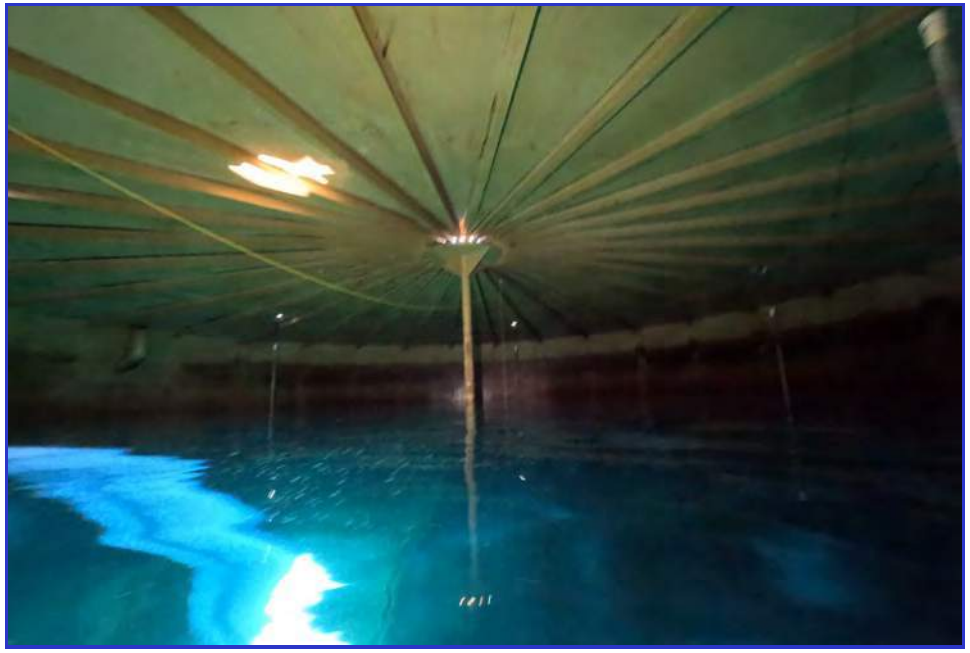
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -003



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -004



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -005



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -006



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -007



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -008



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -009



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -010



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -011



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -012



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -013



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -014



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -015



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -016



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -017



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -018



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -019



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -020



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -021



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -022



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -023



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -024



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -025



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -026



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -027



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -028



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -029



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -030



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -031



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -032



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -033



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -034



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -035



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -036



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -037



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -038



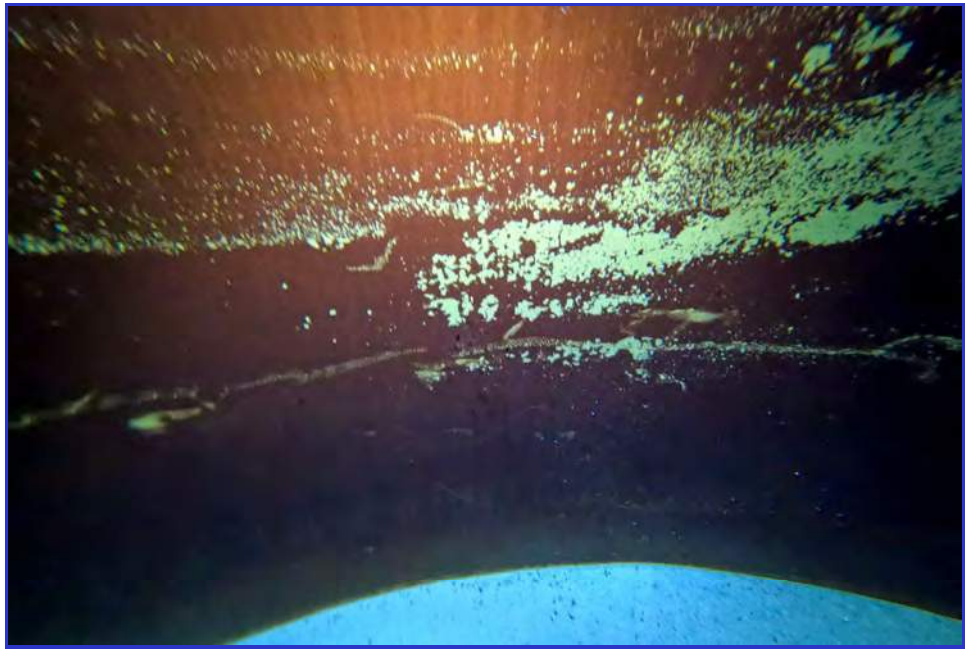
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -039



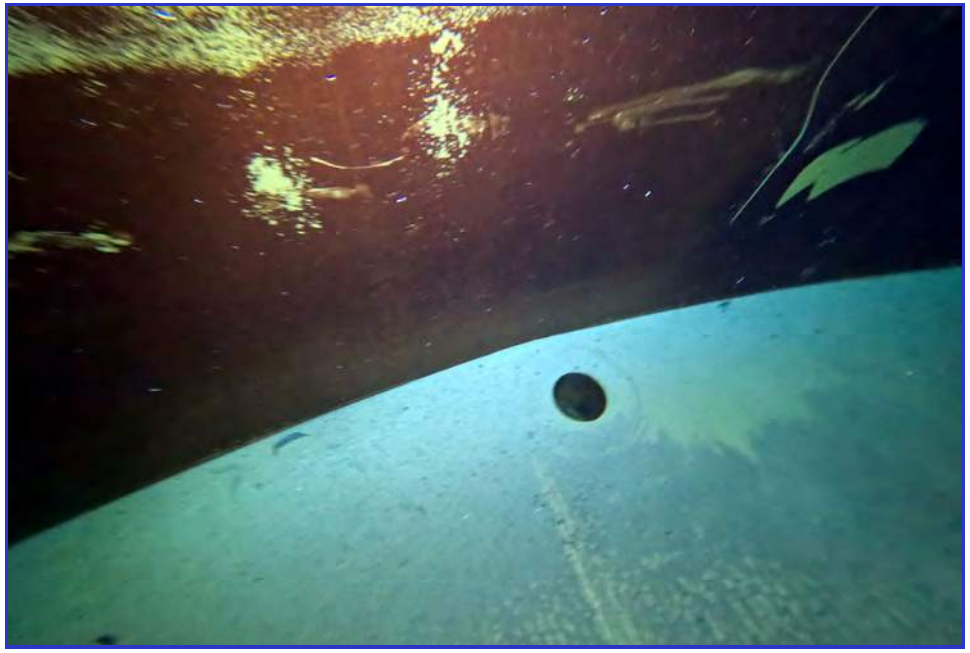
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -040



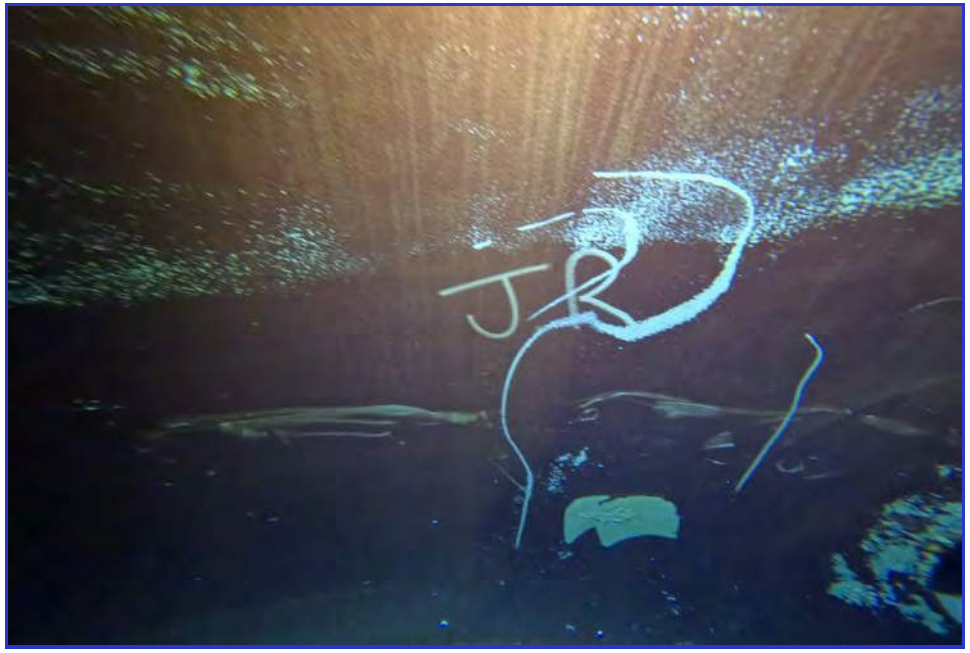
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -041



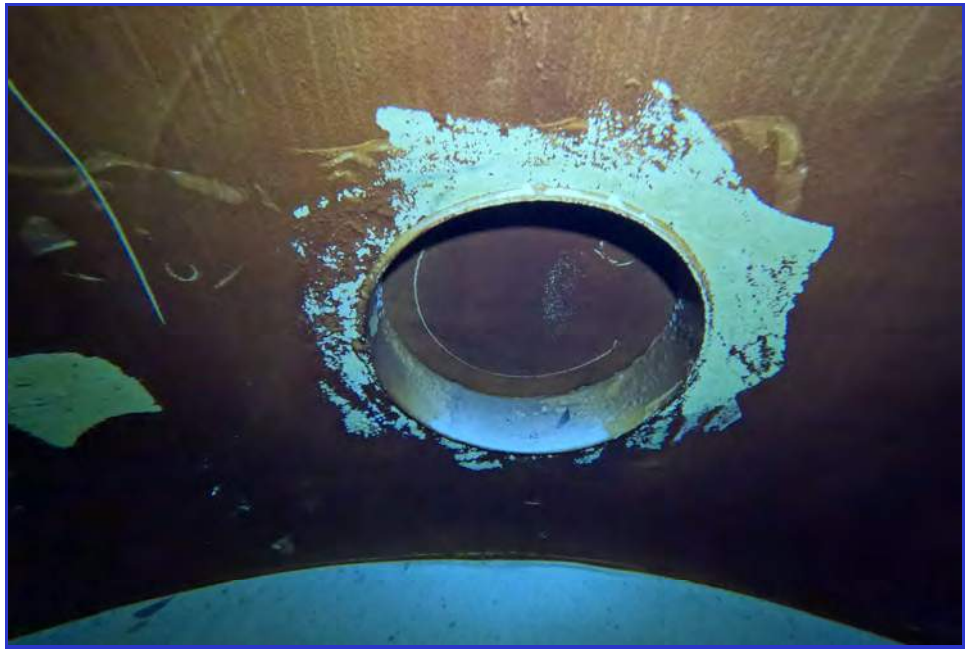
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -042



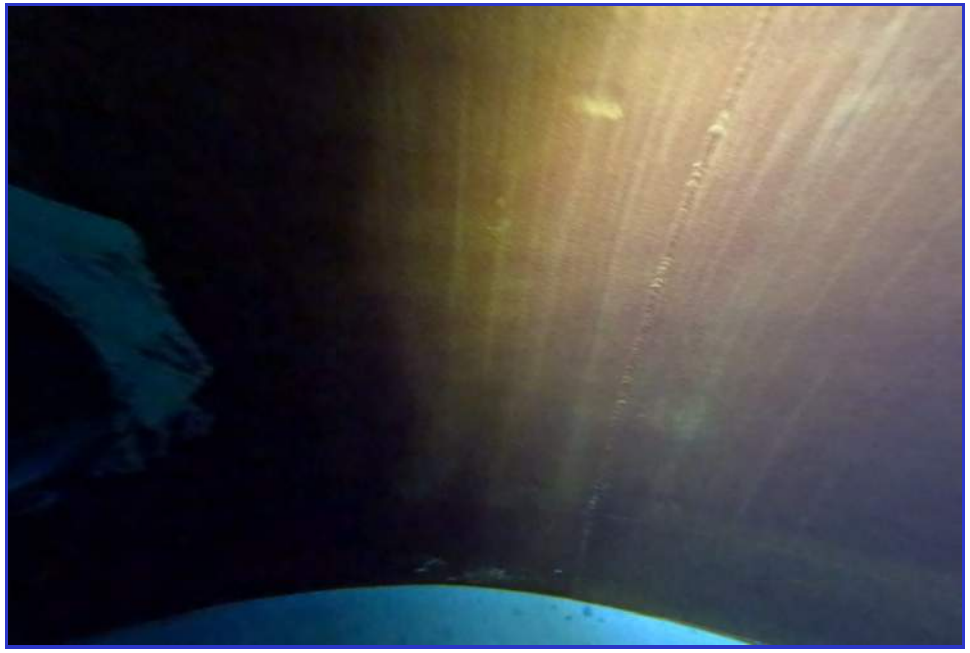
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -043



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -044



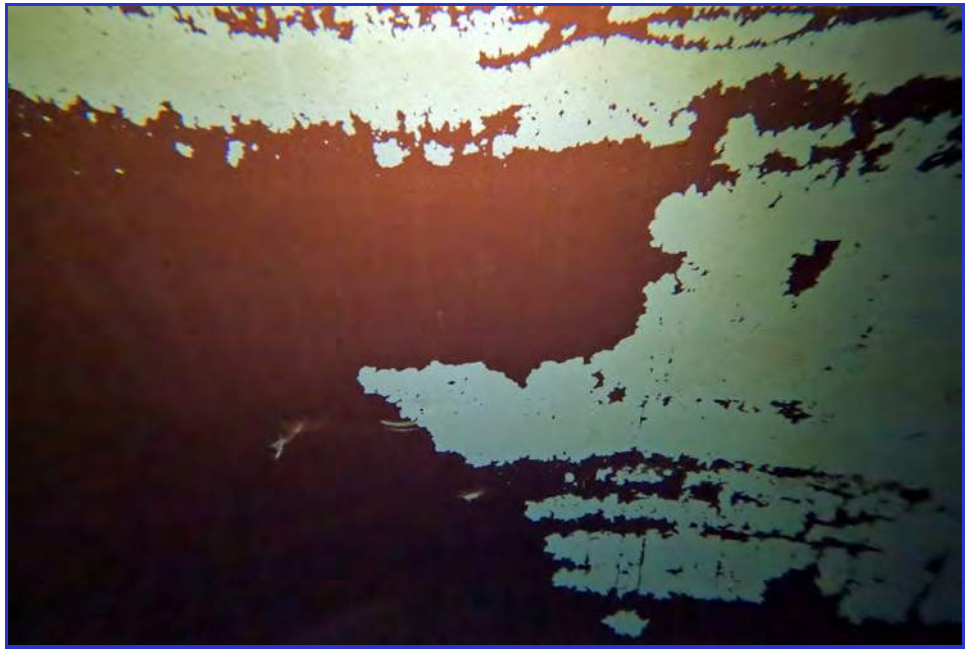
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -045



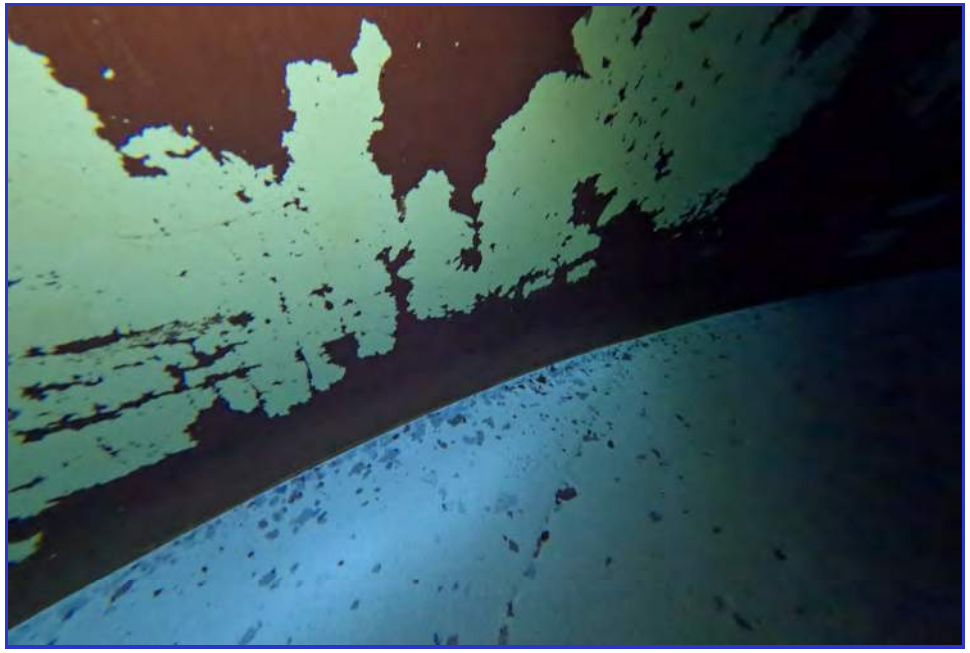
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -046



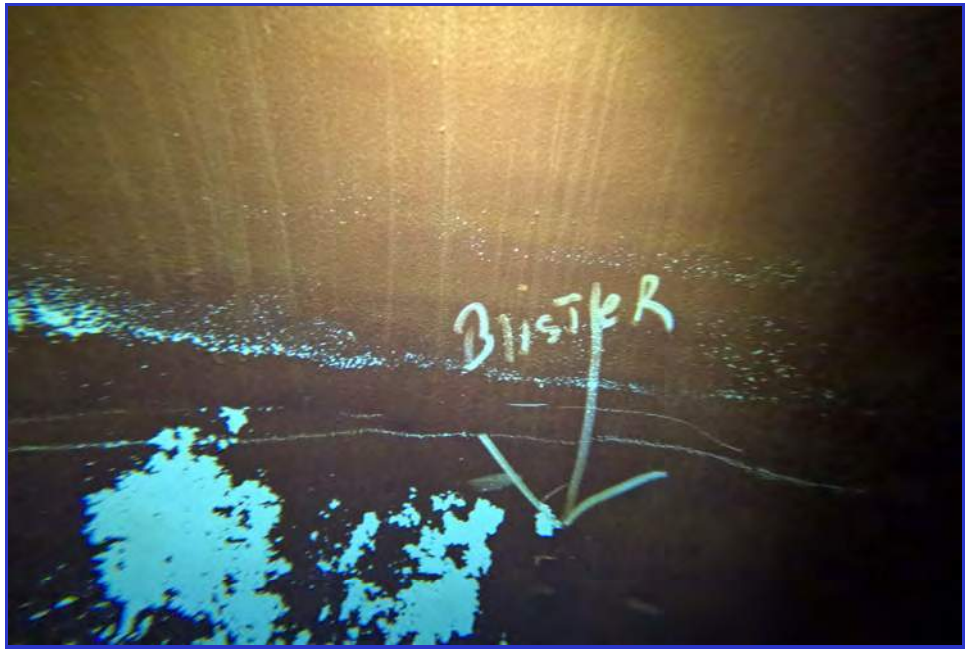
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -047



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -048



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -049



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -050



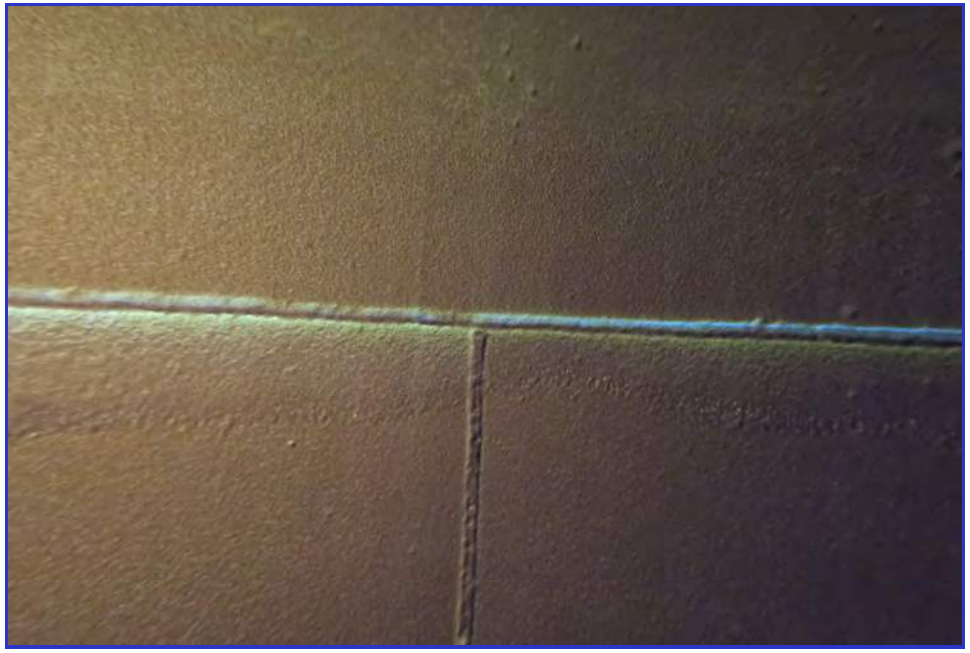
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -051



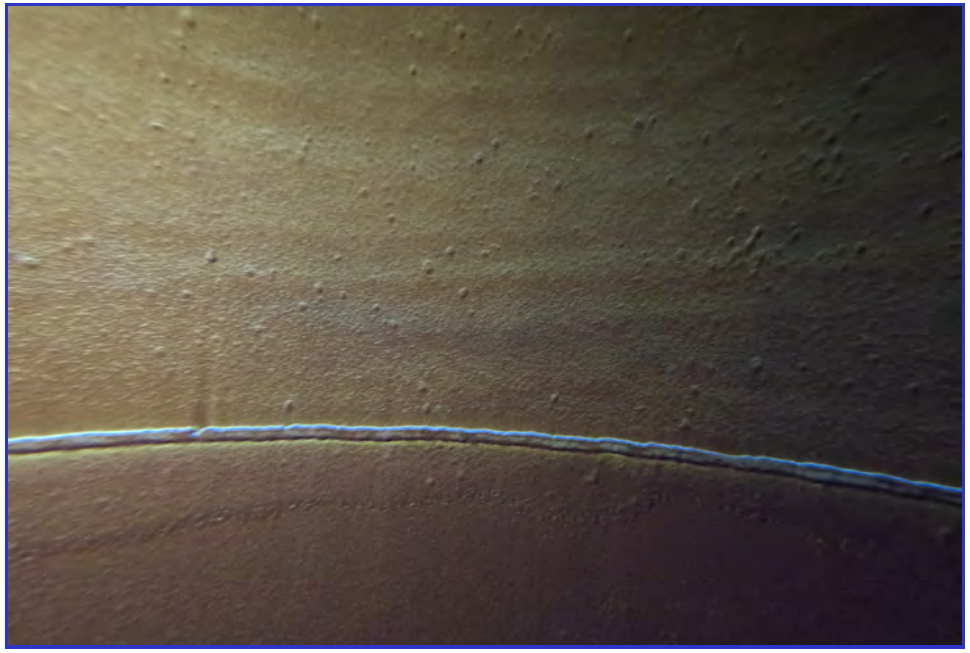
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -052



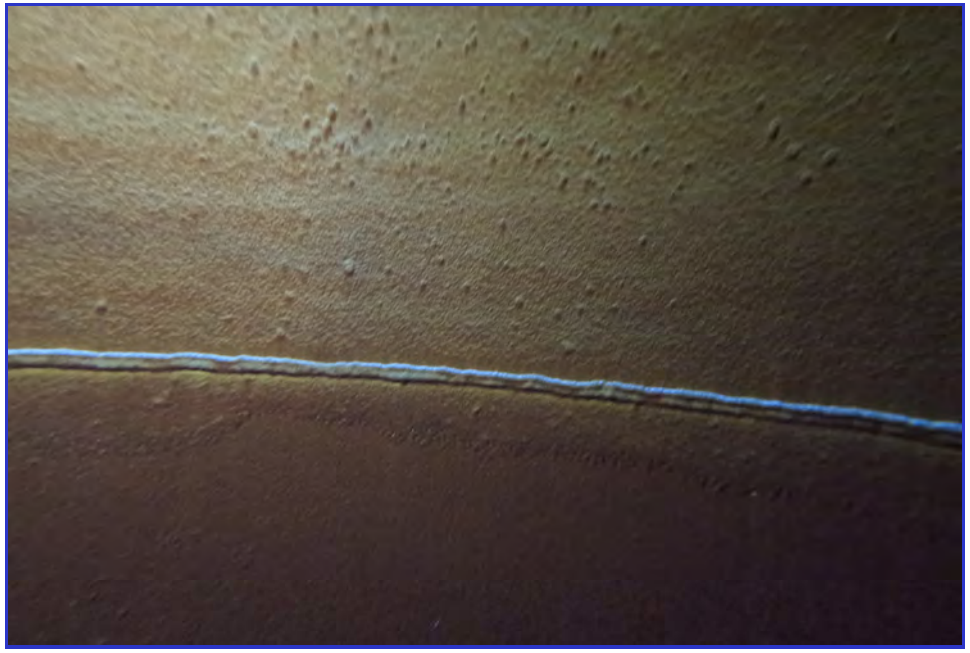
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -053



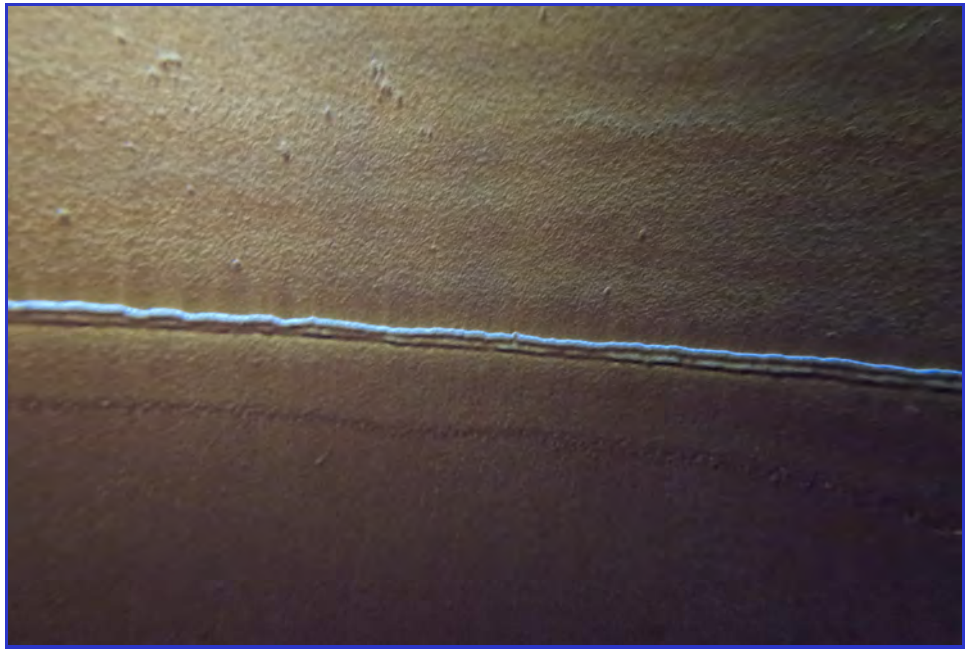
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -054



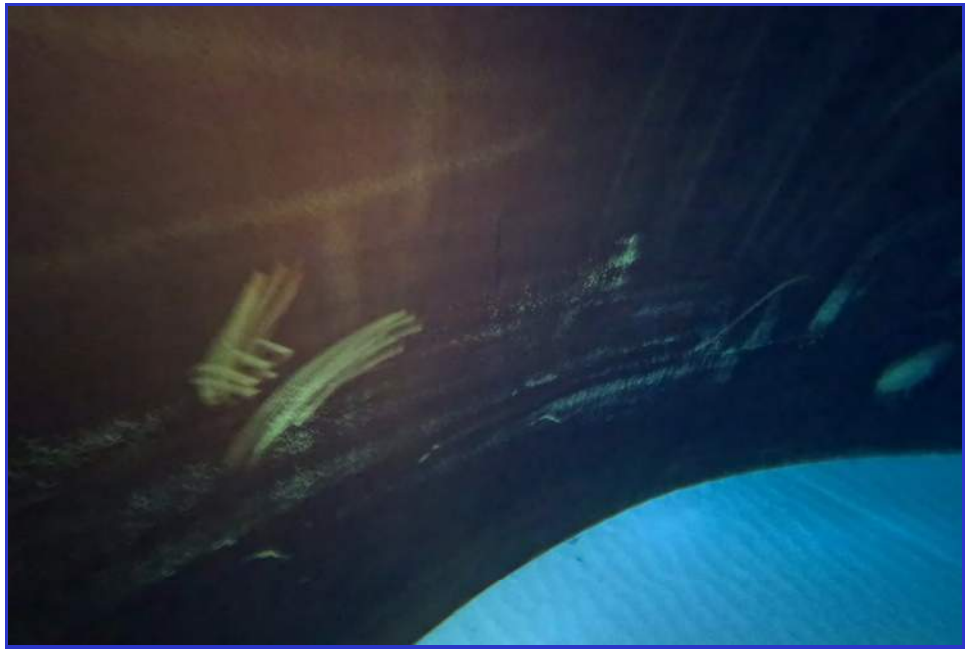
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -055



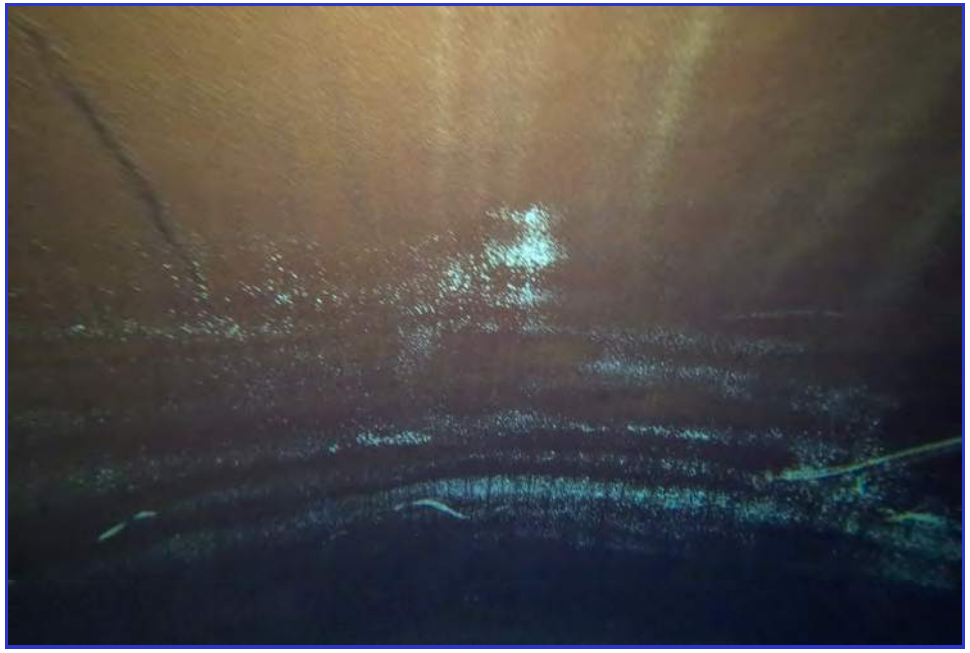
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -056



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -057



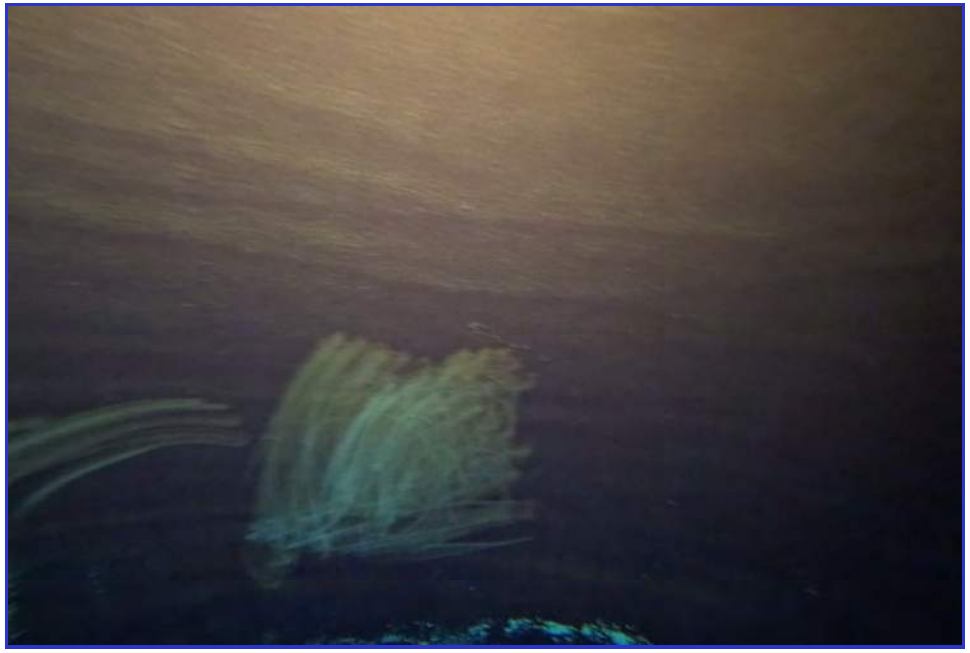
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -058



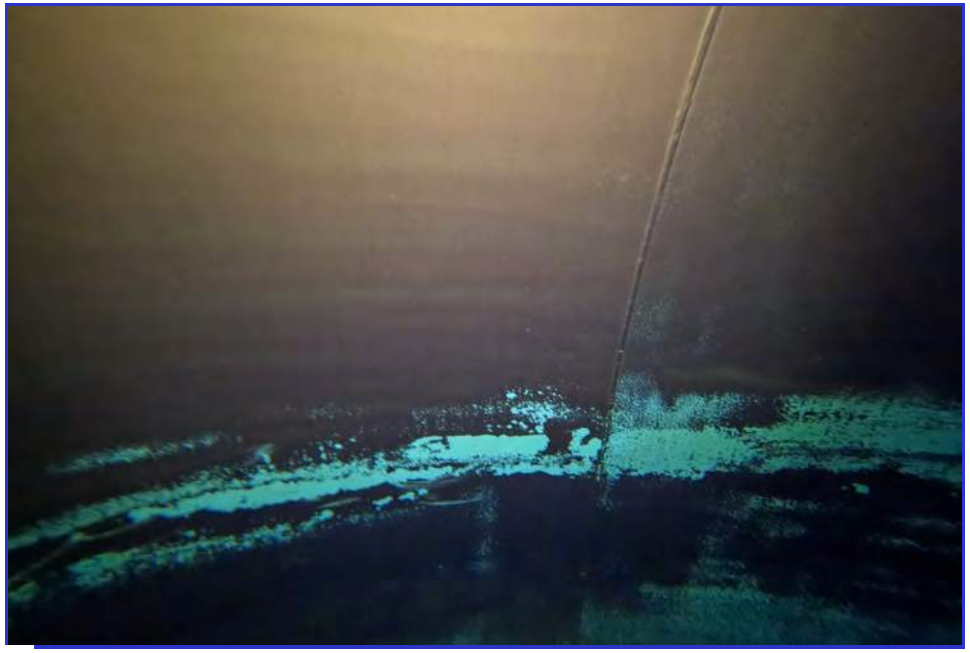
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -059



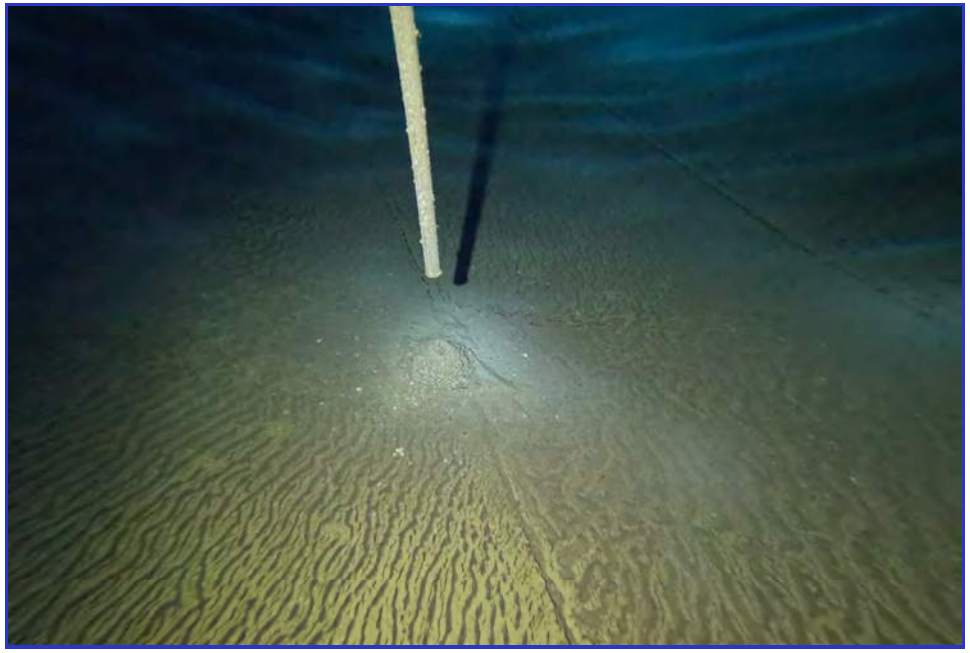
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -060



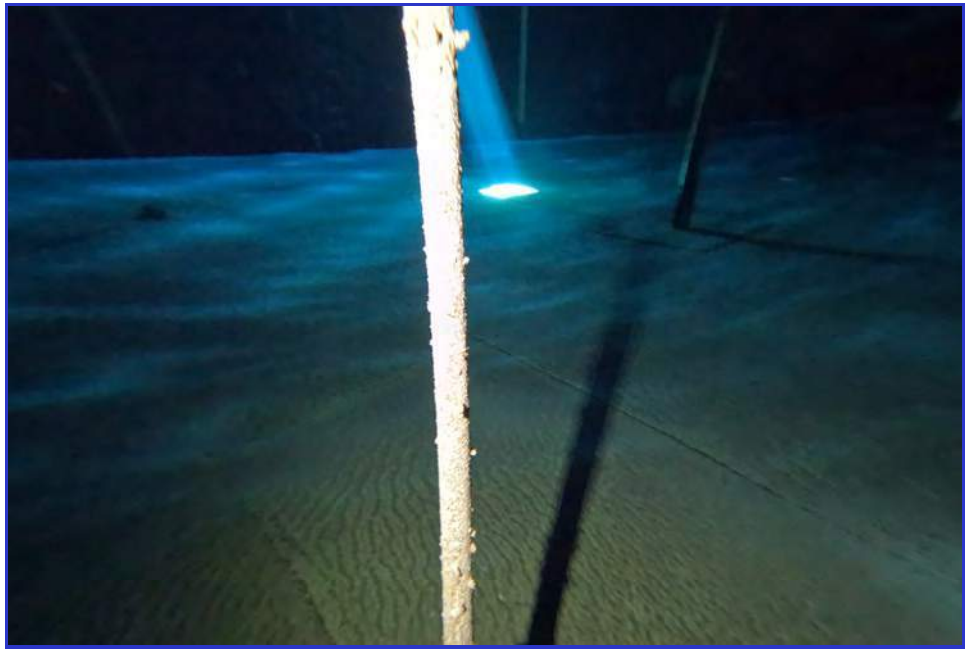
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -061



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -062



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -063



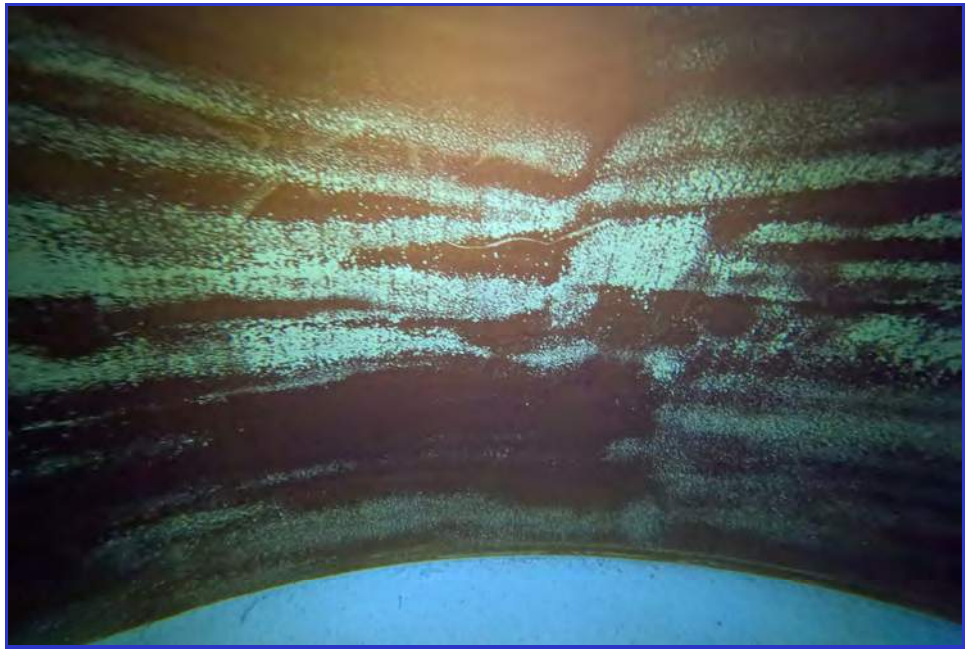
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -064



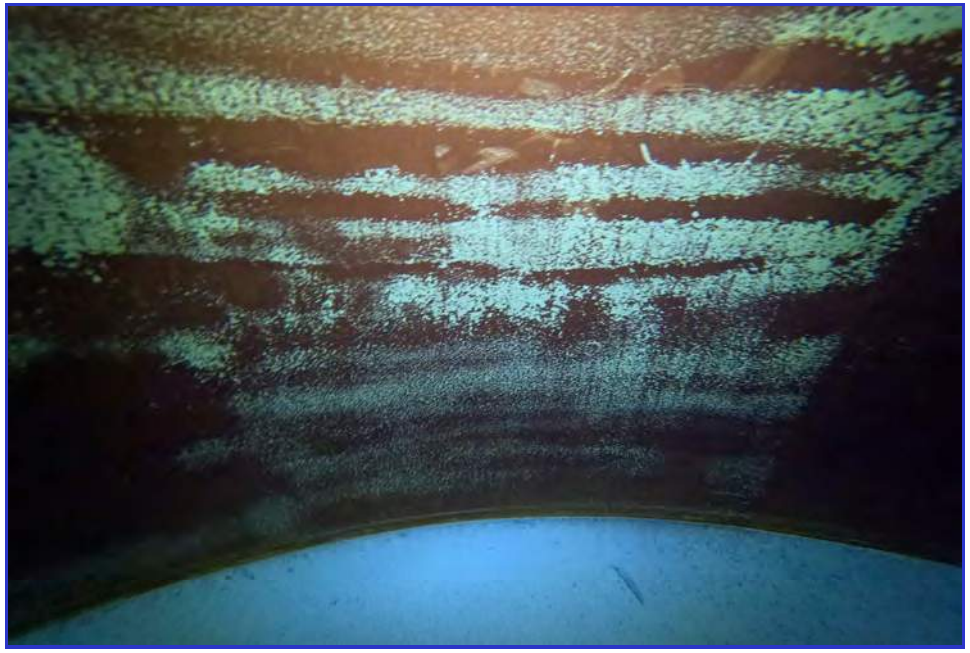
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -065



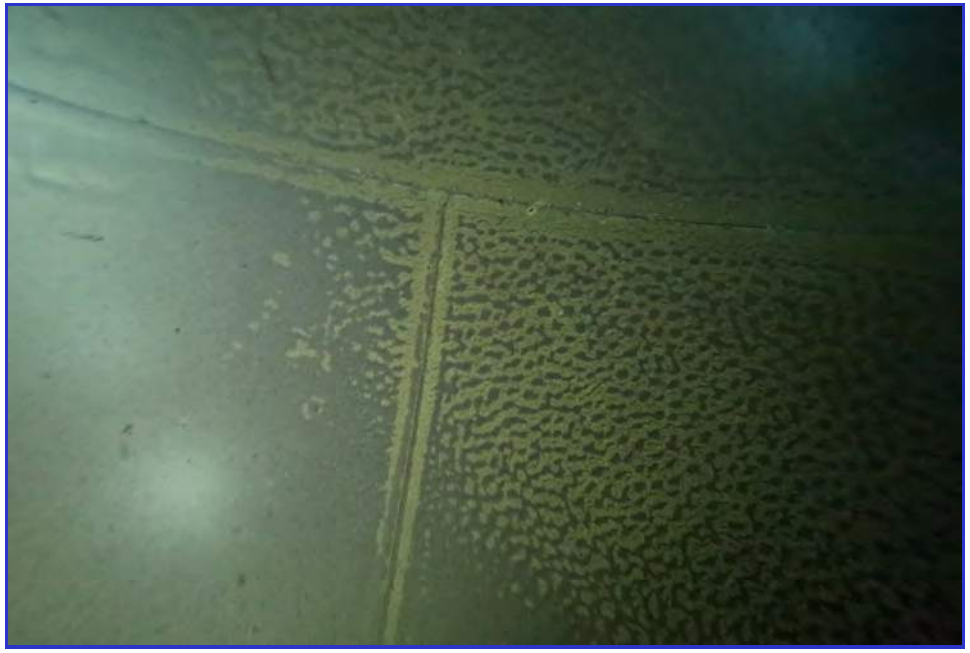
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -066



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -067



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -068



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -069



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -070



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -071



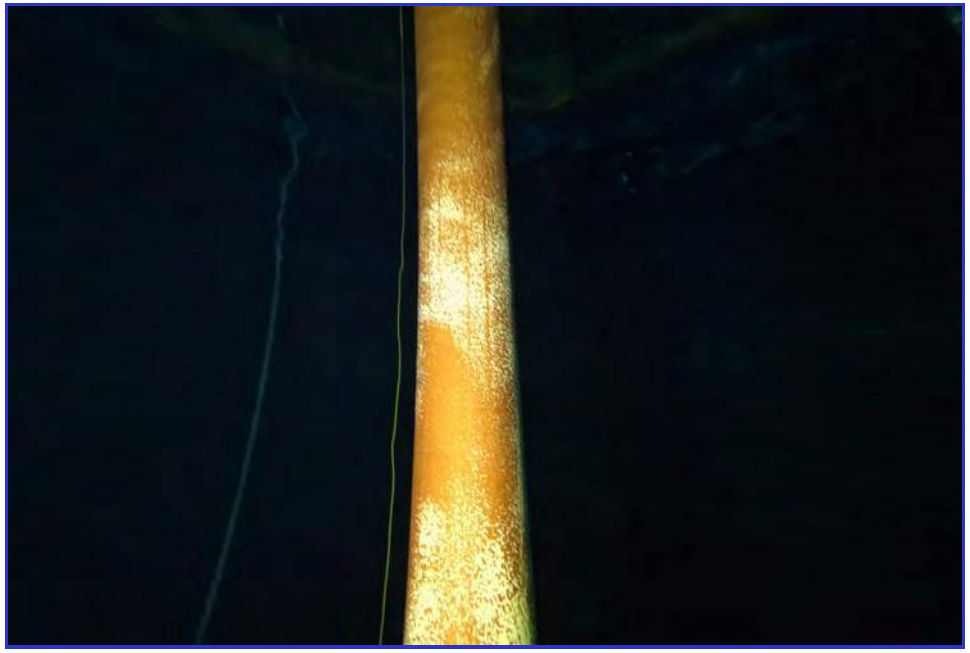
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -072



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -073



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -074



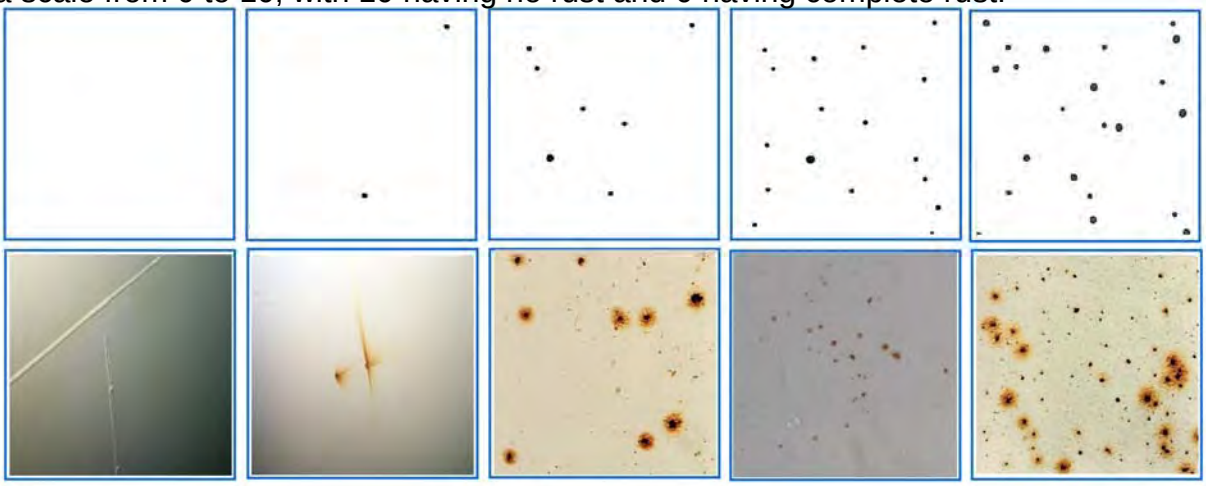
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -075

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

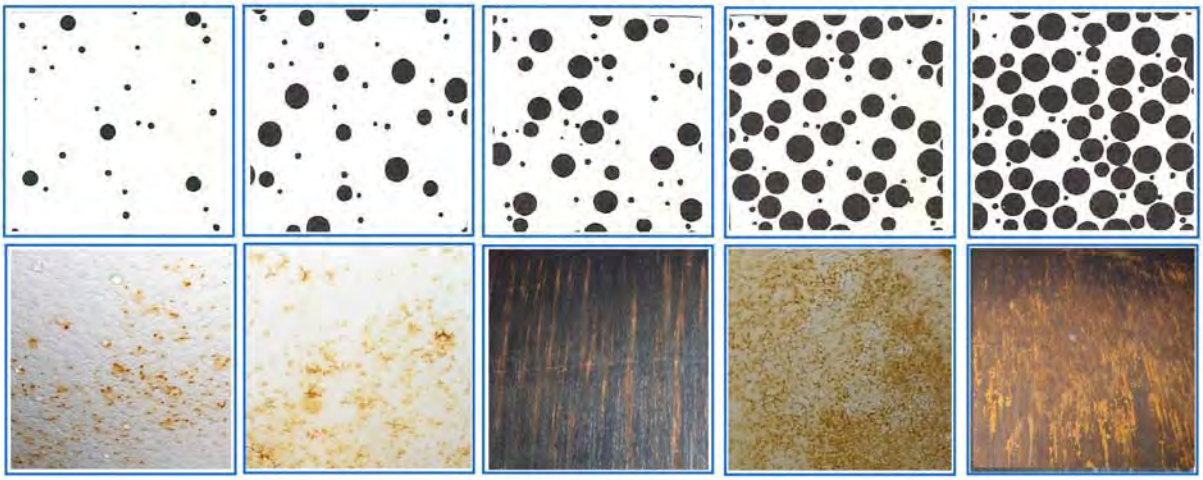
Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

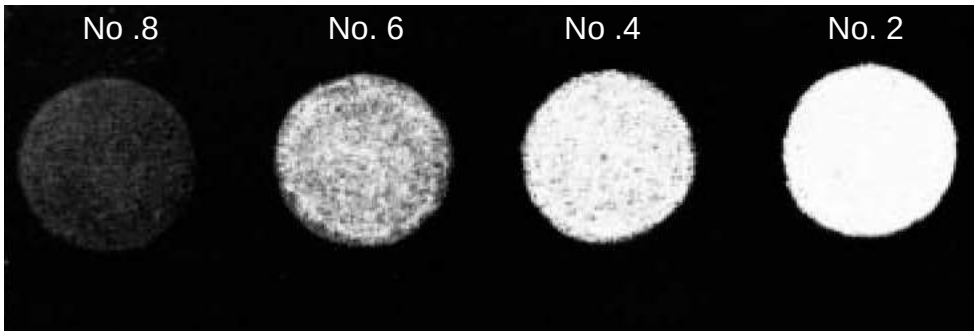
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

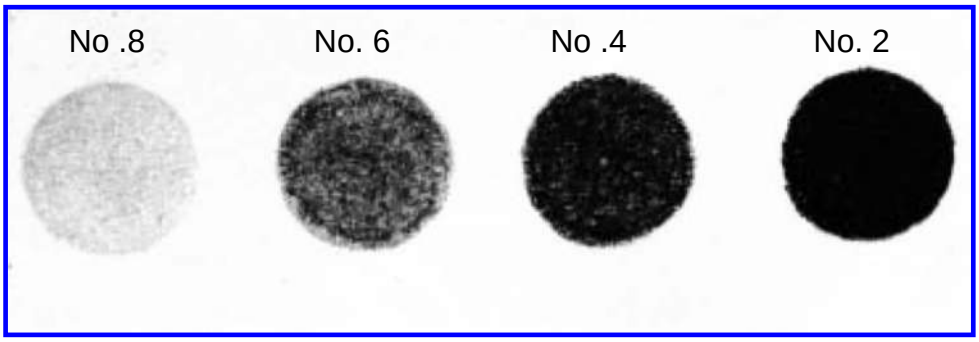
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

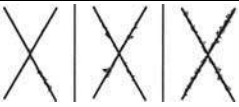
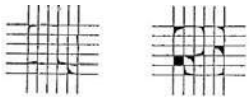
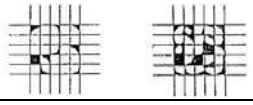
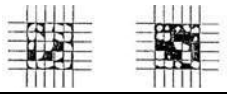


Dark Colored Paints



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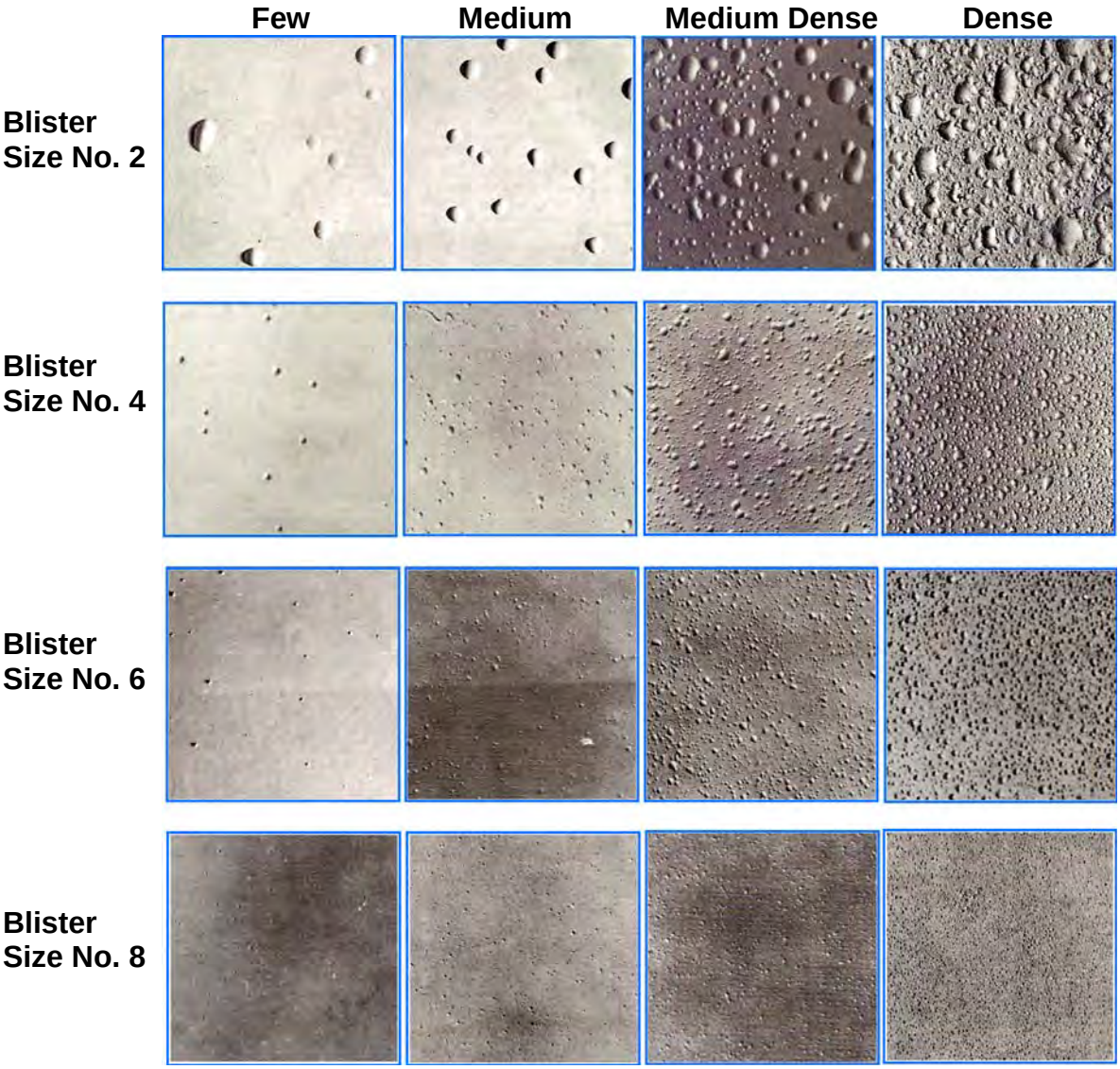
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -001



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -002



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -003



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -004



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -005



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -006



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -007



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -008



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -009



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -010



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -011



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -012



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -013



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -014



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -015



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -016



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -017



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -018



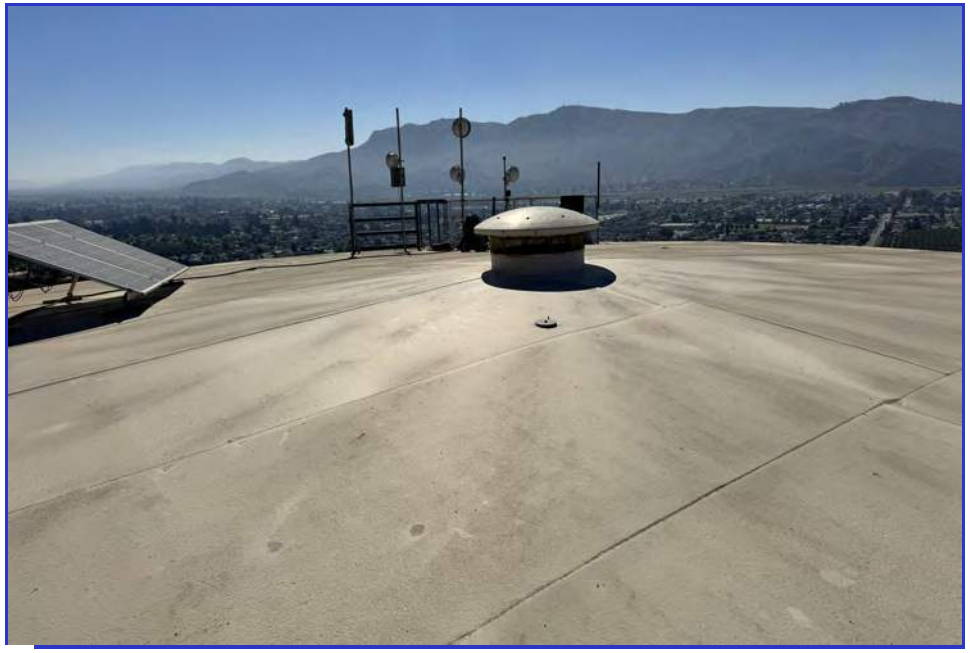
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -019



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -020



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -021



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -022



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -023



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -024



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -025



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -026



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -027



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -028



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -029



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -030



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -031



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -032



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -033



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -034



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -035



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -036



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -037



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -038



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -039



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -040



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -041



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -042



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -043



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -044



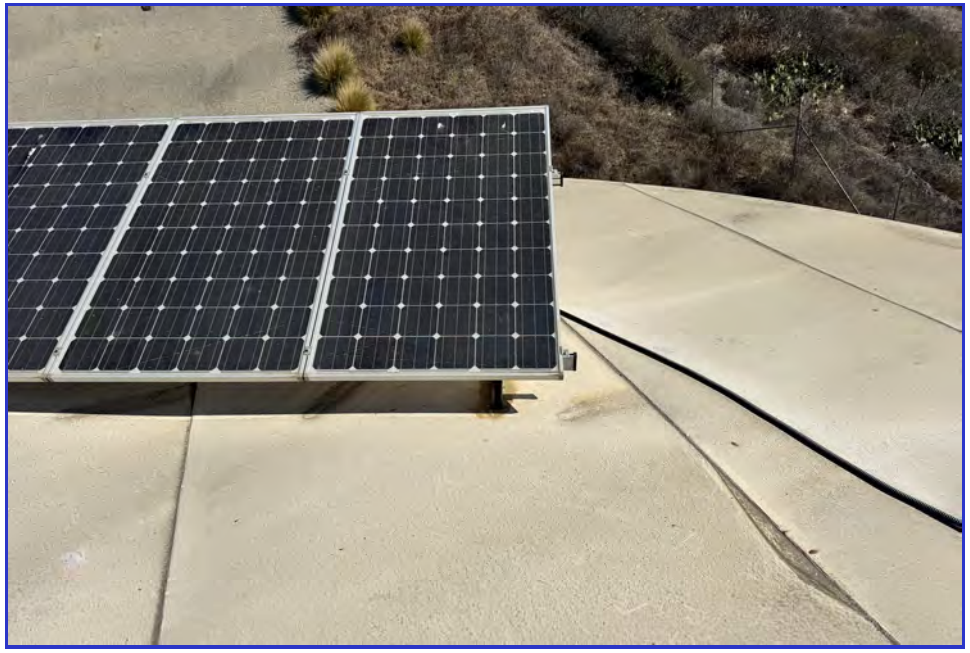
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -045



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -046



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -047



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -048



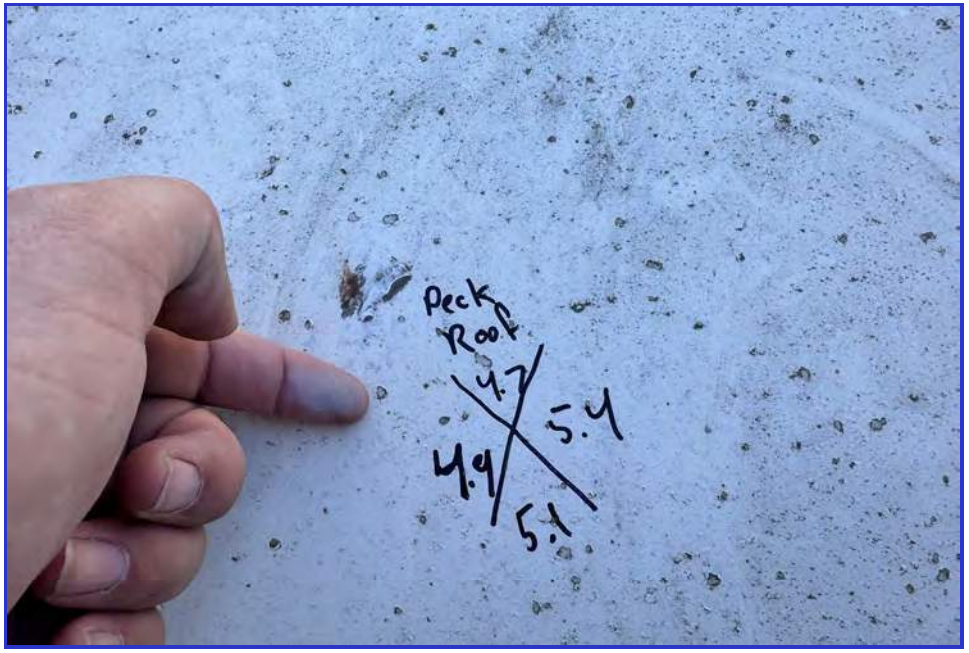
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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -050



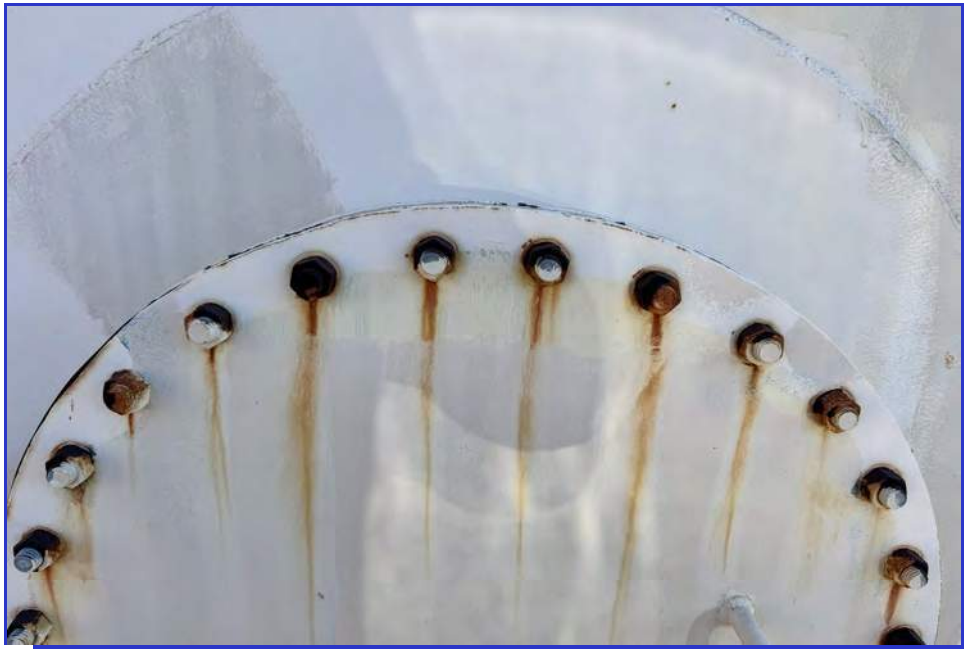
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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -052



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -053



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -054



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -055



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -056



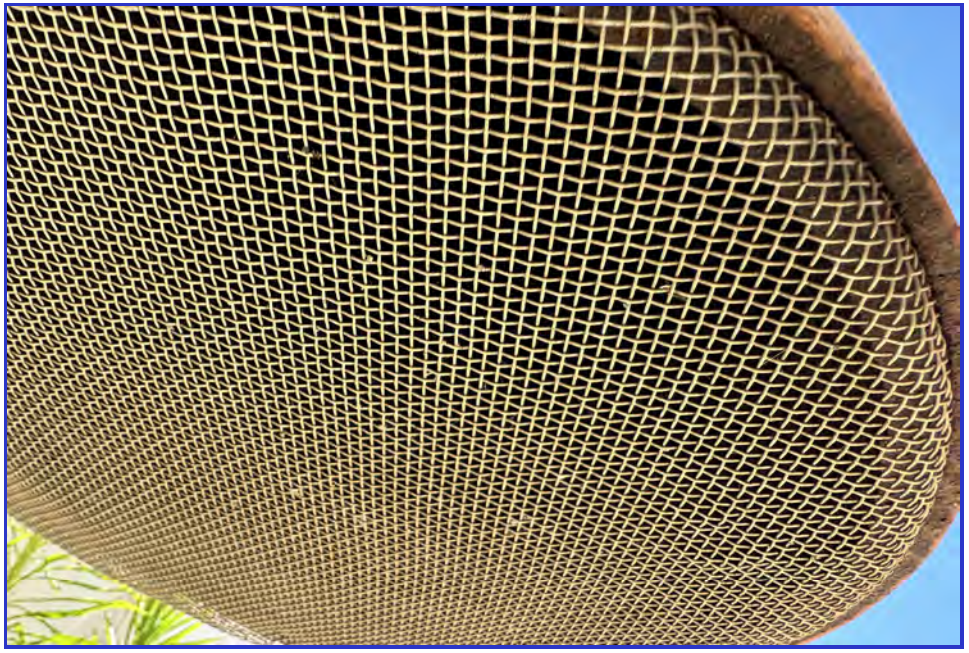
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -057



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -058



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -059



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -060



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -061



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -062



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -063



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -064



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -065



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -066



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -067



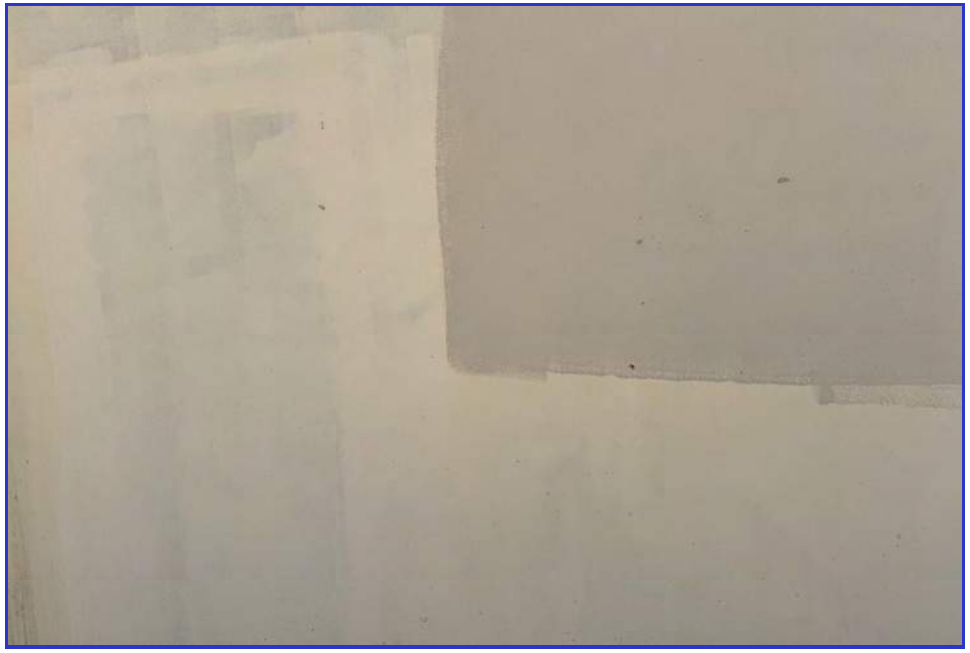
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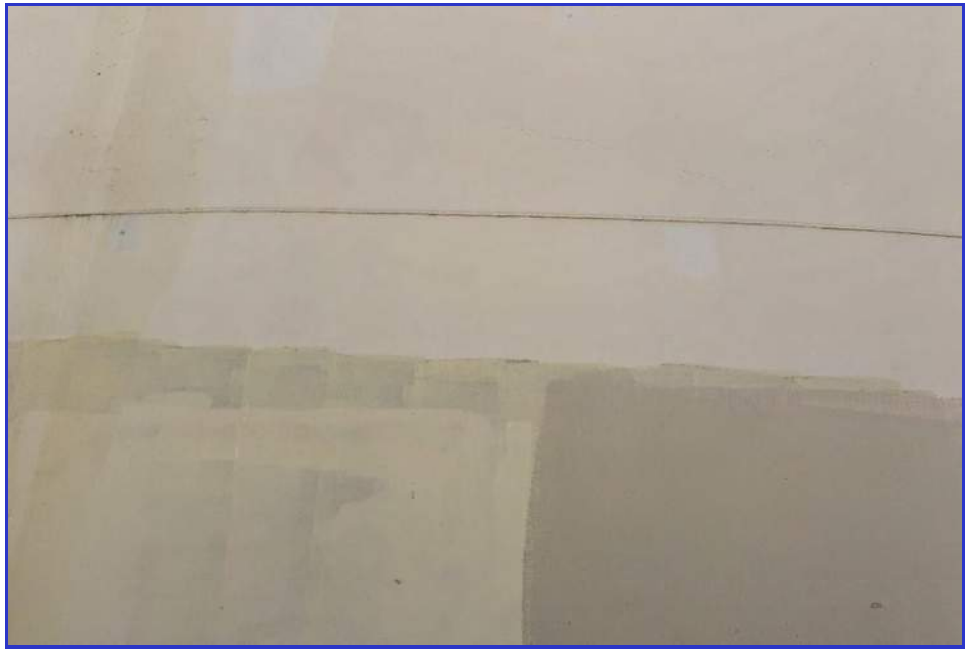
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -069



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -070



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -071



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -072



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -073



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -074



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -075



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -076



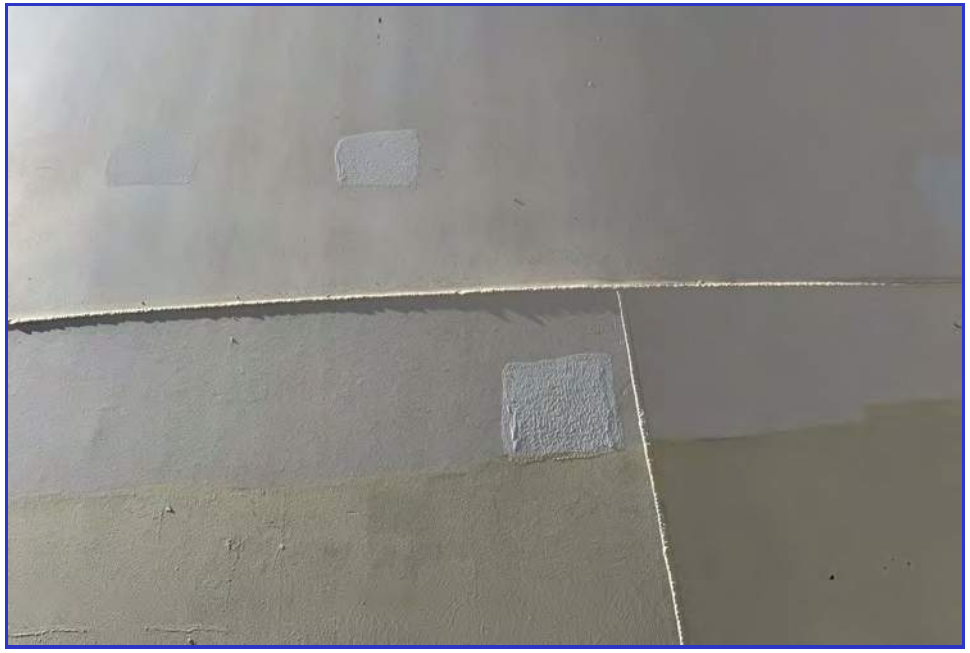
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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -078



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -079



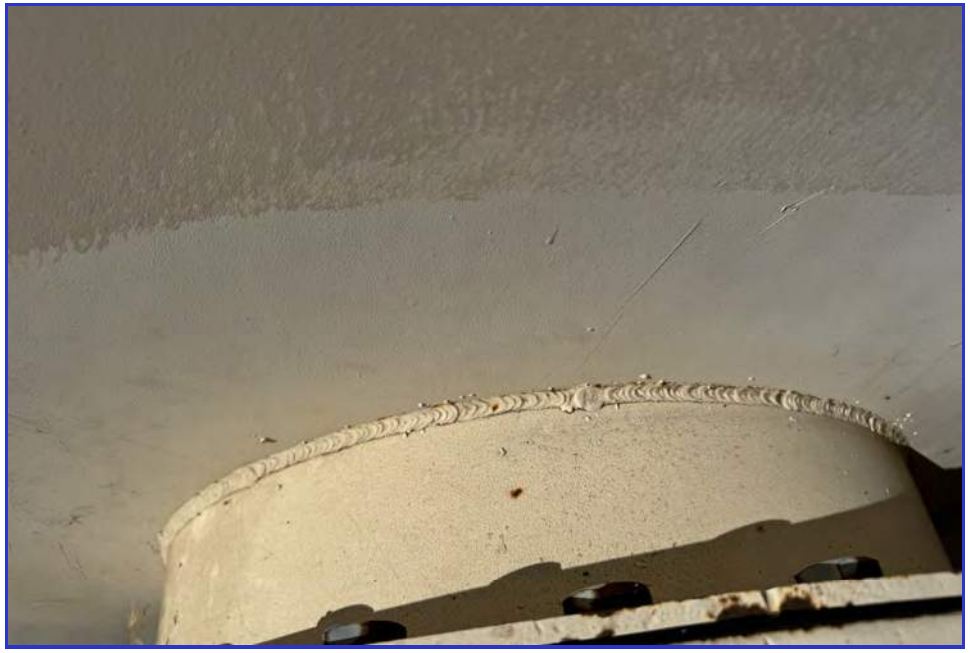
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -080



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -081



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -082



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -083



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -084



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -085



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -086



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -087



EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -088



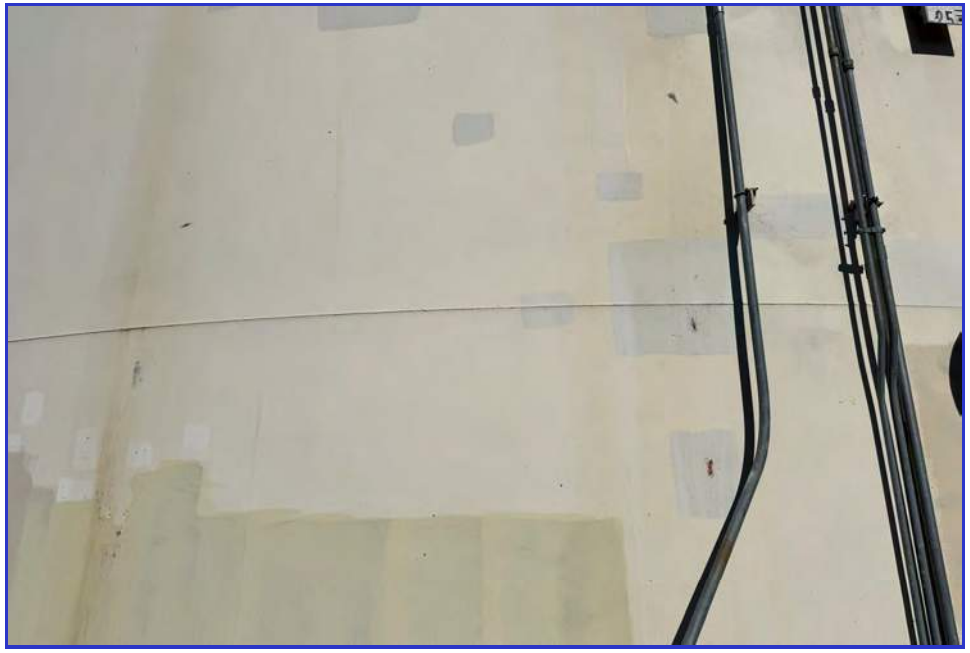
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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -090



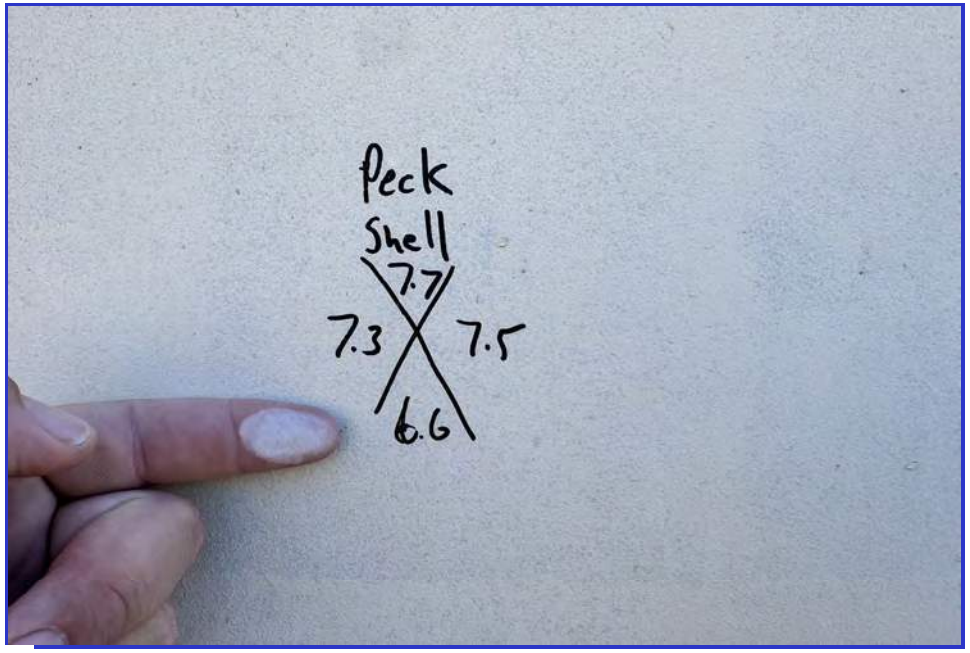
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EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -093



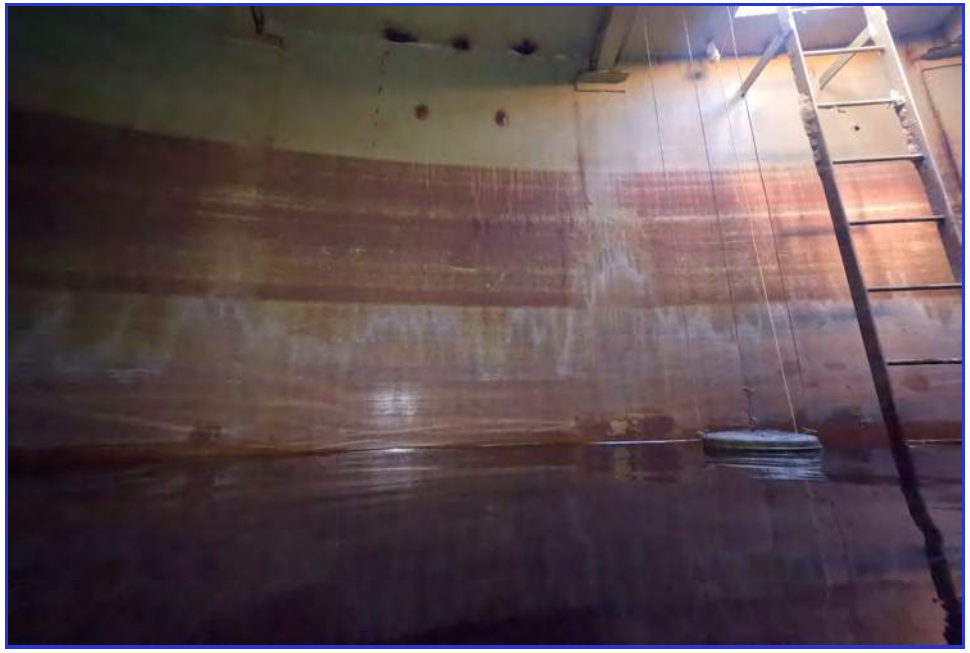
EXTERIOR - City of Santa Paula - Peck - Maintenance Inspection -094



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INTERIOR - City of Santa Paula - Peck - Maintenance Inspection



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -001



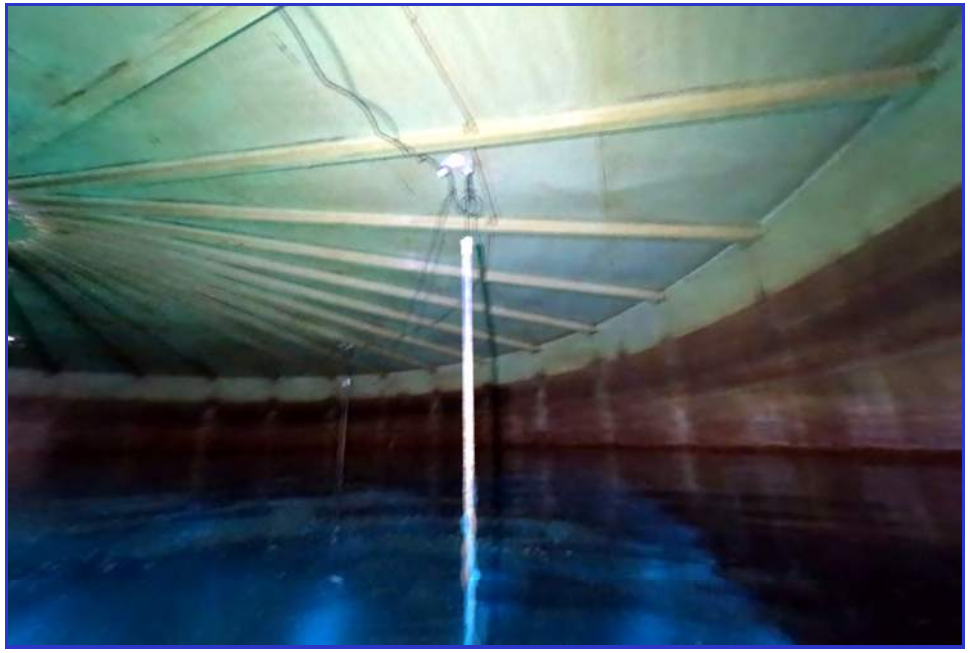
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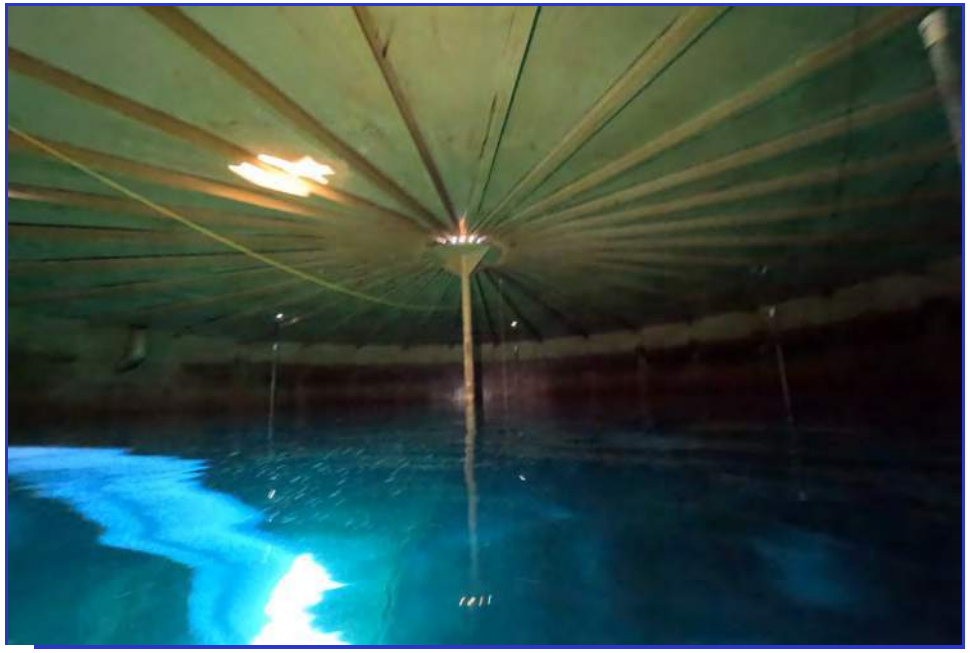
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -003



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -004



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -005



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -006



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -007



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -008



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -009



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -010



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -011



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -012



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -013



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -014



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -015



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -016



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -017



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -018



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -019



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -020



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -021



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -022



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -023



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -024



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -025



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -026



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -027



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -028



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -029



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -030



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -031



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -032



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -033



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -034



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -035



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INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -037



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -038



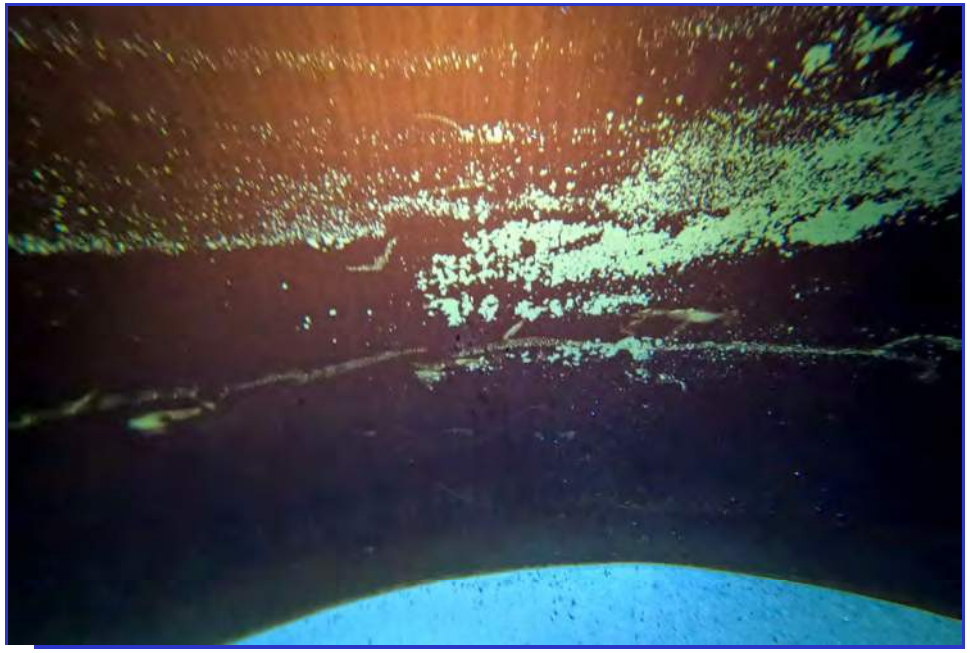
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -039



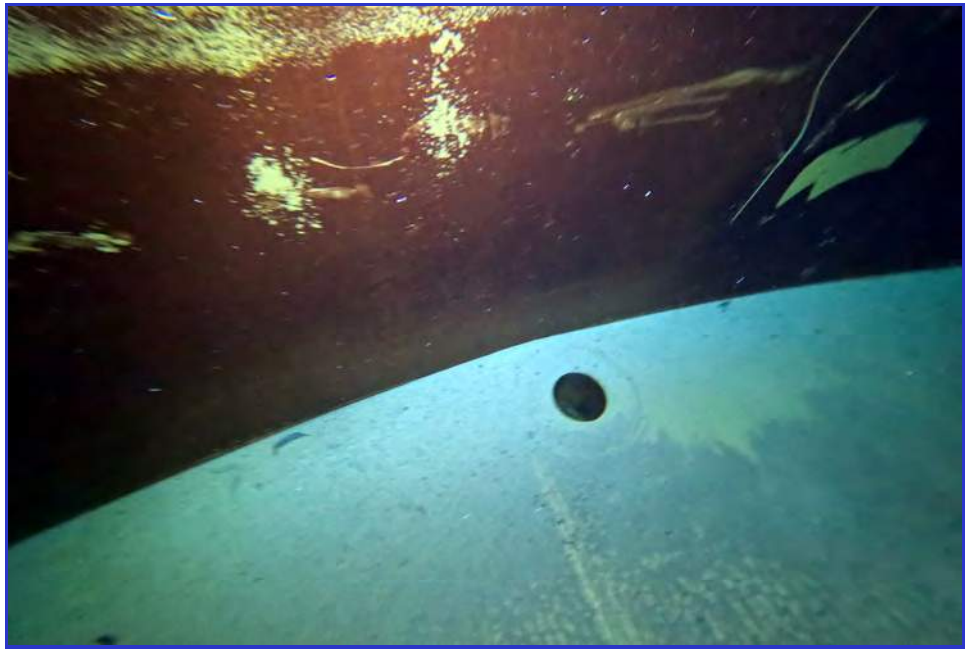
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -040



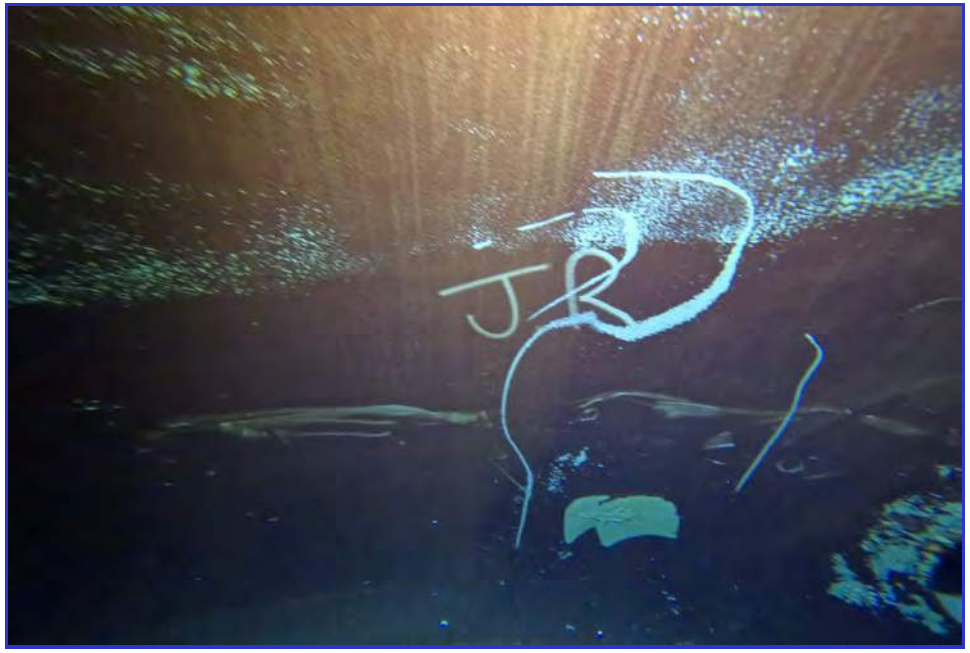
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -041



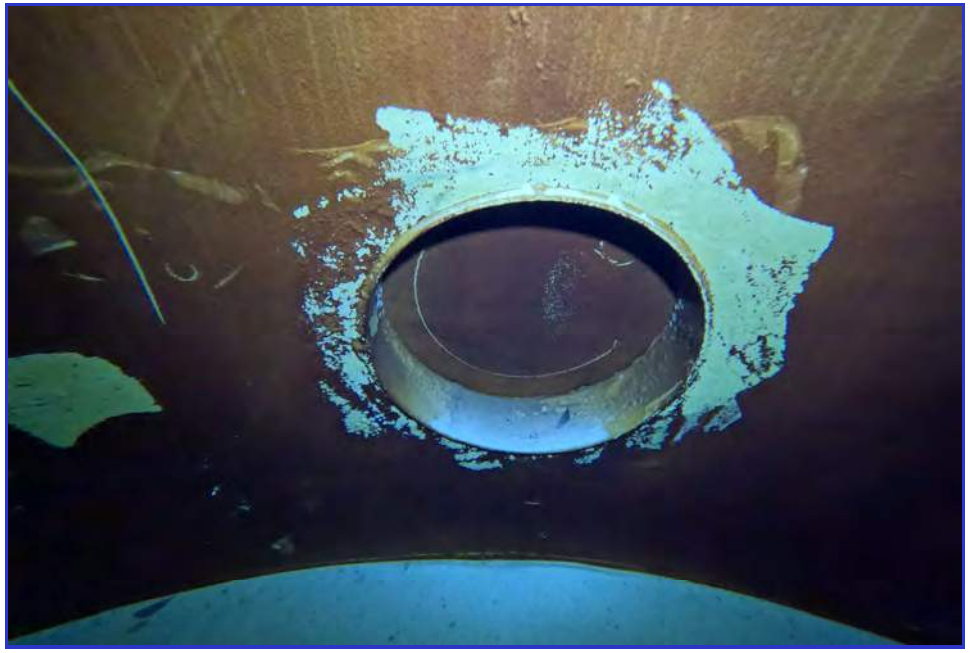
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -042



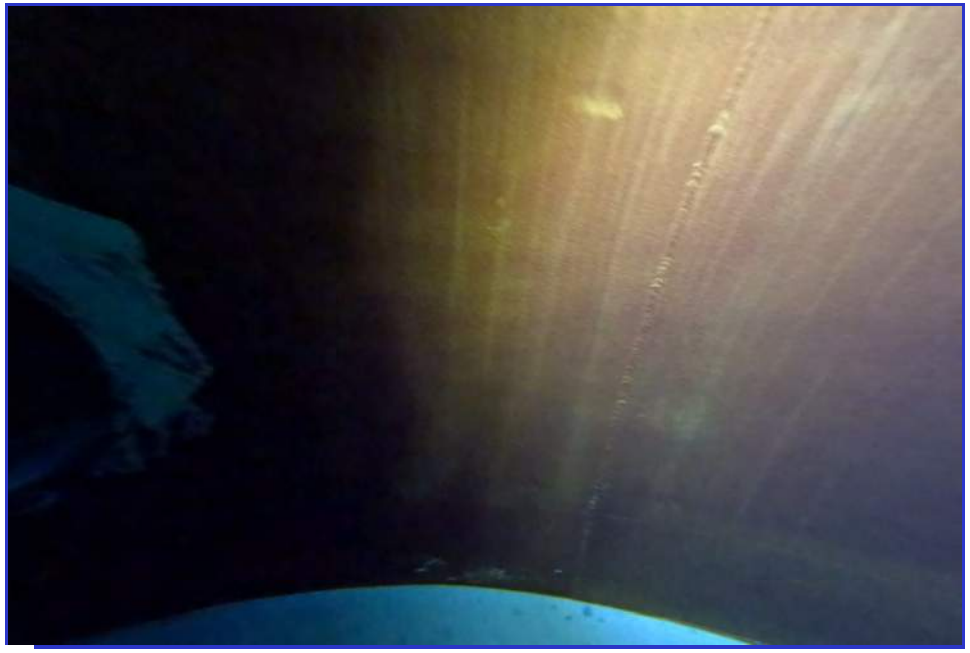
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -043



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -044



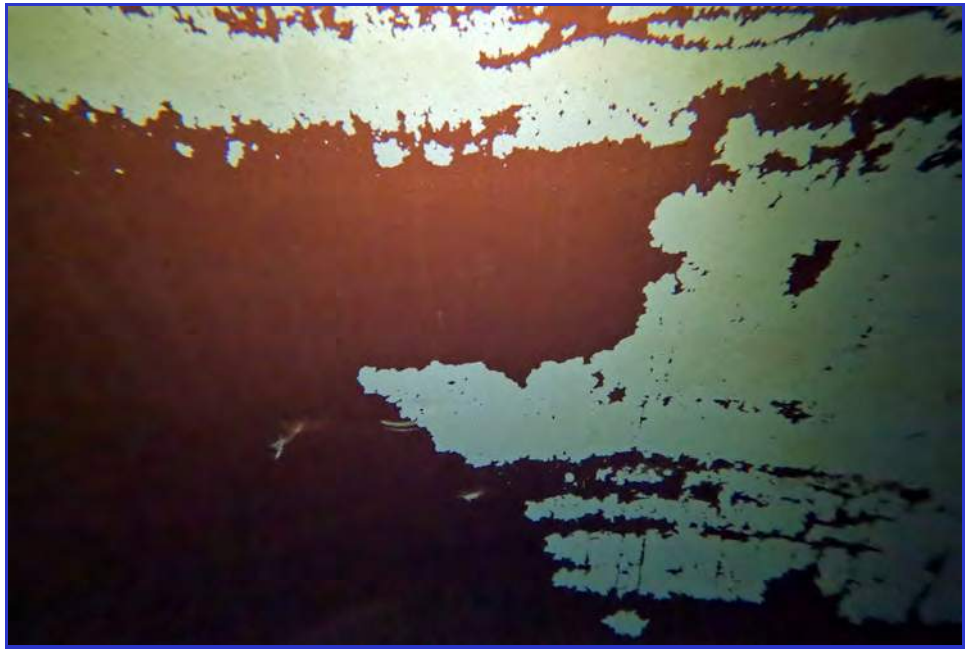
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -045



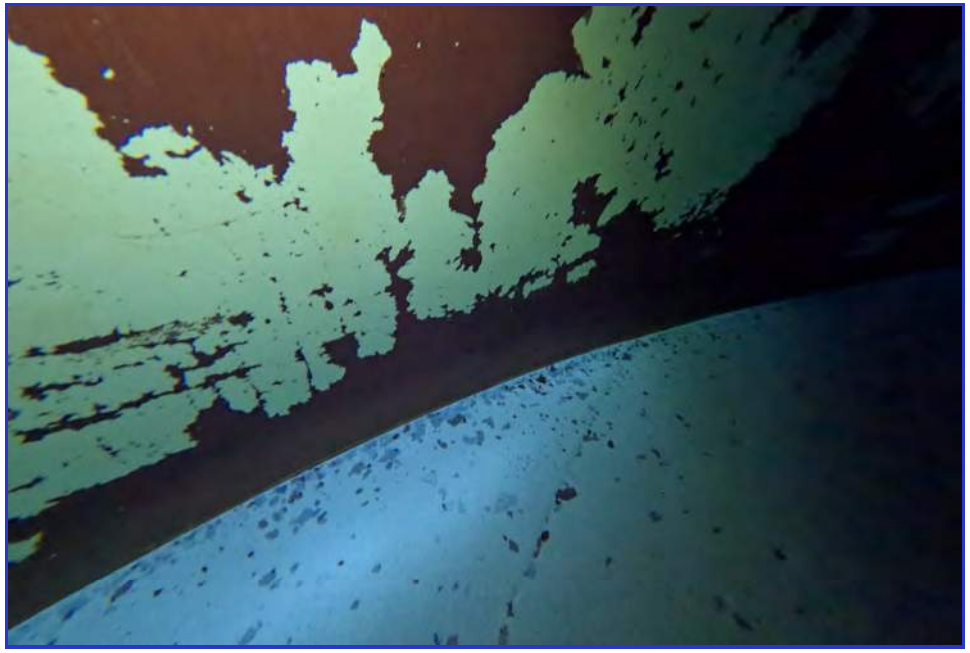
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -046



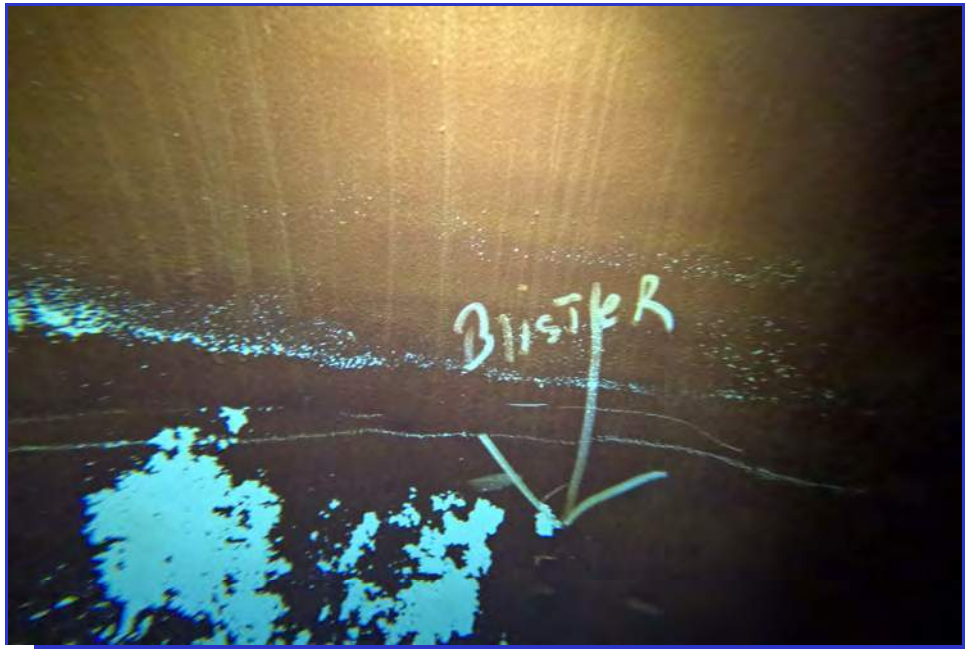
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -047



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -048



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -049



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -050



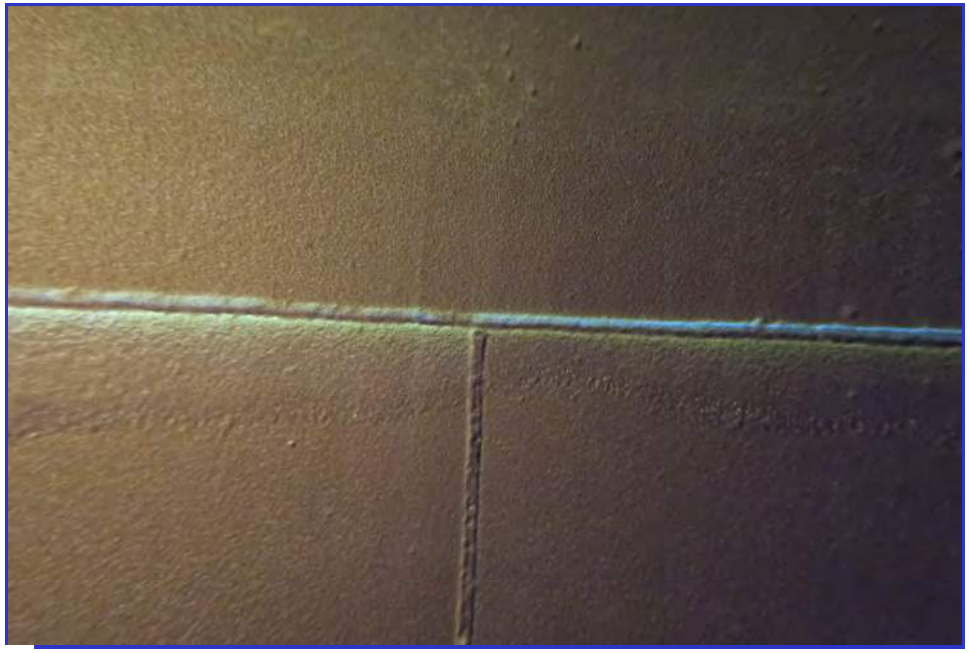
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -051



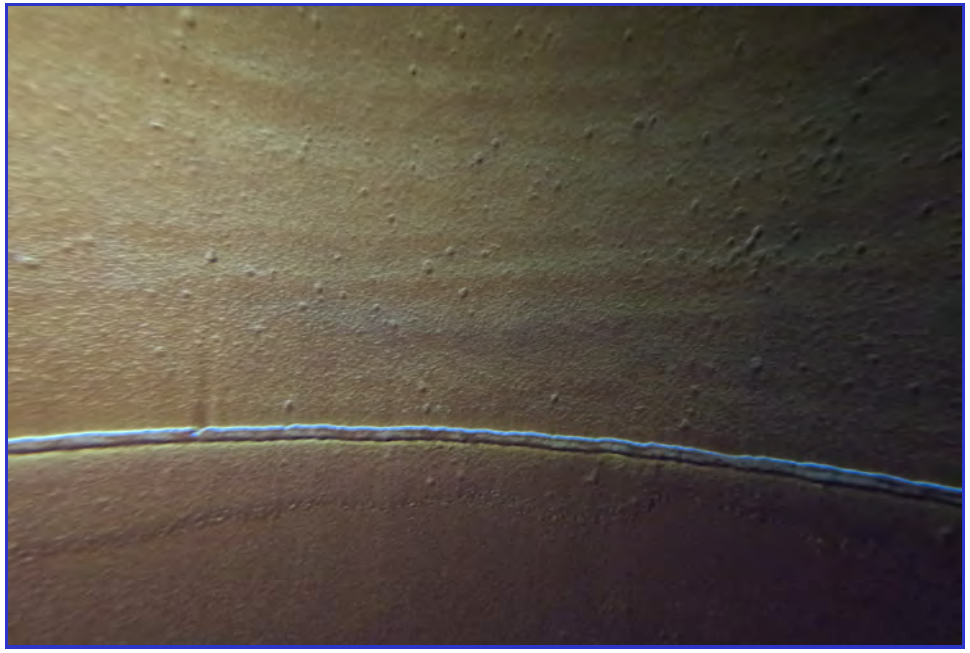
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -052



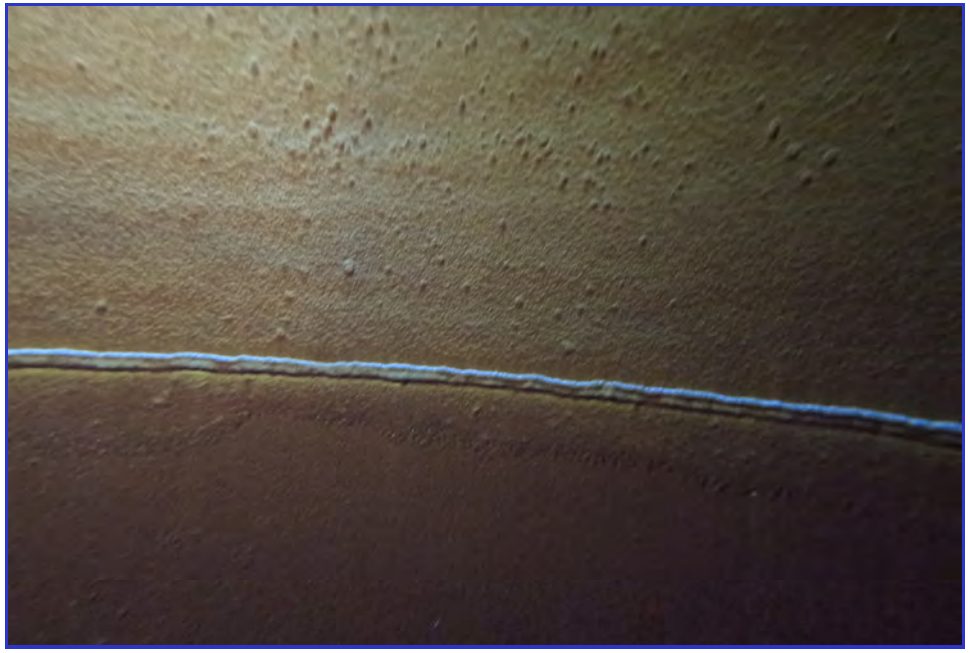
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -053



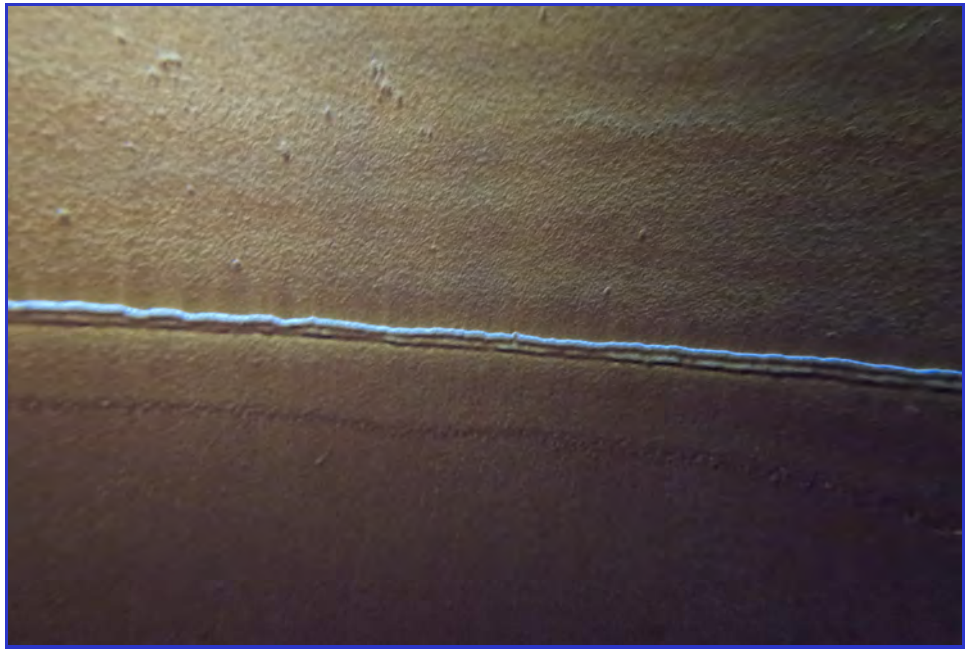
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -054



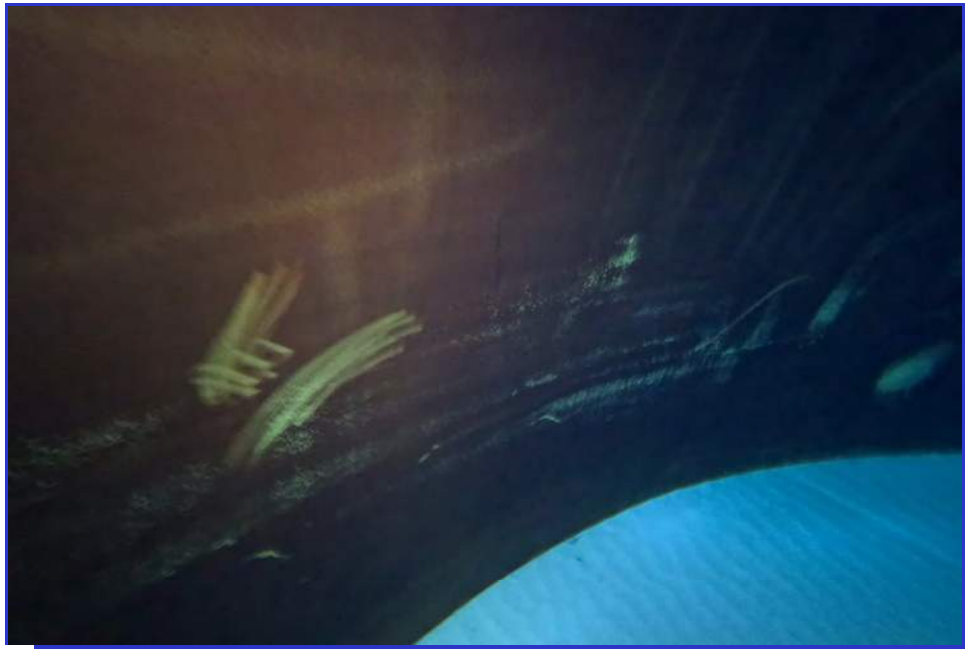
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -055



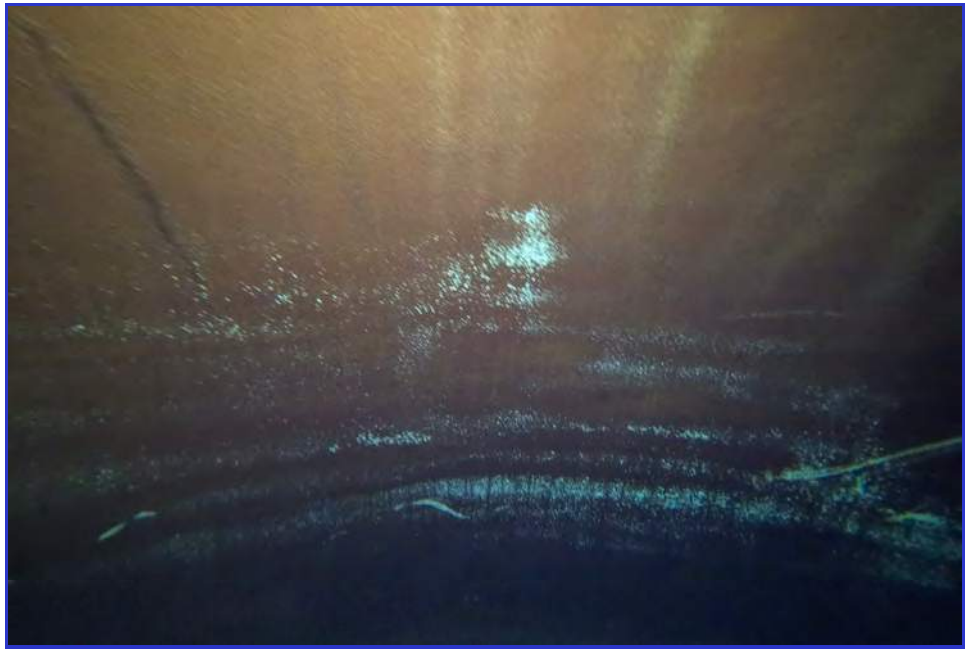
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -056



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -057



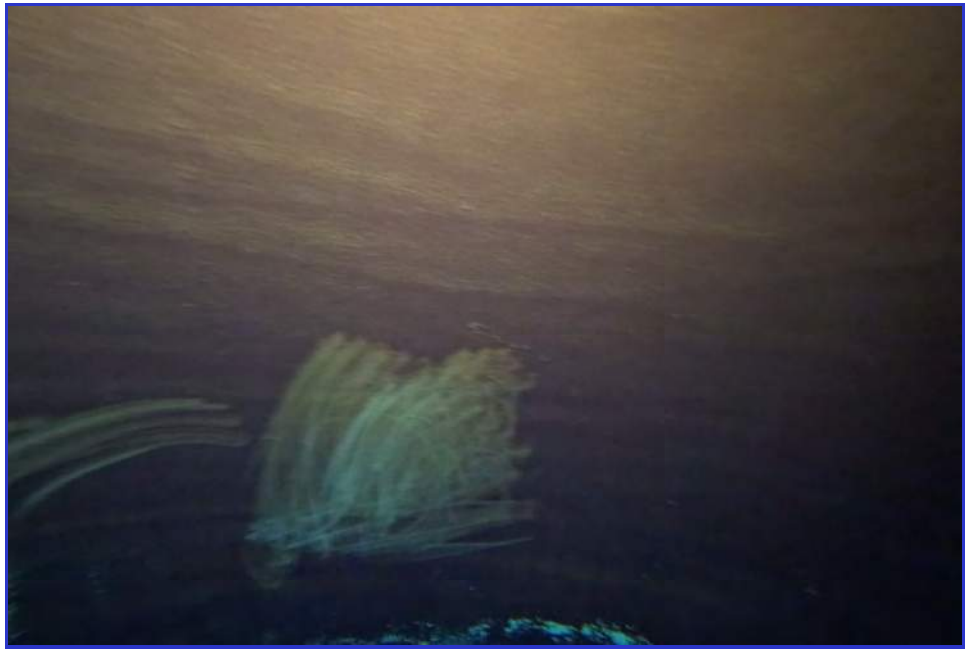
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -058



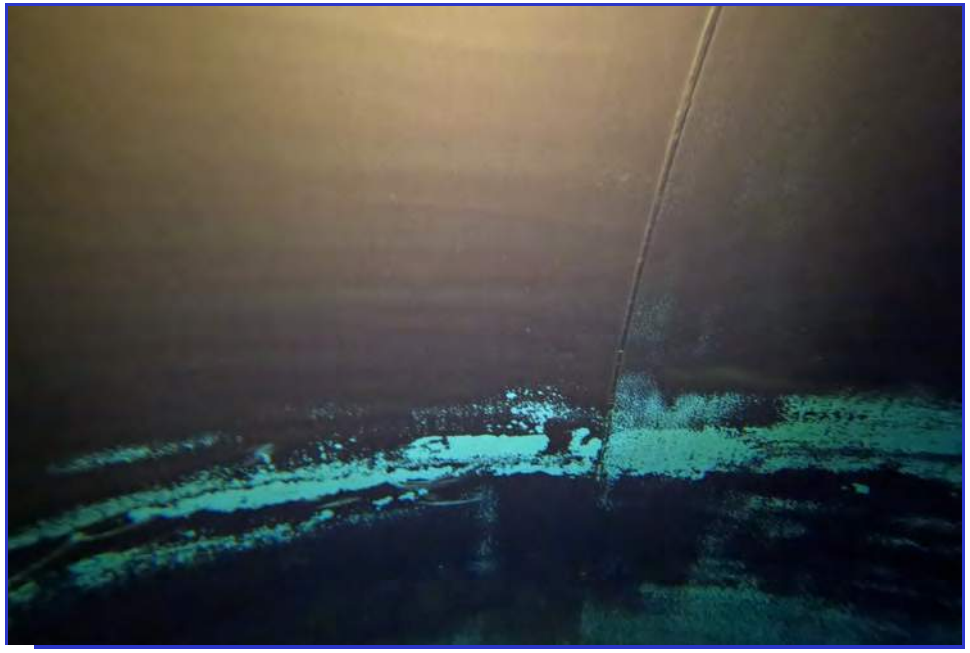
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -059



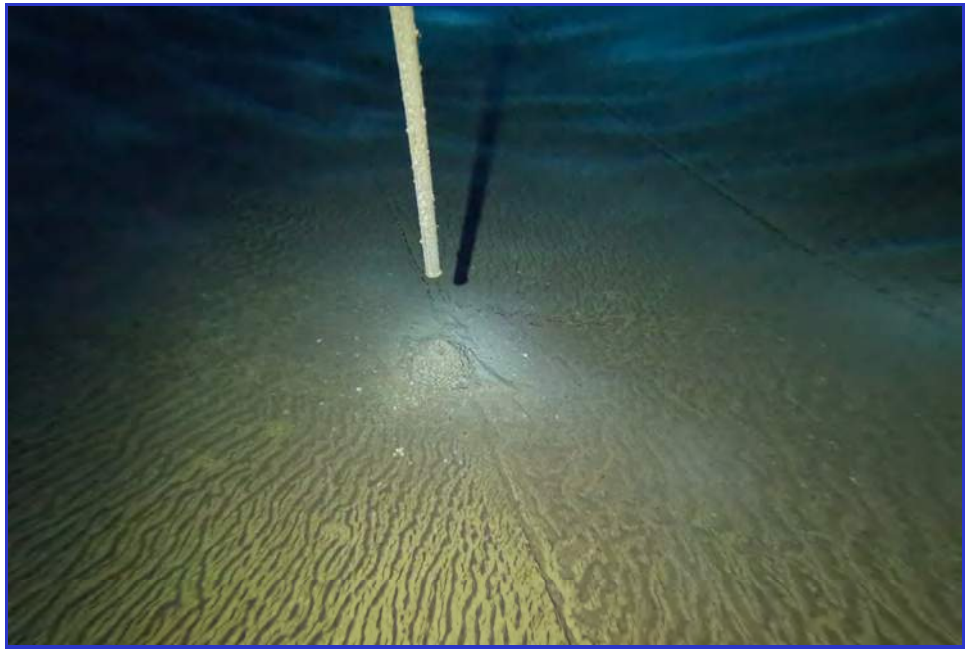
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -060



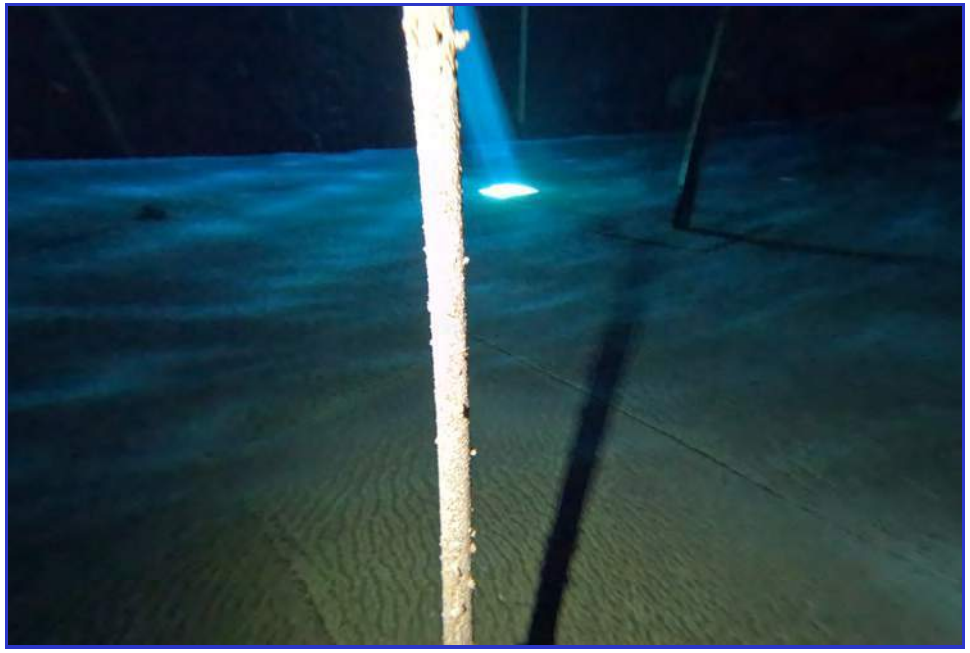
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -061



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -062



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -063



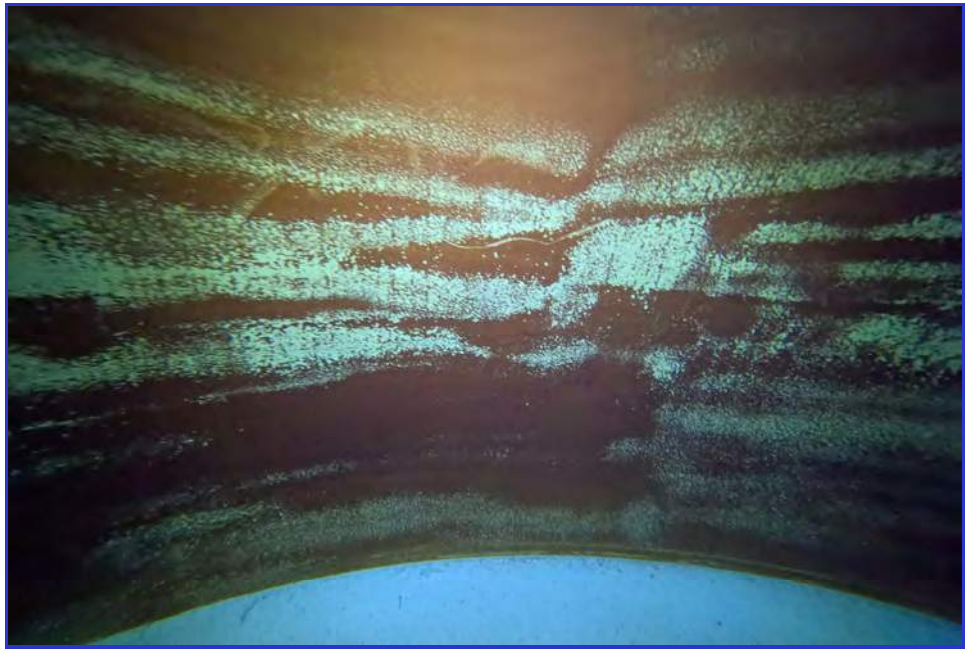
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -064



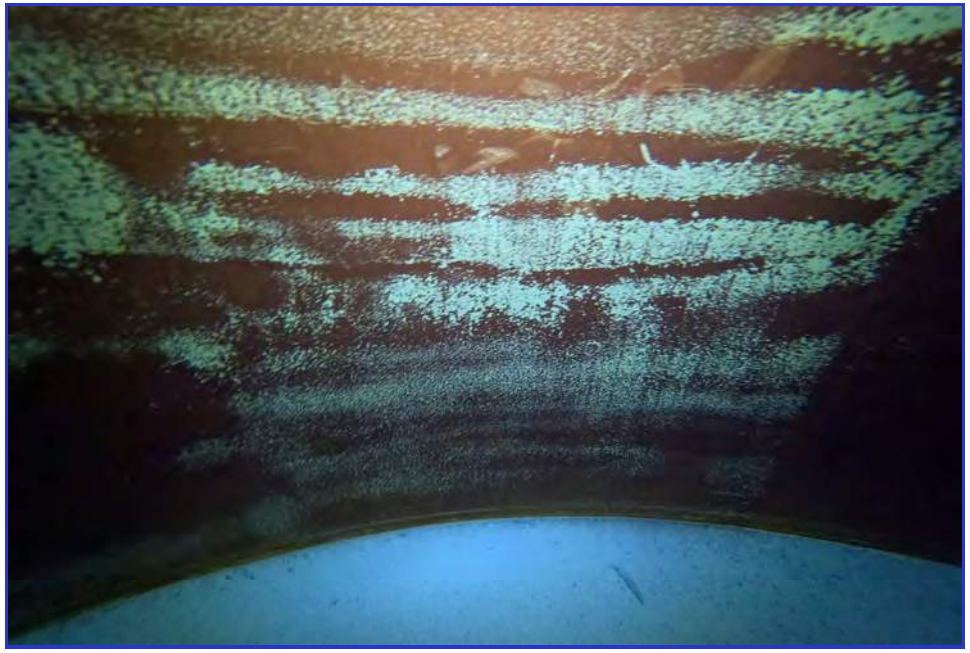
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -065



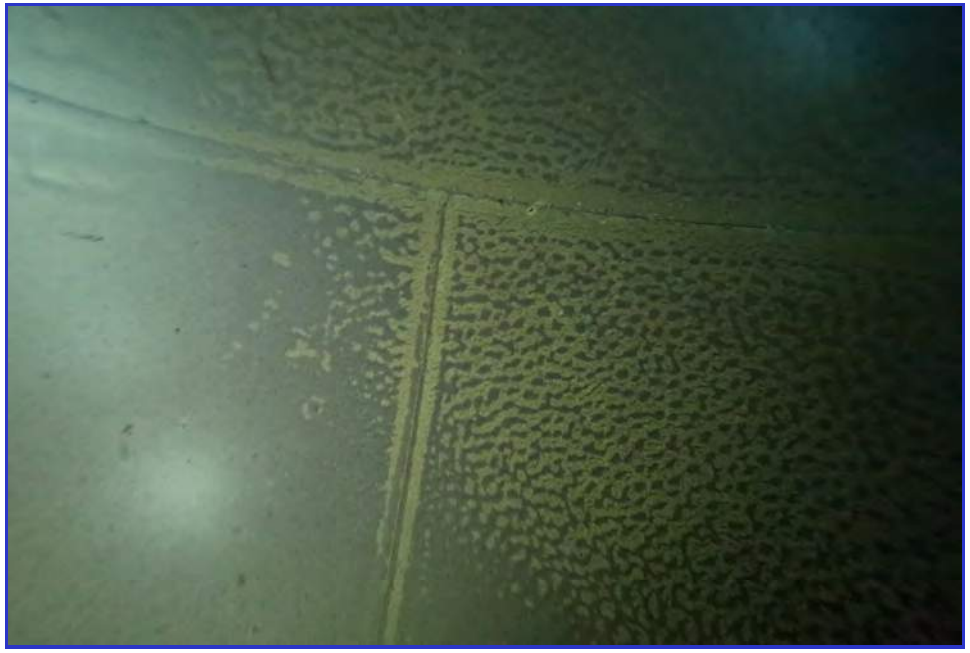
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -066



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -067



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -068



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -069



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -070



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -071



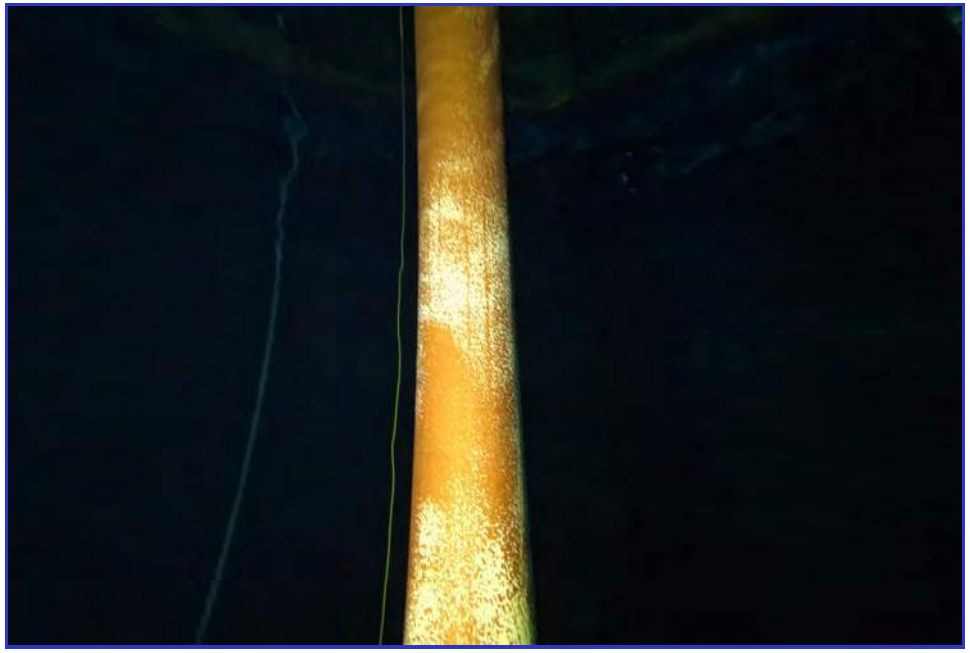
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -072



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -073



INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -074



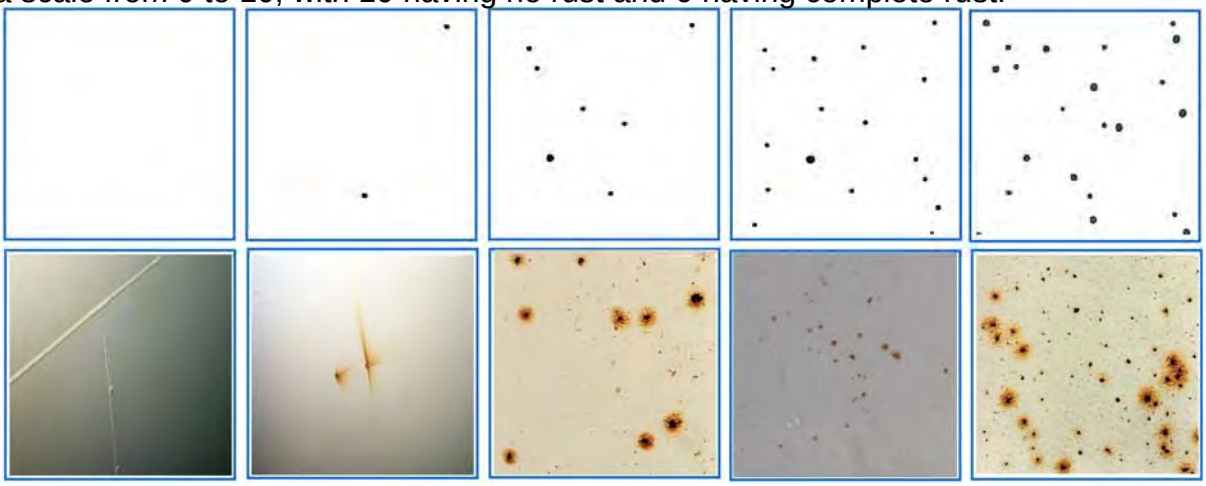
INTERIOR - City of Santa Paula - Peck - Maintenance Inspection -075

Chart 1 - Condition Rating The table below gives a basic description of the four different categories that CSI Services, Inc. uses to provide a general depiction of the condition of each defined area of a structure. The categories are Poor, Fair, Good, or Excellent. The development of these categories is based on historical knowledge and experience of various paint and lining systems over given periods of time in certain service environments. Basically, the rating is determined based on what should be expected of the paint or lining system at that point in its life cycle. As a result, different determinations are made for maintenance inspection versus warranty inspections. A detailed description of each rating with relative consideration addressed follows:

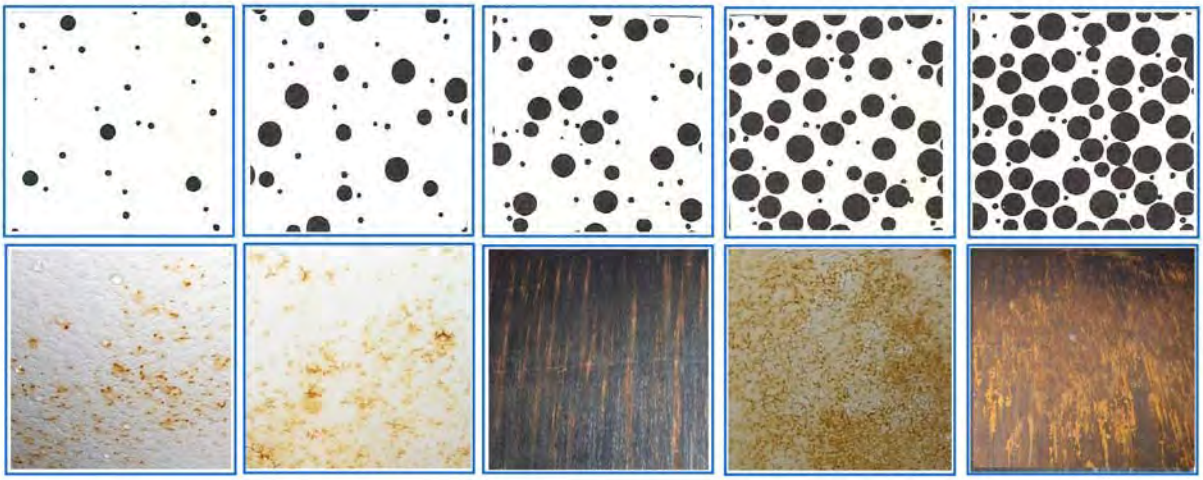
Rating	General Description of Conditions	
	Maintenance Inspection	**Warranty Inspection**
Poor	This condition is usually prioritized for rework in the short-term. Typically, these surfaces have considerably more coating defects and/or corrosion than what is expected for the age of the system.	This condition identifies an area with wholesale coating defects or corrosion concerns that will typically require significant removal and replacement of the coatings in the area.
Fair	Typically, these surfaces have a level of coating defects and/or corrosion that is slightly worse than what should be expected for the age of the system. This condition is placed on a short-term monitoring schedule.	This condition identifies an area with partial coating defects or corrosion concerns that will require significant rework.
Good	This condition is rated for areas without any considerable coating defects or corrosion. These surfaces are in a condition that is typical for the age of the coating system.	This condition identifies areas with coating defects or corrosion that is typically seen in one-year warranty inspections. Typically, only minor spot repairs are required.
Excellent	This condition is for areas without any considerable coating defects or corrosion. Typically, these surfaces are in a condition that is better than expected for the age of the system.	This condition identified areas that typically are in perfect condition and require no repair work.

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Chart 2 -Rust Grade The black and white figures below depict the standards referenced in ASTM D610 “Standard Test Method for Evaluating Degree of Rusting on Painted Surfaces.” Below each standard is a photographic depiction of each level of corrosion, as used by CSI Services, Inc. The standards depict the percentage of rust on a scale from 0 to 10, with 10 having no rust and 0 having complete rust.



Rust Grade 10 Rust Grade 9 Rust Grade 8 Rust Grade 7 Rust Grade 6



Rust Grade 5 Rust Grade 4 Rust Grade 3 Rust Grade 2 Rust Grade 1



Rust Grade 0

Rust Grade	Description
10	No rusting or less than 0.01% of surface rusted
9	Minute rusting, less than 0.03% of surface rusted
8	Few isolated rust spots, less than 0.1% of surface rusted
7	Less than 0.3% of surface rusted
6	Excessive rust spots, but less than1% of surface rusted
5	Rusting to the extent of 3% of surface rusted
4	Rusting to the extent of 10% of surface rusted
3	Approximately one-sixth of the surface rusted
2	Approximately one-third of the surface rusted
1	Approximately one-half of the surface rusted
0	Approximately 100% of the surface rusted

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Chart 3 - Corrosion Grade The figure below depicts the photographic standards referenced by CSI Services, Inc. in the determination of the characteristics and stages of corrosion progression. This standard is used to better quantify the level of corrosion once it has progressed to Rust Grades 3, 2, 1, or 0 (see Chart 2). When applicable, CSI classifies an area as one or more of the five different Corrosion Grades. Corrosion Grades 1 through 5 are described below:

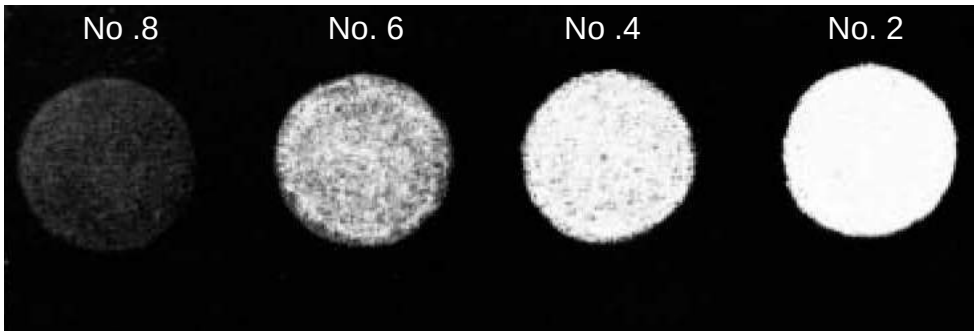
Grade	Description	Photo Examples
1	Light Rust - This condition involves relatively light colored rust that does not have any significant metal loss.	 
2	Dark Rust -This condition involves relatively dark colored, thicker rust that is progressing towards the next phase, significant metal loss.	 
3	Pitting - This condition involves isolated or widespread deep spot corrosion (pitting).	
4	Scale - Also known as lamellar or exfoliation corrosion. The edges of the affected area are leaf like and resemble the separated pages of a wetted book.	 
5	Structural Loss - This condition involves metal loss or failure where components will require structural consideration	 

The photos depicted are examples and were not taken on this project.

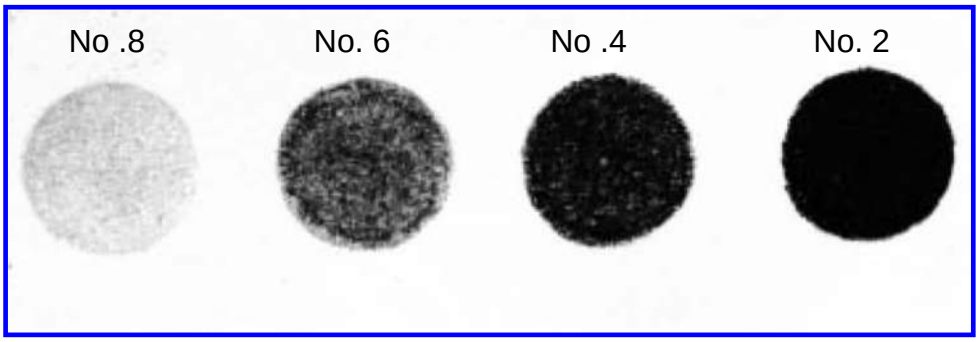
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Chart 4 - Chalking The figure below depicts the photographic standards referenced in ASTM D4214 “Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films,” Method D659, Method C. Generally speaking, chalking is the degradation of a paint’s binder leaving behind loose pigments as the binder reacts with the environment, primarily ultraviolet light and oxygen. Evaluating chalking is a means to measure the performance of a coating system and its life cycle projection. It is also important to quantify for consideration of future overcoating options. This test uses these pictorial standards to quantify the amount of chalking present on paint films. The depictions below represent the mount of colored chalk removed onto a cloth during the test. The scale ranges from 2 to 8 with the rating 2 having the most chalk.

Light Colored Paints

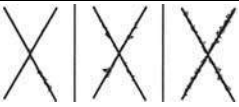
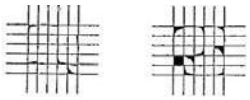
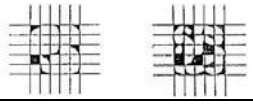
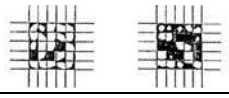


Dark Colored Paints



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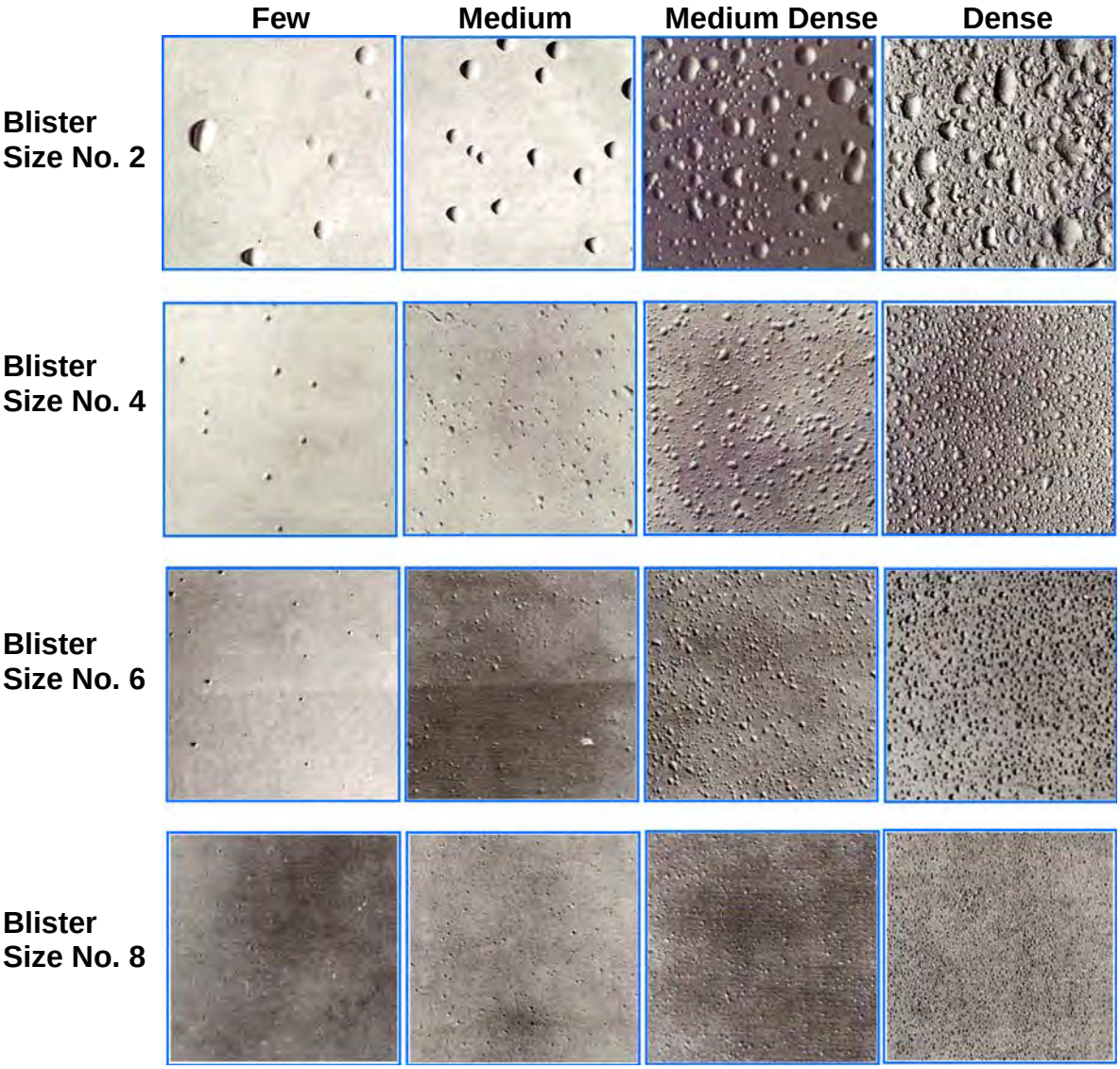
Chart 5 - Adhesion Rating The figures below depict the photographic standards and criteria referenced in ASTM D3359 "Standard Test Method for Evaluating Adhesion by Tape Test" and ASTM D6677 "Standard Test Method for Evaluating Adhesion by Knife." Both Standards are used to assess the condition of a paint system for life-cycle projections. It is also used to evaluate an existing paint system's ability to withstand the added stress that any overcoating strategies can create. Depending upon the thickness of the paint system, ASTM D3359 has two different test methods. The rating criteria for both standards follow:

ASTM D3359					
Method A			Method B		
Rating	**Observation**	**Surface of X-cut from which flaking/peeling has occurred**	**Rating**	**Percent Area Removed**	**Surface of cross-cut area from which flaking has occurred for six parallel cuts and adhesion range by percent**
5A	No peeling or removal	None	5B	0% none	
4A	Trace peeling or removal along incisions or their intersection		4B	Less than 5%	
3A	Jagged Removal along incisions up to 1/16" on either side		3B	5 – 15%	
2A	Jagged removal along most of incisions up to 1/8" on either side		2B	15 – 35%	
1A	Removal from most of the area of the X under the tape		1B	35-65%	
0A	Removal beyond the area of the X		0B	Greater than 65%	

ASTM D6677	
Rating	Description
10	Fragments no larger than $\frac{1}{32}$" x $\frac{1}{32}$" can be removed with difficulty
8	Chips up to $\frac{1}{8}$" x $\frac{1}{8}$" can be removed with difficulty
6	Chips up to $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight difficulty
4	Chips larger than $\frac{1}{4}$" x $\frac{1}{4}$" can be removed with slight pressure
2	Once coating removal is initiated by knife, it can be peeled at least $\frac{1}{4}$"
0	Coating can be peeled easily to length greater than $\frac{1}{4}$"

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Chart 6 – Blistering Rating The figure below depicts the photographic standards referenced in ASTM D714 "Standard Test Method for Evaluating Degree of Blistering of Paints". This test uses these pictorial standards to quantify both the size and density of blisters that may develop in linings. Although the standard uses a blister size scale of 0 to 10 this chart uses the most common sizes of blisters found in the field. The standard does not use a reference for the size of each of the blisters depicted. CSI used this scale as a means for further quantification by qualifying the largest blister depicted as being 1 inch in width (Blister Size No. 2) and the smallest blister being 1/32 of an inch in width (Blister Size No. 8).



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