Posting Date: 07-16-2021

NOTICE OF REGULAR BI-MONTHLY MEETING
BOARD OF DIRECTORS

MEETING DATE: 07-20-2021

TIME: 7:30 p.m.

LOCATION: **This meeting will be held virtually, pursuant to the Governor's Executive Order N-29-20.**

To participate online, go to https://zoom.us/j/97779821239. You can also participate by phone by calling 1-669-900-6833 and entering the webinar ID#: 977 7982 1239.

PARTICIPATION DURING MEETINGS: During the public comment periods, the public may comment by clicking the "raise hand" button on the bottom of the Zoom screen; if you are joining by phone and would like to comment, press *9 and we will call on you as appropriate.

EMAILED PUBLIC COMMENTS: You may submit your comments in advance of the meeting by emailing them to BoardComment@MarinWater.org. All emailed comments received by 3 p.m. on the day of the meeting will be provided to the Board of Directors prior to the meeting. Those emailed comments on approval items received by 3 p.m. will also be summarized by the board secretary at the board meeting. All emails will be posted on our website. (Please do not include personal information in your comment that you do not want published on our website such as phone numbers and home addresses.)

AGENDA ITEMS	RECOMMENDATIONS
Call to Order and Roll Call	
Adopt Agenda	*Approve*
Public Comment Members of the public may comment on any items not listed on the agenda during this time. Comments will be limited to three (3) minutes per speaker, and time limits may be reduced by the board president to accommodate the number of speakers and ensure that the meeting is conducted in an efficient manner.	
Directors' and General Manager's Announcements	

AGENDA ITEMS	RECOMMENDATIONS
Consent Calendar All matters listed on the consent calendar are considered to be routine and will be enacted by a single action of the Board, unless specific items are removed from the consent calendar by the Board during adoption of the agenda for separate discussion and action.	
1. Minutes of the Board of Directors' Regular Bi-Monthly Meeting of July 6, 2021	*Approve*
2. General Manager's Report for June 2021	*Approve*
Regular Calendar	
3. Drought Update	*Information*
Public Hearing	
4. Adoption of Ordinance No. 453 Setting Forth Restrictions on Potable Water Landscape Installations for New Water Service Connections	*Approve*
Regular Calendar	
5. Smith Saddle Tanks Rehabilitation Project	*Information*
6. Future Meeting Schedule and Agenda Items	*Information*
Adjournment	

ADA NOTICE AND HEARING IMPAIRED PROVISIONS:

In accordance with the Americans with Disabilities Act (ADA) and California Law, it is Marin Water's policy to offer its public programs, services, and meetings in a manner that is readily accessible to everyone, including those with disabilities. If you are disabled and require a copy of a public hearing notice, an agenda, and/or agenda packet in an appropriate alternative format, or if you require other accommodations, please contact Board Secretary Terrie Gillen at 415.945.1448, at least two days in advance of the meeting. Advance notification will enable the Marin Water to make reasonable arrangements to ensure accessibility.

INFORMATION PACKETS ARE AVAILABLE FOR REVIEW AT THE CIVIC CENTER LIBRARY, CORTE MADERA LIBRARY, FAIRFAX LIBRARY, MILL VALLEY LIBRARY, MARIN WATER OFFICE, AND ON THE MARIN WATER WEBSITE (MARINWATER.ORG)

FUTURE BOARD MEETINGS:

- CANCELLED - Friday, July 22, 2021
  Finance & Administration Committee/Board of Directors (Finance & Administration) Meeting
  9:30 a.m.

- Tuesday, August 3, 2021
  Board of Directors' Regular Bi-Monthly Meeting
  7:30 p.m.

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Board Secretary

Item Number: 01
Meeting Date: 07-20-2021
Meeting: Board of Directors

Approval Item

TITLE
Minutes of the Board of Directors' Regular Bi-Monthly Meeting of July 6, 2021

RECOMMENDATION
Approve the adoption of the minutes.

SUMMARY
On July 6, 2021, the board held its regular bi-monthly meeting. The minutes of this meeting are attached.

DISCUSSION
None

FISCAL IMPACT
None

ATTACHMENT(S)
1. Minutes of the Board of Directors' Regular Bi-Monthly Meeting of July 6, 2021

DEPARTMENT OR DIVISION	DIVISION MANAGER	APPROVED
Communications & Public Affairs Department	**Terrie Gillen** **Board Secretary**	**Paul Sellier,** **Acting General Manager for** **Ben Horenstein**

Item Number: 01
Attachment: 1

MARIN MUNICIPAL WATER DISTRICT
BOARD OF DIRECTORS

MEETING MINUTES

Tuesday, July 6, 2021

Via teleconference
(In accordance with Governor Gavin Newsom's Executive Order N-29-20)

DRAFT

DIRECTORS PRESENT: Larry Bragman, John C. Gibson, Larry Russell, Monty Schmitt, and Cynthia Koehler

DIRECTORS ABSENT: None

CALL TO ORDER AND ROLL CALL
Board President Koehler called the meeting to order at 6:01 p.m.

ADOPT AGENDA
On motion made by Director Gibson and seconded by Director Schmitt, the board adopted the agenda. The following roll call vote was made.

Ayes: Directors Bragman, Gibson, Russell, Schmitt, and Koehler
Noes: None

PUBLIC COMMENT
There were six public comments made during this portion of the meeting.

DIRECTORS' AND GENERAL MANAGER'S ANNOUNCEMENTS

General Manager Ben Horenstein announced a modification was made to the Urban Water Management Plan (UWMP) consistent with Board direction and approval.

CONSENT CALENDAR (ITEMS 1-6)

Item 1 **Minutes of the Board of Directors' Regular Bi-Monthly Meeting of June 15, 2021 and Special Meeting of June 22, 2021**

Item 2 **An Easement Agreement with the Owners of 30 Forrest Ct., San Anselmo (APN 176-191-13), for the Installation of a New 6-Inch Fire Line and Upgrading a ¾ Inch Water Meter**

Item 3 **Adoption of a Resolution Authorizing the General Manager to Enter Into Professional Services Agreement MA-5963 with Woodard & Curran for Engineering Services for the Preliminary Design of the Pine Mountain Tunnel Replacement Project, in the Amount of $477,662, with a Staff Requested Contingency of $42,000, for a Total Not-To-Exceed $519,662**
(Resolution No. 8640)

Item 4 **Adoption of Resolution Awarding Contract No. 1948 for Fuelbreak Maintenance and Invasive Management to Forester and Kroeger Landscape Maintenance, inc. in the Amount of $1,784,000**
(Resolution No. 8641)

Item 5 **A Lease Agreement at the Mill Valley Tank (APN 046-070-03) with the Marin Emergency Radio Authority ("MERA")**

Item 6 **Adoption of a Resolution Authorizing the General Manager to Execute Miscellaneous Agreement No. 5952 with Miller Pacific Engineering Group for As-Needed Soil and Concrete Testing Services in Support of District Capital Improvement Projects and Water Main Repairs, for an Amount Not-To-Exceed $375,000**
(Resolution No. 8642)

There was no public comment.

On motion made by Director Gibson and seconded by Director Bragman, the board adopted Consent Calendar. The following roll call vote was made.

Ayes: Directors Bragman, Gibson, Russell, Schmitt, and Koehler
Noes: None

REGULAR CALENDAR (ITEMS 7-8)

Item 7 **Adoption of a Resolution Accepting the State Coastal Conservancy Grant Award for Forest Restoration and Vegetation Management, Authorizing the General Manager to Enter Into an Agreement with the State Coastal Conservancy for an Award of $1,000,000, and Authorizing the General Manager to Enter Into a Memorandum of Understanding (MOU) with Marin County Parks and Open Space to Complete a Portion of the Work**

Legislative and Grant Program Coordinator Matt Sagues brought forth this item. Discussion followed.

There was no public comment.

On motion made by Director Bragman and seconded by Director Gibson, the board approved the resolution (Resolution No. 8643). The following roll call vote was made.

Ayes: Directors Bragman, Gibson, Russell, Schmitt, and Koehler
Noes: None

Item 8 Drought Update

Water Quality Manager Lucy Croy, Communications & Public Affairs Director Jeanne Mariani-Belding, and Water Efficiency Manager Carrie Pollard provided PowerPoint presentations to the board. Throughout the presentation, the directors and staff conversed on this item.

There were no public comments.

This was an informational item, so the board did not take any formal action.

PUBLIC HEARING (ITEM 9)

Item 9 Adoption of Ordinance No. 452 to Add Additional Mandatory Water Conservation Measures

Water Quality Manager Croy also presented this item. Afterwards, President Koehler opened the public hearing and the board provided comments and asked questions.

Then, the Board of Directors heard from two members of the public. President Koehler closed the public hearing, and the board deliberated the proposed ordinance.

The board agreed that they would go ahead and adopt this ordinance. However, they directed staff to bring back a new ordinance at a future board meeting that would include similar language to North Marin Water District’s code on new connections to address landscape installation.

On motion made by Director Bragman and seconded by Director Russell, the board adopted Ordinance No. 452. The following roll call vote was made.

Ayes: Directors Bragman, Gibson, Russell, Schmitt, and Koehler
Noes: None

REGULAR CALENDAR (ITEM 10)

Item 10 Future Meeting Schedule and Agenda Items

The board secretary presented this item and asked for the board’s availability for the upcoming 10-Year Financial Plan Workshop 4 in August and Board Retreat in October.

Discussion followed. The Directors came to a consensus confirming August 30 for the Workshop and tentatively agreeing on October 18 for the Board Retreat.

No further action was taken by the board.

ADJOURNMENT

There being no further business, the regular bi-monthly Board of Directors' meeting of July 6, 2021, adjourned at 8:15 p.m.

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Board Secretary

Item Number: 02
Meeting Date: 07-20-2021
Meeting: Board of Directors

Approval Item

TITLE
General Manager's Report June 2021

RECOMMENDATION
Approve Report.

SUMMARY

A. HIGHLIGHTS:

- Submitted 2020 Urban Water Management Report/Water Shortage Contingency Plan to the Department of Water Resources, the California State Library, and Marin County in accordance with State requirements

- Submitted Landscape Area Measurement adjustment request to Department of Water Resources, establishing water budgets for compliance with AB 1668 and SB 606 (Water Conservation and Drought Planning)

- The Water Quality lab ensured that the water supplied met or surpassed water quality regulations by collecting and analyzing over 185 Total Coliform Rule and 25 treatment plant samples.

- Staff completed vegetation management work at 30 district facility sites through June and overall since March vegetation management work has completed at 172 sites.

- Installed a reclaimed water residential pick up distribution facility in the Armory Dr. parking lot adjacent to the Civic Center in San Rafael. The facility is expected to be operational in the next two weeks.

- Hosted June 25th Watershed Recreation Management Public Scoping Meeting which was attended by 127 community members.

- Watershed Maintenance supported Marin County Fire's training of 78 firefighters who worked on removal of Douglas-fir trees encroaching into sensitive grassland habitat along Ridgecrest Blvd.

- Completed over 75 acres of forestry work in Pine Point and Rock Springs area, and 20 acres of broom removal in the Taylor trail area.

- Facilitated Youth Panel for Watershed Recreation Planning Public Scoping meeting.

DISCUSSION

B. SUMMARY:

AF = Acre Feet

Mg/L = milligrams per liter

MPN = most probable number

MPY = mils per year

MG = million gallons

NTU = nephelometric turbidity units

1. Water Production:

Item	FY 2020/21		FY 2019/20	
	(million gallons)	(acre-feet)	(million gallons)	(acre-feet)
Potable				
Total production this FY	8,465	25,979	8,751	26,855
Monthly production, June	707	2,169	905	2,777
Daily average, June	23.56	72.29	30.16	92.57
Recycled				
Total production this FY	58.74	180.25	0.00	0.00
Monthly production, June	30.97	95.04	0.00	0.00
Daily average, June	1.03	3.17	0.00	0.00
Raw Water				
Total production this FY	55.60	170.63	54.50	167.25
Monthly production, June	5.47	16.79	9.16	28.11
Daily average, June	0.18	0.56	0.31	0.94
Imported Water				
Total imported this FY	2,451	7,521	1,833	5,626
Monthly imported, June	248	762	239	732
Reservoir Storage				
Total storage, June	11,473	35,209	20,626	63,299
Storage change during June	-777	-2,383	- 1,032	-3,167
Stream Releases				
Total releases this FY	3,960	12,152	4,289	13,163
Monthly releases, June	356	1,091	268	822

2. <u>Precipitation</u>:

	FY 2020/21 (in.)	FY 2019/20 (in.)
Alpine	23.52	31.48
Bon Tempe	19.20	26.80
Kent	20.97	28.49
Lagunitas *	20.66	34.99
Nicasio	13.60	21.35
Phoenix	18.66	33.97
Soulajule	13.84	23.29

* Average to date = 52.56 inches

3. <u>Water Quality</u>:

Laboratory:	FY 2020/21	FY 2019/20
Water Quality Complaints:		
Month of Record	16	10
Fiscal Year to Date	169	292
Water Quality Information Phone Calls:		
Month of Record	16	22
Fiscal Year to Date	142	152

The lab performed 2,759 analyses on lakes, treatment plants and distribution system samples.

Mild steel corrosion rates averaged 2.42 (0.22–4.22) MPY. The AWWA has recommended an operating level of <5 MPY with a goal of <1 MPY.

<u>Complaint Flushing</u>: No flushing events were performed for this month on record.

<u>Tank Survey Program</u>: 20 water storage tank sanitary surveys were performed during the month. 50.40 % planned survey program has been completed for calendar year 2021.

<u>Disinfection Program</u>: 2,189’ of new pipelines were disinfected during the month. Performed chlorination’s on 10 water storage tanks to ensure compliance with bacteriological water quality regulations.

Tank Water Quality Monitoring Program: Performed 7 water quality-monitoring events on storage tanks for various water quality parameters this month to help ensure compliance with bacteriological water quality regulations.

4. **Water Treatment**:

Treatment Results	San Geronimo Average	San Geronimo Monthly Goal	Bon Tempe Average	Bon Tempe Monthly Goal	Ignacio Average	Ignacio Monthly Goal
Turbidity (NTU)	0.05	≤ 0.10	0.04	≤ 0.10	0.05	≤ 0.10
Chlorine residual (mg/L)	2.59	2.50 *	2.49	2.50 *	2.50	2.50 *
Color (units)	0.7	≤ 15	0.3	≤ 15	0.2	≤ 15
pH (units)	7.8	7.8*	7.9	7.8*	8.0	8.1**

* Set monthly by Water Quality Lab

** pH to Ignacio is controlled by SCWA

5. **Capital Improvement:**

   a. Sir Francis Drake Blvd Corridor Rehabilitation Project
   Summary: This project involves the replacement of 8,500 feet of 100-year-old, leak prone pipe as a joint project with Marin County along Sir Francis Drake Blvd.
      - Project Budget: $4,647,762
      - Monthly Activities: Ghilotti Brothers Inc. is actively working during daytime hours. Contractor has finished installing all the pipeline for this project and is currently finishing minor punch list items.

   b. 5th Ave FFIP Pipeline Replacement Project
   Summary: This project involves the replacement of 3,990 feet of old, undersized fire flow deficient pipe in support of the Districts Fire Flow Improvement Program within the City of San Rafael.
      - Project Budget: $2,279,140
      - Monthly Activities: Contractor has completed this project.

c. San Geronimo Treatment Plant Permanent Emergency Generator Project
Summary: This project involves the installation of two 1.5 MW generators, electrical equipment, fuel storage tanks and site grading all within the community of Woodacre.
   - Project Budget: $5,375,600
   - Monthly Activities: District staff is currently reviewing submittals and request for information from the contractor. Temporary 2 MW generator has been brought on site and connected and made operable as of May 25th. District Staff and Contractor evaluating BAAQMD regulatory changes.

d. Southern Marin Pipeline Replacement Project (D20022)
Summary: This project involves the replacement of 5,080 feet of old, leak prone and problematic pipe in Tiburon and Belvedere, in coordination with the City of Belvedere's earthquake resiliency program and Sanitary District No. 5's Cove Road Force Main Replacement Project and planned paving work to minimize public impacts.
   - Project Budget: $2,985,000
   - Monthly Activities: Contactor is doing final paving on Cove Rd, Beach Rd, Main St and Round Hill Rd. Contractor has installed all main line pipe on Harrison Ave and is working on service transfers and final mainline tie-ins on Harrison Ave. Work to be finished by end of July/early August.

e. Kent Lake Aerator Vent Lines Replacement Project (D19037)
Summary: This project involves the replacement of two 180 foot long 2-inch vent lines and one 200 foot 1-inch air supply line on the Kent Lake aerator.
   - Project Budget: $134,000
   - Monthly Activities: District had pre-construction meeting with Contractor in June and contractor is scheduled to mobilize onsite in July to begin the work.

f. Non-Structural Spillway Repairs Project (D21013)
Summary: This project involves doing non-structural spillway repairs at Kent Spillway, Nicasio Spillway and Soulajule Spillway
   - Project Budget: $325,555
   - Monthly Activities: Contractor has started work on this project at the Soulajule Spillway. Contractor anticipates completing Soulajule work and moving onto Nicasio Spillway towards the end of July.

6. Other:

Pipeline Installation	FY2020/21	FY2019/20
Pipe installed during June (feet)	2,161	76
Total pipe installed this fiscal year (feet)	23,127	20,452
Total miles of pipeline within the District	908*	908*

** Reflects adjustment for abandoned pipelines*

Pipe Locates	FY2020/21	FY2019/20
Month of June (feet)	53,055	50,240
Total this fiscal year (feet)	498,322	507,382

Main Line Leaks Repaired:	FY2020/21	FY2019/20
Month of June	13	5
Total this fiscal year	143	137

Services:	FY2020/21	FY2019/20
Service upgrades during June	14	21
Total service upgrades this FY	173	154
Service connections installed during June	2	2
Total active services as of July 1, 2021	60,495	60,526

7. Demand Management:

	Jun-21	FY 20/21 TOTAL	FY 19/20 TOTAL	FY 18/19 TOTAL
WATER-EFFICIENCY PROGRAMS				
Water-Use Site Surveys				
Conservation Assistance Program (CAP) Consultations				
Residential properties resi 1-2 (single-family)	12	83	127	109
Residential properties resi 3-5 (multi-family units)	0	5	30	2
Non-residential properties resi 6-7 (commercial)	0	5	3	6
Dedicated irrigation accounts resi 8-10 (large landscape)	1	6	-	2
Marin Master Gardeners' Marin-Friendly Garden Walks				
Residential garden walks	13	123	91	122
CYES Water/Energy Surveys				
Residential surveys	0	0	86	238
Public Outreach and Education, Customer Service				
Public outreach events (number of people attending)		0	1,150	13,691
Public education events (number of participants)		0	-	500
Laundry-to-Landscape Graywater webinars (participants)	172	397	-	-
Customer calls/emails admin staff	1,911	5738	2,230	1,835
School Education				
School assemblies				
Number of activities	0	0	15	17
Number of students reached	0	0	6,349	5,915
Field trips				
Number of activities	0	0	11	6
Number of students reached	0	0	91	130
Classroom presentations				
Number of activities	0	1	11	21
Number of students reached	0	22	305	554
Other (e.g. booth events, school gardens)				
Number of activities	0	0	-	1
Number of students reached	0	0	-	250
Incentives				
Number of HECWs approved	66	163	53	61
Number of Rain Barrel/Cisterns approved	8	19	4	8
"Landscape Your Lawn" Turf Replacments approved	7	10		
Number of Laundry-to-Landscape Systems approved	0	0	-	-
Number of Smart Controllers rebates approved	23	84	12	-
Number of Smart Controllers "Flume Direct Distribution" redeemed	614	1135	-	-
Number of Smart Controllers "Rachio Direct Distribution" approved	75	225	-	-
Advanced Metering Infrastructure (AMI)				
AMI leak letters sent to customers (>200 GPD)	124	1601	1,384	896
ORDINANCES				
Water Waste Prevention				
No. of properties reporting activity	250	581	147	148
Landscape Plan Review				
Plans submitted	8	93	89	113
Plans exempt	0	4	5	6
Plans completed	2	19	23	37
Plans in workflow (pass & fail)	20	151	145	173
Tier 4 Exemption				
Inspections that resulted in a pass	0	1	1	1
Graywater Compliance Form				
Applications Received *(as of Dec 2019)*	6	106	39	-
Systems installed	0	7	11	14

8. Watershed Protection:

Medical Aid Calls

During June, the Rangers responded to 11 medical aid calls. Seven calls involved injured bicyclists and four involved injured pedestrians. Seven of these calls resulted in people being transported to the hospital.

Altercations at Leo Cronin Lot

Rangers responded to two separate altercations between visitors as the Leo Cronin Lot. The first was a verbal dispute over a parking space. The second was a physical fight between two males, one reportedly armed with a knife or razor. Alcohol was a factor in the second incident and it began off the watershed in the Ink Wells area across the street from the Cronin Lot.

Ranger Foot and Bike Patrols in June

Rangers logged 52 miles of foot patrol and 19 miles of bike patrol.

Rangers Investigate Firearms Violation

The Rangers found multiple signs along the Liberty Gulch section of Fairfax Bolinas Road had been shot by a small caliber firearm during the month of June. During the investigation the investigating Ranger found one spent pistol cartridge near one of the damaged signs

Rangers and Watershed Maintenance Staff Train on Portable Fire Pumps

During the month June the Rangers trained on the use of the District's portable fire pumps. These valuable tools allows staff to access water sources for firefighting that are not accessible to fire engines.

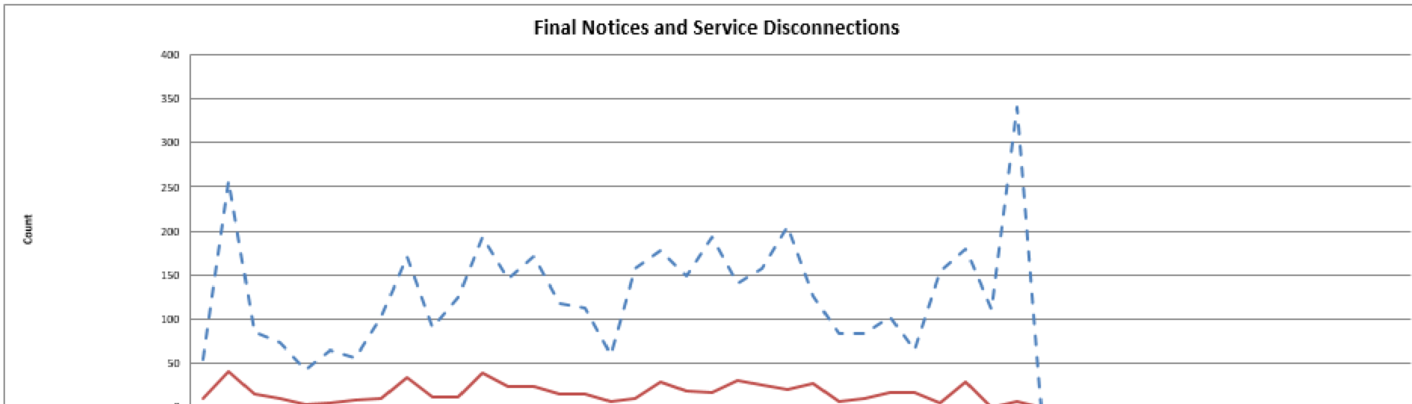
MARIN MUNICIPAL WATER DISTRICT

Incidents and Events	430
Citations	143
Warnings	134
Visitor Assists	52
Dam Check	22
Vandalism	13
Misc. Law Enforcement Calls	11
Medical Aid	11
Suspicious Circumstance	6
Assist Watershed Maintenance	5
Citizen Complaint: Bike Speed	4
Animal or Humane Related	2
Citizen Complaint: Illegal Bike Use	2
Assist Outside Law Enforcement	2
Illegal Trail Work	2
Assist Outside Agency-Misc.	2
Illegal Dumping	2
Disturbance/Dispute Between Visitors	2
Court Appearance: Guilty	2
Search and Rescue	1
Found Property	1
Assist Fire/EMS	1
Theft	1
Citizen Complaint: Smoking	1
Weapons Violation	1
Court Appearance: Not Guilty	1
Court Appearance: No Decision	1
Hit and Run: Property Damage	1
Citizen Complaint: Vehicle Speed	1
Citizen Complaint: eBike use	1
Smoke Check	1
Vehicle Accident	1
Citations	**143**
Non-payment of parking fees	129
Bike on Trail	6
No Parking	4
Park on Roadway or Parking w/ 6' Center	2
Swimming	1
Parking in Front of Fire Road Gate	1

9. Shutoff Notices and Disconnections:

June 2021
Final Notices: 0 Service Disconnections: 0

* Includes 5 day, 10 day and final notices
**3/13/20 Suspended termination of water service for non-payment due to COVID- 19
*3/24/20 Suspended Late Fees and Final Notices



	Jul 2017	Aug 2017	Sept 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	June 2018
*Final Notices	54	257	85	74	42	64	56	103	171	91	124	194
**Service Disconnections	10	40	14	9	2	5	8	9	34	11	12	39

	July 2018	Aug 2018	Sept 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	June 2019
*Final Notices	146	171	118	112	60	158	177	148	194	140	157	205
**Service Disconnections	24	24	15	14	7	9	29	18	16	30	25	20

	July 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	June 2020
*Final Notices	126	83	84	102	64	154	179	111	340	0	0	0
**Service Disconnections	27	7	10	17	16	4	29	0	7	0	0	0

	July 2020	Aug 2020	Sept 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021
*Final Notices	0	0	0	0	0	0	0	0	0	0	0	0
**Service Disconnections	0	0	0	0	0	0	0	0	0	0	0	0

FISCAL IMPACT
None

ATTACHMENT(S)
None

DEPARTMENT OR DIVISION	DIVISION MANAGER	APPROVED
Office of the General Manager	Ben Horenstein General Manager	Paul Sellier Acting General Manager for Ben Horenstein

Item Number: 03
Meeting Date: 07-20-2021
Meeting: Board of Directors

Informational Item

TO: Board of Directors

FROM: Paul Sellier, Acting General Manager for Ben Horenstein

ITEM: Drought Update

SUMMARY

The past 18-months have been the driest on record in nearly 142 years, recording just 32.45 inches over this period. As a result, the District's total reservoir storage volume as of July 15th is 33,975 acre-feet, which is 43% of total storage capacity and 52% of the historical average for this date. In response to drought conditions and historically low reservoir storage levels, the Board declared a water shortage emergency on April 20, 2021, and adopted mandatory water use restrictions targeting an overall 40% reduction in water use to extend current water supplies. Recognizing that the District's typical water use nearly doubles during the summer months as compared to the winter largely due to outdoor irrigation, the Board adopted in May mandatory conservation measures limiting sprinkler irrigation to two days per week. On July 6th, the Board adopted Ordinance No. 452 to further restrict irrigation to limit sprinkler irrigation to one day per week, as assigned by the District.

DISCUSSION

Water Supply and Production:

- In June 2021, the District's total gross water production was 2,167 acre-feet, with 1,406 acre-feet from the District's reservoirs and 762 acre-feet of supplemental water. Over the last three years, the District's total gross water production for the month of June has averaged 2,674 acre-feet.

- The average rate of water production for June 2021 was 23.6 million gallons per day (MGD), an 18.9% reduction in water use compared to the 3-year average for the month of June, 29.0 million gallons per day (MGD).

- As of the end of June, the District has purchased 146% or 7,723 acre-feet of the 5,300 acre-feet that is typically received by end of June.

- The expansion of the Recycled Water Treatment Facility at Las Gallinas Valley Sanitary District was completed earlier this spring and the District has been distributing recycled water since late April 2021. In June, the total recycled water distributed by Marin Water was 95 AF and averaged a daily demand of 1.0 million gallons per day.

- For habitat benefit, in June, the District released a total of 652 acre-feet of water from Kent Reservoir into Lagunitas Creek and from Soulajule Reservoir into Walker Creek.

- Due to the dry conditions and lower than normal reservoir levels, Sonoma Water will reduce allocations to their retail customers, including MMWD, beginning in July. From July through September MMWD will be restricted to 4-MGD and a slight increase in October to 4.6-MGD. Staff expects that reduced allocation may continue if rainfall is below average in the fall.

- As a result of this drought, the district reservoirs are projected to be as low as 18-20,000 acre-feet on December 1, 2021 if rainfall continues to track with amounts received throughout 2020 and 2021. Were conservation efforts to achieve a 40% reduction in demand through December, reservoir storage is projected to be near 25,000 acre-feet.

Drought Response:
A Drought Task Force was instituted consisting of staff throughout the organization to work collaboratively to develop and implement key initiatives to optimize our existing water supply and implement conservation actions.

Operational Initiatives and Water Supply Projects:

- Utilize Soulajule Reservoir – Soulajule reservoir is a reserve reservoir and not used during normal water supply conditions. Pumping initiated in early May, and approximately 1,020 AF of water from Soulajule Reservoir has been transferred to Nicasio Reservoir this year.

- Residential Recycled Water Pick-up Station - Staff have completed installing a residential recycled water pick-up station in the parking lot off Armory Drive near the Marin County Civic Center where residents can fill containers with recycled water to be used for watering their gardens. Staff has collaborated with the County of Marin and expects the residential pick up station will be operable by late-July.

- Kastania Pump Station Rehabilitation Design – Project components are moving ahead as expected to rehabilitate Kastania Pump Station and improve the operational efficiency of the District’s imported supply through the North Marin Aqueduct. Final design of the Kastania Pump Station Rehabilitation Project and acquisition of the Kastania Pump Station property are proceeding simultaneously. District staff are actively meeting with representatives from the Sonoma County Water Agency and the North Marin Water District to facilitate design of the facility and resolution of real property and easement matters. Completion of final design of the civil/mechanical portion of the project is anticipated to occur in August, with construction to commence in September and be completed in December 2021.

- Environmental Releases - Staff is proceeding with a technical study to better understand how to optimize flows in Lagunitas Creek to protect salmonid migration and instream habitat while reducing the volume of water released during severe drought conditions. An update of the study was provided at the Watershed Committee meeting on June 17th and another detailed discussion of the project is planned for the Operations Committee meeting in August. Engagement with stakeholders will continue to be central to this effort as the study progresses over the coming months.

Water Efficiency:

- Water Waste reports have increased since the mandatory conservation actions were adopted and enhanced:
    - February: 5 reports
    - March: 13 reports
    - April: 104 reports
    - May: 203 reports
    - June: 253 reports

- At the July 16th Operations Committee meeting the Board discussed goals for the Drought Response programs. The Drought Response programs continue to have high participation and engagement from the community through the end of June. Staff will provide current participation levels compared to the goals discussed.

Drought Public Outreach Highlights:

- New postcard mailer to all residents was developed and sent out separately from the billing detailing the updated water-use restrictions as of July 6th and includes helpful conservation tips and rebate information

- Launched a Super Savers campaign highlighting customer stories and efforts to save water that is posted and circulating on social media, Marin Water website, and digital ads

- Planning next Drought Drive Up Event due to success of event in June; Working with Sonoma Marin Saving Water Regional Partnership and targeting August 21st for next event

- The advertising campaign with drought messaging continues to run online, at transit shelters, and on bus backs throughout the service area. Phase 2 concept development underway focusing on severe/historic drought with calls to continue saving water.

- Since April, completed more than 45 presentations to stakeholders in the community (city and town councils, homeowner groups, chambers, rotaries, and businesses) regarding the drought and informing customers of Marin Water’s available conservation programs and incentives.

FISCAL IMPACT

As previously shared with the Board, the combined loss in revenue and unbudgeted expenses due to the drought is projected at $20.5M over the next eight months due to mandatory conservation efforts. The District's reserves, along with tight expenditure controls, is anticipated to address the deficit.

ATTACHMENT(S)

None

Item Number: 04
Meeting Date: 07-20-2021
Meeting: Board of Directors

Public Hearing - Approval Item

TITLE
Restrictions on Potable Water Landscape Installations for New Water Service Connections

RECOMMENDATION
Adopt Ordinance No. 453 setting forth restrictions on potable water landscape installations for new water service connections.

SUMMARY
At the July 7th Board meeting, the Board of Directors adopted Ordinance No. 452 to add additional mandatory water conservation measures. In addition to adopting Ordinance No. 452, the Board also directed staff to present an ordinance at the July 20th Board meeting requiring new connections to defer potable water irrigated landscape installation until after the conclusion of the Water Shortage Emergency.

In response to Board direction, District staff have prepared proposed Ordinance No. 453 (see Attachment 1). This proposed ordinance would add an additional provision to Chapter 13.04 for new water service connections to be approved only if the Applicant acknowledges in writing that either (i) the proposed project does not include any new landscaping that will be irrigated using potable water, or (ii) no new landscape that will be irrigated with potable water will be installed in connection with the proposed project until after the termination of the Water Shortage Emergency. The proposed restrictions would preclude fountains and ponds as part of the landscape installation prohibition.

Based on a review of pending water service applications, known future development projects, and pending pipeline extension agreements, staff estimates new connections could add 42AF within the next year, wherein this would be reduced by 14AF by enacting proposed Ordinance No. 453. Staff estimates an additional 62AF of new demand 1-2 years out, which would be reduced by 15AF. A number of factors could impact these figures, including the actual number of water service connection applications received by the District, the timeline for development as well as the duration of the Water Shortage Emergency.

District staff requests the Board of Directors adopt proposed Ordinance No. 453 at the public hearing on July 20, 2021.

FISCAL IMPACT
There is no financial impact associated with this action.

ATTACHMENT(S)
1. Ordinance No. 453

DEPARTMENT OR DIVISION	DIVISION MANAGER	APPROVED
Engineering Services	**Crystal Yezman** **Director of Engineering Services**	**Paul Sellier** **Acting General Manager for Ben Horenstein**

DRAFT

MARIN MUNICIPAL WATER DISTRICT

ORDINANCE NO. 453
AN ORDINANCE AMENDING CHAPTER 13.04 ENTITLED " COMPREHENSIVE DROUGHT WATER CONSERVATION AND ENFORCEMENT MEASURES" OF TITLE 13 OF THE MARIN MUNICIPAL WATER DISTRICT CODE ENTITLED "WATER SERVICE CONDITIONS AND WATER CONSERVATION MEASURES" ADDING POTABLE WATER LANDSCAPE INSTALLATION RESTRICTIONS FOR NEW WATER SERVICE CONNECTIONS

BE IT ORDAINED BY THE BOARD OF DIRECTORS OF THE MARIN MUNICIPAL WATER DISTRICT AS FOLLOWS:

SECTION 1. Purpose: Due to the current drought conditions and low storage reservoir levels existing in the service area of the Marin Municipal Water District (District), the Board of Directors (Board) declared a water shortage emergency on April 20, 2021 pursuant to Water Code sections 350, et seq. and 71640, et seq. as set forth in Board Resolution No. 8630 and subsequently adopted Ordinance Nos. 449, 450 and 452 instituting mandatory water conservation measures for all District customers. The purpose of this ordinance is to add restrictions on potable water landscape installation for new water service connections within the District's service area. The adoption of these additional measures is aimed at reducing increased water demand to preserve the District's limited water supply due to the current drought. This action is necessary to preserve the remaining water supply given the uncertainty of future supply conditions due to drought.

SECTION 2. Section 13.04.020(3) of the Marin Municipal Water District Code entitled "Drought water waste prohibitions" is hereby deleted and replaced to read as follows:

13.04.020(3) The following are prohibited for all new water service connections:

(A) Single pass cooling systems for air conditioning or other cooling system applications unless required for health or safety reasons.
(B) Non-recirculating systems for conveyer carwash applications.
(C) The use of potable water for the installation of any new landscaping until after the termination of the current Water Shortage Emergency. For purposes of this subsection (C), "new water service connection" shall mean and include new, additional, expanded or increased-in-size potable water service connections, meters, and service lines approved as of July 21, 2021. During the Water Shortage Emergency, applications for new water service connections will be approved only if the Applicant acknowledges in writing that either (i) the proposed project does not include any new landscaping that will be irrigated using potable water, or (ii) no new landscaping that will be irrigated with potable water will be installed in connection with the proposed project until after the termination of the Water Shortage Emergency. For purposes of this subsection, landscaping shall include fountains and ponds.

<u>SECTION 3. Findings of Necessity</u>: The Board of Directors, after considering all of the information and testimony presented at its July 20, 2021 public hearing regarding this ordinance, finds as follows:

I. Historic and Current Water Supply Overview

A. Water is a finite and precious resource.

B. The District's water supply currently remains limited to water captured in its seven reservoirs; water transported from the Russian River via the North Marin aqueduct; and recycled water produced at the Las Gallinas Valley Sanitary District Plant (for a variety of non-potable purposes). About 73% of the District's water supply comes from its reservoirs, 25% from the Russian River through the North Marin aqueduct and 2% from recycled water. Although options to increase the District's water supply are being evaluated, the implementation of any preferred alternative will not be immediate.

C. Based upon rainfall patterns for the District, very little rainfall occurs from May to October each year. In recent years, the overall summer peak-period has found water use averages about twice winter use.

D. As of July 7, 2021, the District's water storage level is 34,550 acre feet, which is 43.42% of average for this time of year. As a result of this drought, the District reservoirs are projected to be as low as 25,000 acre-feet on December 1, 2021 in the absence of above average rainfall and runoff, which is less than one year of water supply based on recent demand.

E. The water conservation program already adopted by this Board is necessary to conserve additional water for beneficial use and to preserve the District's water supply.

II. New Water Service Connections.

A. On April 20, 2021, pursuant to Board Resolution No. 8630, the District declared a water shortage emergency pursuant to Water Code sections 350, et seq. and 71460, et seq.

B. Based upon projected demand and current storage levels, the District must preserve its remaining water supply to assure sufficient supply in the coming months given the uncertainty of future weather and water storage.

C. Article X Section 2 of the California Constitution declares that the general welfare requires that water resources be put to beneficial use to the fullest extent of which they are capable and that the waste, unreasonable use or unreasonable method of use of water be prevented, and that conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and the public welfare.

D. California Water Code section 356 authorizes water suppliers, and the Board finds it necessary, to restrict applications for new water service connections during a water shortage emergency to conserve supplies for the greatest public benefit.

E. California Water Code section 71640 authorizes the District to restrict the use of water during any emergency caused by drought, or other threatened or existing water shortage, and prohibit the wastage of District water or the use of District water during such periods for any purpose other than household uses or such other restricted uses as the District determines to be necessary. The District may also prohibit use of District water during such periods for specific uses which it finds to be nonessential.

F. Pursuant to Water Code section 353 when the Board declares the existence of an emergency condition of water shortage within its service area, it shall thereupon adopt such regulations and restrictions on the delivery of water and the consumption within said area of water supplied for public use as will in the sound discretion of such governing body conserve the water supply for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection.

SECTION 4. Environmental Determination: This project has been reviewed for compliance with the California Environmental Quality Act (CEQA) and based upon the above findings and purposes of this ordinance, qualifies for an exemption pursuant to Section 21080(b)(4) of the Public Resources Code in that the Board of Directors find that these measures are necessary to preserve water supply to prevent or mitigate a water supply emergency.

SECTION 5. Severability: If any section, subsection, sentence, clause, phrase, portion or part of this ordinance is for any reason held to be invalid or unconstitutional by any court of competent jurisdiction, such section shall not affect the validity of the remaining portions of this code. The Board of Directors hereby declares that it would have adopted this ordinance and each section, subsection, sentence, clause, phrase, part or portion thereof, irrespective of the fact that any one or more sections subsections, clauses, phrases, parts or portions be declared invalid or unconstitutional.

SECTION 6. Effective Date: Pursuant to Water Code section 376, this ordinance shall be effective on the day of its adoption. Within 10 days of adoption, this ordinance, or a summary hereof, shall be published in the Marin Independent Journal pursuant to Section 6061 of the Government Code.

PASSED AND ADOPTED this 20th day of July, 2021, by the following vote of the Board of Directors:

AYES:

NOES:

ABSENT:

President, Board of Directors

ATTEST:

Secretary, Board of Directors

Item Number: 05
Meeting Date: 07-20-2021
Meeting: Board of Directors

Informational Item

TO: Board of Directors

FROM: Crystal Yezman, Engineering Division Manager

THROUGH: Paul Sellier, Acting General Manager for Ben Horenstein

DIVISION NAME: Engineering Services Division

ITEM: Smith Saddle Tanks Rehabilitation Project (D21010)

SUMMARY

District staff presented to the Operations Committee on January 15, 2021, the need to obtain proposals from qualified engineering consulting firms to conduct a comprehensive structural and seismic evaluation of the two Smith Saddle Storage Tanks. District staff received proposals and then returned on the February 16, 2021 Board meeting to approve a professional services agreement with Kennedy/Jenks Consultants (Consultant) to provide a comprehensive condition assessment and provide tank rehabilitation options for the District to review and evaluate. The Consultant provided comprehensive evaluations of the Smith Saddle Tanks including seismic, structural, interior and exterior coating, safety, security and site area improvements. Based on the findings, three different alternatives were presented in their reports along with a 100-year life cycle cost analysis for the three alternatives. District staff has evaluated the three alternatives and will make a recommendation along with a request for the committee to refer to the full board direction to proceed with optional tasks within the contract to have the Consultant provide design and environmental review and analysis on the preferred project.

DISCUSSION

The Smith Saddle Tanks consist of two (5) five million gallon (5 MG) potable water storage tanks constructed in 1960 of welded steel. The tanks are of identical design and located next to each other in the foothills above the Town of Fairfax, near White Hill Middle School. The exterior of the tanks has been recoated once, in 1983, so they are now 38-years old. The interior coatings are original and are now nearly 60 years old.

The Smith Saddle Tanks are some of the largest transmission storage tanks in the District's system. They are the main transmission storage tanks between San Geronimo Treatment Plant and the rest of the District's potable water distribution system. The Smith Saddle Tanks are rarely allowed to operate below 70% capacity as more potable water cycles through the Smith Saddle Tanks than any other tanks in the District.

The Smith Saddle Tanks have been in service for 60 years and their interior and exterior coatings have reached the end of their useful lives - extensive corrosion has formed throughout the roof structures of the tanks. Previous inspection reports and video inspections have documented the interior conditions of the tanks, summarizing interior coating failures and severe corrosion on the roof structures of the tanks, the rafters and entry points, and specifically above the waterline.

Based on previous inspections noted above, Staff has determined the tanks require major rehabilitation in order to continue to serve the District at their full capacity. As a result District staff issued request for proposal seeking a qualified engineering consulting firm to conduct a comprehensive structural and seismic evaluation of the tanks. Kennedy Jenks Consultants (Consultant) provided the best proposal and a professional services contract was approved at the February 16, 2021 Board meeting.

The Consultant conducted a comprehensive evaluation of the tanks including structural, seismic, interior and exterior coating, safety, security and site area improvements. One of the tanks was completely drained and a detailed interior inspection of the floor, shell and roof steel framing and plates along with protective coatings was conducted. The structural and seismic evaluation identified significant areas of the existing tanks construction that are not in conformance with national standards which result in deficiencies in structural performance. Examples of structural deficiencies include lack of tank anchorage and strengthening to decrease overturning during earthquakes and calculated wave heights generated during earthquakes exceed available tank capacity when the tank is full.

Interior inspection of the floor, shell and roof found that the coal tar coating exhibited numerous blister domes being fractured and exposing the steel underneath. Numerous rust chips from the underside of the roof and roof framing members had delaminated and fallen off and settled on the floor of the tank. The upper tank shell and roof plate within the vapor area above the water surface has loss of metal along with excessive pitting. Severe active corrosion was observed on the roof channel beam flanges showing moderate metal loss.

Tank operational deficiencies were also identified such as the close proximity of the tanks inlet and outlet piping that minimize the water circulation within the tanks. Tank site safety improvements were also identified during the exterior assessment. Improvements including upgrades to the staircase guardrails leading to the top of the tank were identified along with a non-slip stairway, fall protection roof anchorage and larger access manholes into the tanks for accessibility of staff.

The Consultant provided a detailed report and description of three repair or replacement alternatives along with the estimated construction and life cycle cost.

- Alternative 1: Repair, Strengthen, Recoat the two existing tanks
- Alternative 2: Construct two new 5.0 million gallon welded steel tanks
- Alternative 3: Construct two new 5.0 million gallon pre-stressed concrete tanks

Opinion of Probable Construction Cost for Reservoir Alternatives

Description	**Alternative No. 1 Repair/Recoat Two Existing Tanks**	**Alternative No. 2 Two New 5.0-MG Welded Steel Tanks**	**Alternative No. 3 Two New 5.0-MG Pre-stressed Concrete**
Division 1: Allowances – Floor Plate (1)	$148,000	-	-
Division 2: Demolition and Worker Protection (2)	$170,000	$1,207,000	$1,207,000
Division 3: Concrete Foundations (Ringwall)	-	$172,000	-
Division 5: Metals (Stairs & Platforms) (3)	$156,000	$159,000	$159,000
Division 9:Blasting & Protective Coatings (4)	$6,998,000	$4,670,000	-
Division 26: Electrical and Instrumentation	$150,000	$300,000	$300,000
Division 31: Earthwork (Excavate and Subgrade) (5)	-	$107,000	$154,000
Division 32: Site Improvements (6)	$498,000	$438,000	$368,000
Division 33: Utilities			
Water Piping and Valves	$200,000	$250,000	$500,000
Tanks and Appurtenances	$2,514,000	$6,434,000	$9,800,000
Cathodic Protection Systems	$32,000	$32,000	-
Subtotals	**$10,866,000**	**$13,769,000**	**$12,488,000**
Markups (7)	$7,734,000	$9,831,000	$9,112,000
Total Estimated Construction Cost	**$18,600,000**	**$23,600,000**	**$22,100,000 (9)**
100-Year Cumulative Maintenance Cost (8)	$24,400,000	$24,400,000	$1,200,000
Estimated 100-Year Total Life-Cycle Cost (8)	**$43,000,000**	**$48,000,000**	**$23,300,000**

Notes:

1. Allowances includes cost for replacement of 50% of existing floor plates in Alternative 1.
2. Demolition is for either selective or complete tank demolition and worker protection for lead during cutting.
3. Stair extension for Alternative 1; new stairs for Alternatives 2 and 3. Vent for Alternative 1. Vents for Alternatives 2 and 3 are included with tank.
4. Containment of lead abatement with Blastox. Remove hot mop coal tar with PCBs. Dehumidification equipment.
5. Excavation for ringwall footing and buried utilities. Earthwork for new tank pads.
6. Re-grading around tanks and drainage improvements. Includes access road grading and paving improvements.
7. Markups include Division 1 costs (10%), taxes on materials (8.25%), contractor markups on subcontractors (12%), general contractor overhead and profit (15%), bonds and insurance (3%), estimate contingency (25%), and escalation to mid-point of construction (24 months at 3.5% per year).
8. Capital and maintenance costs for concrete and welded steel tanks are $100,000 every 20 years for concrete tanks and $1,190,000 every 20 years for exterior coatings and cathodic protection and $3,840,000 at 50 years for interior coatings for steel tanks assuming an elastomeric polyurethane coating. A 2% annual interest rate was utilized to determine cumulative compound amount of future sums over the estimated 100 years.
9. The total estimated construction cost is based on an accelerated construction duration of 30 weeks for the Alternative No. 3 two new 5.0-MG prestressed concrete tanks option. If a regular construction duration of 32 to 33 weeks were to be required by the construction documents the total estimated construction cost would be decreased from $22,100,000 to $21,600,000.

The level of accuracy from the table on page 3 is commensurate with the levels developed by the Association for the Advancement of Cost Engineering International (AACEI). This estimate is based on competitive bidding, which assumes bids from five or more general contractors.

District staff is currently reviewing the report and alternatives along with construction scheduling for this project. Staff will make a recommendation along with a request to proceed with the optional tasks with the Consultant to develop plans, specifications and finalized construction estimate along with the required environmental review and analysis and permitting for this project at a future Board meeting.

FISCAL IMPACT

The total estimated cost for the Smith Saddle Tanks Rehabilitation Project ranges from $18,600,000 to $21,600,000, and is dependent of the selected design alternative and refined construction cost. Funding for design and environmental documentation exists in the current capital improvement budget for fiscal year 21/22.

Project Implementation:

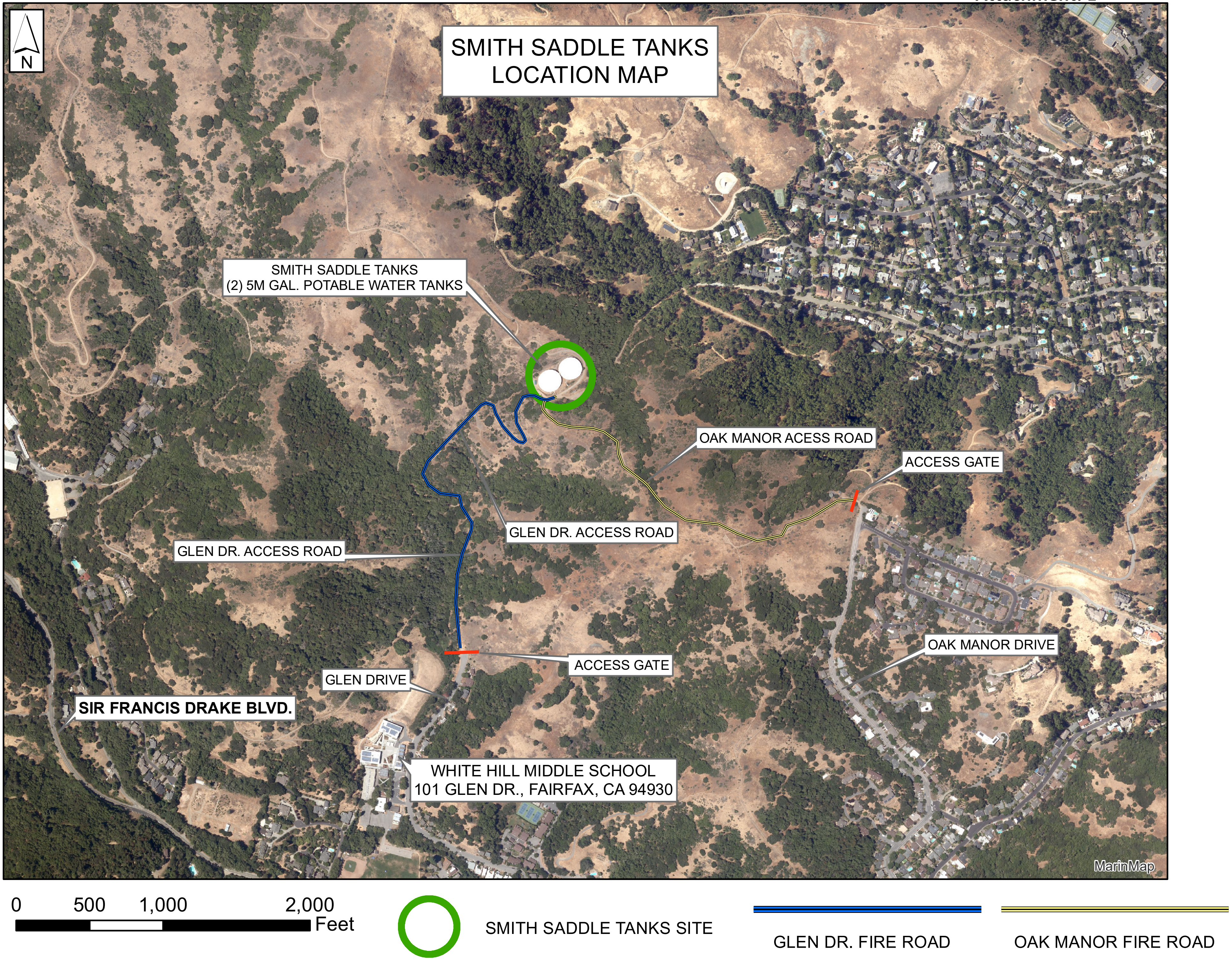
Agreement for Professional Services Executed	August 3, 2021
Design and Environmental completed	January 14, 2022
Advertise Project	January 18, 2022
Bid Opening	February 15, 2022
Award Contract	March 15, 2022
Submittal review and Site Access Improvements completed	October 31, 2022
Construction Start - Tank 1 of 2 (Tentative)	November 1, 2022
Construction Finish - Tank 1 of 2 (Tentative)	April 29, 2023
Construction Start - Tank 2 of 2 (Tentative)	November 1, 2023
Construction Finish - Tank 2 of 2 (Tentative)	April 30, 2024

Note: The Smith Saddle Tanks are a critical asset and must be rehabilitated one-at-a-time, throughout the low-demand seasons of fall and winter. Tank rehabilitation during high-demand seasons of spring and summer is not feasible.

ATTACHMENT(S)

1. Smith Saddle Tanks Location Map
2. Kennedy Jenks Report

Item Number: 05
Attachment: 1



Item Number: 05
Attachment: 2

Kennedy Jenks
275 Battery Street, Suite 550
San Francisco, California 94111
415-243-2150

Final Evaluation Report for Smith Saddle Tanks Rehabilitation Project

6 July 2021

Prepared for

Marin Municipal Water District
220 Nellen Avenue
Corte Madera, CA 94925

KJ Project No. 2168002*00

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Table of Contents

Table of Contents (cont'd)

Table of Contents (cont'd)

List of Tables

List of Figures

List of Appendices

Executive Summary

The Marin Municipal Water District (District) owns and operates the Smith Saddle Tanks which consist of two 5,000,000-gallon potable water ground supported welded steel storage tanks constructed in 1960. The tanks are located next to each other in the foothills above the Town of Fairfax, CA. The purpose of the Smith Saddle Tanks Rehabilitation Project was to evaluate the condition of the existing tanks and conduct a structural and seismic evaluation of the tanks and recommend modifications, repairs, and retrofits to correct deficiencies in the tanks or provide a recommendation for replacement of the tanks.

Tank observations and assessment of the condition of the two welded steel tanks consisted of evaluation of the tank structures, including floor, shell, and roof steel plates and steel framing, protective coatings on the interior and exterior of the tanks, and tank appurtenances with respect to loading, exposure, and corrosion. Significant tank and site observations include the following:

- The tank floors are susceptible to corrosion damage from several factors including: insufficient slope away from the floor plate to shell plate connections at the base of the tanks; the oiled subgrade and asphalt material of the tanks having eroded significantly exposing the underside of the floor plate; and the shell to floor plate connection exposed on the underside of the tanks with subgrade materials eroded away from the tanks; coal tar exhibited numerous blister domes being fractured and exposing the steel substrate.

- The tank shells had significant areas of damage that include the following: external corrosion beneath the vent sheet metal panels; rock damage exposing the steel with minor rust; mold under the exterior protective coatings; the upper 5 feet of the perimeter shell on the interior have coating failure and bare metal exposure; and coal tar is brittle and exhibited numerous blister domes being fractured and exposing the steel substrate.

- The tank roofs had significant areas of damage that include the following: crumbling of rust and chips falling from roof into water; significant quantities and depths of large size chips of rusted steel from roof plates and roof framing on the floor; rock damage from vandals throwing rocks at the tank; and complete failure of the protective coatings on the underside of the roof plates and the roof framing with areas of moderate corrosion and loss of metal.

The preliminary site geotechnical evaluations identified the following:

- Of the potential geologic and seismic hazards assessed for the project, strong ground shaking is the most significant.

- No subsurface explorations or geophysical investigations were performed for the preliminary geologic and geotechnical assessment. If the District was to determine to proceed with either foundation improvements on the existing tanks or replacement of the existing steel water tanks with new tanks, then the subsurface exploration and geophysical investigations developed for the project should be performed.

The structural and seismic evaluation of the tanks identified significant areas of the tanks construction that are not in conformance with national standards which result in deficiencies in structural performance. These deficiencies and recommended seismic improvements include the following:

- While the overturning ratio is acceptable, any repair or strengthening of the existing tanks or replacement of the tanks with self-anchored tanks should include a thickened annular ring that would decrease the overturning ratio to an acceptable level resulting in no uplift.
- The tanks do not provide sufficient minimum distance measured to the edge of the connection reinforcement for bottom piping connections. In order to prevent damage to the tank and avoid release of the tank contents due to failure of the piping system, the District should consider removing, plating over, and replacing the bottom piping connections to the two tanks.
- The calculated wave heights during design level earthquakes in this evaluation exceed the available freeboard when tanks are filled to the current top capacity levels. The existing roof framing, roof plates, and either portions or all of the existing columns, will be removed and after adding two new shell rings and replacing the columns new roof framing and roof plates will be constructed approximately 6 feet-0 inch higher than the existing roof to provide sufficient freeboard.

The reservoirs have several deficiencies that were observed in conformance with the distribution reservoir regulations of the Division of Drinking Water:

- Roof vents were not constructed to prevent the entry of insects with vent screen openings too large.
- Sample taps are not protected against freezing.
- Reservoirs do not have adequate lighting of reservoir interior for inspections, cleaning or repair.
- While the reservoirs have separate inlet and outlet, they are adjacent to each other and have not been oriented to minimize short-circuiting and stagnation of the water flow through the reservoir.
- The tank drains are directly connected to the buried site drainage system with no protection from cross-contamination or rodents or other animals entering drains.

Site safety recommendations for worker protection includes recommendations for walking and working surfaces and fall protection on the tops of the tanks, additional requirements for the fixed industrial stairs, and the addition of guardrails.

Improvement in the Smith Saddle Tanks reservoir site and the Glen Drive access road include the following:

- Increase the perimeter road width around the tanks to a minimum of 12 feet with a retaining wall. Regrade the perimeter road around both tanks and pave with hot mixed asphalt (HMA) with catch basins and added storm drain piping around the tanks.

- Regrade the longitudinal slope of the Glen Drive access road to a maximum of 15%. Construct a hot mix asphalt pavement surface with v-ditches on each side of the road. Increase the minimum turning radius to 30 feet and add retaining walls as necessary and turn-around points near the base of the grade.

Corrosion protection including protective coating systems and cathodic protection system improvements include the following:

- The top of the radial beams should be seal welded to the underside of the roof plates continuously.

- Ventilation must be improved through the use of a larger center vent and additional perimeter roof vents.

- Exterior protective coating systems on the shell and roof of the tanks should contain zinc primers to protect the tanks from rock damage.

- The recommended protective coating system on the interior of tanks should be a elastomeric polyurethane coating applied in solid and expanded forms in a single coat.

- The recommend protective coating system on the exterior shell and roof of the tanks should be a urethane zinc-rich primer, followed by a fast cure high solids epoxy, followed by a fluoropolymer or polysiloxane.

- It is recommended that individual rectifier systems be provided for each tank, which can provide for differences in current requirements due to the differences in time and deterioration of coating systems. It is recommended that the existing rectifier be used to protect the exterior of the bottom plate of both tanks and two new automatic potential control rectifiers be purchased to protect the interior. The existing mixed metal oxide anodes system should be replaced. It is recommended that supports of all anodes be replaced.

Abatement of hazardous materials in interior and exterior coatings for construction workers and the surrounding environment including waste segregation and off-site disposal will require the following recommendations be included:

- The Contractor will need to prepare a “Site Specific Health and Safety Plan” and implement prior to abatement of interior coatings from both tanks for the health and safety of the construction workers. Waste segregation and profiling will be required to properly characterize the waste for off-site disposal.

- The Contractor must establish a written Lead Compliance Program in compliance with 8 CCR 1532.1, when disturbing lead containing painted surfaces using Trigger Task Activities.

The following sections and appendices provide a more detailed description of the tank and site findings and recommendations resulting from this evaluation.

The estimated costs for the repair and replacement alternative of the two tanks are included in Table 5. These costs incorporate the feedback received from City staff and include all improvements recommended in this report. The total project cost for replacement of the two steel tanks with prestressed concrete tanks is $22,100,000 based on an accelerated construction duration of 30 weeks.

At the time of this Final Report, the District is in the process of evaluating an additional tank to be located in the immediate area of the existing two tanks. The intent of this third tank would be to provide additional storage while part of the existing storage is unavailable during construction on the existing two tanks. The District has requested for further support of this evaluation, which KJ will plan on completing as part of the Design portion of this work.

Section 1: Introduction

The Marin Municipal Water District (District) owns and operates the Smith Saddle Tanks which consist of two 5,000,000-gallon potable water ground supported welded steel storage tanks constructed in 1960. The tanks are located next to each other in the foothills above the Town of Fairfax, CA, and are shown on Figure 1, located at the end of this section.

The purpose of the Smith Saddle Tanks Rehabilitation Project was to evaluate the condition of the existing tanks and conduct a structural and seismic evaluation of the tanks and recommend modifications, repairs, and retrofits to correct deficiencies in the tanks or provide a recommendation for replacement of the tanks.

1.1 Report Format

Kennedy Jenks Consultants, Inc. (Kennedy Jenks) was retained by the District to prepare the Rehabilitation Report for the Smith Saddle Tanks under the Agreement for Professional Services (Misc. Agreement No. 5909) executed on 18 February 2021. This report summarizes the evaluations conducted on the two water tanks and makes a recommendation for improvement. The report is organized in the following sections:

- Section 1: Introduction
- Section 2: Background Data and Site Assessments
- Section 3: Site Geotechnical Evaluation
- Section 4: Structural and Seismic Evaluation
- Section 5: Corrosion Evaluation
- Section 6: Alternatives Evaluation and Recommendations

The following is a summary of the evaluations that were conducted for the two water tanks:

- Site Geotechnical Evaluation
- Structural and Seismic Evaluation
- Corrosion Evaluation
- Site Constructability Evaluation
- Site Safety and Security Evaluation

The evaluations were based on field observations and investigations conducted by the evaluation team described below, as-built drawings, and other miscellaneous information provided by District staff. The original fabrication drawings were provided by the District and reviewed by the evaluation team. However, original structural design calculations were not available for the tanks. Therefore, assumptions were made based on the original fabrication drawings.

1.2 Evaluation Team

Kennedy Jenks conducted the overall tank, site and access road assessments including internal tanks assessments from scaffolding and raft, structural and seismic evaluations, corrosion and cathodic protection review, and safety, security, and code evaluations. The structural and seismic evaluations included analysis of the tanks to establish whether the structures meet the current seismic design requirements of the California Building Code (CBC) and provided rehabilitation recommendations. The safety, security, and code evaluations included review of the safety, general site conditions including drainage and security, and a code review related to American Water Works Association (AWWA) AWWA D100, California Title 22, and Cal/OSHA requirements for the tanks.

Underwater Resources, Inc. (URI) conducted the dive inspection of Smith Saddle Tank No. 1. Inspection was conducted with a three-person commercial dive team with surface-supplied air diving equipment to provide a narrated underwater video, photographs, and summary report after the inspection.

GEI Consultants, Inc. (GEI) conducted the site geotechnical evaluation. This investigation developed the site-specific recommendations for seismic design parameters with consideration to soil and bedrock conditions at the reservoir site. Recommendations are compliant with the 2018 International Building Code/2019 CBC and applicable reference standards including American Society of Civil Engineers/Structural Engineering Institute (ASCE)/SEI 7-16 and American National Standards Institute (ANSI)/AWWA D100-11.

Bay Area Coating Consultants, Inc. (BACC) conducted the protective coating evaluations. This assessment included review of existing protective coatings records, condition assessment of the interior and exterior protective coatings, testing, and identification of potential corrosion and protective coating issues related to the reservoirs, metal appurtenances, and the associated piping. Field investigation included visual inspection by National Association of Corrosion Engineers (NACE) certified coatings inspectors per all Steel Structures Painting Council (SSPC), NACE, International Concrete Repair institute (ICRI), AWWA, and ASTM International (ASTM) current guidelines and standards.

EnviroSurvey Inc. (ESI) conducted the hazardous materials evaluations. This assessment included hazardous materials survey of interior and exterior protective coatings of the two tanks. Survey, sampling and analysis of protective coatings was performed on the interior and exterior of the two tanks for lead, asbestos, polychlorinated biphenyls (PCBs) and heavy metals.

1.3 Applicable Codes

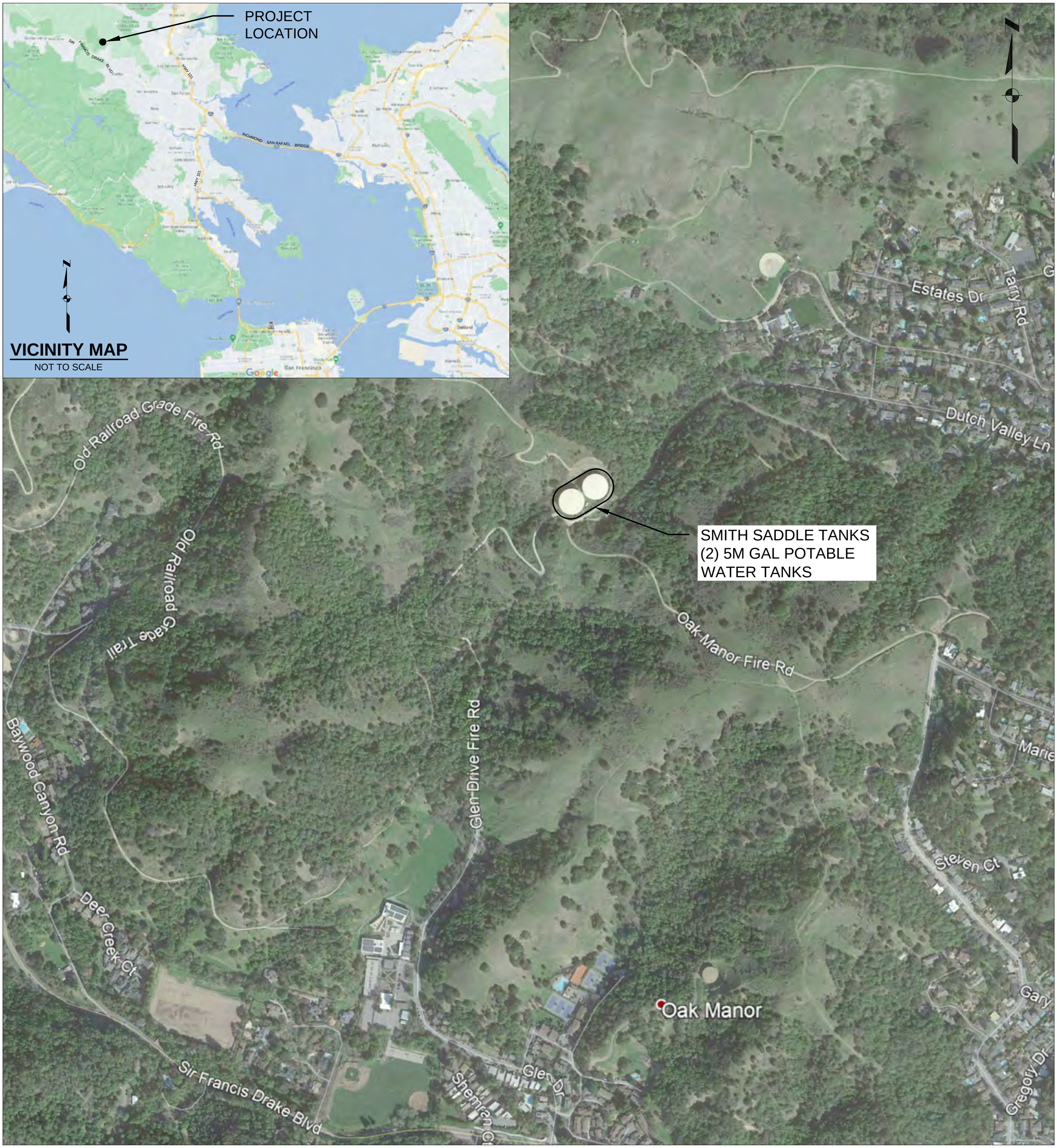
The following is a list of applicable codes and standards used to conduct the evaluations.

- 2019 California Building Code (CBC) California Code of Regulations, Title 24, Part 2, Volumes 1 and 2, California Building Standards Commission

- ASCE/SEI 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (American Society of Civil Engineers)
- ANSI/AWWA D100-11 Welded Carbon Steel Tanks for Water Storage (American Water Works Association)
- ACI 318-14 (American Concrete Institute) Building Code Requirements for Structural Concrete
- California Code of Regulations Title 22, Chapter 16. California Waterworks Standards, Article 6. Distribution Reservoirs
- California Code of Regulations Title 8 (Cal/OHSA)

1.4 Reference Documents

A list of reference documents, including all documents provided by the District, used to conduct the evaluations of the tanks are included at the conclusion of this report in the References section.



\\KJC\KJC-Root\KJ-Cad\SanFrancisco\2021\2168002.00\2168002.00 – MMWD Smith Saddle Tanks\2168002.00 – Figure 1.dwg 5-20-21 12:25:38 PM RoyceO

LOCATION MAP

SCALE: 1" = 800'

Kennedy Jenks

MARIN MUNICIPAL WATER DISTRICT
SMITH SADDLE TANKS
REHABILITATION PROJECT

TANK SITE LOCATION

K/J 2168002*00
MAY 2021

FIGURE 1

Section 2: Background Data and Site Assessments

2.1 Existing Tanks and Site Description

The Smith Saddle Tanks site is located in the foothills above the Town of Fairfax, CA (GPS 38.010662, -122.602498) in Marin County, California, roughly at an elevation of about 486 feet. The location of the tanks is shown on Figure 1. The tanks are accessed from the south via a gated, gravel access road at the north end of Glen Drive (i.e., the Glen Drive fire road). The north end of the Glen Drive access road has a steep grade just prior to the tank site. The tanks are surrounded by a perimeter chain-link fence to prevent public access. The site contains two 5.0-MG ground supported welded steel transmission potable water tanks located next to each other and constructed in 1960. The top of Tank No. 1 is accessed by an industrial spiral staircase with a landing platform. A walkway platform near the landing at the top of Tank No. 1 provides rooftop access to Tank No. 2. A metal security gate prevents unauthorized entry to the staircase. The tank's foundation type is an asphalt ring with an oiled sand placed within the asphalt ring beneath the tanks. Additional information on the description of the tanks structure is included in Section 4. The tank's interior is original cold-tar from the 1960 installation date. The exterior of both tanks were recoated in 1983. Both tanks are cathodically protected with an impressed current cathodic protection system. Additional information on the existing protective coating systems and cathodic protection system is included in Section 5. Each of the tanks have shell manhole(s), roof access hatches, and center vent. The tanks were originally constructed with an approximately 11-inch wide screened vent area at the top of the shell which was subsequently sealed with sheet metal with metal screws. Each of the tanks have above ground pipeline connections to flanged nozzles on the tank for inlet, outlet, and overflow and floor penetrations for drain and intertie connections. Record drawings of the Smith Saddle Tanks utilized in the evaluations are included in the References section at the end of this report.

2.2 Background Data and Information

Background data and information collected from the District and other sources in preparing the evaluation report are summarized below.

2.2.1 District Provided Information

The District provided a collection of various documents to aid in our evaluation including drawings, geotechnical reports, past structural evaluations. We relied on the following documents which are listed in the References section for data used in the evaluations of the tanks.

2.2.2 Information Gathered in the Field

Information was gathered in the field on several dates throughout the month of March 2021 by several Kennedy Jenks team members and other project subconsultants. Visual observations of the tanks, site and access road conditions were made, photographs of the interior and exterior of the tanks, appurtenances, site and access road which were accessible were made, and relevant rough measurements where possible such as shell, bottom plate, and roof plate thickness were collected.

2.3 District Staff Interviews

Through numerous conferences calls and site visits information on the tanks was provided by the District. Kickoff meeting minutes as well as regular biweekly meeting minutes document information provided in interviews with District staff. In addition, two specific meetings were held with District staff to exchange information related to tank safety and the cathodic protection systems.

2.3.1 Tank Safety

On 10 March 2021, an interview was held between Bert Drews, Kennedy Jenks, and Eric Goldman, the District's safety manager, regarding District safety concerns related to staff accessing the roof of the tanks and conducting periodic inspections and maintenance. Primary concerns and comments were related to enhancing fall protection for staff accessing the top of the tanks. It was stated that periodically the roof's integrity must be inspected, which involves staff approaching the leading edge of the tanks.

2.3.2 Cathodic Protection System

On 9 April 2021, an interview was held between Don Barraza, Adam Butler, Milt Larsen, and Bob Ryder, Kennedy Jenks; and Zak Talbot, Gary Anderson, Alex Anaya, and Tony DelSanto, District, regarding the District's cathodic protection system on the two tanks. The meeting covered an understanding of the existing impressed current cathodic protection system, water quality data, observations of the existing system components, and potential recommendations for system replacement and improvements.

2.4 Tank and Site Observations

Tank observations and assessment of the condition of the two welded steel tanks consisted of evaluation of the tank structures, including floor, shell, and roof steel plates and steel framing, protective coatings on the interior and exterior of the tanks, and tank appurtenances with respect to loading, exposure, and corrosion. Notable results from the observations and assessments are noted below.

In many cases, the optimal method for the condition assessment is a physical investigation involving a combination of visual observations, documented with digital photographs, and substrate testing. It should be noted that much of the condition assessment data is objective based on industry standards, as noted. However, there is some subjective assessment based on the evaluator's expertise.

2.4.1 Tank Evaluation Work Plan

An assessment work plan was prepared for the two tanks. The work plan included pre-field condition assessment coordination including coordination with the District on dive inspections, requirements for shutdown, draining and cleaning of the tanks, tank access, power, lighting and water, requirements for both diver and raft inspections and interior inspection with scaffolding. The condition assessment sequencing including inspection criteria, areas and components of observation, and sequencing were also documented. The work plan documented evaluation details such as equipment, testing, and standards for thickness tests, coating tests, hazardous materials, dive equipment, scaffolding, and cathodic protection equipment. The final assessment work plan was transmitted to the District on 14 April 2021.

2.4.2 Health and Safety

A job specific Hazard Appraisal and Recognition Plan (HARP) was prepared and was submitted and reviewed with the District Health and Safety officer. The plan contained job hazard analysis and references the Marin Municipal Water District Confined Space Program or Procedures. The final HARP including the permit required confined space program utilized for all site activities by Kennedy Jenks personnel and subcontractors was transmitted to the District on 8 March 2021.

2.4.3 Tank No. 1 Observations

Tank No. 1 observations were performed between 10 March and 1 April 2021. Photographs referenced in the tank observations are included in Appendix A.

2.4.3.1 Tank No. 1 Exterior Observations

Exterior observations of Tank No. 1 shell and roof were performed on 10 and 11 March 2021.

2.4.3.1.1 Floor

1. There is insufficient slope away from the floor plate to shell plate connection at the base of the tank resulting in earth, water, vegetative growth, and debris burying the joint in the tank especially on the south and west sides of the tank (Photo #1).

2. The oiled subgrade and asphalt material on the west side of the tank has eroded significantly exposing the underside of the floor plate. A retainer ring would have helped to prevent erosion of the subgrade materials (Photo #2).

3. The shell to floor plate connection is exposed on the underside of the tank with subgrade materials eroded away from the tank on the northeast side of the tank (Photo #3).

2.4.3.1.2 Shell

1. The top of the shell on the exterior has isolated areas of corrosion beneath the vent sheet metal panels (Photo #4).

2. The upper rings above the tub ring are in fair condition.

3. On the backside by the trail there is a lot of rock damage exposing the steel with minor rust.

4. The tub ring has been overcoated numerous time due to the graffiti. Different types of coatings have been used and mold is evident under the coatings. This is caused by using water-based paints (Photo #5).

5. The upper section above the tub ring was over coated with an acrylic based coating which has poor adhesion to the original coating system. If this coating were not used the tank could have been over coated on the upper sections.

6. All growth and debris around the base of the tank shell should be removed.

2.4.3.1.3 Roof

1. When walking on the roof there is significant deflection of roof panels between supports and crumbling of rust and chips falling from roof into water. There was no evidence of significant damage to roof coatings as a result of ponding of water.

2. The roof has many rocks from people throwing rocks at the tank. The existing coating on the roof is exhibiting numerous areas of corrosion coming through the coating due to the coatings age. The coating on the roof due to its age is thinning out and allowing the corrosion to come through the existing coating.

3. The bolts attaching the vent screen are also deteriorating (Photo #6). The retainer ring on the inside of the vent screens is significantly corroded.

4. A zinc-based primer should be specified to help protect the steel from rock damage.

2.4.3.1.4 Appurtenances and Miscellaneous

1. The 8-inch drain elbow Mark No. DR-1 shown on the northwest side of the tank on the fabrication drawings is actually constructed on the northeast side of the tank.

2. Each of the tanks has EBBA Iron flexible tendon couplings on the above ground inlet and outlet pipeline connections to the tanks. The flexible couplings were added to the tanks during seismic upgrades in 1999.

3. There is a 24-inch bottom outlet (balancing) connection between the two tanks. The actuator on the valve between the two tanks was replaced approximately 5 years ago.

4. Tank No. 1 has a hinged shell manhole on the southeast side of the tank and a second 24-inch flanged shell nozzle on the southwest side of the tank.

5. There is a pressure tap with a corporation stop or ball valve on the 24-inch shall manway nozzle on the southeast side of the tank for water level measurement.

6. The 30-inch outlet and 24-inch inlet pipeline connections to the tank including flexible couplings are not provided with supports, are radial in their construction to the shell of the tank, obstruct travel around the tanks for pedestrians and vehicles, and are not isolated from the tank (Photos #7 and #8).

7. The 30-inch outlet and 24-inch inlet are located adjacent to each other which does not prevent short circuiting of water in the reservoir.

8. The overflow pipe only has one support or brace over the height of the tank.

9. There are numerous unused shell nozzles on both tanks.

10. The roof access hatches are extensively corroded on the underside with pitting resulting in small holes on the top of the hatches (Photo #9).

2.4.3.2 Tank No. 1 Interior Observations

Interior observations of Tank No. 1 floor, shell and roof were performed on 31 March and 1 April 2021. Tank No. 1 interior observations by a diver were performed on 31 March and from a raft on 1 April. Representatives with Kennedy Jenks and BACC performed interior observations from the raft.

2.4.3.2.1 Floor

Due to the tank being full of water interior observations of the Tank No. 1 floor are limited to those documented in Section 2.3.3.3 below and in the dive report in Appendix B.

2.4.3.2.2 Shell

1. Areas of the shell above the water level also has blisters and fractures in the protective coating system with minor surface corrosion of the metal. No measurable metal loss was observed in the shell of the tank.

2. The upper 5 feet of the perimeter shell have coating failure and bare metal exposure (Photo #15). This is mostly evident on all portions of the shell except the northeast quadrant of the tank (Photo #16).

2.4.3.2.3 Roof

1. The protective coatings on the underside of the roof plates and the roof framing have completely failed with areas of minor to moderate corrosion.

2. Roof plates between the outer perimeter columns and shell have severe coating failure with exposed bare metal (Photo #10). The coatings have failed over about ±90% of the roof plates. The roof plates along the perimeter near the shell show the most significant corrosion (Photo #11).

3. Roof plates in between the intermediate and outer columns exhibit loss of coatings and corrosion over ±75% of the panel area.

4. Roof plates in between the inner and intermediate columns exhibit delaminated coatings over ±50% of the plates and complete loss of coating with exposed bare metal over the remaining 50% of the plate area.

5. Roof plate coating around the center and inner columns are bubbled but still intact. No bare metal exposure (Photo #19).

6. Bottom flanges of radial channel beams in between the intermediate and outer columns have corrosion resulting in expansion and delamination of the steel. Pieces can be lifted off the top of the flange. This type of corrosion occurs at about 25% of the flanges around the entire tank. The flange condition progressively improves towards the center of the tank. Approximately 0.30-inch of flange thickness was recorded below the “flaked” portion (Photo #12).

7. Intermediate girder column connections are in poor condition with significant corrosion. However, there is fairly solid metal below the “flaking” (Photo #13). Blasting and coating removal will be needed to assess the quantity of metal loss in these areas because other connections are in favorable condition. Localized spots at girder webs of coating failure and rust (Photo #18).

8. Center column top plate still intact with coating failure and areas of corrosion. Five (5) of the radial channel beam connections at the top plate have missing bolts (Photo #17). Beams with loss of bolt connections appear to have moved as the hole is not visible through both the flange and top plate. Top of column top plate in similar condition to bottom surface.

9. Earthquake rods between the outer radial channel beams have severe corrosion over ±90% of their area. Complete failure was observed at one rod (Photo #14).

10. The coating exhibited numerous blister domes being fractured and exposing the steel substrate.

11. The most severe corrosion was observed on the east side of the tank on the outer and intermediate girders.

12. The tops of columns had blistered coating and minor surface corrosion.

13. There is significant metal loss of the roof framing radial beams and circumferential girders.

14. There was significant corrosion and loss of metal on one of the earthquake rods on the outer radial beams to result in failure of the rod connection to the beam.

15. There is corrosion of the metal at the overlapping locations of the roof plates.

16. There is moderate corrosion at the tops of flanges on the channel radial beams and on the underside of roof plates. Connection hardware for the exterior radial beams was corroded with loss of metal.

17. The was moderate corrosion on the bottom of flanges of radial beams with loss of metal.

18. There were bolts missing between the attachment of center radial channel beams and the top plate of the center column.

2.4.3.2.4 Appurtenances and Miscellaneous

1. The sheet metal covering the original vent area was loose in areas and exhibited multiple holes from corrosion.

2.4.3.3 Dive Inspection Report

A underwater dive inspection of Smith Saddle Tank No. 1 was performed by URI. The purpose of the dive inspection was to assess and document via photographs and video the below water condition of the interior floor, shell, columns and appurtenances of Tank No. 1 and identify any significant damage or deterioration in the tank structure or protective coatings. A 3-person commercial dive team along with surface-supplied air diving equipment disinfected in accordance with AWWA C652-11 was utilized to conduct the inspection. Significant observations documented in the dive inspection report are summarized below:

- Significant quantities and depths of large size chips of rusted steel from roof plates and roof framing were observed on the floor.
- Around the shell there were sparsely scattered coating blisters typically 1-inch in diameter and many of which were popped. There were also several large areas of cracked coating. Above the first horizontal seam, there was intermittent coating cracking that occurred in a pattern of vertical stripes.
- Like the walls all of the columns were observed to have coating blisters to varying extents.
- There was some minimal coating damage on the interior of pipe penetrations at the nozzles in the tank. The findings of inspections of each of columns are summarize Table 1 of the URI dive inspection report. Major concentrations of blisters in the coatings on the columns were observed on 12 columns typically in the lower areas of the columns.
- One broken anode was observed on the floor at the base of Column 2 on the outer ring of columns.
- The interior ladder was in acceptable condition.
- The overflow weir box was in acceptable condition.

The complete observations and findings of the dive inspection and select photographs are presented in the dive inspection report prepared by URI and included in Appendix B. The following link can be utilized to view/download the narrated video: https://www.dropbox.com/sh/xoguga7bskymyin/AAApp1U9J69zqnPfbzObRFora?dl=0

2.4.4 Tank No. 2 Observations

Tank No. 2 observations were performed between 10 March and 16 March 2021. Photographs referenced in the tank observations are included in Appendix A.

2.4.4.1 Tank No. 2 Exterior Observations

Exterior observations of Tank No. 2 shell and roof were performed on 10 March and 11 March 2021.

2.4.4.1.1 Floor

1. There is insufficient slope away from the floor plate to shell plate connection at the base of the tank resulting in earth, water, vegetative growth, and debris burying the joint in the tank (Photo #20).

2. There were several areas around the circumference of the tank where the subgrade materials had been allowed to erode away from the bottom of the tank exposing the underside of the floor plate of the tank (Photo #21). One areas on the southwest side of the tank, adjacent to the balancing valve, had a gap between the underside of the floor plate and the subgrade materials for more than 12 feet-0-inch beneath the empty tank. A second area near the 8-inch drain floor penetration on the west side of the tank had the underside of floor plate exposed and significant loss of subgrade materials adjacent to an un-shored excavation.

3. All growth and debris should be removed along base of tank.

4. Areas of subsidence, settlement, and erosion of subgrade materials should be grouted.

5. A retaining ring should be provided around the tank. Grading should be revised around the tank.

2.4.4.1.2 Shell

1. Extensive damage to the exterior protective coatings with rusting of the shell on the west and northwest sides of the tank as a result of rocks thrown against the side of the tank (Photo #22).

2. The upper rings above the tub ring are in fair condition.

3. On the backside by the trail there is a lot of rock damage exposing the steel with minor rust.

4. The tub ring has been overcoated numerous time due to the graffiti. Different types of coatings have been used and mold is evident under the coatings (Photo #33). This is caused by using water-based paints. All of the areas where the ASTM D-3359 x-scribe adhesion test were performed on the shell failed (Photo #34).

5. The upper section above the tub ring was over coated with an acrylic based coating which has poor adhesion to the original coating system. If this coating were not used the tank could have been over coated on the upper sections.

2.4.4.1.3 Roof

1. The roof has many rocks from people throwing rocks at the tank. The existing coating on the roof is exhibiting numerous areas of corrosion coming through the coating due to the

coatings age (Photo #23). The coating on the roof due to its age is thinning out and allowing the corrosion to come through the existing coating.

2. The bolts attaching the vent screen are also deteriorating.

3. A zinc-based primer should be specified to help protect the steel from rock damage.

2.4.4.1.4 Appurtenances and Miscellaneous

1. Shell access manway should be added.

2. The top and bottom flat bar swivel hinges on the 24-inch manhole were cut off the manhole, because the hinges had rusted in the closed position and would not permit opening of the manhole (Photo #24). Tank No. 2 only has a single 24-inch shell manhole.

3. A new or temporary nozzle had been provided adjacent to the manhole for the pressure level sensor for the tank eliminating the original tap on the side of the shell access manhole.

4. The baseplates for the gravity supports on both the inlet and outlet flexible piping connections were not anchored to concrete foundations (Photo #25).

5. The sleeve of the flexible piping connection had been pulled out on the 20-inch inlet to a 34-inch length between the double ball flange faces to facilitate the new isolation valve installation reducing the axial expansion capability of the flexible piping connection. The flexible piping connections should be verified for positioning in the optimum arrangement for resistance to earthquake forces.

6. The 30-inch outlet pipe penetration is not shown on the original fabrication drawings for the tank.

7. A nozzle with two ball valves and a spigot was added to the shell of the tank just west of the shell manhole for water quality sampling.

8. The 24-inch pipe penetration identified as Mark No. N-5 is not oriented as shown on the original fabrication drawings.

9. The District was in the process of replacing the 24-inch inlet and 30-inch outlet isolation valves on the tanks during the exterior observations period.

10. Similar to observations on Tank No. 1 the inlet and outlet piping on Tank No. 2 are above ground and obstruct vehicle and pedestrian travel around tank, radial orientation does not provide for maximum flexible coupling deflection between above ground piping and tank, supports for above ground piping should be anchored to concrete slab, and isolation joints should be provided for above ground piping (Photo #26).

2.4.4.2 Tank No. 2 Interior Observations

Interior observations of Tank No. 2 floor, shell and roof were performed on 15 March and 16 March 2021.

2.4.4.2.1 Floor

1. Coal tar exhibited numerous blister domes being fractured and exposing the steel substrate. The coal tar is very brittle (Photo #27).

2. No metal loss in the fractures due to the cathodic protection system protecting the steel. No measurable metal loss was noted (Photos #28 and #29).

3. Coal tar system is failing and has exceeded its performance life.

2.4.4.2.2 Shell

1. Coal tar system is failing and has exceeded its performance life (Photo #30). The coal tar jet set primer on the interior shell of the tanks is grey. The hot coal tar enamel appears white.

2. Upper shell in the vapor space is failing with evidence of corrosion and metal loss (Photos #37, #39, #40, #41 closeup, and #42).

3. Coal tar exhibited numerous blister domes being fractured and exposing the steel substrate. The coal tar is very brittle (Photo #31). Small cracks in the coal tar coating observed on tank walls allow water absorption under the coating which can lead to coating blisters and failure.

4. No metal loss in the fractures due to the cathodic protection system protecting the steel. No measurable metal loss was noted (Photo #32).

5. Calcareous deposits were present on top of the coating on the interior shell, on the columns especially near the bottoms, and on the ladder rungs (Photo #35). Calcareous deposits form on organic coatings due to water quality and the presence of cathodic protection.

2.4.4.2.3 Roof

1. There were numerous rust chips including failed coating and delaminated metal from the underside of the roof plates and roof framing that had fallen off the roof and settled on the floor of the tank. Many of the rust chips were removed from the tank; however, many were pushed to the perimeter of the floor (Photo #38).

2. The protective coatings on the underside of the roof plates and roof framing has completely failed (Photo #45).

3. The outer bay adjacent to the abandoned shell vents has moderate corrosion on the roof plates and rafters (Photo #43). The upper shell in the vapor area of the tank has loss of metal and excessive pitting and along the shell to roof plate interface.

4. Severe active corrosion was observed on the topside and lower radial channel beam flanges exhibiting moderate metal loss (Photos #44 and #46).

5. The topside of the rafters due to the exposed steel has fused the top of the rafter with the roof plate in areas.

6. The nuts and bolts that fasten the rafters to the shell support exhibited 50% +/- metal loss (Photo #44).

7. The inner and intermediate spans where the radial rafters support the coating have completely failed. The existing coating is fractured and detaching. Most of the roof plates rafters, and supports are exhibiting active corrosion.

8. The radial rafter center support exhibited minimal metal loss on the rafter ends and bolted connections on the dollar plate.

9. The interior protective coating system is failing and should be removed and replaced with a new protective coating system meeting the new NSF 600 requirements.

10. Support columns and baseplates are in good condition. The lining system on the columns of the tank is completely failed and should be replaced (Photos #47 and #48).

2.4.4.2.4 Appurtenances and Miscellaneous

1. Some of the nozzles have cracked and spalling protective coatings (Photo #49).

2. The overflow weir box and diagonal support brackets were intact and appeared in favorable condition (Photo #50).

3. At least six of the eight cathodic protection system anode lead strands were missing weight which had corroded off of the copper wire and fallen to the floor of the tank (Photo #51).

2.4.4.3 Ultrasonic Thickness Testing

Ultrasonic thickness (UT) testing was performed on the metal elements and appurtenances of the tanks. UT testing is a nondestructive evaluation technique that allows for the determination of metal wall thickness. High frequency sound waves are transmitted through one side of a metal wall from a transducer. When sound waves reach the other side of the metal wall, a fraction of the waves will echo back to the transducer. The metal thickness is determined by recording the time it takes for the sound wave to travel through the metal and return. A Olympus 38DL Plus UT gauge was utilized to obtain thickness measurements for the metal components. Prior to taking measurements, the gauge was calibrated to the velocity of sound in steel (0.2345-inch per microsecond). When properly calibrated, the gauge has a measurement accuracy of thousandths of an inch (0.001-inch).

Ultrasonic thickness measurements were recorded on the exterior floor, shell and roof of Tank Nos. 1 and 2 and the interior floor and shell of Tank No. 2. The results are summarized in Table 1.

Table 1: Summary of Ultrasonic Thickness Gauge Measurements

	Number of Measurements	Specified Thickness (inches)	Average Thickness (inches)	Minimum Thickness (inches)
Tank No. 1				
Exterior				
Floor	4	0.2500 (1/4)	0.214	0.123
Shell	36	1.1875 (1 3/16)	1.211	1.185
Roof	174	0.1875 (3/16)	0.166	0.090
Tank No. 2				
Exterior				
Floor	6	0.2500 (1/4)	0.194	0.092
Shell	36	1.1875 (1 3/16)	1.206	1.176
Roof	172	0.1875 (3/16)	0.171	0.113
Interior				
Floor	9	0.2500 (1/4)	0.238	0.222
Shell	8	1.1875 (1 3/16)	1.217	1.182

2.4.4.4 Division of Drinking Water Distribution Reservoir Deficiencies

In accordance with the State of California Water Resources Control Board Division of Drinking Water (DDW), R-14-03 Revision of Water Works Standards, California Code of Regulations Title 22, Chapter 16, Article 6, Distribution Reservoirs, Section 64585 the following deficiencies were identified in conformance with the standard for both tanks. Each deficiency is noted with the appropriate subsection reference from Section 64585.

- (a)(2) Roof vents were not constructed to prevent the entry of insects with vent screen openings too large.
- (a)(3) Sample taps are not protected against freezing.
- (b)(8) Reservoirs do not have adequate lighting of reservoir interior for inspections, cleaning or repair.
- (b)(4) While the reservoirs have separate inlet and outlet they are adjacent to each other and have not been oriented to minimize short circuiting and stagnation of the water flow through the reservoir.
- (b)(5) The tank drains are directly connected to the buried site drainage system with no protection from cross contamination or rodents or other animals entering drains.

2.4.5 Tank and Site Safety Observations

Site observations associated with the Smith Saddle Tanks safety system and security systems for worker protection was performed by Bert Drews of Kennedy Jenks on 10 March 2021. The scope of the safety review was associated with Cal/OSHA code review related to safety requirements for the tanks and access stairs, ladders, guardrails, fall protection, etc. The following observations are provided with respect to tank and site safety:

- The top of Tank No. 1 is accessed by an industrial spiral staircase with a landing platform. A walkway platform near the top of the landing of Tank No. 1 provides access to Tank No. 2. Access to the platform and the two square access hatches on the top of each tank are protected by a guardrail system.

- Tank No. 1 has two access manholes at the base of the tank. Tank No. 2 has a single access manhole at the base of the tank. In addition, each tank has above ground inlet and outlet water pipelines perpendicular to the shell of the tanks. During the site visit, workers were observed climbing over the above ground pipelines.

- The water tanks are enclosed in a chain-link fence. A metal security gate prevents unauthorized entry up the Tank No. 1 staircase. Additional security includes a security camera and lighting.

2.4.5.1 Walk Working Surfaces / Fall Protection

The roofs of the water storage tanks are considered "platforms" for purposes of Subpart D of the General Industry standards (CCR Title 8) depending on the frequency of employee use. Federal OSHA has issued guidance on when an elevated working surface will be treated as a platform covered by the standard. (OSHA Instruction STD 1-1.13, "Fall Protection in General Industry 29 CFR §1910.23(c)(1), (c)(3), and 29 CFR §1910.132(a), April 16, 1984).

Platforms are interpreted to be any elevated surface designed or used primarily as a walking or working surface, and any other elevated surfaces upon which employees are required or allowed to walk or work while performing assigned tasks on a predictable and regular basis (See 29 CFR 1910.21(a)(4) for definition of "platform".)

Predictable and regular basis means employee functions such as, but not limited to, inspections, service, repair and maintenance which are performed:

- At least once every 2 weeks, or

- For a total of 4 man-hours or more during any sequential 4-week period (e.g., two employees once every 4 weeks for 2 hours = 4 man-hours per 4-week period).

In addition, in 2003, OSHA revised the requirements of Subparts D and I of 29 CFR Part 1910 (55 Federal Register 13360, April 10, 1990, and 68 Federal Register 23528, May 2, 2003). Under the revisions, the roof of a water tank where employees sometimes perform inspection or maintenance duties would fall within the definition of a "walking and working surface" and fall protection would usually be required if the surface is more than 4 feet above an adjacent level (§1910.27(b)(1).

Based on the infrequent inspection of the top or interior of the tanks by District staff, by definition, the tanks' roofs would not be considered a working platform, and only Cal/OSHA regulations pertaining to walk and working surfaces would apply.

In situations where the safeguarding requirements (i.e., guardrail systems) are not applicable because employees are exposed to falls from an elevated surface other than on a predictable and regular basis, personal protective equipment as required by CCR Title 8 Section 3380 or other effective fall protection shall be provided.

2.4.5.2 Fixed Industrial Stairs

In accordance with CCR Title 8 Section 3234 –Fixed Industrial Stairs, the spiral industrial staircase must meet the following minimum requirements.

1. Fixed stairways shall be designed and constructed to carry a load of five times the normal live load anticipated but never of less strength than to carry safely a moving concentrated load of 1,000 pounds.

2. Fixed stairways shall have a minimum usable width of 22 inches.

3. Treads and tread nosings must be non-slip.

4. Fixed stairs shall be installed at angles to the horizontal of between 30 and 50 degrees.

5. Any uniform combination of rise-tread dimensions may be used that will result in a stairway at an angle to the horizontal within the permissible range. Table IS-1 is a table of rise/tread dimensions that will produce a stairway in the permissible range.

2.4.5.3 Guardrails

In accordance with CCR Title 8 Section 3209 –Standard Guardrails, guardrails at the top of the tank must meet the following minimum requirements:

1. A standard guardrail shall consist of top rail, midrail or equivalent protection, and posts, and shall have a vertical height within the range of 42 inches to 45 inches from the upper surface of the top rail to the floor, platform, runway, or ramp level.

2. Guardrail systems are capable of withstanding, without failure, a force of at least 200 pounds applied in a downward or outward direction within 2 inches (5 cm) of the top edge, at any point along the top rail.

3. All guardrails and other permissible types, including their connections and anchorage, shall be designed for a live load of 20 pounds per linear foot applied either horizontally or vertically downward at the top rail.

4. If constructed of standard metal pipe, the top rails and single midrail, where permitted, to be 1-1/2-inch outside diameter or larger. The posts to be 1-1/2-inch outside diameter or larger, the spacing not to exceed 8 feet.

2.4.6 Access Road and Tank Site Observations

Site observations of the Smith Saddle Tanks Glen Drive access road and site around the tanks was performed by Christy Suttich, PE, with Kennedy Jenks on 10 March 2021. Based on discussions with District representatives, the following input was provided with respect to historical issues associated with the access road and tank site:

- Turning radius of the access road for the last turn just before the tank site is tight and sometimes difficult to traverse, especially when its muddy.
- The access road was regraded to remove ruts and a layer of crushed rock was placed in early 2021.
- Access road drainage issues included major rutting and erosion following rain events.
- The steepness or longitudinal slope does not prevent vehicles from navigating the road.
- Maintenance teams regularly are required to clear vegetation and debris from the existing catch basin grates on the site.
- Historically as much as 2 feet of stormwater has been observed ponding next to the tanks in large rain events where the two existing catch basins are blocked by vegetation and debris.

The following observations were made with respect to the Glen Drive access road and Smith Saddle tanks site.

2.4.6.1 Glen Drive Access Road Observations

The following observations of the Glen Drive access road are primarily associated with the north end of the road near the steep grade just prior to tank site. The Glen Drive access road width is approximately 12 to 15 feet. At the top of the access road, a large boulder and an existing valve vault with surrounding bollards minorly impeded the access width. The cross and longitudinal slopes of the access road are not documented. When driving along the road, no obvious concerns of changes in slope, i.e., where bottoming out could occur, was noted. All but one of the existing road turning radii appeared to be adequate for a large delivery or construction vehicle. The last turn, just before the top, did not appear to be wide enough to support anything larger than a pick-up truck with trailer. A rough field estimate of the turning radius indicated a radius of 17 to 18 feet, from the center to the inside edge of road point of curvature. A typical minimum radius for a large delivery or construction vehicle ranges from 25 to 40 feet. In general, the access road drainage and wearing surface appeared to be in favorable condition due to the recent work completed. Concentrated drainage paths were observed reforming where erosion and/or muddy low spots are likely to occur along the path of travel.

2.4.6.2 Smith Saddle Tanks Site Observations

The Smith Saddle Tanks site observations were focused primarily on adequate access around the tanks, grading, drainage, and site fencing.

An approximately 10-foot-wide perimeter road is provided around the tanks. Two chain-link gates are located onsite to provide vehicle access around all sides of the tanks and the above ground piping. No turn around is provided in the road along the east/southeast/south portion of Tank No. 2, so a vehicle driving around Tank No. 2 in the clockwise direction, is either required to drive onto the existing berm or back-up along the road to get out as the above ground piping blocks access completely around the tank. When walking the perimeter road, evidence of vehicle tracks and maintenance vehicles driving up onto the existing earth berm were noted.

There are two main components of grading and drainage that require consideration at steel tank sites: 1) positive drainage away from the tanks; and 2) tank foundation height. The following deficiencies were observed at the tank site:

- The water tank site does not prevent entry of surface runoff or drainage into the reservoir (Article 6 Distribution Reservoirs, §64585 (b)(10).

- Site grading around the tank does not provide for positive drainage away from the tank and the top of the foundation is not a minimum of 6 inches above finished grade (AWWA D100-11 Sections 12.6 and 12.7).

- The water tank site does not prevent corrosion of the interior walls of the reservoir (Article 6 Distribution Reservoirs, §64585 (b)(11)).

Runoff was observed ponding against the existing tank walls, tank foundation and within the 10-foot-wide perimeter road. The perimeter road appeared to either not be sloped or was sloped from the perimeter earth berm back towards the tanks such that ponding in some locations was up to 8 inches deep and either next to the tanks or very close to the tank foundations and walls. Ponding was also observed in proximity to the existing CMU building and electrical boxes.

Two existing catch basins are located onsite within the vegetated areas between the two tanks. However, both were either partially or almost completely covered with debris and vegetation, blocking runoff from entering. The grate of the catch basin closer to Tank No. 2 was less blocked because a District maintenance team was onsite and cleared it. Even if the catch basins were clear, the site was insufficiently sloped to promote runoff towards the catch basins.

The height of the tank foundations, measured from top of foundation to finished grade, were estimated to range from less than 0-inch (the foundation was buried under earth) to approximately 6 inches. Tanks No. 1 and No. 2 had portions of the existing foundation eroding such that water was almost under the tank wall. A portion of the existing foundation at Tank No. 2 appeared to be failing and bulging creating cracks for water to enter encouraging more runoff to sit next to and potentially under the tank wall.

2.5 Field Observation Notes and Photos

All of the notes from field observations have been summarized in the previous sections. There are additional notes from field observations contained in the dive, geotechnical, coatings, and hazardous materials reports included in the appendices. Photographs referenced in the tank observations are included in Appendix A. There are numerous additional photographs from interior and exterior assessments that will be electronically transferred to the District.

Section 3: Site Geotechnical Evaluation

3.1 Geotechnical Scope of Work and Purpose

A preliminary geologic and geotechnical assessment of the Smith Saddle Tanks site was performed by GEI. The purpose of the preliminary geologic and geotechnical assessment was to assess potential geologic hazards present at the site and provide seismic design criteria to aid in the seismic evaluation of the existing tanks. The assessment did not provide design criteria suitable for retrofit of the existing tanks nor construction of new tanks. The findings of the preliminary geologic and geotechnical assessment are presented in the Draft Technical Memorandum (TM) prepared by GEI and included in Appendix C.

3.2 Site Description and Geology

The Smith Saddle Tanks are on Smith Ridge in the Northern California Coast Ranges of Marin County, roughly at an elevation of about 500 feet. Key observations in the site description are noted below:

- Topographic information provided by the District indicates the ground surface directly around and adjacent to the tank's ranges from about elevation 486 to 488 feet.
- The tanks were constructed on a cut surface excavated into the top of the ridge. The cut slopes for the tank pad are inclined at about 1:1 (horizontal to vertical) and on the order of about 75 feet high, generally decreasing in height from northeast to southwest.
- A 6-inch-thick asphalt ring was placed around the perimeter of the tanks, extending 18 inches inward (beneath) and outward of the tank shell (wall). A 6-inch-thick layer of "oiled sand" was placed within the asphalt ring beneath the tanks.
- The site surface soils around the tanks are impacted by petroleum products.
- The tank site is primarily underlain by sandstone, with mélange mapped along the southwest margin of the site. In the Project area, the mélange unit includes large blocks of greenstone and chert.

For a complete site description along with geologic and seismic setting, refer to the Draft TM prepared by GEI in Appendix C.

3.3 Site Field Observations

GEI performed a site reconnaissance on 11 March 2021. The reconnaissance involved walking around the perimeter of the tanks, including sections of the adjacent access roads, to observe the general geologic conditions. Key observations from the site field observations are summarized below:

- The cut slopes exhibit minor raveling and very small (less than about 12 inches in dimension) block failures in places, with much of the debris from past failures accumulating against the base of the perimeter chain-link fencing on the northern side of the site. No evidence of a large or significant block failure that could potentially damage one of the tanks was observed.
- At the southwest end of the site, a fill was constructed at the head of a steep, west-flowing drainage directly adjacent to the tank pad. The fill may have been constructed sometime after 2000. At the west end of the fill pad, two drain pipes (8-inch corrugated metal pipe (CMP) and 15-inch CMP) daylight from the fill and discharge onto the fill slope and into the natural drainage below.
- The south-facing slopes above the northwest end of the tank site exhibit minor slumping and/or creep of colluvial soils. None of the minor slumps observed are directed toward the tanks.

For complete observations and selected photographs from the site geology and field observations. refer to the TM in the Appendix C.

3.4 Potential Geologic and Seismic Hazards

The potential geologic and seismic hazards assessed for the project included strong ground shaking, surface fault rupture, landsliding, and liquefaction. Of the potential hazards, strong ground shaking is the most significant. The potential for surface fault rupture, landsliding, and liquefaction were judged to be very low or negligible.

3.5 Seismic Design Criteria

Seismic design parameters were developed by GEI following the procedures of the 2019 CBC (CBSC, 2019) and ASCE 7-16 (ASCE, 2016). Based on review of available tank as-built information, publicly available geologic mapping and field observations, it is the opinion of GEI that a Site Class B classification (Rock) is appropriate for characterizing potential earthquake ground shaking and developing seismic design parameters. The code-based spectral accelerations parameters summarized in the TM were obtained from the United States Geological Survey (USGS) national seismic hazard mapping website based on ASCE 7-16 as required by the 2019 CBC utilizing the site location of 38.010662°N and 122.602498°W. The recommended values of S_S = 1.5 g, S_1 = 0.6 g, S_{DS} = 1.0 g, and S_{D1} = 0.4 g were utilized for the seismic evaluation of the existing tanks in the subsequent Section 4 of this report and should be utilized for the design of any new water tanks at the site.

3.6 Geologic Limitations and Recommendations

No subsurface explorations or geophysical investigations were performed for the preliminary geologic and geotechnical assessment. If the District was to determine to proceed with either foundation improvements on the existing tanks or replacement of the existing steel water tanks with new tanks, then the subsurface exploration and geophysical investigations developed for the project should be performed. For the complete findings of the preliminary geologic and geotechnical assessment, refer to the Draft TM prepared by GEI and included in Appendix C.

Section 4: Structural and Seismic Evaluation

This section documents the results and findings of structural and seismic evaluation of the tanks. This section and the attached calculations included in Appendix D, present the findings and conclusions on the structural evaluation on the tanks.

The primary purpose of the seismic evaluations was to determine whether the water tanks meet current code requirements that would be applicable for the design of a new tank and to provide mitigation concepts to address structural deficiencies identified in the analysis.

4.1 Existing Tanks Structural Description

The two existing tanks are identical structures based on a single set of fabrication drawings prepared by United States Steel dated 1960. The tanks have a 150-foot-6-inch mean diameter and a 39-foot-11-inch shell height. The shell of each tank is constructed five rings of A-7 steel plate with shell ring thickness varying from 1-3/16-inch thick plate at the bottom to 5/16-inch thick plate at the top. Each tank has a top constructed of 3/16-inch thick A-7 steel roof plates sloped upward from the perimeter to the center at ½-inch vertical over 1-foot horizontal. Each tank has bottom constructed of ¼-inch thick A-7 steel floor plates sloped upward from the perimeter to the center at 5/32-inch vertical over 1-foot horizontal. The roof framing for each tank consists of radial A-7 steel C7x9.8 channel rafters with four spans from shell to intermediate girders, between intermediate girders, and from intermediate girders to the center column. There are three rings of circumferential intermediate girders of A-7 steel of either C15x33.9 or C18x42.7 size. The intermediate girders are supported by 28 interior columns arranged in three rings and one center column. All columns are constructed from 10-inch diameter Schedule 30 pipe of steel construction. For additional detailed fabrication information on the tanks, refer to the fabrication drawings listed in the References section at the end of the report.

4.2 Seismic Evaluation Approach, Assumptions and Limitations

This section presents a summary of the approach taken for the structural and seismic evaluation of the tanks and assumptions and limitations in the methodology.

4.2.1 Structural Evaluation Approach

As part of this evaluation, the seismic evaluation approach included the following steps:

1. Define the seismic input per the current building code as provided by the geotechnical engineer.

2. Model the tank information in Kennedy Jenks' tank design spreadsheets.

3. Perform seismic calculations for the tanks using AWWA D100-11, the 2019 CBC, and referenced ASCE 7-16 standard.

4. Evaluate tank stability, sloshing wave height, anchorage ratio, and other parameters that define overall ability to withstand seismic loads in the tank's as-designed condition under current code design load conditions.

5. Provide comments and/or recommendations on feasibility of potential rehabilitation measure such as raising tank wall heights, reducing fill height, or anchoring the tank.

4.2.2 Structural Assumptions and Limitations

Kennedy Jenks evaluated the existing tanks based on the requirements for new tanks according to the provisions of the following standards:

- ASCE, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," (ASCE 7-16).

- AWWA, "Welded Carbon Steel Tanks for Water Storage" (AWWA D100-11).

GEI provided values for the design level earthquake used in the tank evaluation, corresponding to the code-based spectral acceleration parameters developed following the procedures of the 2019 CBC (Chapter 16, Section 1613) and ASCE 7-16 (Chapter 11). Appendix D summarizes the seismic parameters used for the tank site obtained from Section 6.2 in the GEI report (Appendix C).

The following general assumptions and limitations are part of the seismic evaluation:

1. In some instances, the drawings were not able to provide data for the tank components. Where information on the tank and tank components was not available, but was still needed in order to carry out other analyses, we assumed typical values or made best estimate approximations. Assumptions and limitations specific to each tank are listed in Section 4.2 of this report.

2. Seismic Importance factor is equal to 1.5 based on Seismic Use Group III, as defined in AWWA D100-11 Section 13.2. Seismic Use Group III includes tanks deemed "essential to the life, health, and safety of the public, including post-earthquake fire suppression." All tanks are required to provide minimum operational, fire, and emergency flow capacities. As such, we considered these tanks Seismic Use Group III and used a Seismic Importance Factor of 1.5 in our analyses. As presented in Section 4.3.3, individual tanks could have their service requirement, also known as the risk category or seismic use group, and their seismic importance factor redefined for the tank, if the currently serviced water system facilities are no longer dependent on the tank for essential or emergency purposes after a seismic event.

3. Seismic rehabilitation design and the creation of drawings or sketches of rehabilitation options are not included in the scope of work and will be performed as part of the design of repair/strengthening of the tanks.

4.3 Desktop Design Seismic Evaluation

4.3.1.1 Tank and Tank Ring Wall Stability

Resistance to the overturning moment at the bottom of the tank shell may be provided by the weight of the tank shell, weight of roof reaction on the shell, and weight of a portion of the tank contents adjacent to the shell for self-anchored tanks, or by mechanically anchoring the tank shell. The resisting force is adequate for tank stability, and the tank may be self-anchored provided the overturning ratio J is less than 1.54. Otherwise, the following are applicable for other values of J:

1. If J is less than 0.785, there is no shell uplift because of the overturning moment, and the tank is self-anchored.

2. If J is greater than 0.785, but less than 1.54, there is shell uplift. However, the tank is stable provided the shell compression requirements are satisfied.

3. If J is greater than 1.54, the tank is not stable and the tank needs mechanical anchorage.

With the updated seismic parameters and updated resistance to the overturning moment at the bottom of the tank based on the weight of the tank and weight of a portion of the tank contents adjacent to the shell the tank was determined to have an overturning ratio of 1.40 with the effects of vertical acceleration included.

The resistance to the tank overturning is provided by a total width of approximately 1-foot-7 inches of ¼-inch thick steel plate in the floor of the tank directly adjacent to the shell of the tank. While not required, the District could significantly increase the resistance to overturning, reduce the instance of shell uplift, and protect the connections to the floor of the tank directly adjacent to the shell by increasing the floor plate thickness from ¼-inch to approximately ¾-inch over a 5-foot-3-inch wide area of the floor of the tank.

If the District were to permanently operate the tanks at a reduced water level, then the maximum operating level provided by the top capacity level of the tank the overturning ratio would be lower.

4.3.1.2 Tank Wall (Shell) Compression Stresses

When determining tank wall (shell) compression stresses, the tank's overturning moment is determined in accordance with AWWA D100-11, Section A.13.5.4.2.2. A linear reduction in the overturning moment from the base to the roof was assumed in our calculations. This will allow us to determine if shell courses above the lowest (tub) shell were undersized in the original design and are currently overstressed for shell compressive stresses. Like "elephant's foot" buckling, exceeding the tank wall (shell) compression stresses, may either result in the deformation of the lower ring of the tank shell or the failure of the welds at the base of the tank shell and at penetrations resulting in the loss of tank contents. The maximum longitudinal shell compression stress in the bottom ring of the shell was determined to be 1,083 psi well below the seismic allowable longitudinal shell compression stress of 7,014 psi. The allowable shell plate stresses in compression for the self-anchored tanks for each ring are summarized in Table 2.

Table 2: Allowable Shell Plate Stresses in Compression

Ring No.	(Eq. 13-49) Δσcr	(Eq. 3-11) (Table 10) σa or F_L	Max Long Shell Compression Stress, σc (psi)	Seismic Allowable Compression Stress, σe (psi)	Demand/Capacity
5 Top	1,851	609	193	2,046	9.44%
4	2,771	921	414	3,075	13.47%
3	3,740	1,371	635	4,321	14.70%
2	4,678	1,915	859	5,672	15.15%
1 Bottom	5,520	2,500	1,083	7,014	15.44%

4.3.1.3 Tank Wall (Shell) Tensile (Hoop) Stresses

Cylindrical shell plates in welded steel and bolted steel tanks have the thickness of the shell plates determined based on limiting the stresses in the plates based on the pressure of the tank contents. The maximum allowable unit stress for shell plates in tension in the tank shell is 15,000 psi unless high strength steels were utilized in the design of the tank and noted on the tank nameplate. In a seismic event, hydrodynamic hoop tensile stresses are required to be added to the hydrostatic stress in determining the total hoop tensile stress in the cylindrical shell plates. A one-third increase in the basic allowable stress increase is permitted for seismic loading.

Tanks rarely fail in seismic events as a result of exceeding the shell tensile (hoop) stress, because generally there is sufficient over capacity provided by the thickness of the shell plate and the allowable tensile stress in the steel compared with the design stress. A hoop tensile stress failure of the tank would most likely occur in those tanks with a significant corrosion of the shell plate at a given location, significant undersize in the tank shell plate thickness, or a significant under capacity in the provided strength of the steel utilized. A yielding of the shell plate or the welds in the shell plate would generally be a very ductile failure mode eventually resulting in a tear or crack in the shell plate contributing to a loss of tank contents.

When evaluating the combination of hydrostatic and hydrodynamic hoop stress in the tanks when vertical acceleration is specified, it was found that total stress in the lower four rings of the shell slightly exceeded the seismic allowable stress of 17,000 psi with values varying from 17,748 psi to 19,721 psi. However, when the combination of hydrostatic and hydrodynamic hoop stress were compared with the allowable tensile stress maximum of 60% of the published minimum yield point (strength) or one-third of the published minimum tensile strength of the A-7 steel including reduction by the applicable joint efficiency, it was determined that all of the shell rings were within the seismic allowable stress of 22,440 psi. The total stress for each shell ring along with the demand to capacity ratio based on the 22,440 psi seismic allowable stress is summarized in Table 3.

Table 3: Hydrodynamic Seismic Hoop Tensile Stress in Tank Shell when Vertical Acceleration is Specified

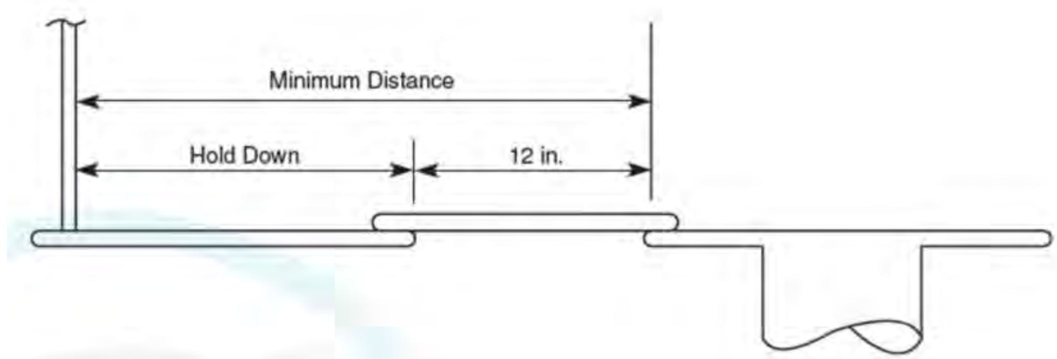
Ring No.	Impulsive Hoop Force, Ni (lb./in)	Convective Hoop Force, Nc (lb./in)	Hydrostatic Force, Nh (lb./in)	Total Stress σ_s dynamic + σ_s static (psi)	Demand/Capacity
5 Top	1,713	1,031	2,527	14,585	65.00%
4	3,393	918	5,641	19,721	87.88%
3	4,597	841	8,755	19,762	88.07%
2	5,330	795	11,910	18,721	83.43%
1 Bottom	5,575	779	15,065	17,748	79.09%

If new tanks were to be constructed, the shell plate thickness in all of the rings of the tanks would be increased to account for the combination of hydrostatic and hydrodynamic hoop stress based on the lower seismic allowable stress of 20,000 psi and to account for wind design per AWWA Section 3.5.

4.3.1.4 Piping Connections

Bottom connections for self-anchored tanks should be located inside the shell a sufficient distance to minimize damage by uplift. The existing tanks have two bottom connections on each tank. An 8-inch-diameter drain connection, which is located approximately 10 inches from the inside of the shell on the tank to the centerline of the connection and a 24-inch-diameter intertie connection between the two tanks, which is located approximately 3 feet-0-inch from the inside of the shell on the tank to the centerline of the connection. In accordance with Section 13.6.2 of AWWA D100-11, the minimum distanced measure to the edge of the connection reinforcement should be the required width of the bottom annulus, 1-foot-7 inches, plus 12 inches, or 2 feet-7 inches overall, see Figure 1. The existing bottom connections provide 1-¾-inch for the 8-inch drain connection and 11-¼-inch for the 24-inch intertie connection. In order to prevent damage to the tank and avoid release of the tank contents due to failure of the piping system, the District should consider removing, plating over, and replacing the bottom piping connections to the two tanks.

Figure 2: Bottom Piping Connection of Self-Anchored Tank



Above ground piping connections were provided for the inlet and outlet on each tank with flexible connectors to provide sufficient flexibility. Based on AWWA D100-11 Table 30, the inlet and outlet piping connections to the tank should provide upward vertical displacement of at least 4 inches, downward vertical displacement of at least 1-inch, and horizontal displacement (radial or tangential) of at least 2 inches. Based on the type of flexible connectors provided, there should not be any reason why the minimum design displacements for above ground piping attachments would not be sufficient.

4.3.1.5 Freeboard and Sloshing

The currently published AWWA D100-11 indicates that sloshing shall be considered in determining the freeboard above the maximum operating level. The requirements for calculating sloshing heights have changed considerably since 1995. Freeboard is defined as the distance from the maximum operating level to the lowest level of the roof framing. The maximum operating level is defined as the specified maximum water level under normal operating conditions. Unless otherwise specified, the maximum operating level shall be taken as the top capacity level. The top capacity level is the water level defined by the lip of the overflow. The freeboard or sloshing was determined in accordance with both the requirements of AWWA D100-11 and ASCE 7-16 as adopted by the 2019 CBC.

Based on documented past experience of welded and bolted steel tank performances in earthquakes, the consequence of damage to the roof system and the top of the shell of the tank from sloshing wave damage has been known for many years. The new more stringent requirements for freeboard to address the sloshing wave damage in steel tanks is a significant issue that is likely to directly impact a tank's survivability and functionality following a major earthquake. While sloshing wave damage may not reduce the tank's ability to maintain containment of the stored water, it can result in sufficient damage to the top of the tank shell, roof and columns and result contamination of the water supply at a minimum and collapse of the tank roof in the worst case scenario.

In general, freeboard, as calculated in accordance with AWWA D100-11, was the more conservative requirement. The calculated wave heights during design level earthquakes in this evaluation exceed the available freeboard when tanks are filled to the current top capacity levels. However, the District may be able to operate at maximum operating levels below the top capacity levels with reductions in storage capacity. The steel roof plate, the rafter beams, and their bolted connections do not have adequate strength to resist the sloshing loads exerted on the roofs. When the freeboard requirements are not satisfied, a tank is vulnerable to damage to the roof framing, roof plates, and shell plates at the top of the tank as shown. The calculated freeboard was determined to be 5 feet-6 inches and when combined with the depth of the 7-inch and 15-inch roof framing would result in a required freeboard of 7 feet-4 inches. Given the 38 feet-6 inches maximum operating level in the tanks would result in an overall shell height of approximately 45 feet-10 inches, which could be rounded to 46 feet-0-inch for the repair on new tank shell height.

While insufficient freeboard alone may not be a sufficient reason to increase the height of the tank roof where tanks have significantly deteriorated roof plates and framing, the freeboard should be addressed when replacing the tank roofs. Another option would be to lower the maximum operating level in the tank to maintain freeboard requirements at all times during operation of the tank on a temporary basis until the tanks can be repaired or replaced.

4.3.1.6 Interior Column

Interior columns were evaluated for compression in accordance with the American Institute of Steel Construction (AISC) Steel Manual and AWWA D100 provisions. Center and interior columns were evaluated utilizing load combinations with weight of roof supported by the column, plus roof live load supported by the column, plus the vertical seismic force. The interior columns did have enough strength to resist the lateral force of water during a design seismic event. Even if the columns were extended to accommodate the added height in the tank for sloshing and freeboard, the columns would approach but not exceed the allowable bending strength.

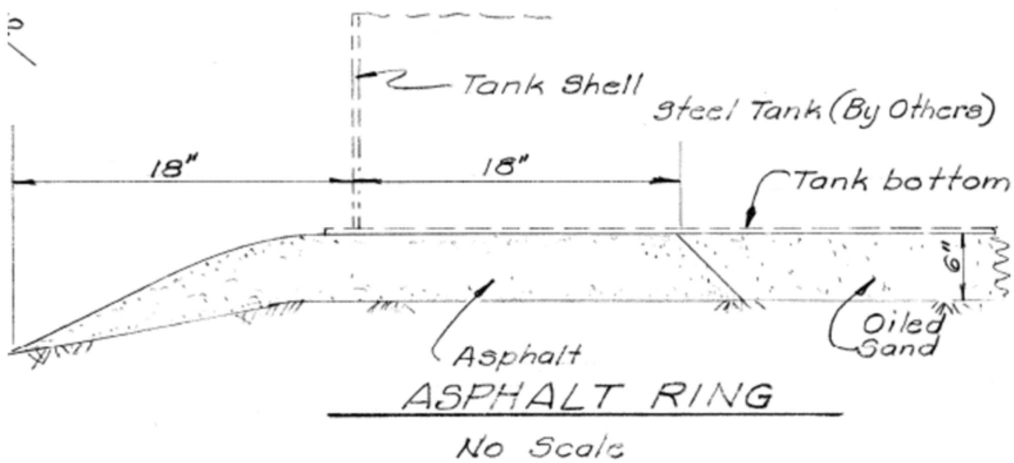
4.3.1.7 Sliding

Due to horizontal design acceleration, the design shear at the top of the foundation should be determined for self-anchored ground supported flat-bottom tanks and the design shear at the top of the foundation shall be less than the allowable lateral shear or additional shear resistance should be provided. The allowable lateral shear is a function of the coefficient of friction and the weight of the tank shell, roof, and fluid contents. For the analysis, we assumed a conservative coefficient of friction of 0.32. Tanks where the design shear exceeds the allowable lateral shear are vulnerable to failure of piping connections. Because of the large diameter of the tanks relative to the heights, the allowable shear far exceeds the actual shear for the tanks.

4.3.1.8 Foundation

Based on the District's Drawing No. 2873/C9-10-4, Sheet 1 of 4, asphalt ring detail the existing tanks were originally constructed with an asphalt ring of approximately 3 feet-0-inch width and 6-inch thickness with one-half of the ring width, 18 inches, intended to be placed beneath the floor plate of the tank, see Figure 2. The asphalt ring was intended to contain the 6-inch thick oiled sand layer beneath the floor plates of the tank. The 18-inch thickness beneath the tank floor is consistent with the total width of bottom annulus intended for bearing in accordance with AWWA D100-11 Section 13.5.4.1.1 based on the ¼-inch floor plate thickness of the bottom annulus. Many of the deficiencies with the bottom of the tank and lack of conformance with AWWA D100-11 were already presented in Sections 2.3 and 3. The existing asphalt ring foundation is similar to a Type 4 foundation, as noted in AWWA D100-11. However, asphalt was utilized instead of a granular material and the asphalt was not provided with adequate protection to ensure against foundation washout and adequate provisions for drainage. New tanks should be supported on reinforced concrete ringwall foundations.

Figure 3: Existing Asphalt Ring Detail



4.4 Seismic Deficiencies

The seismic deficiencies in the two tanks can be summarized as follows:

1. **Overturning Ratio:** While the overturning ratio J = 1.40 is acceptable, any repair or strengthening of the existing tanks or replacement of the tanks with self-anchored tanks should include a thickened annular ring that would decrease the overturning ratio to an acceptable level at or below J = 0.785 resulting in no uplift.

2. **Piping Connections:** The tanks do not provide sufficient minimum distanced measure to the edge of the connection reinforcement for bottom piping connections. In order to prevent damage to the tank and avoid release of the tank contents due to failure of the piping system, the District should consider removing, plating over, and replacing the bottom piping connections to the two tanks in any repairs.

3. **Freeboard and Sloshing:** The calculated wave heights during design level earthquakes in this evaluation exceed the available freeboard when tanks are filled to the current top capacity levels. The steel roof plate, the rafter beams, and their bolted connections do not have adequate strength to resist the sloshing loads exerted on the roofs. The calculated freeboard was determined to be 5 feet-6 inches and when combined with the depth of the 7-inch and 15-inch roof framing would result in a required freeboard of 7 feet-4 inches.

4.5 Continued Operation with Deficiencies

In order to protect the Smith Saddle Tanks from damage in a seismic event, the tanks should be operated at a lowered water level to eliminate sloshing damage from water loads to the top of the shell, roof framing and roof plates. A recommended water level to eliminate seismic deficiencies would be approximately 32 feet-7 inches. Operating the tanks at 32 feet-7 inches water depth would reduce the nominal capacity of the tanks from 5.0 MG to 4.3 MG. Operating the water tanks at 32 feet-7 inches water depth would still result in an overturning ratio of J = 0.96, which would still result in uplift and potential damage to bottom piping connections.

4.6 Seismic Repairs and Strengthening

Seismic repairs and strengthening should include the following structural improvements to the two welded steel tanks:

1. Add a minimum 5-foot-3 inch wide by ½-inch thick annular ring to the perimeter of each tank adjacent to the shell by welding the plates over the existing ¼-inch thick floor plates. The welding may require back gouging of the existing shell to floor plate weld on the interior of the tank. Complete penetration groove welds would be required on three sides and fillet welds on the interior side.

2. The existing 24-inch intertie and 8-inch drain piping connections to the floors of the tanks should be removed by cutting the pipe from the bottom of the tanks and plating over the floor penetrations. New shell nozzles of the same size should be provided to above ground piping connections in a similar location as the existing floor penetrations.

3. The existing roof framing, roof plates, and either portions or all of the existing columns, will be removed and after adding two new shell rings and replacing the columns new roof framing and roof plates will be constructed approximately 6 feet-0-inch higher than the existing roof to provide sufficient freeboard.

4.6.1 Structural Evaluation of Existing Roof for Solar Panels

For welded steel tanks the minimum roof design live load from AWWA D100 shall be 15 lbs./ft^2. However, we would typically specify a minimum roof design live load of 25 lbs./ft^2 outside guardrails platform areas and 50 lbs./ft^2 in enclosed guardrail areas in platform areas of the tank around access hatches. For prestressed concrete tanks, the minimum roof design live load from AWWA D110 shall be 20 lbs./ft^2. However, we would recommend a minimum of 50 lbs./ft^2. Most photovoltaic or solar panels that are mounted on roofs of buildings typically have a dead load of between 2 and 4 lbs./ft^2. However, we would typically specify a minimum roof design dead load of 10 lbs./ft^2.

Rooftop solar panels for welded steel or prestressed concrete water storage tanks should be designed for wind pressures in accordance with ASCE 7-16 Standard, Section 29.4.3, for rooftop solar panels for buildings of all heights with flat roofs or hip roofs with slopes less than 7-degrees.

If rooftop solar panels are constructed with panels parallel to the roof surface and with a maximum height above the roof surface not exceeding 10 inches, then the design wind pressures shall be determined in accordance with ASCE 7-16 Standard, Section 29.4.4 for rooftop solar panels parallel to the roof surface on buildings of all heights and roof slopes.

For either of the above approaches for determining design wind pressures the roof shall be designed for both of the following conditions: 1) cases where solar panels are present; or 2) cases where the solar arrays have been removed.

Due to the presence of significant rock damage on the roof and shells of the two existing tanks (as a result of rocks thrown from the access road above and on the north side of the tanks), it is questionable if rooftop solar panels would be sufficiently strong and durable to withstand the damage associated with the numerous rocks thrown on the panels.

4.7 Structural Calculations

Structural calculations were prepared evaluating the following elements of the existing tanks:

1. Sloshing and freeboard in accordance with ASCE 7-16, AWWA D100-11, AWWA D110-13 and ACI 350.3.
2. Maximum rafter spacing per AWWA D100-11 Section 3.6.1.7.
3. Radial C7x9.8 channel beam and C15x33.9 and C18x42.7 girder loading, shear, and flexure with earthquake loading.
4. Columns, 10-inch Schedule 30, loading including vertical acceleration and lateral water loads.
5. Seismic evaluation of the water tanks in accordance with AWWA D100-11 Section 13.

The structural calculations are included in Appendix D.

4.8 Preliminary Structural Design Criteria

Preliminary structural design criteria will differ depending on whether repairs or replacement of welded steel tanks or replacement with prestressed concrete tanks are selected. The preliminary structural design criteria that should be evaluated and documented based on the different types of reservoirs are summarized in Table 4:

Table 4: Preliminary Structural Design Criteria

Structural Design Criteria	Alternative Nos. 1 and 2 Welded Steel Tanks	Alternative No. 3 Prestressed Concrete Tanks
Material Specifications	AWWA D100, Section 2	AWWA D110, Section 2
Design Loads (Dead, Water and Roof Live Loads)	AWWA D100, Section 3.1	AWWA D110, Section 3.3
Wind Loads	AWWA D100, Section 3.1.4 and ASCE 7 Chapters 26 and 29	AWWA D110, Section 3.3.1.4 and ASCE 7 Chapters 26 and 29
Seismic Loads	AWWA D100, Section 13 and ASCE 7 Section 15.7.7.1	AWWA D110, Section 4 and ASCE 7 Section 15.7.7.3
Venting	AWWA D100, Section 5.5 pressure differential not exceeding 1.47 inches of water column.	AWWA D110, Section 3.11.3.2 pressure differential not exceeding 2 inches of water column.
Settlement	AWWA D100, Section 12.6	ACI 372, Appendix A
Corrosion Allowance	AWWA D100, Section 3.9	

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Section 5: Corrosion Evaluation

5.1 Introduction

The two 5.0-MG potable water steel storage tanks were constructed in 1960. These tanks provide water storage for peak flow balancing and fire protection. The tanks were constructed by welding plates of A-7 mild steel 1 3/16-inch thick to 3/16-inch thick and were coated with coal tar enamels on the interior and rust preventive primers and enamels on the exterior common for the time of construction. The tanks are subject to corrosive environments from: 1) water in the interior below the top capacity level; 2) the atmosphere in the interior of the tank, above the top capacity level, due to elevated humidity and chlorine vapors; 3) sun, rain, condensation of atmospheric acid salts of sulfur and nitrous oxides, salt precipitation from oceanic winds, dust, and rocks thrown by vandals on the exterior plate surfaces; and 4) salts and pH migration through the oiled sand base with oxygen and moisture on the underlying floor plates. Particularly vulnerable areas are near the outside circumference of the tanks where rain and moisture together with elevated oxygen concentrations can penetrate several feet or more beneath the floor plate to locally aggravate corrosiveness.

5.2 Corrosion Protection Measures and Existing Practices

The corrosion protection measures utilized for steel water storage tanks are to initially provide a barrier coating over the steel and then to periodically recoat the interior and exterior surfaces when coating deteriorates due to ageing. Brittleness and cracking is evident with attendant rusting of the steel that expands and lifts the coating. The tanks also have impressed current cathodic protection systems installed for interior floor and shell protection and exterior floor protection.

The tanks were constructed on oil-sand bases and there were pipe couplings and caps installed on the floors to periodically add more oil to the base sand to minimize bottom floor plate corrosion because that bottom surface would not be accessible for periodic recoating. However, with the advent of more environmental awareness of potential groundwater contamination in the 1970s, this oiling of the sand base practice was discontinued. Therefore, a deep well anode was installed adjacent to the tanks to protect the bottom plates.

Additional information on the existing protective coatings based on background information provided by the District and observations and assessments provided by Bay Area Coating Consultants is summarized below in Section 5.4 and included in Appendix E. Additional information on the existing cathodic protection systems based on background information provided by the District, interviews with District corrosion staff, and observations is summarized below in Section 5.4.

5.3 Protective Coatings Evaluation

This section summarizes the existing protective coatings on the tanks, the assessment of the coatings, and recommendations for new protective coatings on either repair of the existing tanks or replacement of the tanks with new welded steel tanks.

5.3.1 Existing Protective Coating Systems

The two tanks were originally specified and constructed to have a coal tar primer and hot coal tar enamel on the floor and shell below the half-way point and a coal tar primer and enamel above the top edge of shell and halfway down shell. The existing coal tar coatings have PCBs and heavy metals. The coal tar coatings have bubbled on both the floors and shells and the coatings are brittle and crumbling on the shell and underside of the roof. The original specifications for the interior coal tar coatings are summarized below:

1962 Smith Saddle Tanks Coating Specifications Job 5686:

1. Interior (Koppers)
    a. Above top edge of shell and halfway down shell:
        i. Coal Tar Primer and Enamel - Koppers Bitumastic Super Tank Solution (two coats)
    b. Below the halfway point on the shell:
        i. Coal Tar Primer - Koppers Bitumastic Jet Set Primer
        ii. Hot Coal Tar Enamel – Koppers Bitumastic 70-B Enamel

The exterior of the tanks were originally specified to be coated with one coat of a rust preventive primer and two coats of enamel (possibly Proven Paints, Inertol, or Rust-Oleum). In 1984, the exterior coatings were brush blasted and recoated. Below are the specifications for the 1984 exterior recoatings:

1984 Smith Saddle Tank No. 2 ReCoating D8502 Materials Specifications and Inspector's Reports:

1. Exterior (Porter Coatings)
    a. Exterior Roof and Shell
        i. Zinc-Lock #312 (one coat, 3 mils/coat, 3 mils total)
    b. Exterior Roof and Shell
        i. Acri-Shield 3410 (two coats, 2 mils/coat, 4 mils total)

5.3.2 Protective Coating Systems Assessment

The protective coatings on the interior and the exterior of the two tanks were evaluated in the field by representatives with BACC on 16 March 2021 and 1 April 2021. The observations of the condition of the protective coatings were presented in Section 2.4 Tank and Site Observations. The methods and procedures are included in the two assessment reports prepared by BACC in Appendix E. The reports include documentation of the equipment utilized for pit depth measurement, dry film thickness, and qualitative visual assessment, detailed observations, and the results of dry film thickness readings on the floor and exterior of the two tanks.

5.3.3 Protective Coating Systems Recommendations

The following recommendations are provided regarding the existing protective coatings systems:

1. The interior and exterior protective coating systems on the roof plates and roof framing, including radial channel beams, circumferential channel girders, and columns of both tanks have completely failed and should be removed and replaced.

2. The tops of shell plates in the 5th ring of the tanks and along the shell to roof plate interface, in the vapor area of the tank have complete failure of protective coatings and loss of metal with excessive pitting. The protective coatings on the shell plates of the tanks have completely failed and should be replaced.

3. The protective coating system on the floor plates of the tanks have completely failed and should be replaced.

4. The exterior protective coatings on the roof plates and the shell plates of both tanks have failed and should be removed and replaced.

5.3.4 Recommended Protective Coating Systems

Before discussing recommended protective coating systems there are a few recommendations that should be provided related to long term performance of any internal and external protective coatings systems.

1. Because the existing tanks had clear evidence of areas where the top of the steel radial beams were fused to the underside of the steel roof plates due to corrosion, it is recommended that the top of the radial beams be seal welded to the underside of the roof plates continuously. Another option is to temporarily wedge the radial beams off the roof plates so that the faying surfaces can be coated. A third option is to utilize a polyurethane sealant along the faying surfaces between the radial beams and the roof plates. However, this is only a temporary solution and generally does not provide protection for more than a few years for the life of the sealant.

2. Ventilation must be improved through the use of a larger center vent and additional perimeter roof vents.

3. Exterior protective coating systems on the shell and roof of the tanks should contain zinc primers to protect the tanks from rock damage.

5.3.4.1 Internal Protective Coatings

Two options are available for internal protective coatings for the tanks: 1) epoxy coatings; or 2) elastomeric polyurethane coatings.

5.3.4.1.1 Alternative No. 1: Epoxy Coatings

Alternative No. 1 for internal protective coatings on the floor and shell beneath the maximum water surface would be an edge retentive ultra-high solids epoxy amine coating (Sherwin Williams Sher-Plate PW, or equal) engineered for immersion service in potable water storage tanks. The materials should be applied to 25.0 to 35.0 mils thickness. As an option, a urethane zinc-rich primer (Sherwin Williams Corothane I Galvapac 1K Zinc Primer, or equal) at 2.0 to 3.0 mils could be provided. Alternative No. 1 for internal protective coatings on the underside of the roof plates including roof framing, ladder, overflow weir box, columns, and the shell above the maximum water surface would be (Sherwin Williams Tank Clad, or equal). The materials would be applied at 12.0 to 18.0 mils thickness. SSPC SP #5 white metal blast is recommended for surface preparation due to the heavy anchor profile required. No sand abrasives should be permitted, only grit type abrasives to provide a sharp angular profile. Ratio testing and hardness testing should be specified prior to any coating application. The budgetary cost estimate for internally coating one of the tanks is $1,475,500 ($22.00/sq. ft.). This cost did not include removing the coal tar enamel and dehumidification equipment.

Based on input received from the coating manufacturer, the urethane zinc-rich primer is commonly recommended on interior surfaces in the vapor zone and was considered not to be necessary on tanks with cathodic protection systems. However, we would still recommend use of the zinc-rich primer above the maximum water surface due to the surfaces not being protected by the cathodic protection system.

Coating specifications may be dependent on the date of the project. The NSF 61/600 Standard is anticipated to go into effect on 1 January 2023. There will be some different materials used to comply with the new regulations. It is believed these protective systems will conform with the upcoming NSF 61/600 requirements. It is estimated to take approximately 5.5 months to complete interior coating application scaffolding, removal of the existing coatings, surface preparation, protective coatings application, curing, and cleanup.

5.3.4.1.2 Alternative No. 2: Elastomeric Polyurethane Coatings

Alternative No. 2 for internal protective coatings would be Global Eco Technologies, Inc. (GET) Endura-Flex 1988 elastomeric polyurethane coating applied in solid and expanded forms in a single coat. It is recommended that the elastomeric polyurethane coating be applied at a thickness of 50 to 60 mils on the floor, shell and columns. The recommended application thickness for the underside of the roof plates, roof framing, ladders and other miscellaneous structural steel items is 100 mils of the expanded polyurethane coating system. The additional thickness on these surfaces is to provide additional corrosion protection on the edges of steel elements and in the vapor zone. There is no solid elastomeric polyurethane film required over expanded material in the upper zones. A budgetary estimate for the elastomeric polyurethane coatings was prepared and provided by representatives with E.A. Wilcox. Based on the assumption these are classified as hazardous materials, the estimate includes full removal and disposal of the coal tar enamel protective coatings on the floor, shell, and roof of the tanks. It is recommended for the sequence of protective coatings removal to include: prior to elevation extension of the tank, remove a band of coal tar epoxy in the area where the shell plate would be cut between the existing 4th and 5th shell rings and leave the rest of the coal tar enamel coatings until erection is complete to avoid blasting the lower part of the tank twice.

If new tanks are constructed, the same protective coating system with the recommended application thickness should be field applied. However, a shop hold primer would be used to hold shop blast of the steel panels. EndurFlex representatives indicated there is one tank fabricator that is EnduraFlex approved and licensed for application of expansion coatings. The budgetary cost estimate for internally coating one of the tanks is $1,900,000 ($23.75/sq. ft.). This estimate includes labor, materials, equipment, scaffolding, and general conditions. The manufacturer estimated that it would take approximately 4 months to complete coating application scaffolding, removal of the existing coatings, surface preparation, protective coatings application, curing and cleanup. Elastomeric polyurethane coatings have been in immersion service in potable water steel tanks for 24 years with no reported problems. The manufacturer estimates, based on field surveys of existing potable water steel tanks, a life cycle of at least 50 years.

The manufacturer's representative is John Munson with E.A. Wilcox Co., Corte Madera, CA; Phone: (415) 286-0118; e-mail: john@eawilcox.com. The manufacturer has several licensed applicators in the geographic region.

5.3.4.2 External Protective Coatings

Prior to application of the exterior protective coating systems for the existing steel tanks fill containment and an SSPC SP #10, blast will be required to ensure all lead-based paint (LBP) systems are removed. Before 1978, when the use of LBP was discontinued, many water storage tanks were painted with red lead primers. LBP abatement and disposal is problematic. The U.S. Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) classifies any waste that leaches 5 parts per million (ppm) or more of lead (as determined by the USEPA toxicity characteristic leaching procedure [TCLP] test) a hazardous waste, which requires special handling and disposal. BLASTOX (Kleen Industrial Services, Hayward, CA) additive should be added to the abrasive for disposal and recycling. The BLASTOX additive chemically stabilizes the lead in the residual waste and reduces its potential for the leaching of lead to less than 5 ppm, thereby rendering the waste product nonhazardous. The estimated costs associated with removal of the existing LBP on the exterior shell of the tank was based on a strip rate of 100 sq. ft./hour and an abrasive blast media consumable rate of 7.5 lbs./sq. ft.

The recommend protective coating system on the exterior shell and roof of the tanks would be a urethane zinc-rich primer (Sherwin Williams Corothane I Galvapac 1K Zinc Primer, or equal) at 2.0 to 3.0 mils, followed by a fast cure high solids epoxy (Sherwin Williams Macropoxy 646, or equal) at 4.0 to 6.0 mils, followed by a fluoropolymer or polysiloxane (epoxy siloxane hybrid that combines the properties of both a high performance epoxy and a polyurethane, Sherwin Williams Sher-Loxane 800, or equal) at 4.0 to 6.0 mils. The budgetary cost estimate for externally coating one of the tanks is $712,000 ($18.00/sq. ft.). This cost does not include removing, handling, and disposal of the existing lead based protective coatings. It is estimated that it would take approximately 2 months to complete exterior coating application scaffolding, removal of the existing coatings, surface preparation, protective coatings application, curing and cleanup.

5.4 Cathodic Protection System Evaluation

This section summarizes the existing cathodic protection systems on the tanks, the assessment of the system, and recommendations for new cathodic protection systems on either repair of the existing tanks or replacement of the tanks with new welded steel tanks.

5.4.1 Existing Cathodic Protection System Background Information

Background information on the existing cathodic protection systems for the Smith Saddle Tanks was provided by the District and included a spreadsheet with cathodic protection reads for Tank

Nos. 1 and 2 from 12/20/2010 through 7/29/2020. Also, the District provided water quality data from the San Geronimo Treatment Plant (SGTP) for the past three years including conductivity, chlorine residual, temperature, pH, chloride anions, and alkalinity. Water quality data was provided from the SGTP, because Smith Saddle Tanks receives this water. Water quality that might be influenced by the water storage tanks was not collected. Water quality data on temperature was provided for the SGTP not the tanks.

5.4.2 Existing Cathodic Protection System Description

The existing cathodic protection systems at the Smith Saddle Water Tanks consist of both interior and exterior impressed current systems that were designed and installed by the District's corrosion department in July 2010. The water levels in both tanks vary both daily and seasonally. The typical water level operating range is 24 feet to 34 feet.

The interior impressed current rectifier is a Universal ES-1 – 5 amps/20-volt rectifier. This rectifier serves to protect the interior shell and columns of both tanks beneath the water surface. The interior rectifier is currently running at 3.36 amps/5.1 volts. Each tank interior has impressed current anode "strings" installed, consisting of eight (8) strings per tank suspended vertically from the interior roof along the line of the outer girders (approximately 57 feet-0-inch radius from the center of the tank) and connected together using a header wire. Each anode string consists of six (6) Lida titanium based, mixed metal oxide tubular type 2.5 cm/50 cm anodes on 5-foot center-to-center vertical spacing. There is a 5-lb. weight on the bottom of each anode string. In addition, each string was ordered with an additional 25 feet of High Molecular Weight Polyethylene (HMWPE) insulated wire for connection to the header wire. The District was unable to confirm whether or not the existing anode wires were NSF 61 certified.

The exterior impressed current rectifier is a Universal ASAI – 10 amps/20-volt rectifier. This rectifier serves to protect the floor plates of both tanks. The exterior rectifier is currently running at 2.58 amps/19.3 volts. The impressed current exterior anode well for the tank floor is a 150-foot deep well drilled in January 1997 utilizing six (6) Durichlor 51 TA-4 high silicon cast-iron tubular anodes, backfilled with coke breeze. There are no insulating flange kits separating the tank piping connections from the shells of the tanks. The tank site piping is part of the exterior cathodic protection system.

There are no permanently installed reference electrodes for either the interior or exterior systems. The District uses a portable reference electrode to manually adjust rectifier settings. The District does not have any drawings or O&M manuals of the existing cathodic protection systems just hand drawn sketches from the installation of systems by the District's corrosion department staff.

5.4.3 Existing Cathodic Protection System Observations

The discussion with District staff indicated they maintained the electrical potential of cathodic protection of the interior system at -1,000 millivolts to a copper/copper sulfate reference electrode (CSE), which are better than the criteria of NACE International SP0388-2018 and AWWA D104-17 of a polarized tank-to-water potential of at least as negative as -850 millivolts CSE. The District inspects and adjusts the rectifier systems every 6 months and after lightning storms.

5.4.4 Cathodic Protection System Recommendations

It is advised that individual rectifier systems be provided for each tank, which can provide for differences in current requirements due to the differences in time and deterioration of coating systems. It is advised that the existing rectifier be used to protect the exterior of the bottom plate of both tanks and two new automatic potential control rectifiers be purchased to protect the interior. The existing mixed metal oxide anodes system should be replaced. It is recommended that supports of all anodes be replaced.

The District staff have not seen a benefit with automatic potential control rectifiers. However, automatic potential control rectifiers have improved and are likely to provide better cathodic protection for changes in the condition in the protective coatings, water quality temperature, and depth of water in the tanks. AWWA D104 does not recommend manual rectifiers for water storage tanks. AWWA D104 Appendix B recommends bimonthly monitoring of the cathodic protection system and an annual tank-to-water potential survey using a calibrated portable reference electrode. Appendix C recommends the survey be conducted at five separate locations in the tank. Older technology reference electrodes provided reliable operation no more than 3 to 5 years. Whereas newer reference electrodes have a 10-year minimum life, but often provide reliable, reproducible results for much longer periods. Borin provides a minimum 30-year service life warranty for their STELTH 1 reference electrodes.

Several additional measures to reduce corrosion to the tanks are recommended. The cathodic protection systems do not protect the interior of the roof plate and support purlins and shell plates above the waterline. These are the most vulnerable areas to corrosion. Inspection showed extensive rust deposits that fell to the floor of the tanks from the roof and areas of rust are present in the interior of the tank shell. It is recommended that the roof plates and framing of the tanks be replaced as well as the upper shell area, because more than 50% of the thickness loss is due to corrosion. Seal welding of the purlins to the lower roof plate and seal welding of the roof plates should be provided. Roof ventilation should be increased to reduce moisture accumulation on the roof interiors. This will permit airflow to keep the roof dry.

Typically, tanks without cathodic protection can have an average service life of 50 years, but with cathodic protection and periodic recoating of the interior, they can more than double the tank life. The cost of cathodic protection systems are much less than recoating tanks, about 10% of the cost of recoating; therefore, it is very cost-effective to provide cathodic protection systems on steel tanks. The estimated cost of replacing the cathodic protections systems is in the range of $30,000 to $50,000.

5.5 Hazardous Materials Evaluation

A hazardous materials evaluation of the interior and exterior protective coatings on the two tanks was performed by ESI of San Francisco, CA. The purpose of the evaluation was to identify the potential presence concentrations of hazardous materials including asbestos-containing materials, lead-containing paint, and hazardous materials such as PCBs and heavy metals by on-site sampling and performing laboratory analysis of suspect materials found throughout the interior and exterior tank components. The survey for asbestos-containing materials (ACMs) was performed in compliance with NESHAP and Cal-OSHA regulations (8 CCR-1529). Similarly, the lead paint survey and sampling were performed in compliance with

Cal-OSHA Standards (8 CCR 1532.1). In addition, representative samples of interior tank coatings were collected and analyzed for the potential presence of PCBs and heavy metals to assist construction contractors in proper handling and disposal of the waste during the future repairs or replacement of these tanks. The findings including observations and recommendations by Certified Asbestos Consultant/California Department of Public Health certified professionals and copies of analytical reports are included in the Hazardous Materials Survey Report for the Smith Saddle Tanks prepared by ESI dated 22 April 2021 and included in Appendix F.

Staff with ESI visited the site on 16 March 2021 to collect samples from Tank No. 2 and on 2 April 2021 to collect samples from Tank No. 1. Staff performed the onsite hazardous materials survey and collected and analyzed samples of the protective coatings on the interior and exterior of the tanks for asbestos-containing materials, lead-containing paint, and hazardous materials such as PCBs and heavy metals. Analytical testing of samples included the following tests.

- Bulk samples for asbestos by polarized light microscopy (PLM).
- Bulk paint chip/samples for lead analysis by AA-Flame.
- Coal tar samples for PCBs analysis by EPA method 8082.
- Coal tar samples for CAM 17 Metals by EPA 6000/7000 Series.
- Bulk samples for Mercury by Vapor Extraction (SW 846) EPA 7471B

5.5.1 Summary of Analytical Results

A summary of the analytical results of bulk samples collected from Tank No. 2 on 16 March 2021 and Tank No. 1 on 1 April 2021 are as follows:

1. **Lead-Containing Paint:** Based on the analytical results of paint chip samples, the beige paint/primer on the exterior shell and roof of both tanks is characterized as lead-containing paint with total lead concentration of the exterior paint ranging from 63 to 250 mg/kg. Paint coatings on the interior of roof access hatches were also characterized as lead-containing paint with lead concentrations at 8,900 mg/kg (Tank No. 2) and 5,600 mg/kg (Tank No. 1), respectively. A summary of the analytical results for lead-containing paints for both tanks is contained in Appendix A of the hazardous material survey report, Appendix F.

2. **PCB Containing Waste:** Total PCBs at hazardous concentrations of 480 mg/kg and 2,200 mg/kg are present in the coal tar coating materials on the interior floors and interior shells of Tank No. 2, respectively. No PCBs were detected on the interior roof coatings of Tank No. 2. Similarly, no PCBs were found in the bulk samples collected from the interior shell and roof of Tank No. 1, as analyzed by EPA 8082 with Reporting Limits (RL) of 0.5 mg/kg. PCBs at concentrations exceeding 50 mg/kg are designated as hazardous waste.

3. **Heavy Metals:** Elevated concentrations of heavy metals such as arsenic (85 mg/kg), chromium (430 mg/kg), copper (1,800 mg/kg), nickel (870 mg/kg), and zinc (940 mg/kg) were found throughout the interior shell and roof protective coating of Tank No. 2. Similarly, the interior shell and roof of Tank No. 1 detected maximum concentrations of arsenic (83 mg/kg), chromium (130 mg/kg), cobalt (190 mg/kg), copper (690 mg/kg), and nickel (520 mg/kg). No mercury was found at or above the lab detection limits in the interior protective coatings.

4. **Asbestos-Containing Materials:** No asbestos was found in all interior and exterior bulk samples collected from both Tank No. 2 and Tank No. 1, as analyzed by Polarized Light Microscopy (PLM) EPA/600R/93/116.

5.5.2 Health and Safety Considerations

Due to the presence of hazardous level of PCBs in Tank No. 2 and elevated concentration of several heavy metals in the interior coatings of both tanks, the District should require the Contractor prepare a “Site Specific Health and Safety Plan” and implement prior to abatement of interior coatings from both tanks for the health and safety of the construction workers. Waste segregation and profiling will be required to properly characterize the waste for off-site disposal.

Asbestos-Containing Materials: Based on the results of the survey, no asbestos was found throughout all interior and exterior coatings on both tanks. Other suspect materials discovered during future renovation and/or reconstruction of the tanks must be tested for asbestos content prior to disturbance of the material. Regardless of the presence of asbestos, a 10-day advanced notification will be required by the Bay Area Air Quality Management District (BAAQMD) if the tank structures are subject to complete demolition.

Lead-Containing Paint: Loose and damaged painted components, when present, require stabilization prior to removal and demolition of said components. Demolition and disassembly activities directly impacting surfaces containing lead may classify the work into one of the “Trigger Task” categories, as defined by the California Division of Occupational Safety and Health (Cal-OSHA) Standards. Examples of trigger tasks include manual demolition, sanding, grinding, torching, and abrasive blasting. The contractor must establish a written Lead Compliance Program in compliance with 8 CCR 1532.1, when disturbing lead containing painted surfaces using Trigger Task Activities.

PCB Containing Waste: Laboratory results of the composite samples collected from the interior floors and interior shells of Tank No. 2 revealed hazardous concentrations of PCBs. Analytical results also confirmed that the coatings on the roof plates of Tank No. 2 and Tank No. 1 did not contain any PCBs at or above the laboratory detection limits. However, due to the presence of water in Tank No. 1, samples could not be collected from the interior coating on the floor and lower interior shell. Therefore, the presence of PCBs throughout the floor and the interior shell of Tanks No. 1 was not evaluated.

Heavy Metals: Elevated concentration of heavy metals such as arsenic, chromium, copper, nickel and zinc are present throughout all interior coatings, which will contribute to the toxicity of the interior coating waste when subject to removal.

The exterior and adjoining above ground pipelines and fittings were not part of the hazardous material survey. Based on the elevated concentration of total metals in the protective coatings of Tank No. 1 and Tank No. 2, further analysis of the waste stream by waste extraction test (WET) and analysis for soluble threshold limit concentration (STLC) will be required to properly characterize the waste for disposal. The minimum elements of a health and safety are contained in the final survey report. The final survey report of findings including observations and recommendations by Certified Asbestos Consultant/California Department of Public Health certified professionals and copies of analytical reports are included in Appendix F.

Section 6: Alternatives Evaluation and Recommendations

Section 6 provides a description of three alternatives for repair or replacement of the Smith Saddle Tanks. Recommendations are also provided for the tank site and safety improvements and the Glen Drive access road improvements. Estimated construction and life-cycle costs are presented and a recommendation is provided for bid packaging, scheduling and implementation of the project.

6.1 Tank Repair or Replacement Alternatives

Three alternatives were developed for repair or replacement of the Smith Saddle Tanks:

- Alternative No. 1: Repair/Strengthen/Recoat Two Existing Tanks
- Alternative No. 2: Two New 5.0-MG Welded Steel Tanks
- Alternative No. 3: Two New 5.0-MG Prestressed Concrete Tanks

Summarized below are detailed descriptions of the three alternatives utilized as the basis for cost estimates.

6.1.1 Alternative No. 1: Repair, Strengthen, and Recoat Tanks

In this alternative, the deterioration and damage to the two existing tanks would be repaired and elements of the tanks would be strengthened to improve seismic resistance, tank appurtenances would be updated, and the interior and exterior of the tanks would be recoated and provided with a new impressed current cathodic protection systems. The following elements were included in the development of Alternative No. 1:

1. Tank repair would include new roof plates, new roof framing including all radial beams and circumferential girders, extension of the columns to replace the upper sections above the maximum water surface, and extend the columns to provide additional freeboard when raising the roof. Seal welding of roof plates to roof framing and seal welding of the underside of roof plates.

2. The top or 5th shell ring in the tanks would be replaced and a new 6th ring would be provided to raise the shell of the tank from 39 feet-11 inches to 46 feet-0-inch.

3. The floor plates of the tanks would be reinforced with a new 5-foot-3-inch wide by ½-inch thick annular ring.

4. The bottom piping connections in the tank would be sealed and be replaced with shell penetrations or flanged nozzles.

5. Removal, forming and grouting of asphalt beneath the annular ring and subgrade pressure grouting of voids beneath the floor plates of the tanks.

6. Demolition of the roof plates, roof framing, columns and 5th shell ring.

7. A new landing with guardrail, intermediate platform and guardrail between Tank Nos. 1 and 2, and extension of the circular staircase on Tank No. 1 for the increased shell height of the tanks. The estimate includes the cost of new guardrail around the entire perimeter of the tanks.

8. New tank appurtenances for each tank to include: 14 feet overflow nozzle and weir box with supports, 8-inch drain nozzle, 24-inch intertie nozzle, interior ladder, 39-inch square roof hatches, and an additional 30-inch manhole for Tank No. 2.

9. One new center roof vent and eight (8) peripheral roof vents for each tank.

10. New NSF61-600 high solids epoxy interior protective coating including dehumidification equipment. Removal by chipping and blasting and disposal of the existing coal tar coatings including protective measures for workers for PCBs and heavy metals.

11. New three coat protective coating system on the exterior shell and roof of the tanks consisting of urethane zinc-rich primer, followed by a fast cure high solids epoxy, followed by a polysiloxane.

12. Full containment of the tank exterior for removal of existing lead based paints. Labor, abrasive blast material including Blastox, environmental testing including air monitoring (both personal and site), and disposal costs for nonhazardous waste.

13. Cleaning, washdown, and disinfection of the tank interiors.

14. Electrical, instrumentation and controls, and SCADA systems improvements.

15. New impressed current cathodic protection system for each tank.

16. Tank site improvements to include widening and paving of the road around the tanks, additional site paving between the tanks, construction of a new storm drain with catch basins around the tanks, and addition of a low retaining wall on the west side of the tanks to minimize debris on the road around tanks.

17. Tank access road improvements to include regrading the access road, addition of a retaining wall at one curve in the road, aggregate base and paving of the road, and the addition of v-ditches along the side of the access road to improve drainage.

18. Replacement of as many as 50% of the tank floor plates.

6.1.2 Alternative No. 2: Welded Steel Tanks

In this alternative, the two existing tanks would be demolished and removed from the site and replaced with new welded steel tanks designed and constructed in accordance with the minimum requirements of AWWA D100-11. Unless determined otherwise by District demands, the two tanks would be replaced by two 5.0-MG nominal capacity water storage tanks of the same approximately 150-foot diameter and an increased 46-foot-0-inch shell height. The following elements were included in the development of Alternative No. 2:

1. Demolition, loading, hauling, and disposal of the two existing welded steel tanks and appurtenances, including electrical items and worker protection and containment during cutting of demo materials with lead based paints.

2. Excavation, forming, and construction of reinforced concrete ringwall foundations with anchor bolts for both tanks.

3. Two 5.0-MG welded steel tanks of 150.5-foot diameter and 46-foot-0-inch shell height with steel framed roofs designed, fabricated and constructed in accordance with AWWA D100-11.

4. New tank appurtenances for each tank to include: 24-inch inlet nozzle, 30-inch outlet nozzle, 14-inch overflow nozzle and weir box with supports, 8-inch drain nozzle, 24-inch intertie nozzle, interior ladder, 39-inch square roof hatches, and two 30-inch manholes for each tank.

5. One center roof vent and eight (8) peripheral roof vents for each tank.

6. A landing with guardrail for each tank, intermediate platform with guardrail between Tank Nos. 1 and 2, and circular staircase on Tank No. 1. The estimate includes the cost of new guardrail around the entire perimeter of the new tanks.

7. Surface preparation, shop priming, and NSF61-600 high-solids epoxy interior protective coatings including dehumidification equipment.

8. Surface preparation, shop priming, and three-coat protective coating system on the exterior shell and roof of the tanks consisting of urethane zinc-rich primer, followed by a fast cure high-solids epoxy and polysiloxane.

9. Cleaning, washdown, and disinfection of the tank interiors.

10. Electrical, instrumentation and controls, and SCADA systems improvements.

11. Earthwork for new tank pads, aggregate base subgrade and asphalt pavement beneath the tank floor plates and inside the concrete ringwall foundation.

12. Excavation, backfill, and compaction and pipeline construction with supports for 24-inch inlet, 30-inch outlet, 24-inch intertie, and 8-inch drain pipelines connections to the new welded steel tanks above and below grade.

13. Tank site improvements to include widening of the road around the tanks and paving of the road around the tanks, additional site paving between the tanks, construction of a new storm drain with catch basins around the tanks, and addition of a low retaining wall on the west side of the tanks to minimize debris on the road around tanks.

14. Tank access road improvements to include regrading the access road, addition of a retaining wall at one curve in the road, aggregate base and paving of the road, and the addition of v-ditches along the side of the access road to improve drainage.

15. New impressed current cathodic protection system for each tank.

6.1.3 Alternative No. 3: Prestressed Concrete Tanks

In this alternative, the two existing tanks would be demolished and removed from the site and replaced with new strand-wound prestressed concrete tanks designed and constructed in accordance with the minimum requirements of AWWA D110-13. This alternative was developed based on the assumptions that the tank would have a 150.50-foot inside diameter and 38-foot-6-inch side water depth with an assumed freeboard of 6 feet-6 inches. The nominal capacity would be 4.983 MG and is from the finished floor elevation near the perimeter wall to the top of the overflow based on a 2% floor slope and the reduction for interior columns and footings. If the outlet were located above the finished floor, there would be a loss in the volume determined. The tanks would be designed and constructed in accordance with AWWA D110-13, ACI 350, ASCE 7-16, local building codes, and national standards. The following elements were included in the development of Alternative No. 3:

1. Complete demolition, loading, hauling, and disposal of the two existing welded steel tanks and appurtenances including electrical items and worker protection and containment during cutting of demolished materials with LBP.

2. Earthwork for new tank pads with 6-inch aggregate base subgrade, polyethylene sheeting, liner and below floor underdrain systems.

3. The alternative was developed based on a tank structure complete with a 6-foot-wide spread footing, 6-inch thick concrete floor slab, concrete roof, bi-axially compressed prestressed tank walls, and shotcrete exterior with gunblast surface finish.

4. The tank is assumed to be at-grade or uniformly backfilled, with no soil or excessive live loads present on the tank roof. If the geotechnical engineer provides additional information identifying items that would impact the tanks foundations, this alternative will need to be re-evaluated for added costs.

5. The following tank appurtenances were assumed for each tank: six 6-inch roof sleeves; aluminum handrail (100 feet or less); aluminum exterior ladder with cage and Safe-T-Climb (50 feet or less); stainless steel interior ladder (50 feet or less) with a 3-foot square access hatch; two 4 feet x 8 feet double-leaf aluminum roof equipment or access hatches; one 30-inch roof vent; fifteen (15) scuppers and downspouts; and four (4) stainless steel pipe brackets (for the overflow).

6. No interior or exterior protective coatings on the finished concrete surface. The exterior surface of the tank would receive a rough shotcrete gun blast surface finish.

7. A new landing with guardrail for each tank, intermediate platform with guardrail between Tank Nos. 1 and 2, and circular staircase on Tank No. 1. The estimate includes the cost of new guardrail around the entire perimeter of the new tanks.

8. Excavation, pipeline construction, and concrete encasement for new 24-inch inlet, 30-inch outlet, 24-inch intertie, and 8-inch drain pipelines connections to the new concrete tanks below grade. Any buried pipeline modifications between the tanks and serving the Smith Saddle Booster Station will be investigated and developed as part of the final design.

9. Tank site improvements to include widening and paving of the road around the tanks, additional site paving between the tanks, construction of a new storm drain with catch basins around the tanks, and addition of a low retaining wall on the west side of the tanks to minimize debris on the road around tanks.

10. Tank access road improvements to include regrading the access road, addition of a retaining wall at one curve in the road, aggregate base and paving of the road, and the addition of v-ditches along the side of the access road to improve drainage.

11. Electrical, instrumentation and controls, and SCADA systems improvements.

6.1.4 Alternative Non-Cost Parameters

Besides the total construction costs and life cycle costs there are several non-cost parameters which should be considered when evaluating tank alternatives for either repair or replacement of the two tanks. The advantages and drawbacks have been summarized in Table 5.

Table 5: Alternative Non-Cost Parameters

Alternative	Advantages	Drawbacks
Alternative No. 1: Repair, Strengthen and Recoat Two Existing Tanks	• Fully welded plate joints with no leakage at initial construction. • Depending on hazardous materials abatement, should be shortest construction duration. • Does not require complete replacement of electrical, instrumentation and controls conduit and wiring.	• Unless annular ring is thickened, tanks are vulnerable to uplift damage. • Unless bottom connections are removed, tanks are vulnerable to uplift damage. • Unless asphalt is repaired and bottom pressure, grouted tanks are vulnerable to exterior corrosion of the underside. • Even with vent improvements, roof framing is vulnerable to corrosion deterioration. • Cathodic protection required to prevent corrosion to submerged elements. • Larger thermal range in water temperatures. • Unless interior is coated with elastomeric polyurethanes, interior recoating required every 20 to 30 years. • Exterior recoating required every 20 to 30 years. • Unless piping is reconstructed would only permit pedestrian access fully around tanks for maintenance and operations.
Alternative No. 2: Two New 5.0-MG Welded Steel Tanks	• Fully welded plate joints with no leakage at initial construction. • Improved anchored ringwall foundations for both tanks. • New appurtenances for both tanks with improved drainage for cleanout and washdown. Would permit the addition of flush type cleanout fittings. • Would permit shop coating of interior and exterior of tank plates. • Should be shorter construction duration than concrete.	• Even with vent improvements, roof framing is vulnerable to corrosion deterioration. • Cathodic protection required to prevent corrosion to submerged elements. • Larger thermal range in water temperatures. • Unless interior is coated with elastomeric polyurethanes interior recoating required every 20 to 30 years. • Exterior recoating required every 20 to 30 years. • Unless piping is reconstructed, would only permit pedestrian access fully around tanks for maintenance and operations. • New tanks of high strength steels with thinner sections are more reliant on cathodic protection and coatings for corrosion protection.
Alternative No. 3: Two New 5.0-MG Prestressed Concrete Tanks	• Concrete tank held in permanent compression when filled with water resulting in lower stresses in concrete. • Circumferential and vertical prestressing result in better use of construction materials; prestressing in tension and concrete in compression. • Smaller range of water temperatures; lower in summer and warmer in winter. • Improved seismic response modification coefficient (R = 3.25). • When prestressing is protected from corrosion, longest useful life of any tank construction material. • Improved water quality as result of piping reconfiguration. • Improved resistance to rock damage on shell and roof. • May offer better protection from fire damage.	• Requires 10-foot setback from tank wall for strand wrapping machine operation. • Does not permit piping connections through wall due to prestressing conflicts. • May require replacement of joint sealants exposed to chlorine or UV degradation. • Only one company can prestress tanks. • Requires underdrain system to monitor for leakage.

6.1.5 Aluminum Dome Roof

Water agencies in the San Francisco Bay Area have performed cost analysis and determined aluminum dome roofs are less expensive than recoating roof plates and framing. Representatives with CST Industries, Inc. were contacted to gather technical information and estimated construction costs associated with aluminum dome roofs for the two existing tanks. Aluminum strut and panel fully triangulated dome roofs with noncorrugated panels would be specified in accordance with AWWA D108-19. Dome roofs can be supplied with clear spans to 150 feet diameter or with stainless steel columns to reduce the overall height. Estimated costs for aluminum dome roofs varied from $400,000 to $630,000 per reservoir. However, we believe an approximate cost of $570,000 for each of the reservoirs would be most appropriate for a low rise roof with stainless steel columns and a mill finish. The budgetary cost includes two double-leaf access hatches per tank, vents, and eyebolt for safety line.

Due to the presence of significant rock damage on the roof and shells of the two existing tanks (as a result of rocks thrown from the access road above and on the north side of the tanks), it is questionable if aluminum dome roof panels with bolted batten and panel connections with circular gusset covers and silicone sealant around each gusset cover would be sufficiently strong and durable to withstand the damage associated with the numerous rocks thrown on to the covers. For the above reasons, the aluminum dome roof covers were not included in the evaluation of alternative cost estimates for Alternative Nos. 1 and 2.

6.2 Review of Alternatives

Table 5 outlines the qualitative advantages and drawbacks associated with each of the three alternatives. This section provides a review of these advantages and drawbacks and quantifies these characteristics to facilitate the District's review of these alternatives.

A summary of this analysis and a review of these alternatives from a risk and consequence of failure perspective are described below.

6.2.1 Alternatives Evaluation Criteria

Table 6 organizes the unique characteristics of each tank alternative into four key evaluation criteria: Maintenance, Cost, Constructability/Schedule, and Performance. Within each of the four key evaluation criteria are the sub-criteria that help compare the unique characteristics across each alternative. Weights were assigned to each sub-criteria that roll up into the four key evaluation criteria to facilitate the final scoring. Weights were also assigned to the four key evaluation criteria as part of the total scoring process.

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Table 6: Alternatives Analysis Evaluation Criteria and Scoring

Alternative Details							Scoring of Alternatives (5 most attractive, 1 least attractive)			
Evaluation Criteria	Alternative No. 1: Repair, Strengthen and Recoat Two Existing Tanks		Alternative No. 2: Two New 5.0-MG Welded Steel Tanks		Alternative No. 3: Two New 5.0-MG Prestressed Concrete Tanks		Criteria Weighting Factor %	Alternative No. 1 Repair, Strengthen and Recoat Two Existing Tanks	Alternative No. 2 Two New 5.0-MG Welded Steel Tanks	Alternative No. 3 Two New 5.0-MG Prestressed Concrete Tanks
Maintenance	*Advantages*	*Drawbacks*	*Advantages*	*Drawbacks*	*Advantages*	*Drawbacks*	**10%**	**1.2**	**2.6**	**4.6**
Coatings		- Requires elastomeric polyurethanes interior coating OR recoating every 20 to 30 years. - Exterior recoating required every 20 to 30 years.	New tank would facilitate shop coating of interior and exterior of tank plates.	- Requires elastomeric polyurethanes interior coating OR recoating every 20 to 30 years. - Exterior recoating required every 20 to 30 years.	No interior or exterior coatings required, except for joint sealants (District may choose to paint the tank if they wish).	May require replacement of floor joint sealant(s) (either one or two if constructed in halves/quadrants) if exposed to chlorine or UV degradation.	40%	1	3	4
Modifications/Appurtenances	Could install new connections, if needed.		New appurtenances for both tanks with improved drainage for cleanout and washdown. Would permit the addition of flush type cleanout fittings.			Floor penetrations only. Does not permit piping connections through wall (not necessarily needed though) due to prestressing conflicts.	5%	3	5	4
Access		Requires piping reconstruction to permit worker access around tanks for O&M.		Requires piping reconstruction to permit worker access around tanks for O&M.	Expanded access due to 10 feet setback. See Site Preparation row.		5%	3	3	4
Health & Safety		Requires the most maintenance and therefore the most risk to staff from a H&S perspective.		Requires some maintenance and therefore the some risk to staff from a H&S perspective.	Minimal maintenance required, and therefore, minimal H&S risk for staff.		20%	1	3	5
Vandalism		Roof can dent and be damaged from rocks		Roof can dent and be damaged from rocks.	Improved resistance to rock damage on shell and roof.		30%	1	1	5
Cost							**40%**	**1.5**	**1.0**	**4.0**
Estimated 100 Year Total Life-Cycle Cost (Capital + O&M)	$43M		$48M		$22.8M		100%	1.5	1	4
Constructability/Schedule							**30%**	**4.8**	**4.8**	**4.8**
Schedule, Design Duration	7 months		7 months		7 months		20%	5	5	5
Schedule, Construction Duration of One tank	12 months		12 months		12 months		60%	5	5	5
Schedule, Construction Duration	Does not require complete demo. Depending on hazardous materials abatement, should be shortest construction duration.	Requires roof and partial shell demo and HazMat abatement.	Should be shorter construction duration than concrete. Mostly fabricated offsite so less potential impact from weather.	Requires demo.		Requires Demo, may have more impact due to weather delays since constructed onsite.	-	See above duration.		
Site Preparation		Will require foundations grout and asphalt improvements.		Requires excavation for new ringwall footing.		Requires 10-foot setback from tank wall for strand wrapping machine operation. Could be addressed as part of site improvements.	10%	3	3	3
Availability of Contractors (resources and bidding competition)	Approximately 5-6 qualified contractors likely to submit.		Approximately 5-6 qualified contractors likely to submit.			Only one company can prestress tanks, this could limit competition on pricing. Multiple concrete tank contractors	10%	5	5	3
Performance							**20%**	**2.0**	**2.8**	**4.8**
Leaks	Fully welded plate joints with no leakage at initial construction.		Fully welded plate joints with no leakage at initial construction.			Requires underdrain system to monitor for leakage.	20%	5	5	4
Historic Performance		- Steel requires coatings and cathodic protection maintenance to mitigate rusting and corrosion. Tank performance could fail if not properly maintained.		- Steel requires coatings and cathodic protection maintenance to mitigate rusting and corrosion. Tank performance could fail if not properly maintained.	- Concrete tanks held in permanent compression when filled with water result in lower stresses in concrete. - Circumferential and vertical prestressing result in better use of construction materials; prestressing in tension and concrete in compression.		10%	1	3	5
Corrosion Potential		- Unless asphalt is repaired and bottom pressure grouted tanks are vulnerable to exterior corrosion of the underside. - Even with vent improvements roof framing is vulnerable to corrosion deterioration. - Cathodic protection required to prevent corrosion to submerged elements.		- Even with vent improvements roof framing is vulnerable to corrosion deterioration. - Cathodic protection required to prevent corrosion to submerged elements. - New tanks of high strength steels with thinner sections are more reliant on cathodic protection and coatings for corrosion protection.	When prestressing is protected from corrosion, longest useful life of any tank construction material.		10%	1	3	5
Water Quality		- Steel transmits heat easily and can cause a larger thermal range in water temperatures. This could become an issue if there is not a high turnover, which can be impacted by the rate of flow through tanks and the location of the inlet/outlets. - Existing penetration locations at inlet/outlets are unlikely to be moved and therefore, could hinder water quality from minimal turnover.	- Option for improve inlet/outlet penetration locations, which can improve water quality.	Steel transmits heat easily and can cause a larger thermal range in water temperatures.	- Concrete is an insulator and therefore results in a smaller range of water temperatures (i.e. lower in summer and warmer in winter). - Option for improved inlet/outlet piping penetration locations reconfiguration, which can improve water quality.		10%	1	2	5
Seismic Performance / Uplift Potential		- Limited seismic performance - Requires existing annular ring to be widened and thickened to avoid to uplift damage.		- Limited seismic performance - Requires improved anchored ringwall foundations for both tanks.	- Improved seismic response modification coefficient (R=3.25). - Minimal uplift potential.		40%	1	2	5
Wildfire Performance		Limited wildfire performance		Limited wildfire performance.	May offer better protection from fire damage.		10%	3	3	5
						Total:	**100%**	**2.8**	**2.7**	**4.4**

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The scoring assigned to these criteria is subjective based on our understanding of the District's service goals and primary objectives. The scoring system uses a 1 to 5 scale, where a score of 1 is the least attractive option and a score of 5 provides the most attractive option. The results of this analysis are summarized in Table 7 using Microsoft Excel's conditional formatting feature to shade the value of cells on the 1 to 5 scale. A value of 1 is least attractive and shown as red, a value of 5 is the most attractive and shown as green, and a value of 2.5 is in the middle and shown as yellow.

Table 7: Alternatives Analysis Scoring Summary

Scoring of Alternatives (5 most attractive, 1 least attractive)				
Evaluation Criteria	Criteria Weighting Factor %	Alternative No. 1 Repair, Strengthen and Recoat Two Existing Tanks	Alternative No. 2 Two New 5.0-MG Welded Steel Tanks	Alternative No. 3 Two New 5.0-MG Prestressed Concrete Tanks
Maintenance	10%	1.2	2.5	4.5
Cost	40%	1.5	1.0	4.0
Constructability/ Schedule	30%	4.8	4.8	4.6
Performance	20%	2.0	2.9	4.8
Total:	**100%**	**2.6**	**2.7**	**4.4**

The results of this analysis indicate that Alternative 3, constructing two new 5.0-million-gallon prestressed concrete tanks, as the most attractive option for the District based on the scoring assigned to the advantages and drawbacks. Because this scoring is subjective and could change based on District's review, final scoring results may change.

A review of Table 7 suggests that Alternative 3 is more attractive in terms of maintenance, cost, and performance whereas Alternative 2 is the next most attractive followed by Alternative 1. Both Alternatives 1 and 2 scored equally well in terms of constructability/schedule given the larger pool of available qualified contractors to complete the steel tank construction work.

6.2.2 Tank Outages

It is understood that the Smith Saddle tanks represent a large portion of the District's transmission level storage capacity and play a critical role in the District's overall operations. Therefore, the District is interested in minimizing the amount of time that any one of the two tanks is out of service as part of construction for a potential repair or replacement and as part of the lifetime maintenance that goes along with that alternative. The information in this section provides more background on these outage periods for the alternatives considered. The more frequent and the longer a tank is out of service, the higher risk that could present for the District.

Both the duration and frequency of a tank being out of service are important to consider during construction and as part of the maintenance needs. Construction durations of a single tank for all three alternatives are estimated at 12 months.

Steel tanks require coating of the walls (different intervals depending on if elastomeric polyurethanes or other materials are used) and this has been reflected in the Maintenance scoring analysis described in Section 6.2.1. Steel tanks are typically recoated in the winter months and require two to three months of down time to complete a recoating on both the interior and exterior of the tanks.

Concrete tanks require power washing and inspections as part of routine maintenance at 20-year maintenance intervals. This process involves draining the tank for up to one week and can be performed during the low seasonal demand periods.

Sealants may or may not need to be replaced every 20 years depending on exposure to degrading chemicals and UV. If the sealant remains flexible and bonded to the surface of the concrete, it may last 30 or 40 years. If the sealant is replaced, it needs to be removed from the joints and then the joints may need to have a new back rod installed along with a bond breaker, primer, and sealant applied. The sealant may take 48 hours to 7 days to cure depending on the type of sealant selected before the tank can be returned to service. Without exposure to degrading chemicals or UV, it is possible that the sealant may perform satisfactorily for up to 40 or 50 years.

Concrete tanks can be inspected with divers to determine the need for maintenance. Depending on performance, operations, and maintenance of the tanks, they may require more frequent maintenance intervals to drain, washdown, clean, and inspect in the dry to observe and document potential damage, which usually will take less than a couple of days.

6.2.3 Risks and Consequences of Failure

Kennedy Jenks performed a risk analysis of the three alternatives compared to the existing conditions based on the potential dominant modes of failure, including rupture, leak, and a compromised water quality event. Each of these modes of failure could occur for a variety of reasons, and these are identified as a potential cause in Table 8.

Table 8: Alternatives Risk Analysis

Dominant Modes of Failure	Cause of Failure	Likelihood of Cause	Exposure Vulnerability/Improvements	Vulnerability	Potential Risk	Effects and Consequences of Failure
Existing Condition - Do nothing						
Rupture	Earthquake, Severe Corrosion	Medium	Observed structural deficiencies, existing tanks do not have ringwall foundation.	High	Med.-High	Loss of all water, inability to transmit water to distribution system.
Leak	Earthquake, Low to Moderate Corrosion	Medium	Observed structural deficiencies.	Medium	Medium	Gradual loss of water, potential water quality issues, quality concerns over transmission of water to distribution system.
Water Quality Issue	Roof vandalism from rocks; erosion on underside of tank; pH, bacteria, or other caused by temperature, breach, or poor turnover; and corrosion.	High	Observed structural deficiencies.	Med.-High	High	Breach in the roof allowing outside contamination, temperature fluctuations impacting water quality, close proximity of inlet/outlet potentially reduce likelihood of 100% turnover.
Alternative No. 1: Repair, Strengthen and Recoat Two Existing Tanks						
Rupture	Earthquake, Severe Corrosion	Medium	Existing annular ring would be widened and thickened to avoid to uplift damage to improve performance in event of an earthquake.	Medium	Medium	Loss of all water, inability to transmit water to distribution system.
Leak	Earthquake, Severe Corrosion, Poor Construction Quality	Medium	- Existing annular ring would be widened and thickened to avoid to uplift damage to improve performance in event of an earthquake. - Coatings will minimize risk of corrosion	Low	Med.-Low	Gradual loss of water, potential water quality issues, quality concerns over transmission of water to distribution system.
Water Quality Issue	Roof vandalism from rocks; erosion on underside of tank; pH, bacteria, or other caused by temperature, breach, or poor turnover; and corrosion.	High	New roof will be stronger than existing, but potential to breach from severe or prolonged vandalism.	Medium	Med.-High	Breach in the roof allowing outside contamination, temperature fluctuations impacting water quality, close proximity of inlet/outlet potentially reduce likelihood of 100% turnover.
Alternative No. 2: Two New 5.0-MG Welded Steel Tanks						
Rupture	Earthquake, Severe Corrosion	Medium	Improved anchored ringwall foundations will improve performance in event of an earthquake.	Low	Med.-Low	Loss of all water, inability to transmit water to distribution system.
Leak	Earthquake, Severe Corrosion, Poor Construction Quality	Medium	- Improved anchored ringwall foundations will improve performance in event of an earthquake. - Coatings will minimize risk of corrosion.	Low	Med.-Low	Gradual loss of water, potential water quality issues, quality concerns over transmission of water to distribution system.
Water Quality Issue	Roof vandalism from rocks; erosion on underside of tank; pH, bacteria, or other caused by temperature, breach, or poor turnover; and corrosion.	High	New roof will be stronger than existing, but potential to breach from severe or prolonged vandalism.	Med.-Low	Med.-High	Breach in the roof allowing outside contamination, temperature fluctuations impacting water quality, close proximity of inlet/outlet potentially reduce likelihood of 100% turnover.
Alternative No. 3: Two New 5.0-MG Prestressed Concrete Tanks						
Rupture	Earthquake, Severe Corrosion	Medium	Reinforced concrete performs well in earthquake events.	Low	Med.-Low	Partial loss of water, potential defected piping connection impacting ability to transmit water to distribution system.
Leak	Earthquake, Low to Moderate Corrosion, Poor Construction Quality	Medium	Cracks could allow for leaks, but tend to form gradually and can be addressed before severe issue.	Med.-Low	Medium	Crack would form gradually and could be addressed before presenting consequence.
Water Quality Issue	Roof vandalism; pH, bacteria, or other caused by temperature, breach, or poor turnover; and corrosion.	Medium	Concrete is a thermal insulator and strong against vandalism.	Low	Med.-Low	Vandalism and temperature unlikely to impact water quality; inlet/outlet penetrations can located to facilitate turnover and improved water quality.

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The potential causes of these failure occurring are fairly consistent across the alternatives and therefore, have a similar likelihood of occurring (an earthquake was a assigned a medium likelihood relative to the other potential causes). However, because each alternative has unique characteristics relative to these causes (i.e., a concrete roof performs better against rock vandalism compared to a steel roof), the exposure vulnerability to these potential causes varies. Where an alternative has the potential to improve exposure to a cause, that improvement was noted.

Table 8 outlines this risk analysis performed and identifies the potential risk of each alternative relative to the dominant modes of failure. The potential risk is based on the likelihood of a Cause occurring and the Vulnerability of that alternative relative to the potential Cause.

The results of this analysis indicate that Alternative 3 could result in a lower overall risk profile for the District relative to these three dominant modes of failure. The existing conditions, or the ‘do nothing’ alternative, represent the highest risk alternative.

It is also worth noting that there is a risk of steel coating regulations changing in the future. New NSF 61/600 regulations are coming forward in the next couple of years that will be affecting all new protective coating system specifications. If the District were to construct new welded steel tanks, regulations could change after the completion of construction that could remove previously approved coating materials from the list of acceptable products.

Recommendations based on this analysis and the other content summarized in this report is described under Section 6.8.

6.3 Access Road and Tank Site Access Recommendations

Recommended improvements for the Glen Drive access road and sitework surrounding the Smith Saddle Tanks are based on best practices, industry standards including AWWA D100 and M42 Standards, and DDW requirements. In order to address the deficiencies documented in Section 2.3.4 and to provide a site access road and tank site access for future operation, maintenance, and construction requirements the following sitework recommendations should be incorporated into the project.

6.3.1 Glen Drive Access Road Recommendations

The maximum recommended longitudinal slope for large delivery and construction vehicles is 15%. If any portion of the road is steeper than 15%, re-grade the road to ensure larger vehicles can access the tank site. It is recommended topographic mapping of the existing access road be performed to verify the longitudinal slope satisfies this recommendation and provide a background for access road improvements and potential turn-around points discussed below.

Two options for improving the existing access road drainage and wearing surface are considered: 1) if the District were restricted on the improvements that could be made to the road based on the mixed use requirements of the road, the road should be re-graded with crushed rock and a liquid asphalt binder surface placed as needed to ensure an adequate driving surface or 2) otherwise, it is recommended the road be re-graded and HMA pavement be constructed on the north end of the access road where the grades steepen. With either wearing surface, it is recommended the road be re-graded to mitigate erosion and flatten any slopes steeper than 15%.

Where the existing turning radius is approximately 17 to 18 feet, the turn radius should be increased to support large delivery and construction vehicles. Typical design vehicles used for assessing minimum turning radii are: a single unit truck, 30 feet long (SU-30), which is comparable to a delivery vehicle or concrete truck; and an intermediate semitrailer (WB-40), if larger deliveries or construction equipment is anticipated. A semitrailer may sometimes be used to deliver steel tank panels and other larger construction equipment and materials. The American Highway Association of State Highway and Transportation (AASHTO) recommends a minimum turning radius for an SU-30 of 30 feet and a minimum turning radius for a WB-40 of 40 feet. Constructing a 40-foot wide turning radius in this location would require substantial earthwork and retaining wall(s). A 30-foot-wide turning radius appears feasible and would most likely require less earthwork and potentially shorter retaining walls. Since the existing tanks were constructed with the existing turning radius and given the frequency of trips by the larger semi-trailers, it is recommended not to increase the turning radius beyond the 30-foot radius. There are no turn-around points along the access road. Final design should consider the addition of turnaround points near the base of the access road.

For the basis of construction costs estimates, a total access road length of 3,000 lineal feet was utilized with 20% of the road length regraded to reduce the longitudinal slope to 15% and the entire length of road paved with v-ditches added along the sides of road. The estimate is based on approximately 60 lineal feet of 6-foot high retaining wall on the uphill side of the radius reconstruction.

6.3.2 Smith Saddle Tanks Site Recommendations

The perimeter road width is a minimum of 10 feet from the existing tank wall to the toe of the existing earth berm and field observations of the perimeter road, indicated trucks driving onto the existing earth berm one to two feet presumably for more clearance when driving around the tanks. For ease of maintenance, drivability around the tanks and protection of the toe of slope, a 12-foot-wide road is recommended. Supporting a wider perimeter road will require installation of a short retaining wall, where necessary, along the edge of roadway to account for the difference in elevation. The existing tank site should be re-graded and the site should be paved with HMA pavement with additional catch basins and associated drainage piping installed around the tanks. Additional catch basins are needed due to requirements for slopes around the tank and minimum height of tank foundation. Piping will collect runoff from the new catch basins and convey it to the existing catch basins. Any buried pipeline modifications between the tanks and serving the Smith Saddle Booster Station will be investigated and developed as part of the final design. HMA pavement will convey runoff away from the tanks, will keep catch basins from being blocked by vegetation and will provide a better working surface for maintenance teams. Consideration for providing a tank foundation height of 6 inches is also recommended to bring the tanks to compliance with AWWA standards. The security chain-link fence appeared to be in good condition and is not recommended for replacement. However, removal and replacement of portions of the fence may be necessary for retrofit or replacement activities on the existing tanks. As part of the final design, consideration for locating a crane at the tank site should be provided. Preliminary research for crane options indicate widths as follows: the back of the crane with outriggers extended may be 10 feet, and the front of the crane with outriggers extended may be approximately 22 feet.

6.4 Tank and Site Safety Recommendations

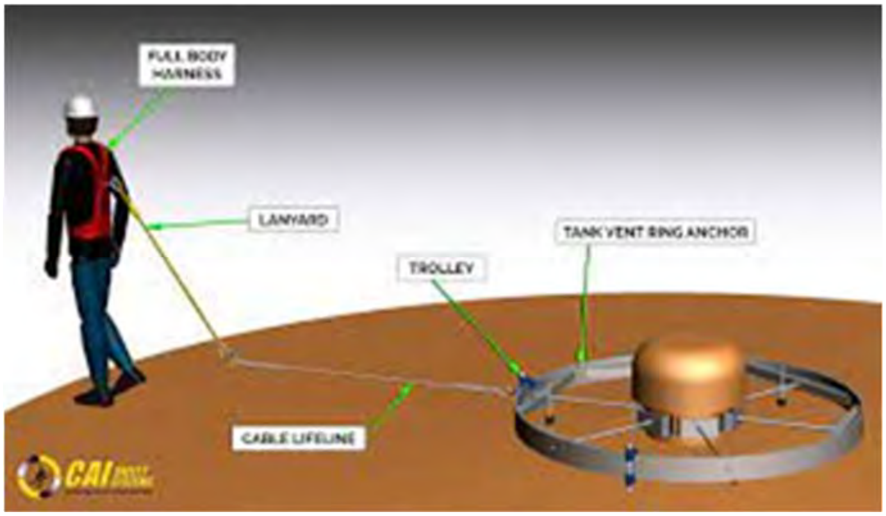
Recommendations for fall protection should be applied to either repair or replacement of the tanks. The following three recommendations are provided to increase fall protection for workers at the tanks:

1. **Guardrails:** The recommended fall protection for the tanks should be to install a perimeter guardrail system with toeboards around the tanks outside perimeters (see illustration below). This engineering solution would provide continuous fall protection without the need to provide workers with additional fall restraint devices and PPE such as fall protection harnesses and lanyards.

Figure 4: Guardrails

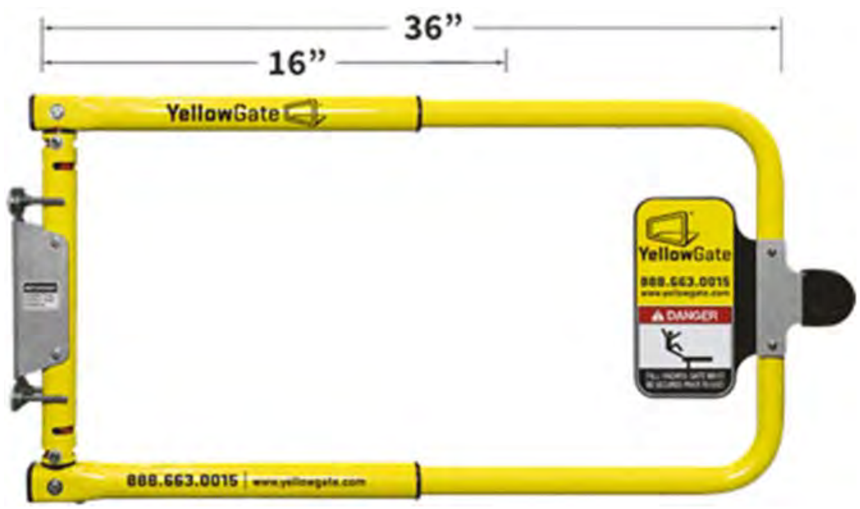
2. **Tank Vent Ring Anchor:** If the District were to elect to not install a complete guardrail system around the roof of the tank's, installing a tank ring anchor around the tanks' vents that would provide a suitable anchor and allow free movement around the perimeter of the tank used in combination with PPE such as a body harness with adjustable lanyards would provide fall restraint during inspections and maintenance.

Figure 5: Tank Vent Ring Anchor



3. **Safety Swing Gate:** An adjustable safety swing gate should be installed at the top of the stairway landing to prevent workers from accidentally falling from the tank roof down the stairway.

Figure 6: Safety Swing Gate



6.5 Opinion of Probable Construction Costs (AACE Class 4)

The engineer’s opinion of probable construction costs (OPCC), both the total estimated construction costs and estimated life-cycle costs, for the three alternatives are presented in Table 6, and include all project costs and costs that would be similar for all alternatives including associated sitework access road improvements, electrical and controls. Estimated construction costs are conceptual and are an AACEI Class 4 Level Estimate. Estimated costs are based on January 2021 construction costs at a current ENR construction cost index of 11698. There were several sources utilized for the estimate including RS Means Costworks 2021, tank fabricator and coating budgetary costs estimates, and similar project construction cost estimates and bid results and bid schedules. In order for estimates to be accurate of the current bidding environment, budgetary quotes and letters were received from Spiess Construction Co., Inc. and Paso Robles Tank, Inc. for steel tanks and DN Tanks for concrete tanks. Budgetary estimates were also received from protective coatings subcontractors for interior coatings for steel tanks. The estimated costs include Division 1 costs at 10%, taxes on materials at 8.5%, markups by General Contractors on subcontractors at 12%, and General Contractors overhead and profit at 15%. The estimated costs also include design contingency allowance of 25% and this allowance is not intended to provide for construction contingency for change orders or to cover unforeseen conditions. The estimated costs are based on current construction costs and include a cost escalation factor of 3.5% for projection of 24 months to the midpoint of construction.

The following items are not included in the estimates:

- Contaminated soils removal or disposal.
- District's administration, permits or construction management expenses or facilities.
- Independent, special inspections, or structural observations in accordance with the building code.
- Service connection fees (power and water).
- No landscaping has been included.
- PLC / SCADA programming design / modifications (if required) by District.

The following assumptions were made in the preparation of the estimates:

- Regular working hours will be allowed. Single 8-hour shift per calendar day.
- Groundwater is below the bottom of the tank excavation. No significant dewatering is included.
- Native material will be suitable for backfill above the bedding zone.
- Tank construction and coatings will be subcontracted to specialty subcontractor.
- One tank at a time will be rehabilitated with the other tank remaining in service.

The level of accuracy in the opinion of probable construction cost is commensurate with levels developed by the AACE, the Association for the Advancement of Cost Engineering International. At increasing levels of design completion, the narrower the range between upper and lower limits and the greater the accuracy of the estimate. This estimate is considered a Class 4 feasibility or study level estimate in accordance with AACEI Guidelines. Typically, this level of estimate has an expected accuracy range of +20% to +50% on the high side to -15% to -30% on the low side. This estimate is based upon competitive bidding, which assumes receipt of multiple bids from five or more general contractors. Without competitive bidding, pricing can vary significantly from the prices assumed in this estimate. The OPCC is only an opinion of possible items that may be considered for budgeting purposes. This estimate is limited to the conditions existing at issuance and is not a guaranty of actual construction cost or schedule. Uncertain market conditions such as, but not limited to, local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events and developing bidding conditions, etc. may affect the accuracy of this estimate.

Table 9: Opinion of Probable Construction Cost for Reservoir Alternatives

Description	Alternative No. 1 Repair/Recoat Two Existing Tanks	Alternative No. 2 Two New 5.0-MG Welded Steel Tanks	Alternative No. 3 Two New 5.0-MG Prestressed Concrete Tanks
Division 1: Allowances – Floor Plate (1)	$148,000	-	-
Division 2: Demolition and Worker Protection (2)	$170,000	$1,207,000	$1,207,000
Division 3: Concrete Foundations (Ringwall)	-	$172,000	-
Division 5: Metals (Stairs and Platforms) (3)	$156,000	$159,000	$159,000
Division 9:Blasting and Protective Coatings (4)	$6,998,000	$4,670,000	-
Division 26: Electrical and Instrumentation	$150,000	$300,000	$300,000
Division 31: Earthwork (Excavate and Subgrade)(5)	-	$107,000	$154,000
Division 32: Site Improvements (6)	$498,000	$438,000	$368,000
Division 33: Utilities			
Water Piping and Valves	$200,000	$250,000	$500,000
Tanks and Appurtenances	$2,514,000	$6,434,000	$9,800,000
Cathodic Protection Systems	$32,000	$32,000	-
Subtotal	**$10,866,000**	**$13,769,000**	**$12,488,000**
Markups (7)	$7,734,000	$9,831,000	$9.112,000
Total Estimated Construction Cost	**$18,600,000**	**$23,600,000**	**$22,100,000 (9)**
100-Year Cumulative Maintenance Cost (8)	$24,400,000	$24,400,000	$1,200,000
Estimated 100-Year Total Life-Cycle Cost (8)	**$43,000,000**	**$48,000,000**	**$23,300,000**

Notes:

1. Allowances includes cost for replacement of 50% of existing floor plates in Alternative 1.
2. Demolition is for either selective or complete tank demolition and worker protection for lead during cutting.
3. Stair extension for Alternative 1; new stairs for Alternatives 2 and 3. Vent for Alternative 1. Vents for Alternatives 2 and 3 are included with tank.
4. Containment of lead abatement with Blastox. Remove hot mop coal tar with PCBs. Dehumidification equipment.
5. Excavation for ringwall footing and buried utilities. Earthwork for new tank pads.
6. Regrading around tanks and drainage improvements. Includes access road grading and paving improvements.
7. Markups include Division 1 costs (10%), taxes on materials (8.25%), contractor markups on subcontractors (12%), general contractor overhead and profit (15%), bonds and insurance (3%), estimate contingency (25%), and escalation to mid-point of construction (24 months at 3.5% per year).
8. Capital and maintenance costs for concrete and welded steel tanks are $100,000 every 20 years for concrete tanks and $1,190,000 every 20 years for exterior coatings and cathodic protection and $3,840,000 at 50 years for interior coatings for steel tanks assuming an elastomeric polyurethane coating. A 2% annual interest rate was utilized to determine cumulative compound amount of future sums over the estimated 100 years.
9. The total estimated construction cost is based on an accelerated construction duration of 30 weeks for the Alternative No. 3 two new 5.0-MG prestressed concrete tanks option. If a regular construction duration of 32 to 33 weeks were to be required by the construction documents the total estimated construction cost would be decreased from $22,100,000 to $21,600,000.

6.6 Life-Cycle Cost Comparison

The estimated 100-year total life-cycle cost is based on adding the total maintenance cost per 20-year return period to the total estimated construction cost for each alternative. For the two concrete tanks, a total estimated maintenance cost per 20-year return period was $100,000 for power washing, routine maintenance including repair of sealant and backer rod in construction joints, and inspection. For the welded steel tanks, a total estimated maintenance cost per 20-year return period was estimated at $1,190,000 for surface preparation and re-coating of the exterior of tanks and a one-time cost of $3,840,000 at 50 years for surface preparation and recoating of the interior of the tanks. Therefore, for the concrete tanks a 100-year total present worth cost of maintenance would be $1,200,000. While for the steel tanks, a 100-year cost of maintenance would be $24,400,000. When added to the construction cost of the tanks, the welded steel tanks would have a total life-cycle cost of $43,000,000 and $48,000,000 for the repair or replacement of steel tanks, respectively. The prestressed concrete tanks would have a total life-cycle cost of $23,300,000.

6.7 Bid Package, Scheduling and Work Sequencing

6.7.1 Bid Package

It is recommended that the District prepare a single bid package for the repair or replacement of the two tanks. While the construction of the two tanks will be one year apart, the District is likely to receive more favorably bids by bidding the tanks in a single package resulting in a single cost for mobilization and demobilization by a single contractor. Scheduling of the advertisement, bid, and award of the bid package is also significant in order to provide the successful Contractor with sufficient time to complete contract administration activities, development of submittals and calculations, review of submittals, and shop fabrication and coatings, and delivery of all materials prior to the scheduled shutdown and demolition of the existing water tanks which cannot begin prior to the winter demand season, tentatively considered to be November 1st. If the District elects to pursue the repair and recoat Alternative No. 1, there may be select bid items, such as floor plates and columns, that the District may want to include on a unit price basis as opposed to a lump sum basis depending on the condition of the materials following surface preparation and blasting.

6.7.2 Estimated Construction Schedules and Work Sequence

An estimated construction schedule was prepared for the recommended alternative of repair and recoating of the welded steel tanks. The construction scheduled is based on notice to proceed in June of 2022 with demo of the existing tank on 1 November of 2022. The estimate is based on the assumptions of construction of foundation and subgrade improvements followed by demolition of the roof, top of shell and interior columns. Simultaneous with the site work on the tank bottom and demolition would be fabrication and delivery of materials for the replacement of the top of the shell and roof. Following reconstruction of the top of the shell and roof, the existing interior and exterior coatings would be removed and field painting would be performed first on the interior and then on the exterior. The estimate is based on 6 weeks for removal of the interior coatings and 4 weeks for removal of the exterior coatings on each tank. The construction schedule assumes shop drawing submittal, review and approval for both tanks prior to construction and demolition of one tank (assumed Tank No. 2 East) initially, followed by construction of the repairs and recoating of Tank No. 2, then demolition of the second tank (assumed Tank No. 1 West), followed by construction of the repairs and recoating of Tank No. 1. Access road and site improvements can be performed simultaneously with the repairs of the two tanks and final paving of the site and access road after completion of the repairs of the second tank. The milestone dates for completion of the repairs of the first steel tank would be 31 May 2023 and for the second steel tank of 31 May 2024. The estimated construction schedule in Gantt Chart format is shown in Appendix H.

Steel tank fabricators indicated that while a 7-month duration (November through May of subsequent year) from demo of the existing tank to completion of the construction of the replacement tank is feasible the completion is contingent on weather which is out of control of the Contractor.

An estimated construction schedule was prepared for the recommended alternative of replacement of the welded steel tanks with two new 5.0-MG prestressed concrete tanks. The construction scheduled is based on notice to proceed in June of 2022 with demo of existing tank on 1 November of 2022. The estimate is based on the assumptions of construction of formwork, placement of reinforcing and placement of concrete for two (2) floor halves per tank, sixteen (16) wall segments per tank, thirty-six (36) columns per tank, and two (2) roof halves per tank. The construction schedule assumes shop drawing submittal, review and approval for both tanks prior to construction and demolition of one tank (assumed Tank No. 2 East) initially. Followed by construction of the new prestressed concrete Tank No. 2, then demolition of the second tank (assumed Tank No. 1 West), and followed by construction of the new second prestressed concrete Tank No. 1. Access road and site improvements can be performed simultaneously with the construction of the two tanks and final paving of the site and access road after completion of the construction of the second prestressed concrete. The milestone dates for completion of the first prestressed concrete tank would be late 31 May 2023 and for the second prestressed concrete tank of 31 May 2024. The estimated construction schedule in Gantt Chart format is shown in Appendix H.

6.8 Recommendations and Implementation Plan

Based on review of the reservoir alternatives, construction materials, estimated total construction cost, and estimated life-cycle cost, it is recommended that the District proceed with design of circular strand-wound prestressed concrete tanks for replacement of the two welded steel tanks. While the prestressed concrete tanks may have an initial construction cost slightly more than the repair and recoating of the existing welded steel tanks, the replacement of the steel tanks will permit the District to have new water storage tanks with improved water quality considerations addressed and at a significantly lower life-cycle cost over the 100-year life of the structures.

At the time of this Final Report, the District is in the process of evaluating an additional tank to be located in the immediate area of the existing two tanks. The intent of this third tank would be to provide additional storage while part of the existing storage is unavailable during construction on the existing two tanks. The District has requested for further support of this evaluation, which KJ will plan on completing as part of the Design portion of this work.

References

1. Marin Municipal Water District, North Marin Balancing Reservoir, Miscellaneous Drawings (12 Drawings), 1960.

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3. 1999 Steel Tank Seismic Retrofit Project, Contract No. 1216, Smith Saddle Tanks Piping Drawings (4 Drawings), 1999.

4. Kleinfelder, 2000, Smith Saddle Tank Site, Preliminary Environmental Assessment, 24 February 2000.

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6. Enviro-Chem, Inc., Laboratory Reports, Smith Saddle Tank No. 1, 30 December 2019.

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8. Marin Municipal Water District, Specifications for Painting of Smith Saddle Tank No. 2, 1984.

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10. LiquiVision Technology Diving Services, Underwater Inspection Report, Smith Saddle No. 1, 5 May 2003.

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12. Aqua Video Engineering, Video Inspection Report, Smith Saddle No. 1, 24 April 1996.

13. Aqua Video Engineering, Video Inspection Report, Smith Saddle No. 2, 29 April 1996.

14. Excel Spreadsheet, Smith Saddle Tanks Seismic Evaluation, AWWA Standard D100-96 (2012).

15. Excel Spreadsheet, Smith Saddle Tanks Seismic Adequacy Review of Steel Tanks (2014).

16. Marin Municipal Water District, Smith Saddle Tanks, Welded Steel Tank Condition Assessment Form, 10 April 2019.

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Appendices

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Appendix A

Select Photographs of Tank Observations

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Photo #1:

Tank 1, Exterior, Floor: Buried shell and floor plate with vegetation and debris and water ponding against floor plate and shell bottom.

Photo #2:

Tank 1, Exterior, Floor: Oiled subgrade and asphalt material eroded significantly exposing underside of floor plate.

Photo #3:

Tank 1, Exterior, Floor: Exposed underside of floor plate with subgrade materials eroded away.

Photo #4:

Tank 1, Exterior, Shell: Isolated areas of corrosion in the top shell ring beneath vent sheet metal.

Photo #5:

Tank 1, Exterior, Shell: Graffiti overcoated with water-based paints resulting in mold under coatings. Acrylic based coatings with poor adhesion over original coatings.

Photo #6:

Tank 1, Exterior, Roof: Bird screen provided but no insect screen. Bolts on vent screen deteriorating.

Photo #7:

Tank 1, Exterior, Appurtenances: 30-Inch Outlet orientation, supports, obstruct travel, lack isolation.

Photo #8:

Tank 1, Exterior, Appurtenances: 24-Inch Inlet, orientation, supports, obstruct travel, and lack isolation.

Photo #9:

Tank 1, Exterior, Appurtenances: Roof access hatch cover with holes in steel plate.

Photo #10:

Tank 1, Interior, Roof: Roof plates near shell with complete loss of coatings and extensive corrosion of metal.

Photo #11:

Tank 1, Interior, Roof: Roof plates near shell with complete loss of coatings and extensive corrosion of metal.

Photo #12:

Tank 1, Interior, Roof: Radial channel beams with corrosion of metal of the bottom flanges and at the faying surfaces on the top of flanges with the underside of roof plates.

Photo #13:

Tank 1, Interior, Roof: Intermediate girder column connections with significant corrosion and loss of metal on tie plates and column top plates.

Photo #14:

Tank 1, Interior, Roof: Failure of earthquake bracing rod on exterior radial channels.

Photo #15:

Tank 1, Interior, Shell: Typical shell condition above maximum water surface with significant coating failure, blisters, fractures, and loss of metal.

Photo #16:

Tank 1, Interior, Shell: Northeast quadrant with improved shell condition above maximum water surface.

Photo #17:

Tank 1, Interior, Roof: Missing bolts in top/hat plate of center column to center radial channel beams.

Photo #18:

Tank 1, Interior, Roof: Girder web with significant coating failure and potential loss of metal.

Photo #19:

Tank 1, Interior, Roof: Coating failure versus coating damage and deterioration.

Photo #20:

Tank 2, Exterior, Floor: Insufficient slope away from floor plate with water, vegetation, and debris burying joint.

Photo #21:

Tank 2, Exterior, Floor: Asphalt subgrade materials eroded away from annular ring resulting in loss of bearing and support.

Photo #22:

Tank 2, Exterior, Shell: Extensive damage to coatings on west and northwest sides as a result of rocks thrown against the tank.

Photo #23:

Tank 2, Exterior, Roof: Rocks thrown on roof damaging coating and contributing to exterior spot corrosion.

Photo #24:

Tank 2, Exterior, Appurtenances: Shell manhole with hinges cut off. Unshored excavation adjacent to annular ring with loss of support to asphalt subgrade.

Photo #25:

Tank 2, Exterior, Appurtenances: Unanchored gravity supports for above ground 30-inch outlet piping.

Photo #26:

Tank 2, Exterior, Appurtenances: 24-Inch inlet piping above ground obstructing vehicle and pedestrian travel around tanks.

Photo #27:

Tank 2, Interior, Floor: Coating blisters on floor.

Photo #28:

Tank 2, Interior, Floor: Closeup of floor with coating removed bare steel with no loss of metal or pitting.

Photo #29:

Tank 2, Interior, Floor: Closeup of floor with coating removed bare steel with no loss of metal or pitting.

Photo #30:

Tank 2, Interior, Shell: Failed coal tar jet set primer and hot coal tar enamel on interior shell on lower half.

Photo #31:

Tank 2, Interior, Shell: Failed coal tar jet set primer and hot coal tar enamel on interior shell on lower half. Close up of vertical weld seam with metal intact.

Photo #32:

Tank 2, Interior, Shell: Failed coal tar jet set primer and hot coal tar enamel on interior shell on lower half. Close up of brittle and cracked coal tar enamel and cracked and delaminating coal tar jet set primer with smooth intact steel with no pitting.

Photo #33:

Tank 2, Exterior, Shell: Poorly adhered coating on exterior with mold growth under the coating as a result of water-based paints.

Photo #34:

Tank 2, Exterior, Shell: 1^{st} (Tub) Shell Ring with failed ASTM D 3359 x-scribe adhesion test.

Photo #35:

Tank 2, Interior, Shell: Calcareous deposits on top of interior coatings on the shell.

Photo #36:

Tank 2, Interior, Shell: Blister domes on interior shell hot coal tar enamel coating.

Photo #37:

Tank 2, Interior, Shell: Note corrosion stains below maximum water surface, note shell corrosion above maximum water surface, note corrosion of steel roof plates compared with steel shell plates below maximum water surface.

Photo #38:

Tank 2, Interior, Floor: Rust chips from roof plates and roof framing pushed to perimeter of floor.

Photo #39:

Tank 2, Interior, Shell: Upper shell in the vapor space is failing with evidence of corrosion and metal loss.

Photo #40:

Tank 2, Interior, Shell: Upper shell in the vapor space just below vent screening is failing with evidence of corrosion and metal loss.

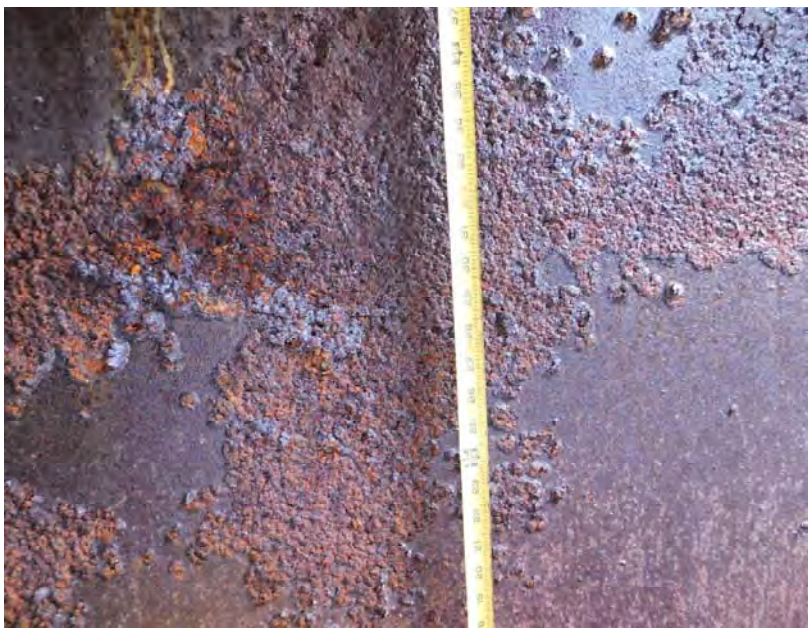

Photo #41:

Tank 2, Interior, Shell: Upper shell in the vapor space is failing with evidence of corrosion and metal loss (closeup).

Photo #42:

Tank 2, Interior, Shell: Upper shell in the vapor space is failing with evidence of corrosion and metal loss. Just below large, corroded areas transitioning to normally submerged region.

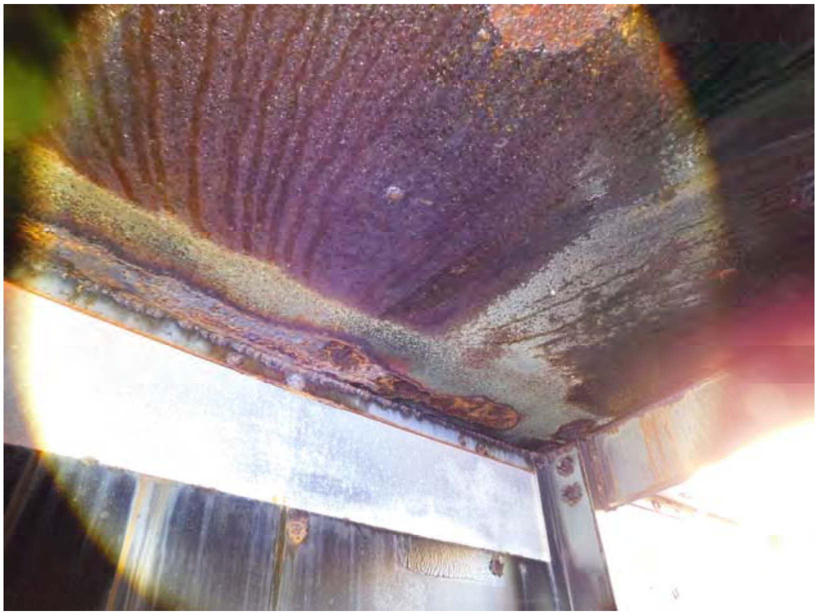

Photo #43:

Tank 2, Interior, Shell: Outer bay adjacent to the abandoned shell vents has moderate corrosion on the roof plates.

Photo #44:

Tank 2, Interior, Shell: Outer bay adjacent to the abandoned shell vents. The nuts and bolts that fasten the rafters to the shell support exhibited 50% ± metal loss

Photo #45:

Tank 2, Interior, Roof: Failure of interior protective coatings on underside of roof plates with loss of metal.

Photo #46:

Tank 2, Interior, Roof: For comparison, a radial roof channel beam with intact protective coatings and no loss of metal or delamination in flanges. Some minor rust chips collecting on lower flange.

Photo #47:

Tank 2, Interior, Roof: Center column top/hat plate with stiffeners. Loss of protective coatings and corrosion of meal.

Photo #48:

Tank 2, Interior, Roof: Column baseplate with stiffeners. Loss of protective coatings and corrosion of meal with calcareous deposits.

Photo #49:

Tank 2, Interior, Appurtenances: Cracked and spalling coatings on nozzle interiors.

Photo #50:

Tank 2, Interior, Appurtenances: Overflow weir and box from below with supports intact.

Photo #51:

Tank 2, Interior, Appurtenances; Cathodic protection anode string with failed weight.

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Appendix B

Dive Inspection Report

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UNDERWATER RESOURCES INC
866 Estabrook St
San Leandro, CA 84577
urdiving.com | 510-957-5097

April 5th, 2021

Kennedy Jenks
275 Battery Street, Suite 550
San Francisco, CA 94111
Attn: Donald Barraza, P.E.

Subject: Smith Saddle Tank No. 1 Dive Inspection Report

Background

Underwater Resources, Inc. (URI) was contracted by Kennedy Jenks to perform a narrated dive video inspection of the MMWD Smith Saddle potable water tank No. 1. URI provided a three-person commercial dive team consisting of a supervisor, diver, and tender along with surface-supplied air diving equipment disinfected in accordance with AWWA C652-11. The diver entered the tank from the top hatch of tank No.1 using a fall protection tripod and performed a narrated underwater video inspection of the tank including the floor, walls, joints/seems, columns, and appurtenances. Photographs were taken of both typical and anomalous conditions. Work was performed over the course of one standard-time shift on Wednesday March 31st, 2021.

Ladder

The diver began the inspection on the ladder beneath the hatch at the northeast perimeter of the tank and noted that it was in good condition with only minor coating damage (pitting) and minimal corrosion throughout. The ladder wall brackets had solid connections and all rungs felt solid. The diver found a large quantity of rust flakes ranging up to 2-inches in length on the floor around the base of the ladder.

Weir Box / Overflow Structure

Next the diver traveled counterclockwise around the perimeter and inspected the weir box/overflow structure. All structural members and connection points were inspected and found to be in good condition with intact coating. The diver also got a view of the underside of the box and noted that it looked clean and in good condition.

Floor

While the floor of the reservoir was generally clean of sediment and its coating was in good condition, there was a layer of rust flakes scattered around it most likely from the ceiling structure. There was a heavier concentration of rust around the base of each pile with large flakes ranging up to 3-inches in length and heavy concentrations around the perimeter at the base of the wall up to 8-inches deep.

Walls

Starting at the ladder, the diver first moved counterclockwise around half of the tank and inspected the walls for anomalies, then moved back to the ladder and completed the second half moving clockwise (due to umbilical hose restrictions). Around the perimeter of the wall there were sparsely scattered coating blisters typically 1-inch in diameter and many of which were popped. There were also several large areas of coating cracking spread around the wall. Above the first horizontal seam, there was intermittent coating cracking that occurred in a pattern of vertical stripes.

Penetrators

The diver inspected all penetrators around the exterior of the tank in the wall and floor and found them all to be in good condition with minimal coating damage. Photos were taken of each penetrator.

866 Estabrook St
San Leandro, CA 84577
urdiving.com | 510-957-5097

Columns

The diver began the column inspection at the center of the tank, then moved to the inner, middle, and outer rings inspecting and numbering the pile in a counterclockwise manner according to the diagram below. All of the column base plates and associated angle pieces were found to be intact and in good condition with no signs of corrosion. Every column had coating blisters to varying extents. The level of blistering has been broken down into the three categories below and shown in Table 1 on the next page.

<u>Major</u> – A heavy concentration of blisters generally 1-inch in diameter and ranging up to 3-inches.
<u>Moderate</u> – Scattered blisters ranging up to 1-inch in diameter.
<u>Minor</u> – Sparse blisters less than 1-inch in diameter.

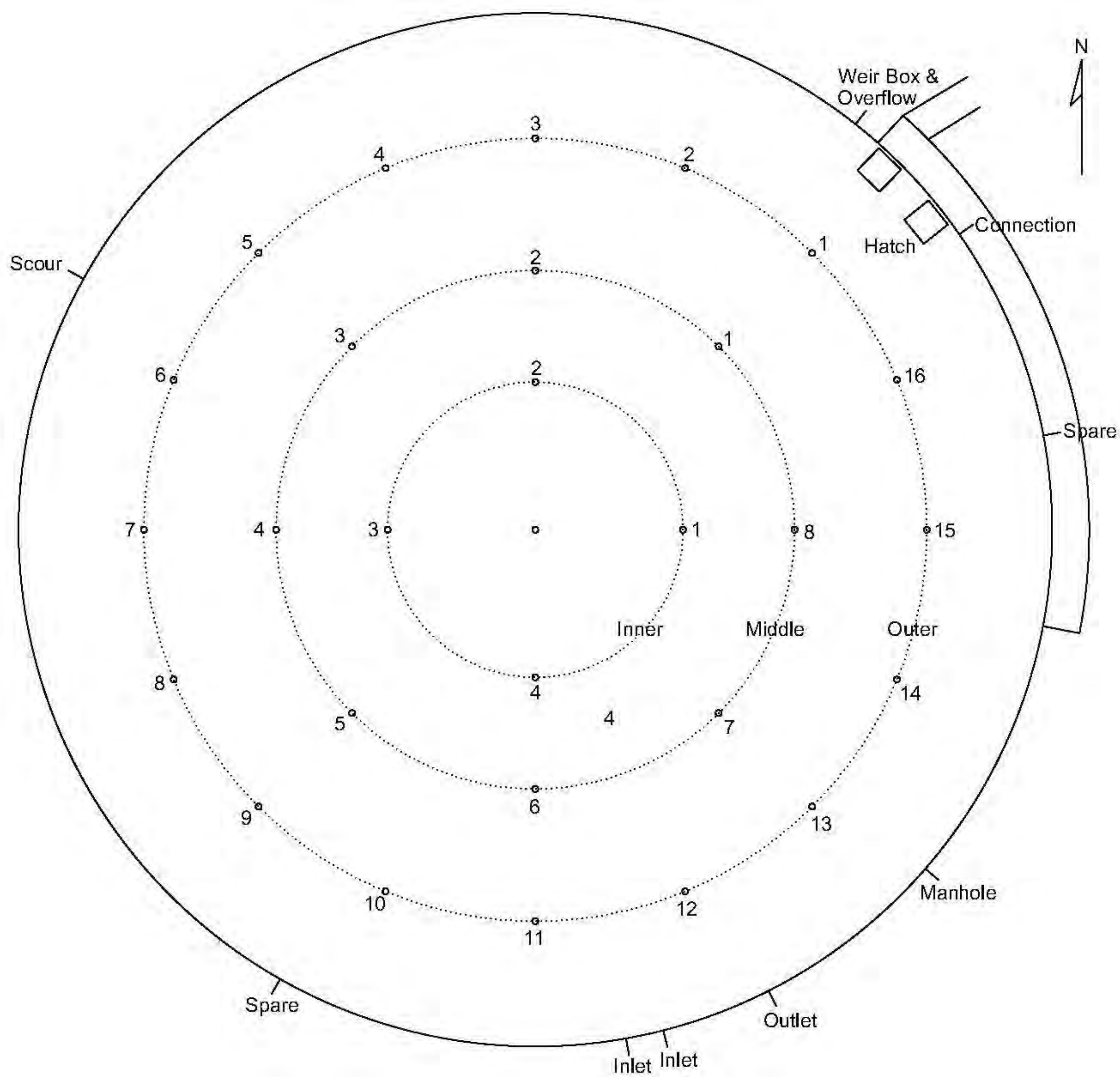

Table 1 – Column Inspection				
	Blistering Concentration on Pile			
Column #	**Lower**	**Middle**	**Upper**	**Notes**
Center	Major	Moderate	Minor	Blisters ranged up to 1-inch
Inner 1	Moderate	Major	Minor	One blister at 3-inch diameter mid-pile.
Inner 2	Moderate	Moderate	Minor	A few large white growths on lower pile.
Inner 3	Moderate	Moderate	Minor	Large rust flakes at base of pile
Inner 4	Minor	Moderate	Minor	A few large white growths on lower pile.
Middle 1	Moderate	Moderate	Minor	Heavy rust pile at base of pile. Small white growths around mid-pile
Middle 2	Moderate	Minor	Minor	Typical rust flakes at base of pile
Middle 3	Minor	Moderate	Minor	A few small white growths on mid-pile.
Middle 4	Moderate	Moderate	Minor	Many blisters on lower half have popped
Middle 5	Moderate	Moderate	Minor	Typical rust flakes at base of pile
Middle 6	Moderate	Moderate	Minor	Typical rust flakes at base of pile
Middle 7	Major	Moderate	Minor	Several large white growths on mid to lower pile.
Middle 8	Major	Moderate	Minor	Several large white growths on mid to lower pile.
Outer 1	Major	Moderate	Minor	Many blisters on lower half have popped. Small area of exposed steel two feet below water line.
Outer 2	Major	Moderate	Minor	Many blisters on lower half have popped. Broken anode sitting on floor at base of pile
Outer 3	Major	Moderate	Minor	Blisters up to 3-inches in diameter on lower half.
Outer 4	Moderate	Moderate	Minor	Typical rust flakes at base of pile
Outer 5	Major	Moderate	Minor	Many blisters on lower half have popped.
Outer 6	Moderate	Moderate	Minor	10-foot-long white growth on bottom half.
Outer 7	Moderate	Moderate	Minor	A few large white growths on lower pile
Outer 8	Moderate	Moderate	Minor	Large rust flakes at base of pile A few large white growths on lower pile.
Outer 9	Moderate	Moderate	Minor	Large white growth at lower & mid pile.
Outer 10	Moderate	Major	Minor	Many blisters on lower half have popped.
Outer 11	Moderate	Moderate	Minor	Many blisters on lower half have popped.
Outer 12	Moderate	Major	Minor	No rust on floor.
Outer 13	Major	Moderate	Minor	Small, popped blister with exposed steel below water line.
Outer 14	Major	Moderate	Minor	Several large bubbles popped on lower pile
Outer 15	Moderate	Major	Minor	Many blisters popped on the lower half. 3-inch diameter blister mid-pile.
Outer 16	Moderate	Moderate	Moderate	A few large white growths on lower pile.

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Table 2 – Video Log – MMWD Smith Saddle Tank #1	
Click here for a link to view/download inspection videos	
Time	**Notes**
10:28:13	Start video
10:30:08	Diver inspecting ladder
10:32:30	Diver inspecting weir box/overflow
10:34:16	Diver back on bottom at base of ladder. Notes rust flakes on floor
10:37:21	Diver inspecting center column
10:41:57	Diver inspection inner ring column #1
10:46:45	Diver inspection inner ring column #2
10:50:05	Diver inspection inner ring column #3
10:53:25	Diver inspection inner ring column #4
10:57:19	Diver inspection middle ring column #1
11:01:35	Diver inspection middle ring column #2
11:09:23	Diver inspection middle ring column #3
11:11:03	Diver inspection middle ring column #4
11:14:04	Diver inspection outer ring column #8
11:18:20	Diver inspection middle ring column #5
11:21:19	Diver inspection middle ring column #6
11:25:20	Diver inspection outer ring column #14
11:29:00	Diver inspection middle ring column #7
11:31:40	Diver inspection middle ring column #8
11:35:15	Diver inspection outer ring column #15
11:40:35	Diver inspection outer ring column #14
11:42:00	Diver inspection outer ring column #13
11:45:23	Diver inspection outer ring column #12
12:22:56	Diver inspection outer ring column #16
12:25:00	Diver inspection outer ring column #1
12:27:35	Diver inspection outer ring column #2
12:30:30	Diver inspection outer ring column #3
12:33:30	Diver inspection outer ring column #4
12:36:45	Diver inspection outer ring column #5
12:40:50	Diver inspection outer ring column #6
12:44:20	Diver inspection outer ring column #7
12:53:12	Diver inspection outer ring column #9
12:56:15	Diver inspection outer ring column #10
12:59:40	Diver inspection outer ring column #11
13:16:20	Floor outlet east of ladder (Connection in northwest quadrant)
13:18:00	2-foot-wide area of cracking paint 10-feet left of the ladder
13:19:27	Diver takes photo of outlet on floor in northeast quadrant
13:26:09	Inlet on wall (assumed to be southernmost inlet)
13:36:30	Spare on east wall
13:39:05	Manhole in southeast quadrant
13:41:16	Outlet in southeast quadrant
13:43:00	Inlet in southeast quadrant
13:43:50	Southernmost inlet with slight flow

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Image 1 – Minor pitting on ladder coating

Image 2 – Rust flakes at the base of the ladder

Image 3 – Weir box/overflow

Image 4 – Weir box/overflow floor connection

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Image 5 – Floor outlet immediately east of ladder

Image 6 – 2-foot-wide area of cracking paint 10-feet left of the ladder (typical)

Image 7 – Coating cracking in vertical stripe pattern above first horizontal seam

Image 8 – Outlet on floor in northeast quadrant

Image 9 – Rust pile on floor at wall in northeast quadrant

Image 10 – Inlet on wall (assumed to be southernmost inlet)

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Image 11 – Spare on east wall

Image 12 – Spare on east wall

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Image 13 – Manhole in southeast quadrant

Image 14 – Outlet in southeast quadrant

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Image 15 – Outlet in southeast quadrant (interior)

Image 16 – Inlet in southeast quadrant

Image 17 – Inlet in southeast quadrant (interior)

Image 18 – Southernmost inlet with minor flow

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Image 19 – Southernmost inlet with minor flow (interior)

Image 20 – Typical blistering at the base of a column

Image 21 – Multiple popped blisters at the base of a column

Image 22 – Exposed steel beneath a popped column coating blister

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Appendix C

Phase I Geologic/Geotechnical Assessment

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Technical Memorandum

Prepared for: Don Barraza, PE / Kennedy/Jenks Consultants

Prepared by: Todd Crampton, CEG and Elliott Ticen, GE / GEI Consultants, Inc.

Reviewed by: Annmarie Behan, PE, GE / GEI Consultants, Inc.

Date: April 6, 2021

Subject: **Phase 1 Geologic/Geotechnical Assessment, Smith Saddle Tanks Rehabilitation Project**

1.0 Introduction

This Technical Memorandum (TM) describes a Phase 1 geologic/geotechnical assessment for the Smith Saddle Tanks Rehabilitation Project (Project). This assessment was performed by GEI Consultants, Inc. (GEI) for Kennedy/Jenks Consultants, Inc. (KJ), who are contracted directly with Marin Municipal Water District (MMWD) to provide engineering services for the Project. Based on information provided by KJ, the Project involves a comprehensive structural and seismic evaluation of two 5-million-gallon steel water transmission tanks in the hills above the town of Fairfax in Marin County. As part of the Project, KJ is evaluating repair or replacement design alternatives to provide another 100 years of service life for the tanks.

The purpose of this Phase 1 Geologic/Geotechnical Assessment is to assess potential geologic hazards present at the site and provide seismic design criteria to aid KJ's seismic evaluation. This TM does not provide design criteria suitable for retrofit of existing tanks or construction of new tanks.

The scope of GEI's Phase 1 geologic/geotechnical assessment included:

- Reviewing readily available published and unpublished information relevant to the geologic/geotechnical conditions at the site;
- Performing a site reconnaissance and limited geologic mapping;
- Performing a screening-level assessment of potential geologic and seismic hazards, including strong ground shaking, surface fault rupture, landsliding, and liquefaction;
- Developing estimated seismic design criteria consistent with the CBC (2019) and ASCE 7-16, and;
- Preparation of this Phase 1 TM.

The work described herein was authorized under the Subcontractor Agreement between GEI and KJ dated February 19, 2021.

2.0 Site Description

The Smith Saddle tanks are on Smith Ridge in the Northern California Coast Ranges of Marin County, roughly at an elevation of about 500 feet. Smith Ridge is a west-northwest-trending ridge between Fairfax

Creek (and Sir Francis Drake Boulevard) on the south and Sleepy Hollow on the north (Figure 1). The tanks are accessed from the south via a gated, gravel access road at the north end of Glen Drive (i.e., the Glen Drive fire road). The tanks are surrounded by a perimeter chainlink fence to prevent public access. Topographic information provided by MMWD indicates the ground surface directly around and adjacent to the tanks ranges from about elevation 486 to 488 feet.

The tanks are situated side-by-side in a northeast-southwest alignment. Based on field observations and available construction drawings (Drawing Nos. 2841, 2843, and 2875) dated April 1960, the tanks were constructed on a cut surface excavated into the top of the ridge. The cut slopes for the tank pad are inclined at about 1:1 (horizontal to vertical) and on the order of about 75 feet high, generally decreasing in height from northeast to southwest. The construction drawings indicate a 6-inch-thick asphalt ring was placed around the perimeter of the tanks, extending 18 inches inward (beneath) and outward of the tank shell (wall). The drawings also indicate a 6-inch-thick layer of "oiled sand" was placed within the asphalt ring beneath the tanks. It should be noted that a previous environmental assessment by Kleinfelder (2000) indicates the site surface soils around the tanks are impacted by petroleum products.

3.0 Geologic and Seismic Setting

Geologic mapping published by the United States Geological Survey (USGS; Blake and others, 2000) indicates the bedrock geology of the Project area consists of rocks of the Jurassic- to Cretaceous-age Franciscan Complex (Figure 2). The Franciscan Complex represents the vestiges of an ancient subduction zone and typically comprises a mélange that consists of a chaotic mixture of resistant rock "blocks" of varying lithologies and dimensions that are encased in a sheared, soil-like, rock matrix. The published mapping by Blake and others (2000) indicates the tank site is primarily underlain by sandstone, with mélange mapped along the southwest margin of the site. In the Project area the mélange unit includes large blocks of greenstone and chert.

The tank site is in an area of relatively high seismicity that is associated with the San Andreas fault system. The California Geological Survey (CGS) maps numerous active[1] and potentially-active strike-slip faults in the region (Figure 3). The major active faults at the approximate latitude of the tank site include (from west to east) the San Andreas fault (proper), the Hayward fault, and the Concord fault. The dominant seismic source in the region is the San Andreas fault, located about 7½ miles southwest of the site. The San Andreas fault has been the source of several large-magnitude historical earthquakes, including the Great (M 7.8) 1906 San Francisco earthquake that ruptured the ground surface for over 290 miles and caused severe damage to structures around the greater Bay Area. Observed ground displacements in Marin County associated with the Great 1906 earthquake were as much as about 19½ feet (Lawson, 1908).

4.0 Site Geology and Field Observations

GEI performed a site reconnaissance on March 11, 2021. The reconnaissance involved walking around the perimeter of the tanks, including sections of the adjacent access roads, to observe the general geologic conditions. Key observations are described below and selected photographs from the site reconnaissance are included as an attachment to this TM.

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[1] The State of California defines an *active* fault as one that has experienced movement within the past 11,000 years and a *potentially-active* fault as one that has experienced movement within the past 1.6 million years.

The cut slopes bordering the northwest and east-southeast sides of the tanks provide near continuous exposures of sandstone (graywacke) bedrock of the Franciscan Complex. The sandstone generally is moderately to slightly weathered, closely fractured, and hard. The cut slopes exhibit minor raveling and very small (less than about 12 inches in dimension) block failures in places, with much of the debris from past failures accumulating against the base of the perimeter chainlink fencing on the northern side of the site. No evidence of a large or significant block failure that could potentially damage one of the tanks was observed and the aforementioned fencing appears to be intact and relatively undamaged.

Several outcrops of greenstone (basalt) are exposed on the south and west sides of the tank site, beyond the cut slopes. These outcrops commonly form prominent “knockers” of hard rock that protrude above the surrounding ground surface and form scraggly-looking spires of rock. The greenstone is also moderately to slightly weathered and typically hard.

At the southwest end of the site, a fill was constructed at the head of a steep, west-flowing drainage directly adjacent to the tank pad. A small cinderblock building (valve house?) is situated on the fill pad. The fill is not shown on the original construction drawings and it also is not documented in the previous soils investigation by Kleinfelder (2000). Thus, the fill may have been constructed sometime after 2000. At the west end of the fill pad, two drain pipes (8” CMP and 15” CMP) daylight from the fill and discharge onto the fill slope and into the natural drainage below. The available construction drawings indicate the drain pipes tie into two catch basins (drop inlets) situated between the two tanks. Other site fills were placed along the southeast side of the tanks, as shown on the available construction drawings.

The south-facing slopes above the northwest end of the tank site exhibit minor slumping and/or creep of colluvial soils. The colluvial soils likely are relatively thin (less than about 10 feet thick), based on nearby outcrops of bedrock. The hummocky appearance of the colluvium may be in part due to runoff from the adjacent fire road directly above the slope, which includes several shallow ditches (waterbars) that divert water on to this slope. None of the minor slumps observed are directed toward the tanks.

5.0 Potential Geologic and Seismic Hazards

The potential geologic and seismic hazards assessed for the Project include strong ground shaking, surface fault rupture, landsliding, and liquefaction. These hazards were assessed using readily available maps and information published by the USGS and the CGS. Our screening-level assessments of these potential hazards are described below.

5.1 Strong Ground Shaking

Of the potential hazards listed above, strong ground shaking likely is the most significant. As previously noted, the nearby San Andreas fault has been the source of several damaging, large-magnitude historical earthquakes. A future earthquake on the San Andreas fault or another Bay Area fault is a near certainty during the lifetime of the Project. Therefore, the potential for strong seismic shaking that could impact the site is considered high. Evaluations of the tanks should be performed considering the seismic parameters presented in Section 6.

5.2 Surface Fault Rupture

Based on review of fault activity maps published by the CGS (Jennings and Bryant, 2010) and the USGS (online Quaternary fault database), the tank site is not located on or near a known active or potentially-active fault. Consequently, the potential surface fault rupture hazard at the site is judged to be very low.

5.3 Landsliding

Landslide mapping of the Project area published by the CGS (Smith et al., 1976) is shown in Figure 4. From this figure it is evident that numerous landslides have been mapped in the Project area; however, the tank site itself is not within a mapped landslide. This is supported by our field observations that indicate the tanks are situated on a cut excavated into bedrock. There are minor slumps and colluvial soils on the slopes adjacent to the tanks, but in our judgement these features do not present a long-term hazard to the tanks. Based on this information, the potential landslide hazard at the site is judged to be very low.

5.4 Liquefaction

The published geologic mapping and our field observations indicate the tanks are founded on bedrock. Liquefaction susceptibility mapping published by the USGS (Witter et al., 2006; Knudsen et al., 2000) indicates the tank site is within an area of "very low" liquefaction susceptibility (Figure 5). Based on this information, the potential liquefaction hazard at the site is judged to be negligible.

6.0 Seismic Design Criteria

Seismic design parameters were developed following the procedures of the 2019 California Building Code (CBC) (CBSC, 2019) and ASCE 7-16 (ASCE, 2016). The recommend site classification and seismic parameters for evaluating the existing steel tanks is presented below.

6.1 Site Classification

Based on review of available tank as-built information, publicly available geologic mapping and our field observations, the tanks are founded on sandstone (graywacke) bedrock of the Franciscan Complex. Site specific velocity measurements are not available; however, based on published shear wave velocity values for various geologic formations in California (Wills and Clahan, 2006) and our experience on other projects situated in similar Franciscan Complex bedrock materials, it is our opinion that a Site Class B classification (Rock) is appropriate for characterizing potential earthquake ground shaking and developing seismic design parameters.

6.2 Seismic Parameters

Code-based spectral acceleration parameters were developed following the procedures of the 2019 CBC (Chapter 16, Section 1613) and ASCE 7-16 (Chapter 11). The recommended values of S_S, S_1, F_a, and F_v are listed below. The values of S_S and S_1 for the site were obtained from the USGS national seismic hazard mapping website based on ASCE 7-16 as required by the 2019 CBC. The site location is taken as 38.010662°N and 122.602498°W. The values of F_a and F_v are provided for Site Class B as discussed in Section 6.1.

Parameter	Values	Description
S_S	1.5 g	Mapped MCE_R spectral acceleration value (0.2 s)
S_1	0.6 g	Mapped MCE_R spectral acceleration value (1.0 s)
F_a	1.0	Site amplification factor (0.2 s)
F_v	1.0	Site amplification factor (1.0 s)
$S_{MS} = S_S * F_a$	1.5 g	Site-modified spectral acceleration value (0.2 s)
$S_{M1} = S_1 * F_v$	0.6 g	Site-modified spectral acceleration value (1.0 s)
$S_{DS} = ⅔ * S_{MS}$	1.0 g	Design spectral acceleration value (0.2 s)
$S_{D1} = ⅔ * S_{M1}$	0.4 g	Design spectral acceleration value (1.0 s)
T_L	12 sec	Long-period transition period
PGA	0.585 g	Mapped MCE_G peak ground acceleration
F_{PGA}	1.0	Site amplification factor at PGA
PGA_M	0.585 g	Site-modified MCE_G peak ground acceleration

7.0 Limitations

The conclusions and screening-level geologic hazard assessments made in this TM are based solely on a review of readily available published maps and information and a site reconnaissance. No subsurface explorations or geophysical investigations were performed for this Phase 1 geologic/geotechnical assessment. In the performance of our professional services, GEI, its employees, and its agent comply with the standards of care and skill ordinarily exercised by members of our profession practicing in the same or similar localities. This TM is intended for use only by KJ and MMWD and is not intended to provide all of the subsurface information needed to construct the Project. No warranty, either express or implied, is made or intended in connection with the work performed by GEI, or by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings. GEI is responsible for the conclusions contained in this TM, which are based on data related only to the specific project and locations discussed herein. In the event conclusions or recommendations based on these data are made by others, such conclusions and recommendations are not GEI's responsibility unless we have been given an opportunity to review and concur with such conclusions or recommendations in writing.

8.0 References

American Society of Civil Engineers (ASCE), 2016, Minimum Design Loads for Buildings and Other Structures ASCE/SEI 7-16, Reston, Virginia.

Blake et al., 2000, Geologic map and map database of parts of Marin, San Francisco, Alameda, Contra Costa, and Sonoma Counties, California: U.S. Geological Survey Miscellaneous Field Studies MF 2337, Online Version 1.0, scale 1:75,000.

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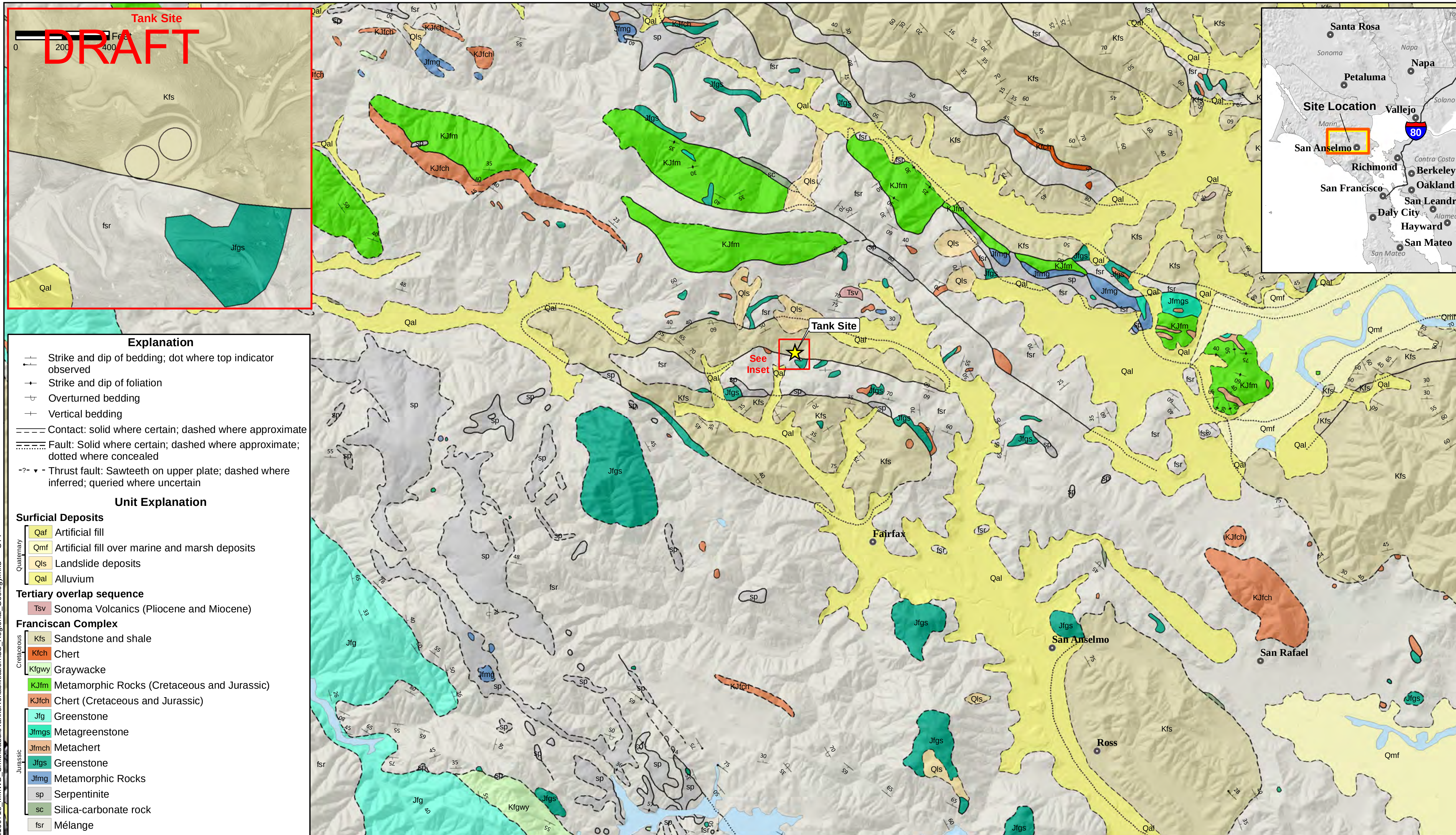
Figures

Smith Saddle Tanks Rehabilitiation Project Marin County, California	GEI Consultants	SITE LOCATION
Marin Municipal Water District		April 2021 DRAFT Figure 1

05-Apr-2021 Z:\Projects\2100718_MMWD_SmithSaddleTanksRehabilitiation\SS_Location.mxd STY



Explanation

- Strike and dip of bedding; dot where top indicator observed
- Strike and dip of foliation
- Overturned bedding
- Vertical bedding
- Contact: solid where certain; dashed where approximate
- Fault: Solid where certain; dashed where approximate; dotted where concealed
- -?- ▾ - Thrust fault: Sawteeth on upper plate; dashed where inferred; queried where uncertain

Unit Explanation

Surficial Deposits

Quaternary
- Qaf Artificial fill
- Qmf Artificial fill over marine and marsh deposits
- Qls Landslide deposits
- Qal Alluvium

Tertiary overlap sequence
- Tsv Sonoma Volcanics (Pliocene and Miocene)

Franciscan Complex

Cretaceous
- Kfs Sandstone and shale
- Kfch Chert
- Kfgwy Graywacke
- KJfm Metamorphic Rocks (Cretaceous and Jurassic)
- KJfch Chert (Cretaceous and Jurassic)

Jurassic
- Jfg Greenstone
- Jfmgs Metagreenstone
- Jfmch Metachert
- Jfgs Greenstone
- Jfmg Metamorphic Rocks
- sp Serpentinite
- sc Silica-carbonate rock
- fsr Mélange

0 4,000 8,000 Feet

SOURCE: Blake et al., 2000

30-Mar-2021 Z:\Projects\2100718_MMWD_SmithSaddleTanksRehabilitation\SS_Regional_Geology.mxd STY

Smith Saddle Tanks Rehabilitation Project
Marin County, California

Marin Municipal Water District

GEI Consultants

REGIONAL GEOLOGY

April 2021 DRAFT Figure 2

0 250 500 1,000

Feet

Smith Saddle Tanks Rehabilitation Project
Marin County, California

Marin Municipal Water District

GEI Consultants

HISTORICAL LANDSLIDE AREAS

April 2021 **DRAFT** Figure 3

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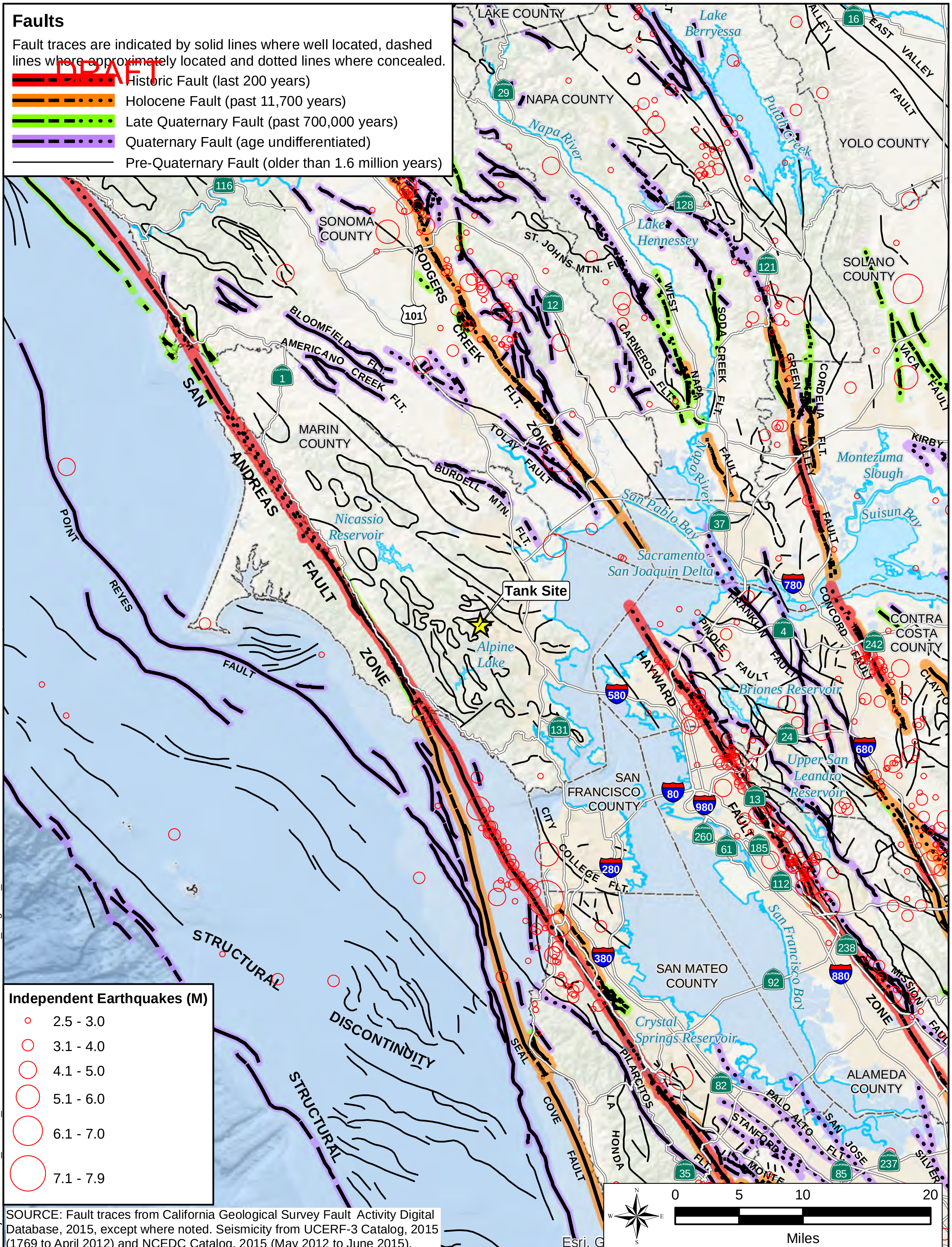

SOURCE: Fault traces from California Geological Survey Fault Activity Digital Database, 2015, except where noted. Seismicity from UCERF-3 Catalog, 2015 (1769 to April 2012) and NCEDC Catalog, 2015 (May 2012 to June 2015).

Smith Saddle Tanks Rehabilitation Project Marin County, California	GEI Consultants	REGIONAL FAULTS AND HISTORICAL SEISMICITY
Marin Municipal Water District		April 2021 DRAFT Figure 4

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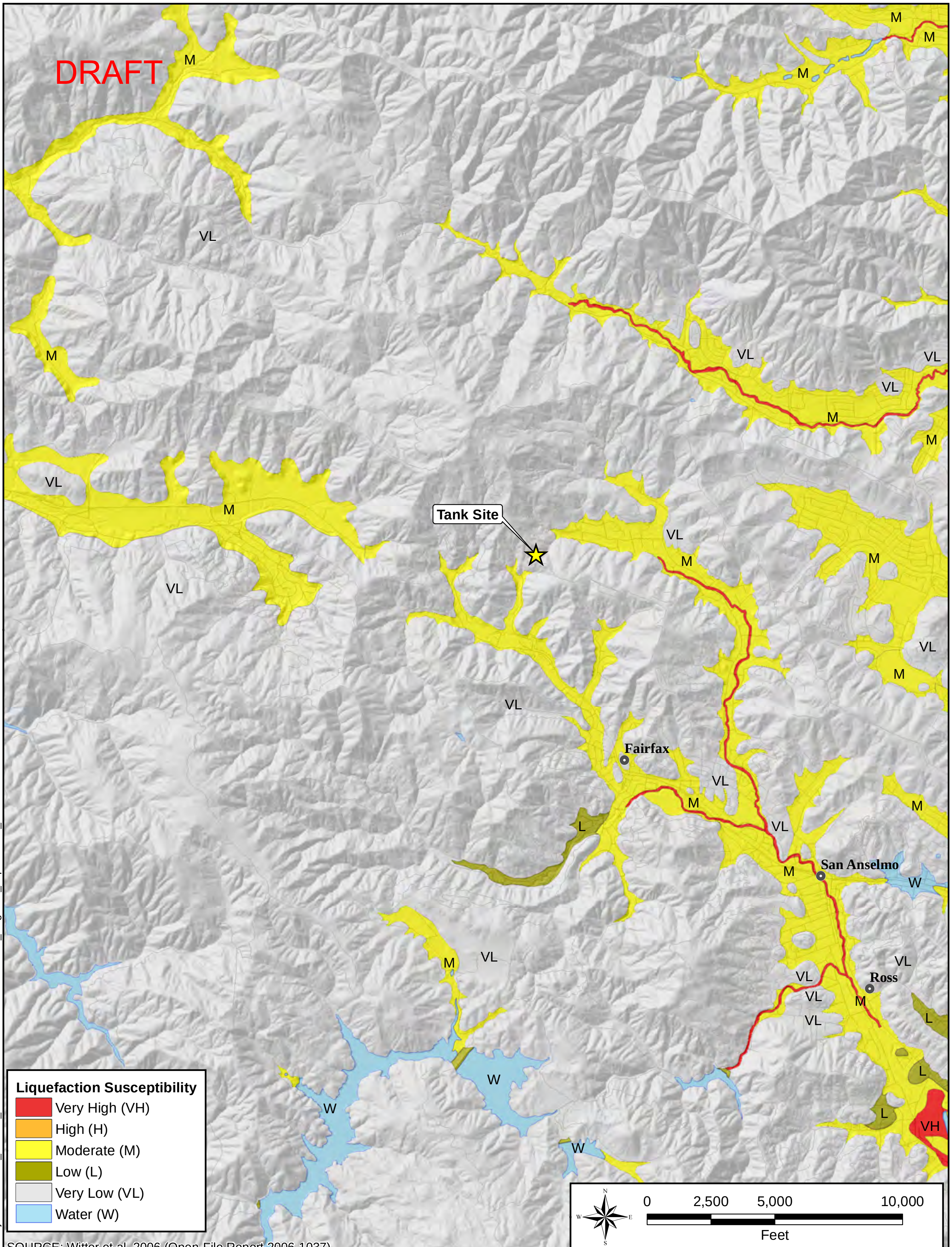

SOURCE: Witter et al. 2006 (Open-File Report 2006-1037)

Smith Saddle Tanks Rehabilitation Project Marin County, California	GEI Consultants	LIQUEFACTION SUSCEPTIBILTY
Marin Municipal Water District		April 2021 DRAFT Figure 5

06-Apr-2021 Z:\Projects\2100718_MMWD_SmithSaddleTanksRehabilitation\SS_Regional_Liquefaction_v2.mxd STY

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Field Photographs

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GEI Consultants


Cut slope exposing sandstone bedrock on northwest side of tanks. Photo by GEI.


Cut slope exposing sandstone bedrock on east side of tanks. Photo by GEI.

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Close up of sandstone bedrock exposed in cut slope. Note minor shale bed. Photo by GEI.

Cut slope and access road exposing sandstone bedrock. Photo by GEI.

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Overview of tank site from access road above. View to southeast. Photo by GEI.


West end of tank site from access road above. Note small building on fill pad. Photo by GEI.

Fill slope on southeast side of tanks. Photo by GEI.

Perimeter fencing along northwest side of tanks. Note rock debris piled against base of fence. Photo by GEI.

Drain pipes emanating from fill slope at west end of site. Note water draining from lower pipe. Photo by GEI.

Outcrop of greenstone near west end of site. View to northeast. Photo by GEI.

Appendix D

Structural Calculations

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- Sloshing / Freeboard in Accordance w/ ASCE 7-16, Section 15.7.6.1.2

- $\delta_s = 0.42\, D_i\, I_e\, S_{ac}$ Eq. 15.7-13

D_i = 150'-6" inside diameter tank, feet
I_e = 1.0 Importance Factor, Risk Category IV (freeboard only)
H = 38'-6" liquid height, feet

$$T_c = 2\pi \sqrt{\frac{D}{3.68\, g \tanh\left(\frac{3.68 H}{D}\right)}} = 2\pi \sqrt{\frac{150'\text{-}6''}{3.68 \times 32.17 \times \tanh\left(\frac{3.68 \times 38'\text{-}6''}{150'\text{-}6''}\right)}}$$

T_c = 8.2580 seconds
T_L = 12 seconds

For $T_c < T_L$ $S_{ac} = \frac{1.5 S_{D1}}{T_c} \leq S_{DS}$ = 1.00 depending on Site Class B

S_{DS} = 1.00 depending on Site Class assignment by GEI.
S_{D1} = 0.40 " " " " " " "

$\delta_s \leq 0.42 \times 150'\text{-}6'' \times 1.0 \times 0.0727 = 4.59$
$0.42 \times 150'\text{-}6'' \times 1.0 \times$ =

however
if $S_{D1} = 0.32 \rightarrow S_{ac} = 1.5 \times 0.32 / 8.2580 = 0.0581 \therefore \delta_s = 0.42 \times 150.5 \times 0.0581 = 3.674$
$S_{D1} = 0.56 \rightarrow S_{ac} = 1.5 \times 0.56 / 8.2580 = 0.1017 \therefore \delta_s = 0.42 \times 150.5 \times 0.1017 = 6.429$
$S_{D1} = 0.40 \rightarrow S_{ac} = 1.5 \times 0.40 / 8.2580 = 0.0727 \therefore \delta_s = 0.42 \times 150.5 \times 0.0727 = \underline{4.592}$

- Sloshing/Freeboard in Accordance w/ AWWA D100-11 Section 13.5.4.4
$d = 0.5\, D\, A_f$
When $T_c < T_L$
$A_f = \frac{K S_{D1}}{T_c} = \frac{1.5 \times 0.32}{8.2580} = 0.0581 \therefore d = 0.5 \times 150'\text{-}6'' \times 0.0581 = 4.3739$ ft.

$A_f = \frac{1.5 \times 0.56}{8.2580} = 0.1017 \therefore d = 0.5 \times 150'\text{-}6'' \times 0.1017 = 7.6544$ ft.

$= \frac{1.5 \times 0.40}{8.2580} = 0.0727 \therefore d = 0.5 \times 150'\text{-}6'' \times 0.0727 = \underline{5.4674 \text{ ft}}$

By D. Barraza Date 2-24-21 Job # 2168002*00

Checked by Date Project MMWD Smith Saddle Tanks

Subject Smith Saddle Tanks - Sloshing/Freeboard AWWA D110-13 & ACI 350.3 Sheet 2 of

– Sloshing/Freeboard in Accordance w/ AWWA D110-13 & ACI 350.3

– AWWA D110-13 $d = 0.42\, C_c D$ AWWA D110 Eq. 4-50

For T_c = 8.258 seconds ≥ 4.5 seconds = 1.6/Ts

$T_s = S_{D1}/S_{DS} =$

Site Class	S_{DS}	S_{D1}	Af S_{ac}	T_s	$1.6/T_s$	C_c	d
A	0.8	0.32	0.0581	0.40	4.0	0.0282	1.7797 ft
B	0.9	0.32	0.0581	0.3556	4.5	0.0317	2.0021 ft
B Estimated	1.0	0.40	0.0727	0.40	4.0	0.0352	2.2246 ft
C	1.2	0.56	0.1017	0.4667	3.4286	0.0422	2.6695 ft

$$C_c = \frac{2.4\, S_{DS}}{T_c^2}$$

– ACI 350.3-06, Section 7.1 - Wave Oscillation, Equation 7-2

$$d_{max} = \frac{D}{2} C_c I = \frac{150'\text{-}6''}{2} \times C_c \times 1.5 =$$

Site Class	d_{max}
A	3.1831 ft
B	3.5781 ft
B Estimated	3.9732 ft
C	4.7633 ft

- Marin Municipal Water District - Smith Saddle Tanks - Fairfax, CA
- Nominal Capacity = 5,000,000 gallons (684,894 cu. ft.; 5,123,366 gal)
- Mean Diameter = 150'-6" Mean Radius = 75'-3"
- Bottom Shell = EL. 484.00
- Maximum Water Surface = EL. 522.50
- Maximum Water Depth at Shell Wall = 38'-6"
- Total Capacity = 684,894 ; 5,123,366 gal
- Operational Capacity = 667,104 ; 4,990,291 gal

- Reference Standards
- 2019 California Building Code, California Code of Regulations Title 24, Part 2, Vol. 1 of 2, Based on 2018 IBC
- AWWA D100-11, American Water Works Association, Welded Carbon Steel Tanks for Water Storage
- ACI 318-14 Building Code Requirements for Structural Concrete
- AISC 360-16 Specification for Structural Steel Buildings
- AISC 341-16 Seismic Provisions for Structural Steel Buildings
- API 650 Welded Steel Tanks for Oil Storage, 11th Edition
- ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures, with Supplement No. 1
- OSHA Occupational Safety and Health Standards, 29 CFR, Part 1910
- CDHP, R-14-03, Water Works Standards, Title 22, Chapter 16 Article 6, Section 64585

- Reservoir (Tank) Site Coordinates

Latitude = 38.010662 N

Longitude = -122.602498 W

4x4 Grid Sheet **Kennedy/Jenks Consultants**

By D. Barraza Date 3.3.21 Job # 2168002*00

Checked by Date Project MMWD Smith Saddle Tanks Rehab

Subject Roof Framing - Structural Evaluation Sheet 2 of

– Roof Dead Loads – Roof Framing

– Roof Plate = $150'\text{-}6''^2 \times \pi / 4 \times 3/16 \times 1/12 \times 490 = 136{,}200^{\#}$ 68.1 tons

– Roof Framing

Central Rafter	– 9.8 #/ft x 15'-0" x 8 =	7" Channel	1,176 #
	9.8 #/ft x 17'-9" x 8 =	"	1,392 #
Inner Rafter	– 9.8 #/ft x 23'-3" x 40 =	"	9,114 #
Interm. Rafter	– 9.8 #/ft x 22'-6" x 64 =	"	14,112 #
Outer Rafter	– 9.8 #/ft x 19'-7 5/8" x 80 =	"	15,394 #
Inner Girder	– 42.7 #/ft x 30'-2" x 4 =	18" Channel	5,152 #
Middle Girder	– 42.7 #/ft x 28'-9" x 8 =	"	9,821 #
Outer Girder	– 33.9 #/ft x 22'-1" x 16 =	15" Channel	11,978 #
			68,139 #

By D. Barraza Date 3.8.21 Job # 2168002*00
Checked by Date Project MMWD Smith Saddle Tanks Rehab
Subject Roof Framing – Structural Evaluation – Roof Plate Sheet 3 of

- Maximum Rafter Spacing per AWWA Section 3.6.1.7

$$L = \frac{2575\,t}{\sqrt{W_{D+L}}} \leq 84'' \;(7'\text{-}0'')$$

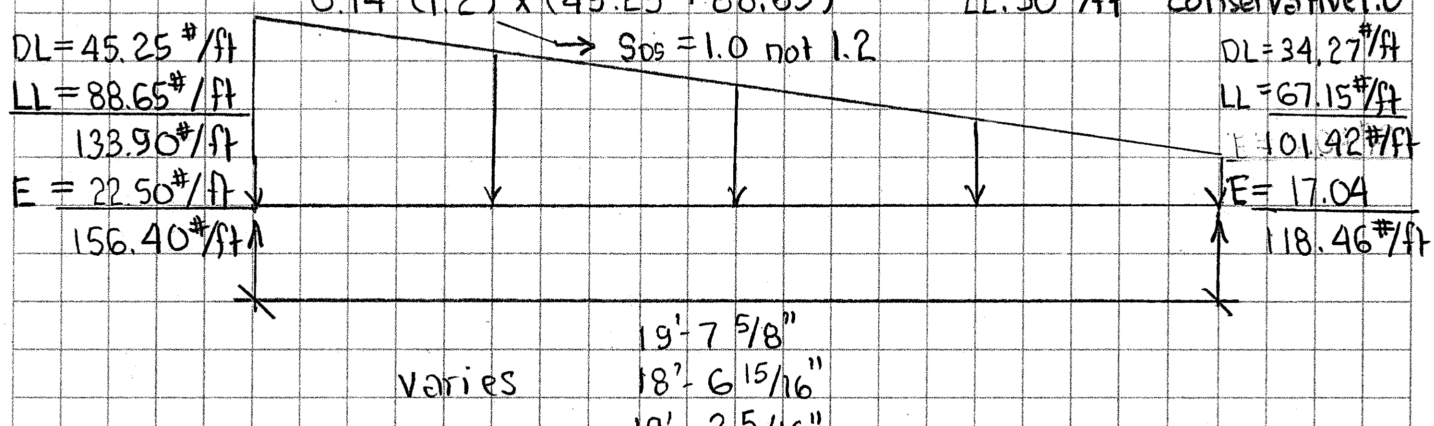
W_L = 15 psf per Sec. 3.1.3.2
W_D = 7.65625 for 3/16" roof plate per Sec. 3.10.2

L = 101.43 in (8'-5 13/32") based on 3/16" roof plate
L = 128.21 in (10'-8 3/16") based on 1/4" roof plate
L = 71.78 in (5'-11 25/32") based on 1/8" roof plate
L = 87.01 in (7'-3") based on 5/32" roof plate

Central Rafter	– Radius = 16'-3",	L = 2 x π x 16'-3"/16 = 6'-4.57"
	– Radius = 19'-0",	L = 2 x π x 19'-0"/16 = 7'-5.53"
Inner Rafter	Radius = 21'-6",	L = 2 x π x 21'-6"/40 = 3'-4.52"
	= 37'-9"	L = 2 x π x 37'-9"/40 = 5'-11.15"
Intermediate Rafter	Radius = 37'-9",	L = 2 x π x 37'-9"/64 = 3'-8.47"
	– Radius = 57'-0"	L = 2 x π x 57'-0"/64 = 5'-7.15"
Outer Rafter	– Radius = 57'-0",	L = 2 x π x 57'-0"/80 = 4'-5.72"
	– Radius = 75'-3",	L = 2 x π x 75'-3"/80 = 5'-10.92"

– Outer Rafter - Loading Diagram – Quan = 80 ; 7" C 9.8# x 19'-7 5/8"; A-7
Span = 18'-6 15/16" to 19'-3 5/16"

Self Weight = 9.8#/l.ft
Dead Load = 7.65 x π x 2 x 57'-0" x 1/80 = 34.27#/ft
Live Load = 7.65 x π x 2 x 75'-3" x 1/80 = 45.25#/ft
Live Load = 15.00 x π x 2 x 57'-0" x 1/80 = 67.15#/ft
15.00 x π x 2 x 75'-3" x 1/80 = 88.65#/ft
Earthquake = 0.14 (1.2) x (34.27 + 67.15) = 17.04#/ft conservative 1.0
0.14 (1.2) x (45.25 + 88.65) = 22.50#/ft conservative 1.0
→ S_{DS} = 1.0 not 1.2



	Self	Self + D	Self + D + L	S + D + L + E
R left (outer)	96.21#	504.52#	1,304.50#	1,507.53#
R right (inner)	96.21#	468.59#	1,198.20#	1,383.36#
Mmax (center)	472.29 ft.#	2,395 ft.#	6,163 ft.#	7,119.26 ft.lbs

Rleft(outer) self = 9.8#/ft x 19'-7 5/8" /2 = 96.21#
Rright(inner) self = 96.21#
Mmax(center) self = 9.8#/ft x 19'-7 5/8"^{2} /8 = 472.29 ft.lbs
Rleft(outer) S+D = 96.21# + 34.27 x 19'-7 5/8 /2 + (45.25 - 34.27) x 19'-7 5/8" x 1/2 x 2/3 = 504.52#
Rright(inner) S+D = 96.21# + 34.27 x 19'-7 5/8 /2 + (45.25 - 34.27) x 19'-7 5/8" x 1/2 x 1/3 = 468.59#
Mmax(center) S+D = 472.29 + 34.27 x 19'-7 5/8^2 /8 + 2 x (45.25 - 34.27) x 19'-7 5/8" x 1/2 x 19'-7 5/8 / 9√3 = 2,3
Rleft(outer) S+D+L = 504.52# + 67.15 x 19'-7 5/8 /2 + (88.65 - 67.15) x 19'-7 5/8 x 1/2 x 2/3 = 1,304.50#
Rright(inner) S+D+L = 468.59# + 67.15 x 19'-7 5/8 /2 + (88.65 - 67.15) x 19'-7 5/8 x 1/2 x 1/3 = 1,198.20#
Mmax(center) S+D+L = 2,395 + 67.15 x 19'-7 5/8^2 /8 + 2 x (88.65 - 67.15) x 19'-7 5/8" x 1/2 x 19'-7 5/8" / 9√3 = 6163#.f
Rleft(outer) S+D+L+E = 1,304.50 + 17.04 x 19'-7 5/8 /2 + (22.5 - 17.04) x 19'-7 5/8 x 1/2 x 2/3 = 1,507.53#
Rright(inner) S+D+L+E = 1,198.20 + 17.04 x 19'-7 5/8 /2 + (22.5 - 17.04) x 19'-7 5/8 x 1/2 x 1/3 = 1,383.36#
Mmax(center) S+D+L+E = 6,163 + 17.04 x 19'-7 5/8^2 /8 + 2 (22.5 - 17.04) x 19'-7 5/8 x 1/2 x 19'-7 5/8 / 9√3 = 7,119 ft.#

– Intermediate Radial Rafters – Loading Diagram – Quan = 64; 7" C 9.8# x 22'-6"; A-7

Span = 20'-0 1/4" to 22'-1 11/16"

Self Weight = 9.8#/ft

Dead Load = 7.65 x π x 2 x 37'-9" x 1/64 = 28.35#/ft

7.65 x π x 2 x 57'-0" x 1/64 = 42.81#/ft

Live Load = 15.00 x π x 2 x 37'-9" x 1/64 = 55.59#/ft

15.00 x π x 2 x 57'-0" x 1/64 = 83.94#/ft

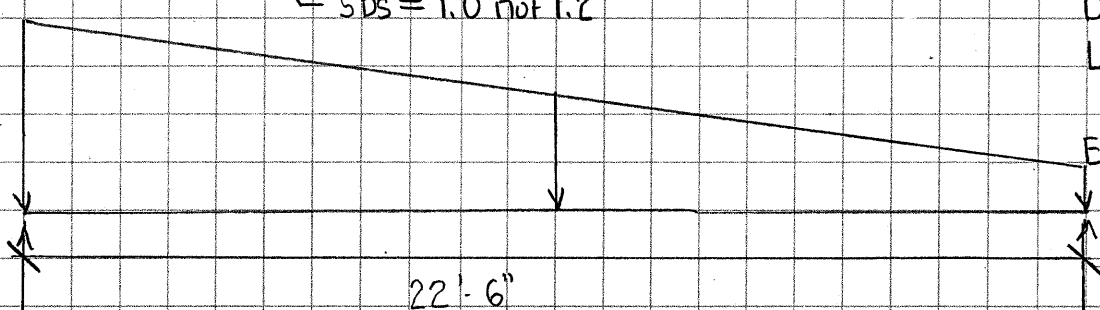
Earthquake = 0.14 (1.2) x (28.35 + 55.59) = 14.10#/ft   1.0 conservative

0.14 (1.2) x (42.81 + 83.94) = 21.29#/ft   1.0 conservative

SDS = 1.0 not 1.2

DL = 42.81
LL = 83.94
EL = 21.29

D = 28.35
L = 55.59
E = 14.10



22'-6"
varies 20'-0 1/4" to 22'-1 11/16"

	Self	Self + Dead	Self + Dead + Live	S + D + L + E
Rleft	110.25#	537.64#	1,375.65#	1,582.20#
Rright	110.25#	483.41#	1,215.11#	1,400.69#
Mmax	620.15 ft.#	2,883.77 ft.#	7,322.26 ft.#	8,448.03 ft.#

Rleft(outer)S = 9.8#/ft x 22'-6" / 2 = 110.25#

Rright(inner)S = = 110.25#

Mmax(center)S = 9.8#/ft x 22'-6"² / 8 = 620.15 ft.#

RL (outer) S+D = 110.25 + 28.35 x 22'-6"/2 + (42.81 – 28.35) x 22'-6" x 1/2 x 2/3 = 537.64#

RR (inner) S+D = 110.25 + 28.35 x 22'-6"/2 + (42.81 – 28.35) x 22'-6" x 1/2 x 1/3 = 483.41#

Mm(center) S+D = 620.15 + 28.35 x 22'-6"²/8 + 2 x (42.81 – 28.35) x 22'-6" x 1/2 x 22'-6" / 9√3 = 2,883.77 ft.#

RL (outer) S+D+L = 537.64# + 55.59 x 22'-6"/2 + (83.94 – 55.59) x 22'-6" x 1/2 x 2/3 = 1,375.65#

RR (inner) S+D+L = 483.41# + 55.59 x 22'-6"/2 + (83.94 – 55.59) x 22'-6" x 1/2 x 1/3 = 1,215.11#

Mm(center) S+D+L = 2,883.77 ft.# + 55.59 x 22'-6"²/8 + 2 x (83.94 – 55.59) x 22'-6" x 1/2 x 22'-6" / 9√3 = 7,322.26 ft.#

RL (outer) S+D+L+E = 1,375.65# + 14.10 x 22'-6"/2 + (21.29 – 14.10) x 22'-6" x 1/2 x 2/3 = 1,582.20#

RR (inner) S+D+L+E = 1,215.11# + 14.10 x 22'-6"/2 + (21.29 – 14.10) x 22'-6" x 1/2 x 1/3 = 1,400.69#

Mm(center) S+D+L+E = 7,322.26 ft.# + 14.10 x 22'-6"²/8 + 2 x (21.29 – 14.10) x 22'-6" x 1/2 x 22'-6" / 9√3 = 8,448.03 ft.#

4x4 Grid Sheet **Kennedy/Jenks Consultants**

By D. Barraza Date 3-26-21 Job # 2168002*00
Checked by Date Project MMWD Smith Saddle Tanks Rehab
Subject Roof Framing – Inner Rafter Radial – Structural Evaluation Sheet 6 of

– Inner Radial Rafters – Loading Diagram – Quan = 40, 7" [9.8# x 23'-3", A-7

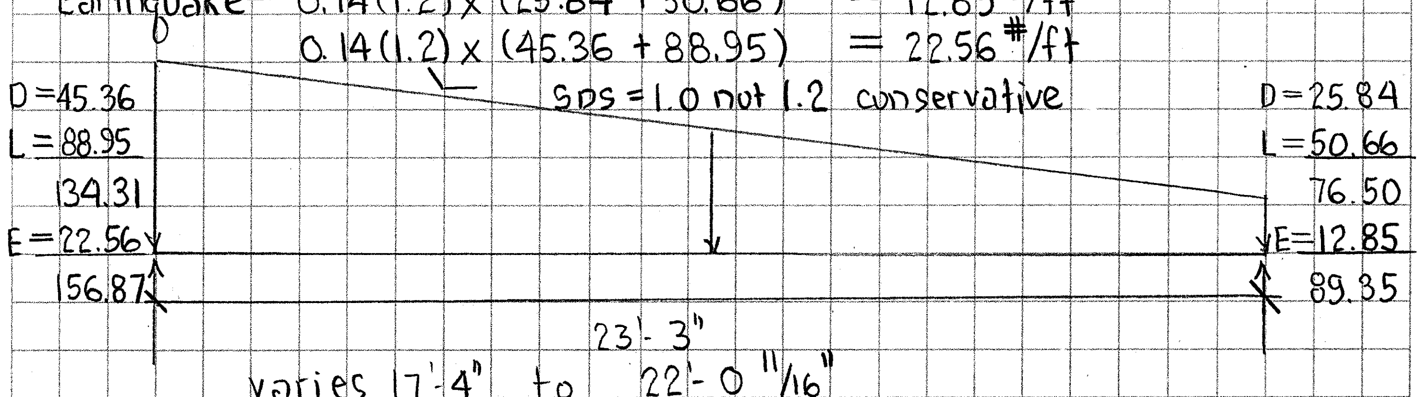
Span = 17'-4" to 22'-0 11/16"

Self Weight = 9.8#/ft

Dead Load = 7.65 x π x 2 x 21'-6" x 1/40 = 25.84#/ft
= 7.65 x π x 2 x 37'-9" x 1/40 = 45.36#/ft

Live Load = 15.00 x π x 2 x 21'-6" x 1/40 = 50.66#/ft
= 15.00 x π x 2 x 37'-9" x 1/40 = 88.95#/ft

Earthquake = 0.14(1.2) x (25.84 + 50.66) = 12.85#/ft
0.14(1.2) x (45.36 + 88.95) = 22.56#/ft



	Self	Self + Dead	Self + Dead + Live	S + D + L + E
Bleft	113.92#	565.59#	1,451.26#	1,675.89#
Bright	113.92#	489.95#	1,227.25#	1,414.25#
Mmax	662.19 ft·#	3,085.10 ft·#	7,836 ft·#	9,041 ft·#

Bleft (outer) S = 9.8 x 23'-3"/2 = 113.92#
Bright (inner) S = 9.8 x 23'-3"/2 = 113.92#
Mmax (center) S = 9.8 x 23'-3"²/8 = 662.19 ft·#
BL (outer) S+D = 113.92 + 25.84 x 23'-3"/2 + (45.36 − 25.84) x 23'-3" · 1/2 · 2/3 = 565.59#
BR (inner) S+D = 113.92 + 25.84 x 23'-3"/2 + (45.36 − 25.84) x 23'-3" · 1/2 · 1/3 = 489.95#
Mm (center) S+D = 662.19 + 25.84 x 23'-3"²/8 + 2 x (45.36 − 25.84) x 23'-3" x 1/2 x 23'-3"/9√3 = 3,085.10

BL (outer) S+D+L = 565.59 + 50.66 x 23'-3"/2 + (88.95 − 50.66) x 23'-3" x 1/2 x 2/3 = 1,451.26#
BR (inner) S+D+L = 489.95 + 50.66 x 23'-3"/2 + (88.95 − 50.66) x 23'-3" x 1/2 x 1/3 = 1,227.25#
Mm (center) S+D+L = 3,085.10 + 50.66 x 23'-3"²/8 + 2 x (88.95 − 50.66) x 23'-3" x 1/2 x 23'-3"/9√3 = 7,836.00 ft·#

BL (outer) S+D+L+E = 1,451.26 + 12.85 x 23'-3"/2 + (22.56 − 12.85) x 23'-3" x 1/2 x 2/3 = 1,675.89#
BR (inner) S+D+L+E = 1,227.25 + 12.85 x 23'-3"/2 + (22.56 − 12.85) x 23'-3" x 1/2 x 1/3 = 1,414.25#
Mm (center) S+D+L+E = 7,836 + 12.85 x 23'-3"²/8 + 2 x (22.56 − 12.85) x 23'-3" x 1/2 x 23'-3"/9√3 = 9,041.00 ft·#

- Center Radial Rafters - Loading Diagram - Quan = 16, 7" [9.8# x 17'-9", A-7

Span = 14'-10 3/4" to 17'-7 3/4"

Self Weight = 9.8 #/ft

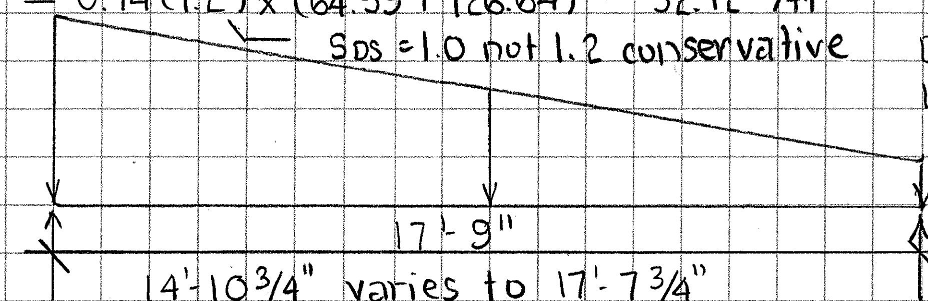
Dead Load = 7.65 x π x 2 x 1'-5" x 1/16 = 4.26 #/ft
7.65 x π x 2 x 21'-6" x 1/16 = 64.59 #/ft

Live Load = 15.00 x π x 2 x 1'-5" x 1/16 = 8.34 #/ft
15.00 x π x 2 x 21'-6" x 1/16 = 126.64 #/ft

Earthquake = 0.14 (1.2) x (4.26 + 8.34) = 2.11 #/ft
= 0.14 (1.2) x (64.59 + 126.64) = 32.12 #/ft

SDS = 1.0 not 1.2 conservative

DL = 64.59
LL = 126.64
191.23
EL = 32.12
223.35



DL = 4.26
LL = 8.34
12.60
EL = 2.11
14.71

	Self	Self + Dead	Self + Dead + Live	S + D + L + E
Rleft	86.98 #	481.74 #	1,255.70 #	1,451.99 #
Bright	86.98 #	303.26 #	727.25 #	834.46 #
Mmax	385.95 ft·#	1,773.06 ft·#	4,492.50 ft·#	5,182.14 ft·#

Rleft (outer) S = 9.8 #/ft x 17'-9" / 2 = 86.98 #
Bright (inner) S = 9.8 #/ft x 17'-9" / 2 = 86.98 #
Mmax (center) S = 9.8 #/ft x 17'-9"² / 8 = 385.95 ft·#

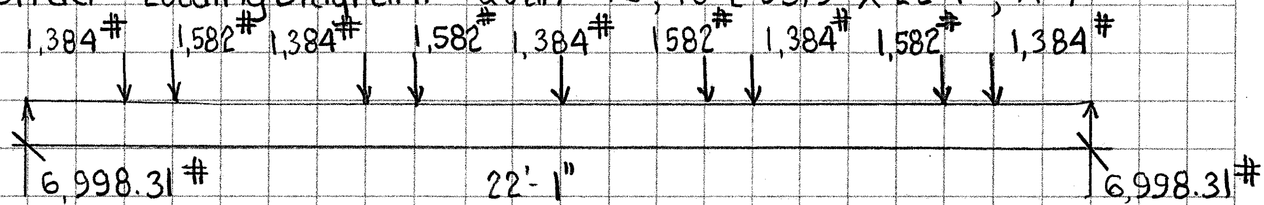
Rleft (outer) S+D = 86.98 + 4.26 x 17'-9"/2 + (64.59 - 4.26) x 17'-9"/2 x 2/3 = 481.74 #
Bright (inner) S+D = 86.98 + 4.26 x 17'-9"/2 + (64.59 - 4.26) x 17'-9"/2 x 1/3 = 303.26 #
Mmax (center) S+D = 385.95 + 4.26 x 17'-9"²/8 + 2(64.59 - 4.26) x 17'-9" x 1/2 x 17'-9"/9√3 = 1,773.06 ft·#

Rleft (outer) S+D+L = 481.74 # + 8.34 x 17'-9"/2 + (126.64 - 8.34) x 17'-9"/2 x 2/3 = 1,255.70 #
Bright (inner) S+D+L = 303.26 # + 8.34 x 17'-9"/2 + (126.64 - 8.34) x 17'-9"/2 x 1/3 = 727.25 #
Mmax (center) S+D+L = 1,773.06 ft·# + 8.34 x 17'-9"²/8 + 2 x (126.64 - 8.34) x 17'-9"/2 x 17'-9"/9√3 = 4,492.50 ft·#

Rleft (outer) S+D+L+E = 1,255.70 + 2.11 x 17'-9"/2 + (32.12 - 2.11) x 17'-9"/2 x 2/3 = 1,451.99 #
Bright (inner) S+D+L+E = 727.25 + 2.11 x 17'-9"/2 + (32.12 - 2.11) x 17'-9"/2 x 1/3 = 834.46 #
Mmax (center) S+D+L+E = 4,492.50 + 2.11 x 17'-9"²/8 + 2 x (32.12 - 2.11) x 17'-9" x 1/2 x 17'-9"/9√3 = 5,182.14 ft·#

By D. Barraza Date 3·26·21 Job # 2168002*00
Checked by Date Project MMWD Smith Saddle Tanks Rehab
Subject Roof Framing – Structural Evaluation – Girders Sheet 8 of

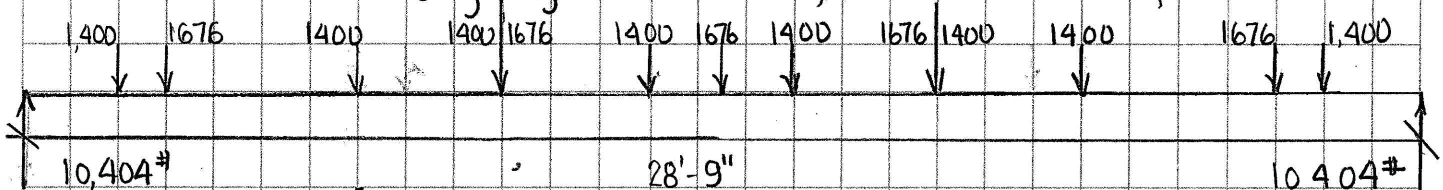
– Outer Girder – Loading Diagram – Quan = 16; 15" [33.9# x 22'-1"; A-7



R = 33.9 x 22'-1" / 2 + [5 x 1,384 + 4 x 1582] / 2 = 6,998.31# S+D+L+E
= 33.9 x 22'-1" / 2 + [5 x 1,198 + 4 x 1376] / 2 = 6,121.31# S+D+L
M = 33.9 x 22'-1"² / 8 + (1,384 x 22'-1") / 4 + 1,384 x 2'-3 3/16" + 1,582 x 2'-9 15/16" + 1,384 x 6'-8 9/16" + 1582 x 8'-4 3/

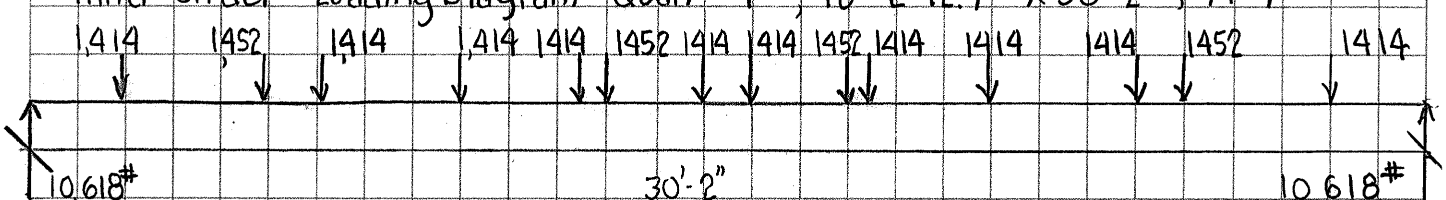
= 39,841.38 ft·lbs S+D+L+E
= 34,838.68 ft·lbs S+D+L

– Middle Girder – Loading Diagram – Quan = 8; 18" [42.7# x 28'-9"; A-7



R = 42.7 x 28'-9" / 2 + [8 x 1400 + 5 x 1676] / 2 = 10,404# S+D+L+E
= 42.7 x 28'-9" / 2 + [8 x 1215 + 5 x 1451] / 2 = 9,101# S+D+L
M = (42.7 x 28'-9"²) / 8 + (1676 x 28'-9") / 4 + 1,400 x 1'-11 9/16" + 1,676 x 3'-1 5/16" + 1,400 x 5'-8 3/8" + 3,076 x 9'-0" + 1400 x 12'-8 1/2"
= 77,871.05 ft·lbs S+D+L+E
= 68,095.84 ft·lbs S+D+L

– Inner Girder – Loading Diagram – Quan = 4; 18" [42.7# x 30'-2"; A-7



R = 42.7 x 30'-2" / 2 + [10 x 1414 + 4 x 1,452] / 2 = 10,618# S+D+L+E
= 42.7 x 30'-2" / 2 + [10 x 1,227 + 4 x 1,256] / 2 = 9,291# S+D+L
M = (42.7 x 30'-2"²) / 8 + 1,414 x 2'-2 1/2" + 1452 x 5'-0 1/4" + 1414 x 5'-10 5/16" + 1,414 x 8'-10 3/8" + 1414 x 11'-6" + 1452 x 12'-1 7/16" + 1414 x 13'-11 1/4"
= 89,656.35 ft·lbs S+D+L+E
= 78,373.63 ft·lbs S+D+L

By D. Barraza Date 3.26.21 Job # 2168002*00
Checked by Date Project MMWD Smith Saddle Tanks Rebab
Subject Roof Framing - Structural Evaluation - Radial Rafters Sheet 9 of

7" [9.8#, A-7, $d = 7$ in, $t_w = 0.21$ in, $S_{x\text{-}x} = 6.08\ in^3$

$A_v = d \cdot t_w = 7\ in \times 0.21\ in = 1.47\ in^2$

$V = 0.40\ F_y \times A_v = 0.40 \times 33{,}000\ psi \times 1.47\ in^2 = 19{,}404\#$

$M = 0.66\ F_y \times S = 0.66 \times 33{,}000\ psi \times 6.08\ in^3 = 132{,}422\# \cdot in = 11{,}035\ ft \cdot lbs$

$= 0.60 \times 33{,}000\ psi \times 6.08\ in^3 = 120{,}384\# \cdot in = 10{,}032\ ft \cdot lbs$

15" [33.9#, A-7, $d = 15$ in, $t_w = 0.400$ in, $S_{x\text{-}x} = 42.0\ in^3$

$A_v = d \cdot t_w = 15\ in \times 0.400\ in = 6.00\ in^2$

$V = 0.40\ F_y \times A_v = 0.40 \times 33{,}000\ psi \times 6.00\ in^2 = 79{,}200\#$

$M = 0.66 F_y \times S = 0.66 \times 33{,}000 \times 42.0\ in^3 = 914{,}760\# \cdot in = 76{,}230\ ft \cdot lbs$

$= 0.60 \times 33{,}000 \times 42.0\ in^3 = 831{,}600\# \cdot in = 69{,}300\ ft \cdot lbs$

18" [42.7#, A-7, $d = 18.0$ in, $t_w = 0.450$ in, $S_{x\text{-}x} = 61.6\ in^3$

$A_v = d \cdot t_w = 18\ in \times 0.450\ in = 8.10\ in^2$

$V = 0.40\ F_y \times A_v = 0.40 \times 33{,}000\ psi \times 8.10\ in^2 = 106{,}920\#$

$M = 0.66\ F_y \times S = 0.66 \times 33{,}000 \times 61.6\ in^3 = 1{,}341{,}648\ in \cdot \# = 111{,}804\ ft \cdot \#$

$= 0.60 \times 33{,}000 \times 61.6\ in^3 = 1{,}219{,}680\ in \cdot \# = 101{,}640\ ft \cdot \#$

By D.Barraza Date 3·26·21 Job # 2168002*00

Checked by Date Project MMWD Smith Saddle Tanks Rehab

Subject Roof Framing - Structural Evaluation - Column Loading Sheet 10 of

- Column Loading

Central Column, Quan = 1, 10" Sch. 30 Pipe x 41'-3 3/4", Steel A36?

Reactions - Self = 16 x 87# = 1,392 #

Self + Dead = 16 x 304# = 4,864 #

Self + Dead + Live = 16 x 728# = 11,648 #

Self + Dead + Live + Earthquake = 16 x 835# = 13,360 #

Inner Column, Quan = 4, 10" Sch 30 Pipe x 39'-3 1/8", Steel A36?

Reactions - Self + Dead + Live = 2 x 9,291 = 18,582 #

Self + Dead + Live + Earthquake = 2 x 10,618 = 21,236 #

Intermediate Column, Quan = 8, 10" Sch. 30 Pipe x 38'-9 1/4", Steel A36?

Reactions - Self + Dead + Live = 2 x 9,101 # = 18,202 #

Self + Dead + Live + Earthquake = 2 x 10,404 # = 20,808 #

Outer Column, Quan = 16, 10" Sch. 30 Pipe x 38'-5 1/2", Steel A36?

Reactions - Self + Dead + Live = 2 x 6,121 = 12,242 #

Self + Dead + Live + Earthquake = 2 x 6,998 = 13,996 #

OSHPD

Latitude, Longitude: 38.010662, -122.602498

Map data ©2021

Date	2/22/2021, 2:00:53 PM
Design Code Reference Document	ASCE7-16
Risk Category	IV
Site Class	B - Estimated (see Section 11.4.3)

Type	Value	Description
S_S	1.5	MCE_R ground motion. (for 0.2 second period)
S_1	0.6	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.5	Site-modified spectral acceleration value
S_{M1}	0.6	Site-modified spectral acceleration value
S_{DS}	1	Numeric seismic design value at 0.2 second SA
S_{D1}	0.4	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1	Site amplification factor at 1.0 second
PGA	0.585	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.585	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	1.756	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.927	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.712	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.793	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.585	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.911	Mapped value of the risk coefficient at short periods
C_{R1}	0.898	Mapped value of the risk coefficient at a period of 1 s

Historical Listing of Selected Structural Steels

CSA Standards

Designation	Date Published	Yield Strength		Tensile Strength (F_u)	
		ksi	MPa	ksi	MPa
A16	1924	½ F_u	½ F_u	55 - 65	380 - 450
S39	1935	30	210	55 - 65	380 - 450
S40	1935	33	230	60 - 72	410 - 500
G40.4	1950	33	230	60 - 72	410 - 500
G40.5	1950	33	230	60 - 72	410 - 500
G40.6	1950	45 [1]	310	80 - 95	550 - 650
G40.8	1960	40 [3]	280	65 - 85	450 - 590
G40.12	1964 *	44 [2]	300	65	450
G40.21	1973 **	Replaced all previous Standards, see CISC Handbook			

* Introduced in May 1962 by the Algoma Steel Corporation as "Algoma 44"
** In May 1997, grade 350W became the only grade for W and HP shapes produced by Algoma Steel Inc.
[1] Silicon steel
[2] Yield reduces when thickness exceeds 1½ inches (40 mm).
[3] Yield reduces when thickness exceeds ⅝ inches (16 mm).

Rivet Steel

Designation	Date Published	Yield Strength		Tensile Strength (F_u)	
		ksi	MPa	ksi	MPa
G40.2	1950	28	190	52 - 62	360 - 430

ASTM Specifications

Designation	Date Published	Yield Strength		Tensile Strength (F_u)	
		ksi	MPa	ksi	MPa
A7 (bridges) A9 (buildings)	1914*	½ F_u	½ F_u	55 - 65	380 - 450
	1924	½ $F_u \geq 30$	½ $F_u \geq 210$	55 - 65	380 - 450
	1934	½ $F_u \geq 33$	½ $F_u \geq 230$	60 - 72	410 - 500
A373	1954	32	220	58 - 75	400 - 520
A242	1955	50 [1]	350	70 [1]	480
A36	1960	36	250	60 - 80	410 - 550
A440	1959	50 [1]	350	70 [1]	480
A441	1960	50 [1]	350	70 [1]	480
A572 grade 50	1966	50	345	65	450
A588	1968	50 [1]	345	70 [1]	485
A992	1998	50 min. to 65 max.	345 min. to 450 max.	65	450

[1] Reduces with increasing thickness
* Between 1900 and 1909, medium steel in A7 and A9 had a tensile strength 5 ksi higher than that adopted in 1914.

Reference: Handbook of Steel Construction, 8th Edition, CISC, 2004.

5.000		Nominal Capacity, MG	D100-11	Design Criteria			
150.50	D	Tank Diameter, feet	AWWA	Design Point Method	2.5	Ri	Force Reduction Coefficient, Table 28
75.25	R	Tank Radius, feet	No	Section 14 Used	1.50	I	Seismic Use Factor, Table 24
39.92	Hs	Tank Shell Height, feet	None	Shell Stress Limit			
38.50	Hp	Liquid Height, feet	0.85	Joint Efficiency, E	550,408	Ws	Total Weight of Tank Shell, pounds
1.00	G	Specific Gravity	50.00	Design Metal Temp.	204,340	Wr	Total Weight of Tank Roof, lbs
5		Number of Rings	15.00	Roof Live Load, psf	181,601	Wf	Total Weight of Tank Bottom, lbs
0.25		Code Minimum Shell t	1.07	Seismic Roof Load, psf			
85		Wind Velocity, mph	0.00	Corrosion Allowance			
Angle		Roof Type					
0.60	Cd	Wind Drag Factor					

Hydrostatic Design (Per AWWA Section 3.7, Reference AWWA D100-11, Equation 3-40)

Unit Hydrostatic Hoop Force = 2.6 x D x G / E = 460.35 lbs / in of shell height / foot of water depth

Hoop Force at Design Point = 2.6 x Hp x D x G / E

Shell Plate Thickness, t = 2.6 x Hp x D x G / s x E (Eq. 3-40)

Ring No.	Ring Height	Material	Allowable Stress, s	Design Depth	Design Pt Elevation	Hoop Force at Design Point	Min t Rqd.	Thickness Used
5	83.5	A7	15,000	6.46	32.04	2,973.1	0.19820752	0.312500
4	95.5	A7	15,000	14.42	24.08	6,636.8	0.44245033	0.468750
3	95.5	A7	15,000	22.38	16.13	10,300.4	0.68669314	0.687500
2	96.75	A7	15,000	30.44	8.06	14,012.0	0.93413284	0.937500
1	96.75	A7	15,000	38.50	0.00	17,723.6	1.18157255	1.187500

Summary of Roof, Shell, and Floor Plate Weights

	tr	0.1875	136,201 lbs	= Wrp	roof plate							
	tk	0.2500	lbs	= Wrk	knuckle plate							
			68,139 lbs	= Wrf	roof framing							
			204,340 lbs	= Wr	total roof							
				Xi		H x Xi		ts	Wi	WiXi	H x tx x Xi
5	ts5	0.3125	41,981 lbs	35.521		35,592	ts5	0.3125	41,981	1,491,213	11,122
4	ts4	0.4688	72,022 lbs	28.063		32,160	ts4	0.4688	72,022	2,021,115	15,075
3	ts3	0.6875	105,632 lbs	20.104		23,039	ts3	0.6875	105,632	2,123,646	15,840
2	ts2	0.9375	145,929 lbs	12.094		14,041	ts2	0.9375	145,929	1,764,831	13,163
1	ts1	1.1875	184,844 lbs	4.0313		4,680	ts1	1.1875	184,844	745,151	5,558
		Ws =	550,408 lbs			109,512		Ws =	550,408	8,145,956	60,758
								Xs =	14.80 feet		
	tf	0.25	181,601 lbs	= Wf	total floor			tu =	0.5548 inches		

Wind Design (Per AWWA Section 3.5, Reference AWWA D100-11, Equation 3-1 and 3-36)

Wind Pressure, Pw = 30 x Cd x (v / 100)^2 ≥ 30 Cd (Eq. 3-1)

Wind Pressure, Pw = 13.01 psf ≥ 18.00 psf

Avg. Shell Thickness, t = (Pw x D^3/2 x h / 10.625 x 10^6) ^ 2/5 (Eq. 3-36)

Ring No.	Ring Height	Cumulative Height Inches	Cumulative Height Feet	Rqd. Avg. t this Height	Corroded Thickness	Avg. t This Height	Check
5	83.5000	83.50	6.9583	0.21632		0.312500	OK
4	95.5000	179.00	14.9167	0.29347		0.390625	OK
3	95.5000	274.50	22.8750	0.34821		0.489583	OK
2	96.7500	371.25	30.9375	0.39291		0.601563	OK
1	96.7500	468.00	39.0000	0.43105		0.718750	OK

Center Column Analysis for Compression and Bending Strength per AISC Steel Manual 14th Edition

Wr =	204,340	Total weight of the tank roof (lbs)
	2%	Percentage of roof weight supported by center column.
Wrc =	4,904	Weight of roof supported by center column.
	192	Vertical seismic force (lbs) (equal to 0.7 x Wrc x 0.4 x Av)
pr,live =	15	Roof live load (psf)
Wr,live =	6,404	Roof live load supported by center column (lbs)
	9,808	Compression demand on column (lbs)
		Assume ASD Load Combination D + 0.75L +0.75(0.7E)

Center Column Compression Strength per AWWA 3.6.1.3

Dcol =	10.75	Column diameter outside (in)
dcol =	0.90	Column diameter outside (ft)
Acol =	0.63	Cross sectional area of column = π dc2 / 4 (not pipe section) (ft2)
wcol =	34.27	Weight of column (lb/ft)
γL =	62.43	Liquid density (pcf)
g =	32.17	Gravitational acceleration (ft/s2)
tcol =	0.307	Column wall thickness (in)
ww =	39.35	Weight of water displaced by column = γL x Acol (lb/ft)
Hp/D =	0.26	
Lcol =	43.06	Length of column (Hs + (0.75 x R/12))
rx =	3.69	Minimum radius of gyration of column (in)
KL/r =	140	Effective slenderness ratio of column, OK if KL/R < 175
Ag =	10.07	Gross area of column section (in2)
Fy_col =	36,000	Yield stress of column (psi)
fa =	487	Compression stress demand (psi)
Fcr / Ω =	7,696	Allowable compression stress (psi) when KL/r < 133, AISC Steel Manual Table 4-22
Fcr / Ω =	7,682	Allowable compression stress (psi) when KL/r > 133, AISC Steel Manual Table 4-22
D/C =	6%	Demand / Capacity Ratio
		OK, colulmn good for compression (static only)

Center Column Compression Strength per AWWA 13.5.4.5 and AISC Chapter E

Fcr =	12,830	Critical compression stress (psi), AISC Table 4-22, Fy increased by one-third per AWWA 13.5.4.5
Pcr =	129,220	Nominal compression strength (lbf) ref AISC (E3-1)
Ω =	1.67	Strength Reduction Factor, AISC Chapter E1
Pcr / Ω	77,377	Allowable compression strength (lbf)
Axial D/C =	13%	*OK, colulmn good for compression (seismic)*

Bending Strength per AISC Chapter F

Lcol =	43.06	Height of column (ft)
w lat =	266	Uniformly distributed horizontal force from water on column (plf) Ref. Wozniak and Mitchell 1978, Appendix 2.
Mr =	61,641	Moment in column from lateral water load (lb-ft). Varies w/ H. Refer to AISC Table 3-23 (5) for Mr.
		Assume ASD load combination D + 0.75L + 0.75(0.7E)
Fy_col =	36,000	Yield stress of column (psi)
D / t =	35	Slenderness ratio
0.07E/Fy =	56	Limiting compactness ratio, AISC Table B4.1b
0.31E/Fy =	250	Limiting slenderness ratio, AISC Table B4.1b
		Column is compact and Mn = FyZx

Zx =	33.49	Plastic section modulus of column section (in3)
Mn =	133,960	Nominal bending strength (lb-ft), Fy increased by one-third per AWWA 13.5.4.5
Ω =	1.67	Strength reduction factor, AISC Chapter F1
Mn / Ω =	80,215	Allowable bending strength (lb-ft)
Bending D/C :	77%	

D/C =	81%	Interaction formula per AISC (H1-1a) and (H1-1b)
		OK, column adequate for seismic loads.
		Note: For design purposes, assume seismic force is applied to entire height of column.

Vf =	21,816	Total lateral seismic force on column = [(Ai (Wcol + Wi)) ^{2} + (AcWc) ^{2}] $^{1/2}$ (lbs)
Vf =	507	Total lateral seismic force on column (lb/ft)

Ai =	**0.42857**	g's	Ai = Sai x I_E / 1.4 x Ri $\geq$ 0.36 x S1 x IE / Ri	(Eq. 13-17)
Ac =	**0.05185**	g's	Ac = Sac x I_E / 1.4 x Rc	(Eq. 13-18)
Wcol =	1,476	Weight of column (lbs)		
W_T =	180,868	Total equivalent weight of tank contents for one foot width across the tank diameter (lbs)		
Wi =	47,751	Weight of effective mass of tank contents that moves in unison with the tank column (effective impulsive weigh		
Wc =	107,100	Weight of effective mass of the first mode sloshing contents of the tank (effective convective weight) (lbs)		

Center Column Analysis for Compression and Bending Strength per AISC Steel Manual 14th Edition

Wr =	204,340	Total weight of the tank roof (lbs)
	2%	Percentage of roof weight supported by center column.
Wrc =	4,087	Weight of roof supported by center column.
	160	Vertical seismic force (lbs) (equal to 0.7 x Wrc x 0.4 x Av)
pr,live =	15	Roof live load (psf)
Wr,live =	5,337	Roof live load supported by center column (lbs)
	8,174	Compression demand on column (lbs)
		Assume ASD Load Combination D + 0.75L +0.75(0.7E)

Center Column Compression Strength per AWWA 3.6.1.3

Dcol =	10.75	Column diameter outside (in)
dcol =	0.90	Column diameter outside (ft)
Acol =	0.63	Cross sectional area of column = π dc2 / 4 (not pipe section) (ft2)
wcol =	34.27	Weight of column (lb/ft)
γL =	62.43	Liquid density (pcf)
g =	32.17	Gravitational acceleration (ft/s2)
tcol =	0.307	Column wall thickness (in)
ww =	39.35	Weight of water displaced by column = γL x Acol (lb/ft)
Hp/D =	0.26	
Lcol =	43.06	Length of column (Hs + (0.75 x R/12))
rx =	3.69	Minimum radius of gyration of column (in)
KL/r =	140	Effective slenderness ratio of column, OK if KL/R < 175
Ag =	10.07	Gross area of column section (in2)
Fy_col =	36,000	Yield stress of column (psi)
fa =	406	Compression stress demand (psi)
Fcr / Ω =	7,696	Allowable compression stress (psi) when KL/r < 133, AISC Steel Manual Table 4-22
Fcr / Ω =	7,682	Allowable compression stress (psi) when KL/r > 133, AISC Steel Manual Table 4-22
D/C =	5%	Demand / Capacity Ratio
		OK, colulmn good for compression (static only)

Center Column Compression Strength per AWWA 13.5.4.5 and AISC Chapter E

Fcr =	12,830	Critical compression stress (psi), AISC Table 4-22, Fy increased by one-third per AWWA 13.5.4.5
Pcr =	129,220	Nominal compression strength (lbf) ref AISC (E3-1)
Ω =	1.67	Strength Reduction Factor, AISC Chapter E1
Pcr / Ω	77,377	Allowable compression strength (lbf)
Axial D/C =	11%	*OK, colulmn good for compression (seismic)*

Bending Strength per AISC Chapter F

Lcol =	43.06	Height of column (ft)
w lat =	266	Uniformly distributed horizontal force from water on column (plf) Ref. Wozniak and Mitchell 1978, Appendix 2.
Mr =	61,641	Moment in column from lateral water load (lb-ft). Varies w/ H. Refer to AISC Table 3-23 (5) for Mr.
		Assume ASD load combination D + 0.75L + 0.75(0.7E)
Fy_col =	36,000	Yield stress of column (psi)
D / t =	35	Slenderness ratio
0.07E/Fy =	56	Limiting compactness ratio, AISC Table B4.1b
0.31E/Fy =	250	Limiting slenderness ratio, AISC Table B4.1b
		Column is compact and Mn = FyZx
Zx =	33.49	Plastic section modulus of column section (in3)
Mn =	133,960	Nominal bending strength (lb-ft), Fy increased by one-third per AWWA 13.5.4.5
Ω =	1.67	Strength reduction factor, AISC Chapter F1
Mn / Ω =	80,215	Allowable bending strength (lb-ft)
Bending D/C =	77%	
D/C =	79%	Interaction formula per AISC (H1-1a) and (H1-1b)
		OK, column adequate for seismic loads.
		Note: For design purposes, assume seismic force is applied to entire height of column.
Vf =	21,816	Total lateral seismic force on column = $[(Ai (Wcol + Wi))^2 + (AcWc)^2]^{1/2}$ (lbs)
Vf =	507	Total lateral seismic force on column (lb/ft)

Ai =	**0.42857**	g's	$Ai = Sai \times I_E / 1.4 \times Ri \geq 0.36 \times S1 \times IE / Ri$	(Eq. 13-17)
Ac =	**0.05185**	g's	$Ac = Sac \times I_E / 1.4 \times Rc$	(Eq. 13-18)

Wcol =	1,476	Weight of column (lbs)
W_T =	180,868	Total equivalent weight of tank contents for one foot width across the tank diameter (lbs)
Wi =	47,751	Weight of effective mass of tank contents that moves in unison with the tank column (effective impulsive weigh
Wc =	107,100	Weight of effective mass of the first mode sloshing contents of the tank (effective convective weight) (lbs)

Seismic Design Loads - Comparison of Impulsive Accelerations (Ai) and Convective Accelerations (Ac)

D =	150.500	ft	Diameter of cylindrical tank.
R =	75.250	ft	Radius of cylindrical tank.
h =	38.500	ft	Height of water surface above the bottom of the tank.
h/R =	0.512		

Period of Vibrations — First Convective (Sloshing) Mode

w^2 =	0.578		Housner, TID 4500 Eq. 6-19
w =	0.760		Circular frequency of free vibration for the nth mode.
Tc =	8.265	sec	First mode sloshing wave period of vibration (also referred to as "Tw").

Period of Vibrations — First Impulsive Tank Water Horizontal Mode

Ti = Ci x H x (r) ^{½} / (h/r) x (E) ^{½} 0.2411 seconds

H/r =	0.5116		0.5116		
Ci =	7.2		7.2		
H =	38.500	ft	11.7348	m	
r =	62.43	lb/ft3	1000.03173	kg/m3	
h =	0.5548	in	0.0141	m	weighted avg. shell thickness over the height of tank.
r =	75.250	ft	22.9362	m	
E =	2.90E+07	psi	2.00E+11	N/m^2	

American Water Works Association AWWA D100-11, Section 13.2.7, General Procedure

Design earthquake ground motion is based on a maximum considered earthquake ground motion defined as the motion casued by an event with a 2 percent probability of exceedence within a 50 year period (recurrence interval of approximately 2,500 years). The design seismic forces have been reduced by a factor of 1.4 and shall be used with the allowable stress design method. Ground supported flat bottom tank, mechanically anchored.

Seismic Use Group III shall be used for tanks that provide direct service to facilities that are deemed essential for post-earthquake recovery and essential to the life, health, and safety of the public, including post-earthquake fire suppression.

Seismic Used Group II shall be used for tanks that provide direct service to facilities that are deemed important to the welfare of the public.

I_E =	**1.50000**	Seismic Use Group III	(Table 24)
Site Class =	**B**	Site Class (Very dense soil and soft rock), Avg Prop Top 100 ft	(Table 25)
		Shear wave velocity, 2,500 $\leq$ vs $\leq$ 5,000 ft/s	
		Standard penetration resistance, not applicable	
		Undrained shear strength, not applicable	
		Site Class D shall be used when the soil properties are unknown.	
Fa =	**1.00000**	Short period site coefficient to modify spectral response.	(Table 26)
Fv =	**1.00000**	Long period site coefficient to modify spectral response.	(Table 27)
Ri =	**2.50000**	Response modification factor (impulsive component)	(Table 28)
Rc =	**1.50000**	Response modification factor (convective component)	(Table 28)
S_S =	**1.50000** g's	Mapped MCE spectral response acceleration, 5% damped, 0.2 sec., gs.	
S_1 =	**0.60000** g's	Mapped MCE spectral response acceleration, 5% damped, 1.0 sec., gs.	
S_{MS} =	**1.50000** g's	MCE spectral response acceleration, 5% damped, 0.2 sec., gs.	(Eq 13-5)
S_{M1} =	**0.60000** g's	MCE spectral response acceleration, 5% damped, 1.0 sec., gs.	(Eq 13-6)
U =	**2/3**	Scaling factor to scale the MCE to the design earthquake.	
S_{DS} =	**1.00000** g's	Design earthquake spectral response acceleration, 5% damped, 0.2 sec., gs.	
S_{D1} =	**0.40000** g's	Design earthquake spectral response acceleration, 5% damped, 1.0 sec., gs.	
Ti =	**0.24106** sec	natural period of the structure, seconds.	
Ts =	**0.40000** sec	SD1/SDS	
TL =	**12.00000** sec	Transition period for longer period ground motion, seconds.	(Figure 19)
Tc =	**8.26491** sec	First mode sloshing wave period of vibration (also referred to as "Tw").	
K =	**1.50000**	Damping scaling factor to convert spectrum from 5% damping to 0.5% damping.	

Sai = design spectral response acceleration for impulsive components, 5% damped, at natural period of the structure Ti.

Sai =	**1.00000** g's	For 0 $\leq$ Ti $\leq$ Ts :	Sai = S_{DS}	(Eq. 13-9)
Sai =	**1.65932** g's	For Ts < Ti $\leq$ TL :	Sai = S_{D1} / Ti < S_{DS}	(Eq. 13-10)
Sai =	**82.60037** g's	For Ti > TL :	Sai = TL x S_{D1} / Ti ^{2}	(Eq. 13-11)

Sac = design spectral response accel. for convective component, 0.5% damped, at first mode sloshing wave period Tc.

Sac =	**0.07260** g's	For Tc < TL:	Sac = K x SD1 / Tc $\leq$ SDS	(Eq. 13-12)
Sac =	**0.10540** g's	For Tc > TL:	Sac = K x TL x SD1 / Tc ^{2}	(Eq. 13-13)

American Water Works Association AWWA D100-11, Section 13.2.9, Horizontal Design Accelerations

For the general procedure, the impulsive design acceleration Ai is independent of Ti, and Sai shall be taken as SDS..

The natural period of the structure Ti is very small and is assumed to be zero for the general procedure.

Ai =	**0.42857** g's	Ai = Sai x I_E / 1.4 x Ri $\geq$ 0.36 x S1 x IE / Ri	(Eq. 13-17)
Ai =	**0.12960** g's	Ai = 0.36 x S1 x IE / Ri	(Eq. 13-17)
Ac =	**0.05185** g's	Ac = Sac x I_E / 1.4 x Rc	(Eq. 13-18)
Av =	**0.14000** g's	Av = 0.14 x SDS	

Tank and Content Weights for Base Shear and Overturning Moment

Wt =	42,757,957	Weight of tank contents (pounds)			(Eq. 13-27)
Ws =	550,408	Weight of tank shell and significant appurtenances (pounds)			
Wr =	204,340	Weight of tank roof including framing and knuckle (pounds)			
Wf =	181,601	Weight of tank bottom (floor) (pounds)			
D/H	3.91				
W_1/W_T	0.295	0.295	0.295		(Eq. 13-24 or Housner Eq. 6.12)
W_1 =	12,601,273	Weight of effective mass of tank contents that moves in unison with the tank shell (pounds)			
Ws+Wr+W_1	13,356,021				
W_2/W_T	0.661	0.458	0.661		(Eq. 13-26 or Housner Eq. 6.16)
W_2 =	28,262,958	Weight of effective mass of the 1st mode sloshing contents of the tank (pounds)			

Ws =	550,408	Xs =	14.7998 feet	8,145,956 ft-lbs	
Wr =	204,340	Ht =	39.9200 feet	8,157,236 ft-lbs	
		X1 / H =	0.375		(Eq. 13-28 or Housner Eq. 6-13)
W_1 =	12,601,273	X_1 =	14.4375 feet	181,930,874 ft-lbs	
Ws+Wr+W_1	**13,356,021**			**198,234,067** ft-lbs	
		X2 / H =	0.534		(Eq. 13-30 or Housner Eq. 6-13)
W_2 =	**28,262,958**	X_2 =	20.5523 feet	**580,868,011** ft-lbs	

Design Shear at the Top of the Foundation (Actual Lateral Shear) (pounds)

V_{ACT} = SQRT { [Ai x (Ws + Wr + Wf + W1)]^2 + [Ac x W2]^2} (D100-11, Eq. 13-31)

V_{ACT} = **5,984,077** lbs — Based on site spectra for Ai = 0.42857 and Ac = 0.05185.

Overturning Moment Applied to the Bottom of the Tank Shell (foot-pounds), Section 13.5.2

$Ms = \{[Ai \times (WsXs + WrHt + WiXi)]^2 + [Ac \times (WcXc)]^2\}^{½}$ (D100-11, Eq. 13-23)

M = **90,138,866** ft-lbs — Based on site spectra for Ai = 0.42857 and Ac = 0.05185.

Uplift Force resulting from Overturning Moment

S = 17,789 sq.ft. — $S = p \times r^2$

M / S = **5,067** lbs/lineal ft — Based on site spectra for Ai = 0.42857 and Ac = 0.05185.

wrs =	40,362	pounds	Roof load acting on shell in (pounds). Roof live load shall not be included. wrs = 1/2 Wrp + 1/2 Wrf + Wrk
ws =	550,408	pounds	Weight of tank shell and significant appurtenances (pounds)
wrs =	85	lbs/lineal ft	Roof load acting on shell in (pounds per foot).
ws =	1,164	lbs/lineal ft	Weight of tank shell and significant appurtenances (pounds per foot)
wt =	1,249	lbs/lineal ft	Weight of tank shell and roof load acting on shell in (pounds per foot)

Resistance to Overturning Moment for Unanchored Tanks (AWWA D100-11 Section 13.5.4.1.1)

wl =	2,226	lbs/lineal ft.	wl = 7.9 x tb x SQRT (sy x H x G)	(Eq. 13-37)
wl ≤	**7,417**	lbs/lineal ft.	wl ≤ 1.28 x H x D x G	(Eq. 13-37)
tb	0.250	inches	thickness of bottom annulus	
tb (max)	0.833	inches	maximum thickness of bottom annulus	
sy	33,000	psi	minimum specified yield strength of bottom annulus	
H	38.500	feet	maximum depth of water	
D	150.500	feet	tank diameter	
G	1.0		specific gravity	

Total Width of Bottom Annulus (AWWA D100-11 Section 13.5.4.1.1)

L = 0.216 x tb x SQRT (sy / H x G) (Eq. 13-38)

L≤ 0.035 x D (Eq. 13-38)

L =	1.58	feet	based on tb
L≤	**5.27**	feet	based on tb max

Shell Compression in Unanchored Tanks (AWWA D100-11 Section 13.5.4.1)

M / D^2 (wt + wL)

		Based on site spectra for Ai = 0.42857 and Ac = 0.05185.	
J =	**1.40**	J = Ms / D^2 (wt (1-0.4Av) + wL)	(Eq. 13-36)
J =	1.37	J = Ms / D^2 (wt + wL) , does not include effects of Av.	(Eq. 13-36)

For J ≤ 0.785 There is no shell uplift because of the overturning moment and the tank is self-anchored.

For 0.785 ≤ J ≤ 1.540 There is shell uplift, but the tank is stable, provided the shell compression rqmts are met.

For 1.540 ≤ J The tank is not stable. Modify the bottom annulus, within the limits of tb and L, or anchor.

Maximum longitudinal shell compression stress when there is no uplift(psi) per Section 13.5.4.2.1.
(This is also the maximum longitudinal shell compression stress in an anchored tank)

sc = [wt (1 + 0.4Av) + M / S] x 1 / (12 x ts) (Eq. 13-39)

sc =	**448**	psi	Based on site spectra for Ai = 0.42857 and Ac = 0.05185.
ts =	1.1875	inches	

Maximum longitudinal shell compression stress when there is uplift(psi) per Section 13.5.4.2.1.

sc = [{(wt (1 + 0.4Av) + wl) / 0.607 - 0.18667 (M / D2 (wt + wl))^2.3} - wl] x 1 / (12 x ts) (Eq. 13-40)

sc =	**1,083**	psi	Based on site spectra for Ai = 0.42857 and Ac = 0.05185.	(Eq. 13-40)
ts =	1.1875	inches		

Freeboard for Sloshing Wave (AWWA D100-11, Section 13.5.4.4)

Af =	0.07260	When Tc ≤ TL:	Af = K x S_{D1} / Tc	(Eq. 13-55)
Af =	0.10540	When Tc > TL:	Af = K x S_{D1} x T_L / Tc 2	(Eq. 13-56)
d =	5.46 feet	d = 0.5 x D x Af		(D100-11, Eq. 13-52)
d =	3.7126 feet	Based on Housner, TID 4500 Equation 6-22. S = Af x g x T / 2 P		(Eq. 6-22)
Oh =	0.060	Angular amplitude of free oscillations at the fluid surface.		
ymax = A1=	4.0414 feet	Maximum displacement of W1.		

Sliding Check for Earthquake Forces with Tank Full (AWWA D100-11 Section 13.5.4.6)

Coefficient of Friction 0.32

Max Coefficient of Friction 0.58

V allowable = tan 30 (Ws + Wr + Wi + Wc) x (1.0 -0.40 x Av) allowable lateral shear, pounds. (Eq. 13-57)

V allowable	V actual		
12,572,261	**5,984,077**	lbs	Based on site spectra for Ai = 0.42857 and Ac = 0.05185.
			Horizontal shear per anchor bolt = 24,567 lbs.

Hydrodynamic Seismic Hoop Tensile Stresses (Per AWWA Section 13.5.4.2.3)

ss = hydrodynamic hoop tensile stress, psi.
Ni = impulsive hoop force, lbs/inch.
Nc = convective hoop force, lbs/inch.
Nh = hydrostatic hoop force, lbs/inch.
av = vertical acceleration (decimal). Av = 0.14 x SDS.
t = thickness of shell ring under consideration, in.
Y = distance from fluid surface, feet (positive down).

Max Design Tensile Stress in Shell Plates

sstat allow	sdyn allow	specification
15,000	20,000	A-7
16,830	22,440	A-7
19,800	26,400	A-7

(Refer to AWWA D100-11, Table 34)

Hydrodynamic Seismic Hoop Tensile Stresses When Vertical Acceleration is Not Specified.

ss = [Ni + Nc] / t

D / H = 3.91
0.75 x D = 112.88

		D100-11
Ai =		0.4286
Ac =		0.0519
tanh [0.866 x D / H] =	0.9977	
cosh [3.68 x H / D] =	1.4768	

For D / H $\geq$ 1.333
Ni = 11.35 [Z x I / Rw] x G x D x H x [Y / H - 0.5 x (Y / H)^2] tanh [0.866 x D / H] — **Utilized** (Eq. 13-43)

For D / H < 1.333 and Y < 0.75D
Ni = 6.98 [Z x I / Rw] x G x D^2 x [Y / 0.75 x D - 0.5 x (Y / 0.75 x D)^2] — **Not Used** (Eq. 13-44)

For D / H < 1.333 and Y $\geq$ 0.75D
Ni = 3.50 [Z x I / Rw] x G x D^2 — **Not Used** (Eq. 13-45)

Nc = 17.55 [Z x I / Rw] x C1 x S x G x D^2 x cosh [3.68 x (H - Y) / D] / cosh [3.68 x H / D] — **Utilized** (Eq. 13-46)

Ring No.	Ring Height	Seismic Allowable Stress, s	Design Depth	Impulsive Hoop Force, Ni (lb/in)	Convective Hoop Force, Nc (lb/in)	Hydrostatic Force, Nh (lb/in)	Shell Ring Thickness, t (inches)	Hydrodynamic Hoop Stress, ss (psi)	Total Stress $s_s$dynamic + $s_s$static
5	83.5	20,000	6.46	1,713	1,031	2,973	0.312500	6,399	15,913
4	95.5	20,000	14.42	3,393	918	6,637	0.468750	7,499	21,658
3	95.5	20,000	22.38	4,597	841	10,300	0.687500	6,797	21,779
2	96.75	20,000	30.44	5,330	795	14,012	0.937500	5,748	20,694
1	96.75	20,000	38.50	5,575	779	17,724	1.187500	4,740	19,665

Hydrodynamic Seismic Hoop Tensile Stresses (Per AWWA Section 13.5.4.2.3)

ss = hydrodynamic hoop tensile stress, psi.
Ni = impulsive hoop force, lbs/inch.
Nc = convective hoop force, lbs/inch.
Nh = hydrostatic hoop force, lbs/inch.
av = vertical acceleration (decimal). Av = 3/4 x Ai.
t = thickness of shell ring under consideration, inches.
Y = distance from fluid surface, feet (positive down).

Max Design Tensile Stress in Shell Plates

sstat allow	sdyn allow	specification
15,000	20,000	A-7
16,830	22,440	A-7
19,800	26,400	A-7

(Refer to AWWA D100-11, Table 34)

Hydrodynamic Seismic Hoop Tensile Stresses When Vertical Acceleration is Specified.

$ss = [Ni^2 + Nc^2 + (Nh \times Av)^2]^{1/2} / t$ (Eq. 13-42)

D / H = 3.91
0.75 x D = 112.88 Tc = 4.2065

	AWWA	Ti = 0.12903
Ai =	0.0000	0.4286
Ac =	0.0000	0.0519
tanh [0.866 x D / H] =	0.9977	
cosh [3.68 x H / D] =	1.4768	
Av =	0.1400	0.1400

For D / H $\geq$ 1.333
$Ni = 11.35 [Z \times I / Rw] \times G \times D \times H \times [Y / H - 0.5 \times (Y / H)^2] \tanh [0.866 \times D / H]$ **Utilized** (Eq. 13-43)
For D / H < 1.333 and Y < 0.75D
$Ni = 6.98 [Z \times I / Rw] \times G \times D^2 \times [Y / 0.75 \times D - 0.5 \times (Y / 0.75 \times D)^2]$ **Not Used** (Eq. 13-44)
For D / H < 1.333 and Y $\geq$ 0.75D
$Ni = 3.50 [Z \times I / Rw] \times G \times D^2$ **Not Used** (Eq. 13-45)

$Nc = 17.55 [Z \times I / Rw] \times C1 \times S \times G \times D^2 \times \cosh [3.68 \times (H - Y) / D] / \cosh [3.68 \times H / D]$ **Utilized** (Eq. 13-46)

Ring No.	Ring Height	Seismic Allowable Stress, s	Design Depth	Impulsive Hoop Force, Ni (lb/in)	Convective Hoop Force, Nc (lb/in)	Hydrostatic Force, Nh (lb/in)	Shell Ring Thickness, t (inches)	Hydrodynamic Hoop Stress, ss (psi)	Total Stress $s_s$dynamic + $s_s$static
5	83.5	20,000	6.46	1,713	1,031	2,973	0.312500	6,536	16,050
4	95.5	20,000	14.42	3,393	918	6,637	0.468750	7,757	21,915
3	95.5	20,000	22.38	4,597	841	10,300	0.687500	7,113	22,096
2	96.75	20,000	30.44	5,330	795	14,012	0.937500	6,117	21,063
1	96.75	20,000	38.50	5,575	779	17,724	1.187500	5,180	20,105

Allowable Shell Plate Stresses in Compression for Mechanically & Self-Anchored Tanks (per AWWA D100-11 Section 13.5.4.2.4)

σe =	see below	seismic allowable stress, psi.
σa =	see below	allowable local buckling compressive stress FL from Section 3.4.3.1.1., psi.
Δσcr =	see below	critical buckling stress increase for unanchored tanks due to pressure, psi.
ΔCc =	see below	pressure stabilizing buckling coefficient (Figure 11)
E =	29,000,000	modulus of elasticity, psi.
t =	see below	thickness of the plate under consideration, inches.
R =	903.00	radius of the tank, inches.
P =	see below	hydrostatic pressure at point under consideration, psi.
M =	90,138,866	Based on site spectra for Ai = 0.42857 and Ac = 0.05185.

For $P / E [R / t]^2 \leq 0.064$

$\Delta Cc = 0.72 [P / E [R / t]^2]^{0.84}$ **Not Used** (Eq. 13-50)

For $P / E [R / t]^2 > 0.064$

$\Delta Cc = 0.045 \ln [P / E [R / t]^2 + 0.0018] + 0.194 \leq 0.22$ **Utilized** (Eq. 13-51)

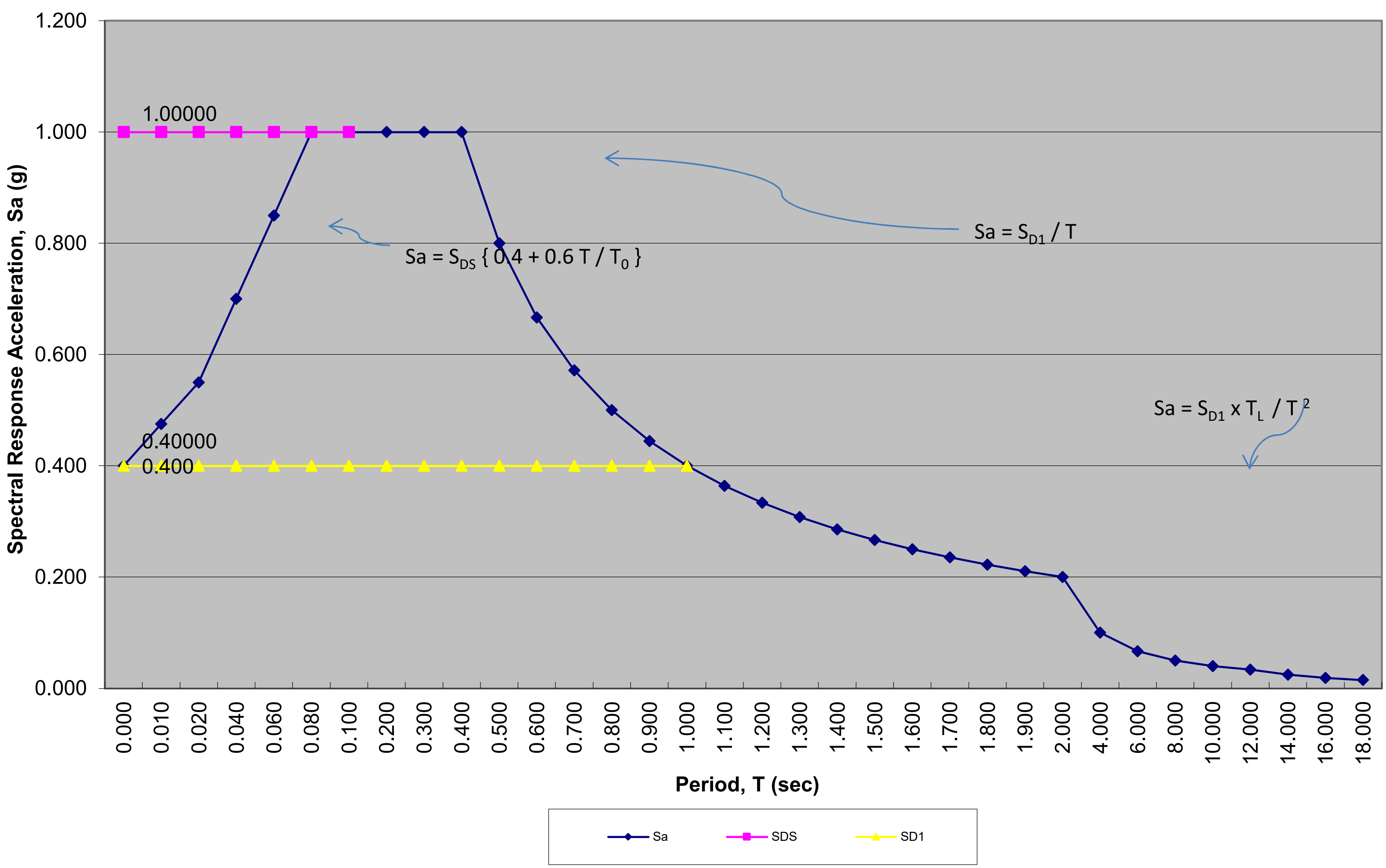
For mechanically anchored tanks:

Ring No.	Shell Ring Thickness, t (inches)	Ring Weight	Shell Wt & Roof Wr	Max Long Shell Comp σc, psi	ti / R	(Eq. 3-11) or (Table 10) σa or F_L	(Eq. 13-47) and (13-48) σe	σc ≤ σe
5	0.312500	41,981	174	80	0.000346	609	812	ok
4	0.468750	72,022	326	171	0.000519	921	1,228	ok
3	0.687500	105,632	550	263	0.000761	1,371	1,828	ok
2	0.937500	145,929	859	356	0.001038	1,915	2,553	ok
1	1.187500	184,844	1,249	448	0.001315	2,500	3,334	ok

For self-anchored tanks:

Ring No.	Shell Ring Thickness, t (inches)	$P/E [R/t]^2$	Shell Wt & Roof Wr	Max Long Shell Comp σc, psi	ti / R	(Eq. 13-50) and (13-51) ΔCc	(Eq. 13-49) Δσcr	(Eq. 3-11) (Table 10) σa or F_L	(Eq. 13-47) and (13-48) σe
5	0.312500	0.806	174	193	0.000346	0.18	1,851	609	2,046
4	0.468750	0.800	326	414	0.000519	0.18	2,771	921	3,075
3	0.687500	0.577	550	635	0.000761	0.17	3,740	1,371	4,321
2	0.937500	0.422	859	859	0.001038	0.16	4,678	1,915	5,672
1	1.187500	0.333	1,249	1,083	0.001315	0.14	5,520	2,500	7,014

Design Response Spectrum



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Appendix E

Reservoir Nos. 1 and 2 Coating Assessments

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MARIN MUNICIPAL WATER DISTRICT

Smith Saddle No. 1 Reservoir Coating and Lining Assessment

Prepared for: Kennedy Jenks
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275 Battery Street, Suite 550
San Francisco, CA 94111

Date: April 1, 2021

Prepared by Mr. Austin Darrimon

National Association of Corrosion Engineers Inspector No. 15642

Table of Contents

1.0 Executive Summary

Bay Area Coating Consultants, Inc. (BACC) assessed the coating and lining condition of the welded carbon steel Smith Saddle Reservoir No.1. The reservoir is in Fairview Ca. The purpose of the visit was to perform a coating and lining condition survey on the exterior and interior roof of Smith Saddle Reservoir No.1.

Interior
BACC preformed a visual assessment from a raft. The interior coating is expected the be the same system as Tank No.2 The interior was coated with two different coating systems. The floor and 20' up the shell are a hot mop coal tar enamel with a Jet set primer. The coating system above 20' is a coal tar-based system bitumastic super tank solution. The coating has completely failed with areas of minor to moderate corrosion. The coating exhibited numerous blister domes being fractured and exposing the steel substrate. The most severe corrosion observed on the east side of the tank on the outer and intermediate girders. The closer to the inner bays/dollar plate the corrosion was less. The roof support columns showed blistered coating and minor surface corrosion. The sheet metal ring was loose in areas and exhibited multiple holes from corrosion. The visible shell also has blisters and fractures in the lining system with minor surface corrosion. The cathodic protection system is doing a good job protecting the steel. Due to the use of cathodic protection no measurable metal loss was noted. The existing coal tar epoxy system is failing and has exceeded its performance life.

The interior lining system is failing and should be removed and replaced. The new lining system should meet the new NSF 600 requirements.

Exterior
The upper rings above the tub ring are in fair condition. On the backside by the trail there is a lot of rock damage exposing the steel with minor rust. The tub ring has been overcoated numerous time due to the graffiti. Different types of coatings have been used and mold is evident under the coatings. This is caused by using water-based paints. The ASTM D-3359 x-scribe adhesion test all failed. The upper section above the tub ring was over coated with an acrylic based coating which has poor adhesion to the original coating system. If this coating were not used the tank could have been over coated on the upper sections. The tub ring coating will also need to be removed. The roof has many rocks from people throwing rocks at the tank. The existing coating on the roof is exhibiting numerous areas of corrosion coming through the coating due to the coatings age. The bolts attaching the vent screen are also deteriorating. A zinc-based primer should be specified to help protect the steel from rock damage.

Table 1-1. Summary of Findings and Recommendations

Component	Conclusions	Recommendations
Roof Plates	The existing lining system is in poor condition.	Remove and replace coating system
Rafters	The rafters are in poor condition and could require metal repair	Remove and replace coating system
Upper shell	The upper shell is in poor condition and could require metal repair	Remove and replace coating system
Exterior coating	The exterior coating is in fair condition	Replacement of coating system
Exterior-Tub ring and chime	Recommendation	All growth and debris should be removed along base of tank.

2.0 Introduction

Bay Area Coating Consultants, Inc. (BACC) assessed the coating and lining condition of the welded carbon steel Smith Saddle Reservoir No.1 on the morning of March 16, 2021. The weather was sunny and cool. The reservoir is in Fairview Ca. The purpose of the visit was to perform a coating and lining condition survey on the exterior and interior of Smith Saddle Reservoir Tank No.1. Tank No. 1 was still in service at the time of the inspection which limited the inspection to the rafters and roof plates.

3.0 Methods and Procedures

3.1 Pit Depth Measurement

Pitting corrosion, or pitting is the form of extremely localized corrosion that creates small holes in the metal. Where pits were encountered, the pit depths were measured utilizing a pit depth gauge. If the nominal thickness is known, the percent of metal wall thickness loss can be calculated. A standard pit depth gauge is shown in Photo 3-1.

Photo 3-1. Standard Pit Depth Gauge

3.2 Dry Film Thickness (DFT)

BACC conducted dry-film thickness (DFT) testing on the shell and floor of Tank No.2. This DFT gauge uses electromagnetic induction and eddy current technology to measure the thickness of a wide variety of coatings on ferrous metal surfaces. DFT measurements on the steel were recorded utilizing an Elcometer 456 DFT gauge as shown in Photo 3-2. The gauge was calibrated prior to use in accordance with SSPC PA-2

Photo 3-2. Elcometer 456T Gauge

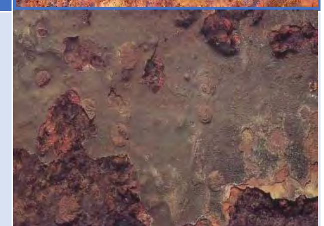
3.3 Qualitative Visual Assessment

Qualitative visual evaluations were conducted during the condition assessment. The visual investigation and examination was supplemented with digital photographs. The visual assessment focused on the condition of the internal lining system. Defects, such as metallic corrosion, pitting, delamination and coating blisters, and coating failures were documented with digital photographs. Visual assessments are subjective in nature and are based on BACC's experience evaluating lining in potable water storage tanks.

3.4 BACC's Metal Condition Rating System

The Metal Condition Index (Table 3-1) was created to provide consistent reporting of corrosion damage based on qualitative, objective criteria. Condition of ferrous metal can vary form Level 1 to Level 4 based upon visual observation and field measurements, with level 1 indication the best condition and Level 4 indication severe damage. As a comparison, the ASTM D-610 General Rust Grade is presented along with the Metal Condition Index.

Table 3-1. Metal Condition Index Rating System

Condition Rating	ASTM D610 Rust Grade	Description	Representative Photograph
Level 1	10-G to 7-G	**Little or No corrosion** Loss of Wall Thickness%: None Pitting Depth (as % of Wall Thickness): None to minimal Extent (Area) of Corrosion: None	
Level 2	6-G to 4-G	**Minor Surface Corrosion** Loss of Wall Thickness%: < 25% Pitting Depth (as % of Wall Thickness): < 25% Extent (Area) of Corrosion: Localized	
Level 3	3-G	**Moderate to Significant Corrosion** Loss of Wall Thickness%: 25% - 75% Pitting Depth (as % of Wall Thickness): 25% -75% Extent (Area) of Corrosion: 25% -75%	
Level 4	2-G to 0-G	**Severe Corrosion; Immediate Repair/Replacement Needed** Loss of Wall Thickness%: > 75% Pitting Depth (as % of Wall Thickness): 75% or more Extent (Area) of Corrosion: Affects Most or All of Surface.	

3.5 Coating Evaluation per ASTM D610

Ratings were assigned to BACC's Metallic Condition Index and ASTM D610 General Rust Grade for painted surfaces. Figure 3-6 shows and example of general rust ratings.
Similar rating scales are available for pinpoint rusting.

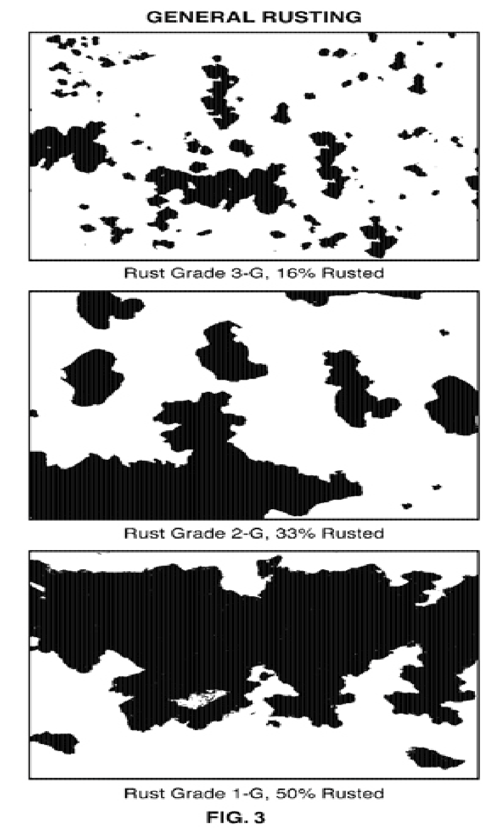


Figure 3-6. ASTM D610 Rust Grade Ratings

4.0 Findings

On April 1, 2021 BACC was onsite to assess the coating and lining condition on Smith Saddle No.1 Reservoir. The weather was sunny and cold at the time of the inspection. Ambient conditions were recorded utilizing an Elcometer 319. All confined space guidelines were followed, BACC conducted a visual assessment of the assessable areas. This report is prepared based on noted field investigations and the review of existing plans and information furnished by Marin Municipal Water District. The conclusions and recommendations contained within this report are those determined by the coating inspection consultant and are consistent with the best practices identified by AWWA, NACE, ASTM and SSPC.

Type: AWWA D-100 welded carbon steel tank
Year Built: 1963
Diameter: 150’ 6”
Hight: 39’-11”
Capacity: 5.0 MG.
Lining: Floor and up 25’ / Jet set primer/Topcoat Hot mop coal tar enamel
Lining: Shell above 25’, roof plates and rafters/ Bitumastic super tank solution
Roof Type: Conical with ½”:12 slope

4.1 Interior Roof Plates and Rafters

Photo 4-1. Upper shell/outer bay

Photo 4-2. Metal loss on rafter/outer bay

Photo 4-3. Failed coating on roof plate

Photo 4-4. Moderate corrosion on roof plate

Photo 4-5 intact coating on web

Photo 4-6 corroded stabilizer rod

Photo 4-7 Moderator corrosion plate overlap

Photo 4-8 Failed coating and moderate corrosion

Photo 4-9 bare steel and failed coating

Photo 4-10 failed coating

Photo 4-11 Gaps between sheet metal

Photo 4-12 holes found in sheet metal

Photo 4-13 Moderate corrosion on flange

Photo 4-14 Moderate corrosion

East side of the tank

Intermediate bay East side of the tank


Photo 4-15 Moderate corrosion on connections


Photo 4-16 moderate corrosion


Photo 4-17 Failed coating moderate corrosion


Photo 4-18 girder not lining up


Photo 4-19 Failed coating on support column


Photo 4-20 Failed coating intermediate bay

Photo 4-21 Moderate corrosion on flange

Photo 4-22 Moderate corrosion on flange

Photo 4-23 Moderate corrosion on flange

Photo 4-24 Moderate corrosion on flange

Photo 4-25 Moderate corrosion on flange

Center bay


Photo 4-26 minor corrosion on center girder


Photo 4-27 minor corrosion


Photo 4-28 minor corrosion


Photo 4-29 minor corrosion


Photo 4-30 failed coating & minor corrosion


Photo 4-31 failed coating & minor corrosion

Photo 4-32 failed coating & minor corrosion

Photo 4-33 failed coating & minor corrosion

Photo 4-34 failed coating & minor corrosion

Photo 4-35 failed coating & minor corrosion

Photo 4-36 failed coating & minor corrosion

Photo 4-37 missing bolts

Dry Film Thickness reading Statistics

Exterior Dry Film Thickness readings

Statistics	
# Readings	100
Mean	11.138 mils
Maximum	16.70 mils
Minimum	7.20 mils
Standard Deviation (σ)	3.226 mils
Mean + 3σ	20.815 mils
Mean - 3σ	1.460 mils
Coefficient of Variation	29.0%

5.0 Conclusion

5.1 Roof plates, Knuckle, Rafters

The lining system on the roof plates and rafters of the tank is completely failed and should be replaced. Moderate to minor corrosion observed.

5.2 Shell

The upper shell in the vapor area of the tank could have excessive pitting and along the shell to roof plate interface. The lower area of the shell that are in immersion is being protected by the cathodic protection system. The lining system on the shell plates of the tank is completely failed and should be replaced.

5.4 Roof Support Columns

The lining system on the columns of the tank is completely failed and should be replaced.

5.6 Exterior

The upper shell of the tank is in fair condition except along the walking trail which has excessive rock damage. The coating on the roof due to its age is thinning out and allowing the corrosion to come through the existing coating. The tub ring has been over coated numerous times and is poorly bonded. There is a light coat on the support shell that looks to be a water-based acrylic which is also poorly attached., for this reason over coating is not an option. The exterior coatings will require full removal and replacement.

Please call if you have any questions or if you want to further discuss the information contained in this report.

Respectfully submitted,

Austin Darrimon
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MARIN MUNICIPAL WATER DISTRICT

Smith Saddle No. 2 Reservoir Coating and Lining Assessment

Prepared for: Kennedy Jenks
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275 Battery Street, Suite 550
San Francisco, CA 94111

Kennedy Jenks

Date: March 18, 2021

Prepared by Mr. Ed Darrimon

National Association of Corrosion Engineers Inspector No. 106

Table of Contents

1.0 Executive Summary

Bay Area Coating Consultants, Inc. (BACC) assessed the coating and lining condition of the welded carbon steel Smith Saddle Reservoir No.2. The reservoir is in Fairview Ca. The purpose of the visit was to perform a coating and lining condition survey on the exterior and interior of Smith Saddle Reservoir.

Interior

The interior was coated with two different types of coating systems. The floor and 20' up the shell are a hot mop coal tar enamel with a Jet set primer. The coal tar exhibited numerous blister domes being fractured and exposing the steel substrate. The shell also has blisters and fractures in the lining system. The coal tar is very brittle. Usually, we would see metal loss in the fractures, but the cathodic protection system is protecting the steel. Due to the use of cathodic protection no measurable metal loss was noted. The roof support columns, base plates, and ladder all looked to be in good condition. The existing coal tar system is failing and has exceeded its performance life.

The upper shell in the vapor space is failing with evident corrosion and metal loss. The coating system above 20' is a coal tar-based system bitumastic super tank solution. The roof plates and rafters are coated with this system. The coating system has completely failed. The most outer bay by the vents; has moderate corrosion on the roof plates and rafters. Severe active corrosion was observed on the topside and lower rafter lips exhibiting moderate metal loss. The topside of the rafters due to the exposed steel has fused the top of the rafter with the roof plate in areas. The nuts and bolts that fasten the rafters to the shell support exhibited 50% +/- metal loss. The second bay and third bay where the center rafter support the coating is totally failed. The existing coating is fractured and detaching. Most of the roof plates rafters, and supports are exhibiting active corrosion. The rafter center support exhibited minimal metal loss on the rafter ends and bolted connections on the dollar plate. The steel with the most corrosion deterioration was on the most outer bay close to the side vents. The interior lining system is failing and should be removed and replaced. The new lining system should meet the new NSF 600 requirements.

Exterior

The upper rings above the tub ring are in fair condition. On the backside by the trail there is a lot of rock damage exposing the steel with minor rust. The tub ring has been overcoated numerous time due to the graffiti. Different types of coatings have been used and mold is evident under the coatings. This is caused by using water-based paints. The ASTM D-3359 x-scribe adhesion test all failed. The upper section above the tub ring was over coated with an acrylic based coating which has poor adhesion to the original coating system. If this coating were not used the tank could have been over coated on the upper sections. The tub ring coating will also need to be removed. The roof has many rocks from people throwing rocks at the tank. The existing coating on the roof is exhibiting numerous areas of corrosion coming through the coating due to the coatings age. The bolts attaching the vent screen are also deteriorating. A zinc-based primer should be specified to help protect the steel from rock damage.

Table 1-1. Summary of Findings and Recommendations

Component	Conclusions	Recommendations
Roof Plates	The existing lining system is in poor condition.	Remove and replace coating system
Rafters	The rafters are in poor condition and could require metal repair	Remove and replace coating system
Upper shell	The upper shell is in poor condition and could require metal repair	Remove and replace coating system
Shell, Floor, overflow, and ladder	The existing lining system is in fair condition.	Remove and replace coating system replaced.
Interior Piping	Interior of piping is in poor condition	Remove and replace coating system
Manways	The manways are in good condition	Add additional manway
Exterior coating	The exterior coating is in fair condition	Replacement of coating system
Exterior-Tub ring and chime	Recommendation	All growth and debris should be removed along base of tank.

2.0 Introduction

Bay Area Coating Consultants, Inc. (BACC) assessed the coating and lining condition of the welded carbon steel Smith Saddle Reservoir No.2 on the morning of March 16, 2021. The weather was sunny and cool. The reservoir is in Fairview Ca. The purpose of the visit was to perform a coating and lining condition survey on the exterior and interior of Smith Saddle Reservoir Tank No.2.

3.0 Methods and Procedures

3.1 Pit Depth Measurement

Pitting corrosion, or pitting is the form of extremely localized corrosion that creates small holes in the metal. Where pits were encountered, the pit depths were measured utilizing a pit depth gauge. If the nominal thickness is known, the percent of metal wall thickness loss can be calculated. A standard pit depth gauge is shown in Photo 3-1.

Photo 3-1. Standard Pit Depth Gauge

3.2 Dry Film Thickness (DFT)

BACC conducted dry-film thickness (DFT) testing on the shell and floor of Tank No.2. This DFT gauge uses electromagnetic induction and eddy current technology to measure the thickness of a wide variety of coatings on ferrous metal surfaces. DFT measurements on the steel were recorded utilizing an Elcometer 456 DFT gauge as shown in Photo 3-2. The gauge was calibrated prior to use in accordance to SSPC PA-2

Photo 3-2. Elcometer 456T Gauge

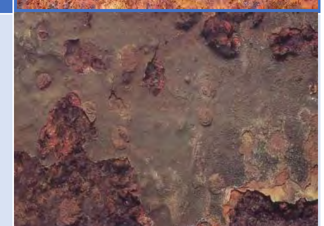
3.3 Qualitative Visual Assessment

Qualitative visual evaluations were conducted during the condition assessment. The visual investigation and examination was supplemented with digital photographs. The visual assessment focused on the condition of the internal lining system. Defects, such as metallic corrosion, pitting, delamination and coating blisters, and coating failures were documented with digital photographs. Visual assessments are subjective in nature and are based on BACC's experience evaluating lining in potable water storage tanks.

3.4 BACC's Metal Condition Rating System

The Metal Condition Index (Table 3-1) was created to provide consistent reporting of corrosion damage based on qualitative, objective criteria. Condition of ferrous metal can vary form Level 1 to Level 4 based upon visual observation and field measurements, with level 1 indication the best condition and Level 4 indication severe damage. As a comparison, the ASTM D-610 General Rust Grade is presented along with the Metal Condition Index.

Table 3-1. Metal Condition Index Rating System

Condition Rating	ASTM D610 Rust Grade	Description	Representative Photograph
Level 1	10-G to 7-G	**Little or No corrosion** Loss of Wall Thickness%: None Pitting Depth (as % of Wall Thickness): None to minimal Extent (Area) of Corrosion: None	
Level 2	6-G to 4-G	**Minor Surface Corrosion** Loss of Wall Thickness%: < 25% Pitting Depth (as % of Wall Thickness): < 25% Extent (Area) of Corrosion: Localized	
Level 3	3-G	**Moderate to Significant Corrosion** Loss of Wall Thickness%: 25% - 75% Pitting Depth (as % of Wall Thickness): 25% -75% Extent (Area) of Corrosion: 25% -75%	
Level 4	2-G to 0-G	**Severe Corrosion; Immediate Repair/Replacement Needed** Loss of Wall Thickness%: > 75% Pitting Depth (as % of Wall Thickness): 75% or more Extent (Area) of Corrosion: Affects Most or All of Surface.	

3.5 Coating Evaluation per ASTM D610

Ratings were assigned to BACC's Metallic Condition Index and ASTM D610 General Rust Grade for painted surfaces. Figure 3-6 shows and example of general rust ratings.
Similar rating scales are available for pinpoint rusting.

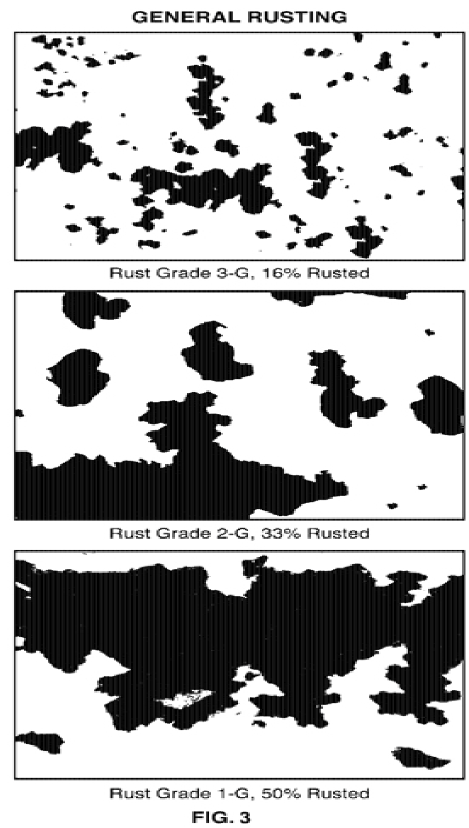


Figure 3-6. ASTM D610 Rust Grade Ratings

4.0 Findings

On March 16, 2021 BACC was onsite to assess the coating condition on Smith Saddle No.2 Reservoir. The weather was sunny and cold at the time of the inspection. Ambient conditions were recorded utilizing an Elcometer 319. The tank had been previously cleaned for inspection. All confined space guidelines were followed, BACC conducted a visual assessment of the assessable areas. This report is prepared based on noted field investigations and the review of existing plans and information furnished by Marin Municipal Water District. The conclusions and recommendations contained within this report are those determined by the coating inspection consultant and are consistent with the best practices identified by AWWA, NACE, ASTM and SSPC.

Type: AWWA D-100 welded carbon steel tank
Year Built: 1963
Diameter: 150' 6"
Hight: 39'-11"
Capacity: 5.0 MG.
Interior:
Lining: Floor and up 25' / Jet set primer/Topcoat Hot mop coal tar enamel
Lining: Shell above 25', roof plates and rafters/ Bitumastic super tank solution
Roof Type: Conical with ½":12 slope

4.1 Interior Roof Plates and Rafters

Photo 4-1. Upper shell/outer bay

Photo 4-2. Metal loss on rafter/outer bay


Photo 4-3. Rafter and bolted support

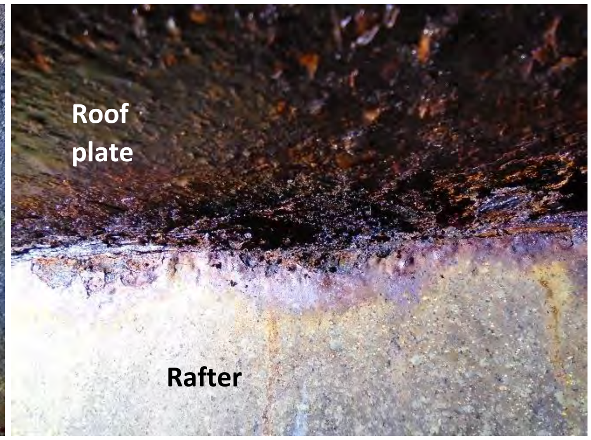


Photo 4-4. Rafter fused to roof plate.

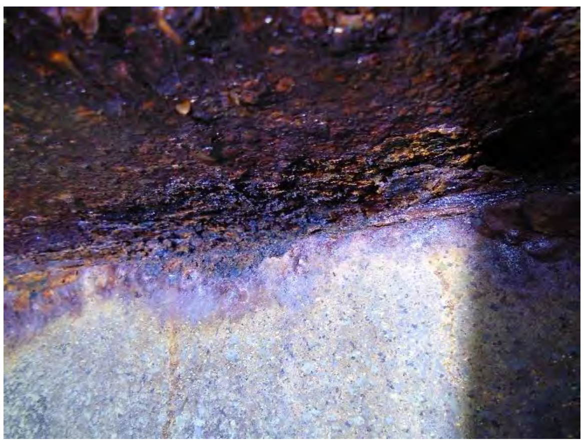


Photo 4-5 Rafter fused to roof plate
.


Photo 4-6 Failed coating. Corrosion where coating has failed


Photo 4-7 Coating and corrosion above shell vents and roof plates


Photo 4-8 Failed coating and corrosion on rafter

Photo 4-9 Photo 4-10

Corrosion and failed coating along rafter lips and rafter stabilizer rods.

Photo 4-11 Failed coating and corrosion on plate overlaps

Photo 4-12Failed coating on supports and roof plates

Photo 4-13 Failed coating roof plates / INT bay

Photo 4-14 Failed coating/ INT Bay


Photo 4-15 Failed coating/ INT bay


Photo 4-16 Failed coating/INT bay


Photo 4-17 Failed coating center bay


Photo 4-18 Failed coating center bay


Photo 4-19 Center bay failed coating

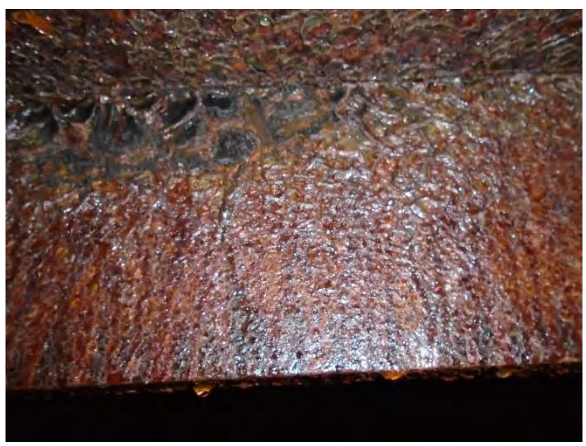


Photo 4-20 Center bay rafters fused to roof plate


Photo 4-21 Failed coating on dollar plate


Photo 4-22 Rafter ends above dollar plate


Photo 4-23 Rafter ends above dollar plate


Photo 4-24 Failed coating on rafters and roof plates


Photo 4-25 Failed coating on roof plates


Photo 4-26 Failed coating on roof plates

4.2 Interior Shell


Photo 4-26 Ladder


Photo 4-27 Fractures and blisters coal tar enamel


Photo 4-28 Blisters and fractures


Photo 4-29 Steel being protected by C/P


Photo 4-30 Under blister steel being protected


Photo 4-31 Corrosion on shell above waterline

4.3 Interior Floor plates


Photo 4-32 Blisters and fractures on floor


Photo 4-33 Blisters and fractures on floor


Photo 4-34 Blisters and fractures on column


Photo 4-35 Blisters and fractures on column base

4.4 Exterior


Photo 4-36 Poorly adhered coating/Mold growth

Photo 4-37 Tub ring ASTM D 3359 / result failed

 Photo 4-37 ASTM D 3359 / Passed	 Photo 4-38 Carbon steel anode covers
 Photo 4-39 Corrosion developing through coating	 Photo 4-40 Corrosion developing through coating
 Photo 4-41 Rocks on roof	 Photo 4-42 Bolt corrosion. No bug screen

Photo 4-43 ASTM 3359 / Failed

Photo 4-44 roof hatch

Photo 4-45 Rock damage on shell

Photo 4-46 rock debris on roof

Photo 4-47 Rock damage on shell

Dry Film Thickness reading Statistics

Floor Dry Film Thickness readings

Statistics	
# Readings	100
Mean	115.9 mils
Maximum	300.42 mils
Minimum	44.5 mils
Standard Deviation (σ)	15.56 mils
Mean + 3σ	39.022 mils
Mean - 3σ	-0.233 mils
Coefficient of Variation	49.7%

Exterior Dry Film Thickness readings

Statistics	
# Readings	100
Mean	16.656 mils
Maximum	34.40 mils
Minimum	8.20 mils
Standard Deviation (σ)	5.786 mils
Mean + 3σ	34.015 mils
Mean - 3σ	-0.703 mils
Coefficient of Variation	34.7%

5.0 Conclusion

5.1 Roof plates, Knuckle, Rafters

The lining system on the roof plates and rafters of the tank is completely failed and should be replaced.

5.2 Shell

The upper shell in the vapor area of the tank could have excessive pitting and along the shell to roof plate interface. The lower area of the shell that are in immersion is being protected by the cathodic protection system. The lining system on the shell plates of the tank is completely failed and should be replaced.

5.3 Floor

The floor plates are protected by the cathodic protection system. The lining system on the floor plates of the tank are completely failed and should be replaced.

5.4 Roof Support Columns

The lower area of the columns that are in immersion is being protected by the cathodic protection system. The lining system on the columns of the tank is completely failed and should be replaced.

5.6 Exterior

The upper shell of the tank is in fair condition except along the walking trail which has excessive rock damage. The coating on the roof due to its age is thinning out and allowing the corrosion to come through the existing coating. The tub ring has been over coated numerous times and is poorly bonded. There is a light coat on the support shell that looks to be a water-based acrylic which is also poorly attached., for this reason over coating is not an option. The exterior coatings will require full removal and replacement.

Please call if you have any questions or if you want to further discuss the information contained in this report.

Respectfully submitted,

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Appendix F

Hazardous Materials Survey Report

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Hazardous Materials Survey Report

Smith Saddle Tanks

Marin Municipal Water District
Glen Drive Access Road, Fairfax, California

Prepared for

Donald L. Barraza, P.E.
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April 22, 2021
ESI Job # 3094

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ACKNOWLEDGMENTS

On March 16 and April 01, 2021, EnviroSurvey, Inc. (ESI) performed a hazardous materials survey of the above ground tanks, known as Smith Saddle Tank #1 and Tank #2 located in the City of Fairfax, California.

The purpose of this survey was to identify the potential presence concentrations of hazardous materials including heavy metals and PCBs by on-site sampling and performing laboratory analysis of suspect materials found throughout the interior and exterior tank components.

The following accredited and certified inspectors performed the inspection and made their corresponding assessments in this Report.

Name: Alex Zebarjadian, MS. Signature Alex R. Zebarjadian Date: 04/22/2021
Cal-OSHA CAC # 93-0928
CDPH Certified Lead Project Monitor # 1693
CSLB-A 790966, Exp 2023

Name: Mazyar Hajiaghai Signature M. Hajiaghai Date: 04/22/2021
CAC No. 14-5253: Exp.:08-13-16
CDPH # I-2754, Exp.:04-19-2017

Name: Andrew Johnson Signature Andrew Johnson Date: 04/22/2021
EPA accredited Asbestos Inspector

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY

This summary is not to be read as a stand-alone document. The report shall be read in its entirety. The reader must review the detailed information provided in the accompanying text. Any interpretation, use, and/or conclusions resulting from the data contained in this report are the responsibility of the reader.

Background

This survey report identified the presence of asbestos-containing materials, lead-containing paint, and hazardous materials such as PCBs and heavy metals found throughout the interior and exterior components of two above 5-Million-gallon storage tank, known as Smith Saddle Tanks, operated by Marin Municipal Water District in the City of Fairfax, California.

Tank Description

The (2) two above ground storage tanks were originally constructed in 1965 of welded steel built on a concrete foundation. Each tank's outside diameter (OD) is approximately 150 feet and height of 40 feet, each with a storage capacity of 5-miilion gallon. The coal/tar interior coating insulation of both tanks was found in old and deteriorating condition. The exterior painted coating was intact and in good condition.

Summary of Results:

Asbestos

No asbestos was found in all interior and exterior bulk samples collected from both Tank #2 and Tank # 1, as analyzed by Polarized Light Microscopy (PLM) EPA/600R/93/116.

Lead in Paint

- Based on the analytical results of paint chip samples, the beige paint/primer on the exterior shell and roof of both is characterized as lead-containing paint with total lead concentration of the exterior paint ranging from 63 to 250 mg/kg. Exterior painted coatings were found intact and in good condition.
- Paint coatings on the interior of roof access hatch were also characterized as Lead-Based Paint with lead concentrations at 8,900 mg/kg (Tank #2) and 5,600 mg/kg (Tank #1), respectively.
- The interior coatings of the roof hatch and ceilings of both Tanks were found severely damaged and in deteriorating condition.

PCB Containing Waste

- Total PCBs at hazardous concentrations of 480 mg/kg and 2,200 mg/kg are present in the coal/tar coating materials of interior floors and interior walls of Tanks 2., respectively.

- PCBs were not detected in the ceiling insulation of Tank #2. Similarly, no PCBs were found in the bulk samples collected from the interior walls and ceilings of Tank #1, as analyzed by EPA 8082 with Reporting Limits (RL) of 0.5 mg/kg.

Heavy Metals

- Elevated concentrations of heavy metals such as arsenic (85 mg/kg), chromium (430 mg/kg), copper (1800 mg/kg), nickel (870 mg/kg) and zinc (940 mg/kg) were found throughout the interior walls and ceiling protective coating of Tank #2.

- Similarly, the interior walls and ceiling of Tank # 1 detected maximum concentrations of arsenic (83 mg/kg), chromium (130 mg/kg), cobalt (190 mg/kg), copper (690 mg/kg) and nickel (520 mg/kg).

Health and Safety Considerations

Due to the presence of hazardous level of PCBs in Tanks #2 and elevated concentration of several heavy metals in the interior coatings of both Tanks, a" Site Specific Health and Safety Plan" shall be in place and implemented during abatement of interior coatings from both Tanks. Waste segregation and profiling will be required to properly characterize the waste for off-site disposal. Recommendations are included in Section 6.4 of the report

Summary Analytical Results are included in **Appendix A.**

1.0 INTRODUCTION

This report presents the results of a comprehensive hazardous materials throughout the accessible interior and exterior components of two large steel tanks, known as Smith Saddle Tank #1 and Tank #2 located in the City of Fairfax, California.

The purpose of the survey was to determine the potential presence, and condition of hazardous materials such as suspect Asbestos Containing Materials (ACM), Lead-Containing Paint (LCP), PCBs, and heavy metals throughout the interior and exterior coatings of the Steel Tanks. This investigation was performed in support of the facility design and upgrades currently undertaken by Kennedy/Jenks Consultants.

Survey for asbestos containing materials (ACMs) was performed in compliance with NESHAP and Cal-OSHA regulations (8 CCR-1529). Similarly, the lead paint survey and sampling were performed in compliance with Cal-OSHA Standards (8 CCR 1532.1). In addition, representative samples of interior tank insulation were collected and analyzed for the potential presence of PCBs and heavy metals to assist the renovation contractor in proper handling and disposal of the waste during the future renovation and upgrade of these Tanks.

Based on the schedule provided by Kennedy/Jenks Consultant, the survey and sampling of Tanks # 2 and Tanks #1 was performed on March 16 and April 01, 2021, respectively.

2.0 TANKS DESCRIPTION

EnviroSurvey, Inc. (ESI) performed a hazardous material inspection of two (2) above-ground storage tanks operated by the Marin Municipal Water District. The tanks are constructed of a welded steel shell built on a concrete foundation. Used to store drinking water, each tank has a storage capacity of approximately 5 million gallons (5 MG). Based on our review of the Technical Specifications, the outside diameter (OD) of each tank is approximately 150 feet with a shell height of 39 feet.

The roof structure is constructed of a steel conical shape with a 1/2: 12 slope and supported by steel columns, girders and rafters. The shells and piping's are covered with beige paint that was found intact but in old condition. The exterior and adjoining pipes and fittings were not part of this survey.

An uncovered steel stairway from the bottom of Tank #1 provides access to the top of the tank and a steel catwalk leads to the top of Tank # 2. Steel hatches located on the top of each tank provide access to the interior of the tanks. At the time of the on-site inspection, Tank # 2 was completely empty and Tank #2 was 90% filled with water.

Based on our review of technical specifications, the interior coating consists of two full coats of Koppers Bitumastic Super Tank Solution over the entire interior surfaces. Bitumus coatings generally consist of coal tar and petroleum base, which are widely used in the water supply industry to protect steel from corrosion. In addition, all galvanized surfaces were pretreated with a Basic Zinc Chromate Washcoat.

Specifications associated with the Tank's interior and exterior coatings are included in **Appendix C.**

3.0 ASBESTOS SURVEY

EPA guidelines under 40 CRF Part 763.86 were used as the basis for sampling procedures. Materials that are visually similar in color, texture, and general appearance are considered homogenous materials.

A total of seven (7) bulk samples of suspect asbestos-containing materials were collected and submitted to the laboratory for analysis. Representative samples of suspect ACMs were collected from the following materials:

- Exterior paint and primer- Steel shells
- Roof Steel Structure- Access Hatch
- Interior coatings- tank's interior walls
- Interior coatings- tank's ceilings
- Interior coating- Tank #2 interior floors

Bulk samples were obtained with the aid of hand tools and placed into individual sampling bags. Sampling tools were cleaned and decontaminated between each sampling event to avoid cross contamination between samples. A Bulk Sampling Log was used to identify each sample based on the type, location, quantity and friability of the suspect material. This log is also used as the Chain of Custody documentation **(Appendix D).**

3.1 Analytical Methodology

Suspect asbestos bulk samples were forwarded to EMSL Analytical Lab (AIHA/NAVLAP accredited) in San Leandro, California for asbestos content analysis using Polarized Light Microscopy (PLM).

PLM analysis was performed by visually observing the bulk samples and preparing slides for microscopic examination and identification. The bulk samples were analyzed for types of asbestos fiber (chrysotile, amosite, crocidolite, anthophyllite, and actinolite / tremolite), and fibrous non-asbestos constituents (mineral wool, paper, etc.).

3.2 Summary of Asbestos Results

Tank # 2 :

On 3/16/21, during the initial phase of the survey, a total of six (6) bulk samples of suspect asbestos containing material were collected from Tank 2 for asbestos analysis. Based on the homogeneity of each material, (3) samples were collected from the interior coal tar coatings and (3) samples from the paint/primer applied on the exterior shell and the roof structure.

No asbestos was found in all (6) bulk samples from Tank #2 submitted to the laboratory, as analyzed by Polarized Light Microscopy (PLM) EPA/600R/93/116.

Tank # 1 :

Similarly, on 4/01/21, ESI collected (7) bulk samples from Tank # 1 for asbestos analysis, including (4) samples of paint /primer from the exterior shell, roof and access hatch and (3) samples of coal/ tar coatings from interior walls and ceiling. At the time of the survey, Tank #1 was 90% filled with water.

No asbestos was detected in all (7) bulk samples from Tank #1, as analyzed by PLM.

Appendix A. Summary Analytical Results Tables
Appendix D. Certified Laboratory Results / Chain of Custody forms

4.0 LEAD CONTAINING PAINT

4.1 Visual Assessment

The investigation was conducted by first identifying paints/coatings on the interior and exterior components that would be impacted during upcoming renovation activities. Paint and painted surfaces on the exterior shell and roof were generally found intact and in fair condition. The coal/tar coatings throughout the interior of the both tanks were found in damaged and deteriorated condition. The coatings on the ceiling of both tanks were severely damaged and appeared in rusty and peeling condition.

4.2 Paint Chip Results

To identify the presence and concentrations of lead in paint, ESI collected a total of (3) paint chip samples of the beige-paint coating from the exterior shell and roof of Tanks #2. Similarly, a total of nine (9) paint chip samples were collected from Tank #1 from the paint coatings on the exterior steel shell, roof structure, access hatch, and the interior wall directly beneath the steel hatch.

After collection, paint chip samples were logged onto the chain of custody form and shipped to the laboratory for lead analysis by Flame Atomic Absorption (AAS). Below is the summary of the total lead concentrations in the paint chip samples collected from the interior and exterior components of both Tanks:

Tank 2	Beige Paint/Primer, Exterior Steel Shell	63 mg/kg	LCP
Tank 2	Beige Paint/Primer, Roof Steel Structure	160 mg/kg	LCP
Tank 2	Grayish/Blue/Beige Paint, Interior Roof Hatch	8,900 mg/kg	LBP
Tank 1	Grayish/Blue/Beige Paint, Interior Steel Hatch	5,600 mg/kg	LBP
Tank 1	Beige Paint/Primer, Wall below the Hatch	250 mg/kg	LCP
Tank 1	Beige Paint/Primer, Roof Steel Structure	160 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Shell, 5th Ring	140 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Shell, 4th Ring	130 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Shell, 3rd Ring	91 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Shell, 2nd Ring	140 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Shell, 1st Ring	120 mg/kg	LCP
Tank 1	Beige Paint/Primer, Exterior Staircase	190 mg/kg	LCP

LCP= Lead-Containing Paint LBP= Lead based Paint (> 5000 mg/kg)

Exterior painted coatings were found intact and in good condition. Paint coatings on the interior ceiling of both Tanks were found in loose and deteriorating condition.

All paint coatings that have detectable concentrations of lead should be treated as lead-containing paint. Compliance with Cal-OSHA Lead Standards(8 CCR 1532.1) and Title 22 Waste Disposal Regulations, will be required, if subject to physical disturbance (Section 6.0).

Appendix A. Summary Asbestos Analytical Results
Appendix B. Site Photos and samples location Map
Appendix D. Certified laboratory results and Chain of Custody

5.0 PCBS AND HEAVY METALS

5.1 Sampling and Visual Observation

During our initial visit on 3/16/2021, Tank #2 was completely empty and accessible. With the assistance of Kennedy Jenks field engineers, ESI collected two (2) grab samples of the coal/tar coatings of each homogeneous material covering the interior steel walls, interior floor, and the ceiling of the Tank #2. The coating on the interior walls and floors was approximately ½ inch thick with visible damages and discoloration but intact condition. The coal/tar and painted coating of the ceiling panels was found severely damaged with rusted metals in deteriorating condition.

On 04/01/2021, ESI's personnel surveyed Tank #1, which was filled with water reaching 5 feet below the interior ceiling. Similarly, representative samples were collected from the coal/tar coatings of the interior walls, interior platform, and the interior ceilings of Tank #1 for laboratory analysis.

Grab samples from both Tanks were logged onto the chain of custody forms and then submitted to an ELAP certified laboratory for compositing and analysis for total PCBs and Heavy Metals, using EPA Methods 8082 and SW 3050/6020, respectively.

5.2 Summary Results

Below are the summary analytical results for PCBs and heavy metals in the Tank's interior coatings:

Tank # 2

- Total PCBs at hazardous concentrations of 480 mg/kg and 2,200 mg/kg are present in the coal/tar coating materials of interior floors and interior walls of Tanks 2., respectively.

- PCBs were not detected in the bulk samples collected from the ceiling coating of Tank #2 at/or above the lab detection limits of 5 mg/l.

- Elevated concentrations of heavy metals such as arsenic (85 mg/kg), chromium (430 mg/kg), copper (1800 mg/kg), nickel (870 mg/kg) and zinc (940 mg/kg) were found throughout the interior walls and ceiling protective coating materials.

- Total concentrations of heavy metals in the samples collected from the walls and ceiling materials of Tank #2 exceeded the 10 x STLC (soluble threshold limits concentrations) threshold limits, suggesting the coating may be characterized as a California Hazardous, if soluble concentrations of the corresponding metals exceed the Title 22 limits.

Tank #1

- No PCBs were detected in the bulk samples collected from all interior protective coatings of Tank #1 at /or above the laboratory reporting limits (RL) of 0.5 mg/L.

- Laboratory results of bulk samples from the interior walls and ceiling of Tank #1 detected maximum concentrations of arsenic (83 mg/kg), chromium (130 mg/kg), cobalt (190 mg/kg), copper (690 mg/kg) and nickel (520 mg/kg).

- Based on the elevated concentration of total metals in the protective coatings of Tank #1 and Tank #2, further analysis of the waste stream by waste extraction test (WET) and analysis for soluble metal (STLC) will be required to properly characterize the waste for disposal.

6.0 RECOMMENDATIONS / RESPONSE ACTIONS

6.1 Asbestos

Based on the results of the survey, no asbestos was found throughout all interior and exterior coatings on both tanks. Other suspect materials discovered during future renovation and/or reconstruction of the tanks must be tested for asbestos content prior to disturbance of the material.

Regardless of the presence of asbestos, a 10-day advanced notification will be required by the Bay Area Air Quality Management District (BAAQMD), if the tank structures are subject to complete demolition.

6.2 Lead

Analytical results of paint chip samples confirmed that lead-containing paint is present in all exterior paint coatings. Lead based paint at concentrations exceeding 5000 mg/kg is found on the painted roof hatches in loose and deteriorated condition. Loose and damaged painted components, when present, require stabilization prior to removal and demolition of said components.

Demolition and disassembly activities directly impacting surfaces containing lead may classify the work into one of the "Trigger Task" categories, as defined by the California Division of Occupational Safety and Health (Cal-OSHA) Standards. Examples of trigger tasks include manual demolition, sanding, grinding, torching, and abrasive blasting.

The contractor must establish a written Lead Compliance Program" in compliance with 8 CCR 1532.1, when disturbing lead containing painted surfaces using Trigger Task Activities.

6.3 PCBs and Heavy Metals

Laboratory results of the composite samples collected from the interior floors and interior walls of Tank #2 revealed hazardous concentrations of PCBs (Polycarbonates Biphenyl). Analytical results also confirmed that the lining on the ceilings of Tank #2 and Tank #1 did not contain any PCBs at/above the laboratory detection limits. However, due to the presence of water in Tank #1, samples could not be collected from the interior lining of the floors and lower interior walls. Therefore, ESI could not evaluate the presence of PCB throughout the floors and the interior walls of Tanks #1.

California's Toxic Substance Control Agency (TSCA) regulatory waste classifications for PCBs is based on ≥ 5 ppm in liquids and/or ≥ 50 ppm in Solid Waste.

In addition, elevated concentration of heavy metals such as arsenic, chromium, copper, nickel and zinc are present throughout all interior coatings, which will contribute to the toxicity of the interior coating waste, when subject to removal.

6.4 Recommendations:

As part of the future Tank's renovation and reconstruction design, due to hazardous concentration of PCBs in Tank #2 and elevated levels of heavy metals in the tank's interior coating, we recommend a comprehensive Health and Safety Plan (HASP) be prepared by the owner or demolition contractor, who is responsible for the health and safety of the construction crew.

The HASP shall contain elements of Cal-OSHA standards pertaining to the health and safety of the workers including but not limited to the following:

- Provide safe entry and exit access to the interior of the Tanks, including training on Confined Space Entry Program.
- Provide a HazWoper trained worker and supervisor for the removal and disposal of all interior coatings from Tank #1 and Tank #2.
- All workers must be fully equipped with PPE including respiratory protection and full protective gear.
- Adequate engineering controls such as proper lighting and ventilation and negative pressure enclosure to provide a minimum of 4 air exchanges every one hour.
- Conduct personal exposure assessment to Airborne PCBs (Arcolor) and heavy metals in compliance with Cal-OSHA standards and permissible exposure limits (PEL).
- During removal of interior lining, provide perimeter air sampling to assess the effectiveness of the contractors engineering controls.
- Provide adequate personal hygiene practices including the decontamination of workers and equipment.
- Segregate the waste generated during renovation and/or reconstruction of the Tanks for proper sampling and characterization of the waste for proper disposal.

If you have any questions about this report or require additional information, please don't hesitate to contact me at (415) 882-4549.

Yours truly,
EnviroSurvey, Inc.

Alex R. Zebarjadian

Alex Zebarjadian, MS.
Project Manager, President

Disclaimer

EnviroSurvey, Inc. (ESI) presents this consultant report, which is based upon site visits or interviews with the client, former site investigations, and abatement records and the laboratory data. No warranties are expressed or implied regarding correctness of the underlying data. ESI provides this report based on information believed to be reliable.

Regarding the contents of this report, ESI assumes no responsibility or liability for any consequential damages arising out of reliance on information in this report.

The contents of this report are based upon interpretation of the information disclosed to ESI, and this information takes into account the ESI consultants' knowledge and experience with similar situations. No other claims are made.

Attachments:

Appendix A	*Summary Analytical Results* *Asbestos, Lead, Heavy Metals, and PCBs*
Appendix B	*Marin Municipal Water District- Smith Saddle Tanks* *Site Plans, Sample Location Maps and Photos*
Appendix C	*Specification -Tank's Interior/Exterior Coatings*
Appendix D	*Certified Analytical Result, Chain of Custody Documentation*

APPENDIX A

Summary Analytical Results

Asbestos, Lead, Heavy Metals, and PCBs

Lead Summary Table
Smith Saddle Tank #1
Glen Dr., Fairfax, CA

Sample ID	Paint Sample Location	Coating/Substrate	Material Color/ ~Quantities SF(1)	Paint Concentration (2)	Cal-OSHA Compliance (3)
3094-Pb01	Roof hatch leading to platform	Paint on metal	Blue/gray / <100	**5,600**	**Y**
3094-Pb02	Interior Coating, Tank #1	Tar/Paint coating on metal	Beige / >10,000	250	Y
3094-Pb03	Roof, near hatch, Tank #1	Paint on metal	Beige / >5,000	150	Y
3094-Pb04	Exterior Shell , 5th ring	Paint on metal	Beige / >10,000	140	Y
3094-Pb05	Exterior Shell , 4th ring	Paint on metal	Beige / >10,000	130	Y
3094-Pb06	Exterior Shell, 3rd ring	Paint on metal	Beige / >10,000	91	Y
3094-Pb07	Exterior Shell, 2nd ring	Paint on metal	Beige / >10,000	140	Y
3094-Pb08	Staircase enclosure	Paint on metal	Beige / 200	190	Y
3094-Pb09	Exterior Shell, 1st ring	Paint on metal	Beige / >10,000	120	Y

Bold =exceeding California Department of Public Health (CDPH) regulatory limits of 5000 mg/kg or 0.5% for lead based paint (LBP)

(1) (Quantities must be field verified).

(2) Analyzed by Flame Atomic Absorption (FL-AA) in accordance with EPA 7000B Rev February 2007.

(3) Requires Compliance with CAL-OSHA (8CCR, 1532.1) "Lead in construction industry"

Y= Yes; N= No SF = Square feet

Lead Summary Table
Smith Saddle Tank #2
Glen Dr., Fairfax, CA

Sample ID	Paint Sample Location	Coating/Substrate	Material Color/ ~Quantities SF[1]	Paint Concentration [2]	Cal-OSHA Compliance [3]
3094-Pb01	Exterior Wall of Tank #2	Paint on metal	Beige / >10,000	<83	N
3094-Pb02	Roof of Tank #2	Paint on metal	Beige / >5,000	160	**N**
3094-Pb03	Steel hatch tank#2	Paint on metal	Blue/gray / <100	**8,900**	**Y**

Bold =exceeding California Department of Public Health (CDPH) regulatory limits of 5000 mg/kg or 0.5% for lead based paint (LBP)

(1) (Quantities must be field verified).

(2) Analyzed by Flame Atomic Absorption (FL-AA) in accordance with EPA 7000B Rev February 2007.

(3) Requires Compliance with CAL-OSHA (8CCR, 1532.1) "Lead in construction industry"

Y= Yes; N= No   SF = Square feet

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Table 1 - Tank Liner Anayltical Results - Metals

MMWD - SMITH SADDLE TANKS

	Sample Number	Description	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium (Total)	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
	Composite Samples	Tank's Interior Coatings	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)	TTLC (mg/kg)
Tank # 1	**01 & 02**	Ceiling	10.0	83.0	ND	ND	ND	130.0	130.0	520.0	ND	ND	29.0	520.0	ND	ND	ND	7.3	ND
	03 & 04	Wall	9.9	83.0	ND	ND	ND	120.0	130.0	510.0	1.1	ND	26.0	490.0	ND	ND	ND	6.8	43.0
	05 & 06	Wall	13.0	130.0	ND	ND	ND	88.0	190.0	690.0	ND	ND	9.3	420.0	ND	ND	ND	5.5	ND
Tank # 2	**01 & 02**	Floor	ND	1.5	21.0	ND	ND	2.3	1.3	4.6	3.9	ND	ND	3.0	ND	ND	ND	3.9	63.0
	03 & 04	Wall	ND	3.7	56.0	ND	1.0	6.0	3.4	16.0	9.5	0.035	0.8	13.0	1.2	ND	ND	10.0	940.0
	05 & 06	Ceiling	27.0	85.0	ND	ND	ND	430.0	94.0	1800.0	8.6	0.063	95.0	870.0	ND	1.1	ND	3.7	19.0
Regulatory Limits	Reporting Limits[1]		0.50	0.50	5.00	0.50	0.50	0.50	0.50	2.50	0.50	0.017	0.50	0.50	0.50	0.50	0.50	0.50	5.00
	Title 22 STLC Limit		15.00	5.00	100.00	0.75	1.00	5.00	80.00	25.00	5.00	0.20	350.00	20.00	1.00	5.00	7.00	24.00	250.00
	10 x Title 22 STLC Limit[2]		75.00	25.00	500.00	3.75	5.00	25.00	400.00	125.00	25.00	1.00	1750.00	100.00	5.00	25.00	35.00	120.00	1250.00
	Title 22 TTLC Limit		500.00	500.00	10000.00	75.00	100.00	2500.00	8000.00	2500.00	1000.00	20.00	3500.00	2000.00	100.00	500.00	700.00	2400.00	5000.00

1) The most frequent RL (Reporting Limit) used for each constituent.

2) Concentrations: Total Thresold Limit Concentration (TTLC) results exceed 10x STLC Limits

Table 2 - Tank Liner Anayltical Results - PCB

MMWD - SMITH SADDLE TANKS

	Sample Number	Description	Aroclor1016	Aroclor1221	Aroclor1232	Aroclor1242	Aroclor1248	Aroclor1254	Aroclor1260	PCBs, total
	Composite Samples	Tank's Interior Coatings	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)	EPA 8082 (mg/kg)
Tank # 1	**01 & 02**	Ceiling	ND	ND	ND	ND	ND	ND	ND	ND
	03 & 04	Wall	ND	ND	ND	ND	ND	ND	ND	ND
	05 & 06	Wall	ND	ND	ND	ND	ND	ND	ND	ND
Tank # 2	**01 & 02**	Floor	ND	ND	ND	ND	ND	480.0	ND	480.0
	03 & 04	Wall	ND	ND	ND	ND	ND	2200.0	ND	2200.0
	05 & 06	Ceiling	ND	ND	ND	ND	ND	ND	ND	ND
Regulatory Limits		Reporting Limits[1]	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		TTLC Limit	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00

1) The most frequent RL (Reporting Limit) used for each constituent.

2) Concentrations: Total Thresold Limit Concentration (TTLC) results exceed Title 22/DTSC Limits

EnviroSurvey Inc.
82 Mary St, San Francisco, CA 94103

Asbestos Summary Table
Smith Saddle Tanks
Glen Dr. Access Rd, Fairfax, CA

Sample ID	Tank Number	Material Type and Description	Sample Location	Approximate Quantity SF (1)	% Asbestos Content (2)
3094-01	Tank #2	Coal tar insulation	Interior walls	>10,000	ND
3094-02	Tank #2	Coal tar insulation	Interior floor	>5,000	ND
3094-03	Tank #2	Coal tar insulation	Interior ceiling	>5,000	ND
3094-04	Tank #2	Pink/beige paint	Exterior wall	>10,000	ND
3094-05	Tank #2	Pink/beige paint	Roof	>5,000	ND
3094-06	Tank #2	Pink/beige paint	Steel hatch on roof	<100	ND
3094-01	Tank #1	Coal tar insulation	Interior ceiling	>5,000	ND
3094-02	Tank #1	Coal tar insulation	Interior walls	>10,000	ND
3094-03	Tank #1	Coal tar insulation	Interior walls	>10,000	ND
3094-04	Tank #1	Beige paint	Roof	>5,000	ND
3094-05	Tank #1	Beige paint	Exterior wall, 4th ring	>10,000	ND
3094-06	Tank #1	Beige paint	Exterior wall, 1st ring	>10,000	ND
3094-07	Tank #1	Beige paint	Hatch door, roof	<100	ND

(1) (Quantities must be field verified).

(2) Analyzed by PLM in accordance with “Method for the Determination of Asbestos in Bulk Building Materials” EPA/600/R-93/116 July 1993.

ND= None Detect

SF =square feet LF=Linear feet

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APPENDIX B

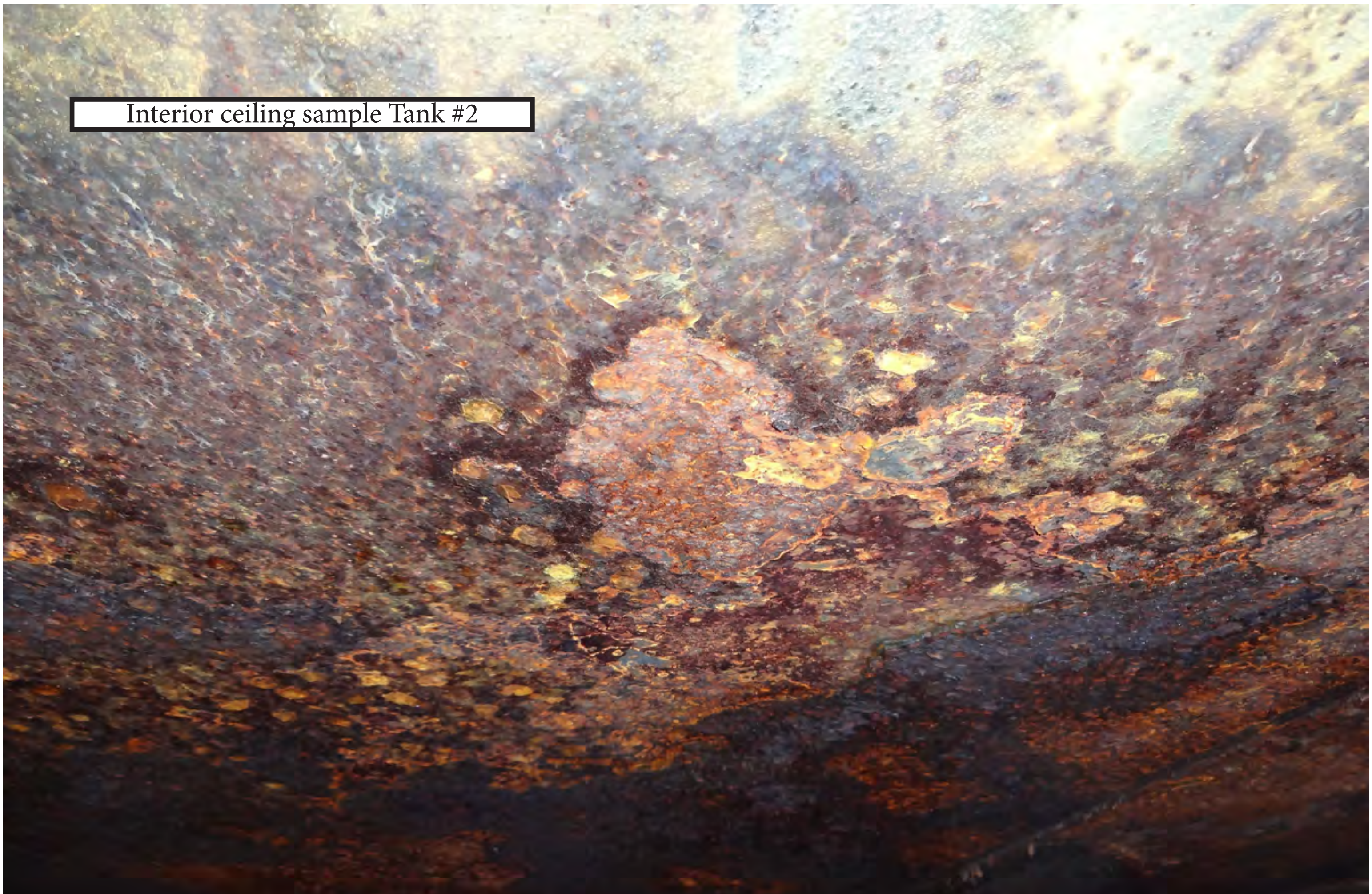
Photos and Sample Location Maps

Exterior Tank #2

Exterior paint sample Tank #2


Interior floor sample Tank #2


Interior wall sample Tank #2

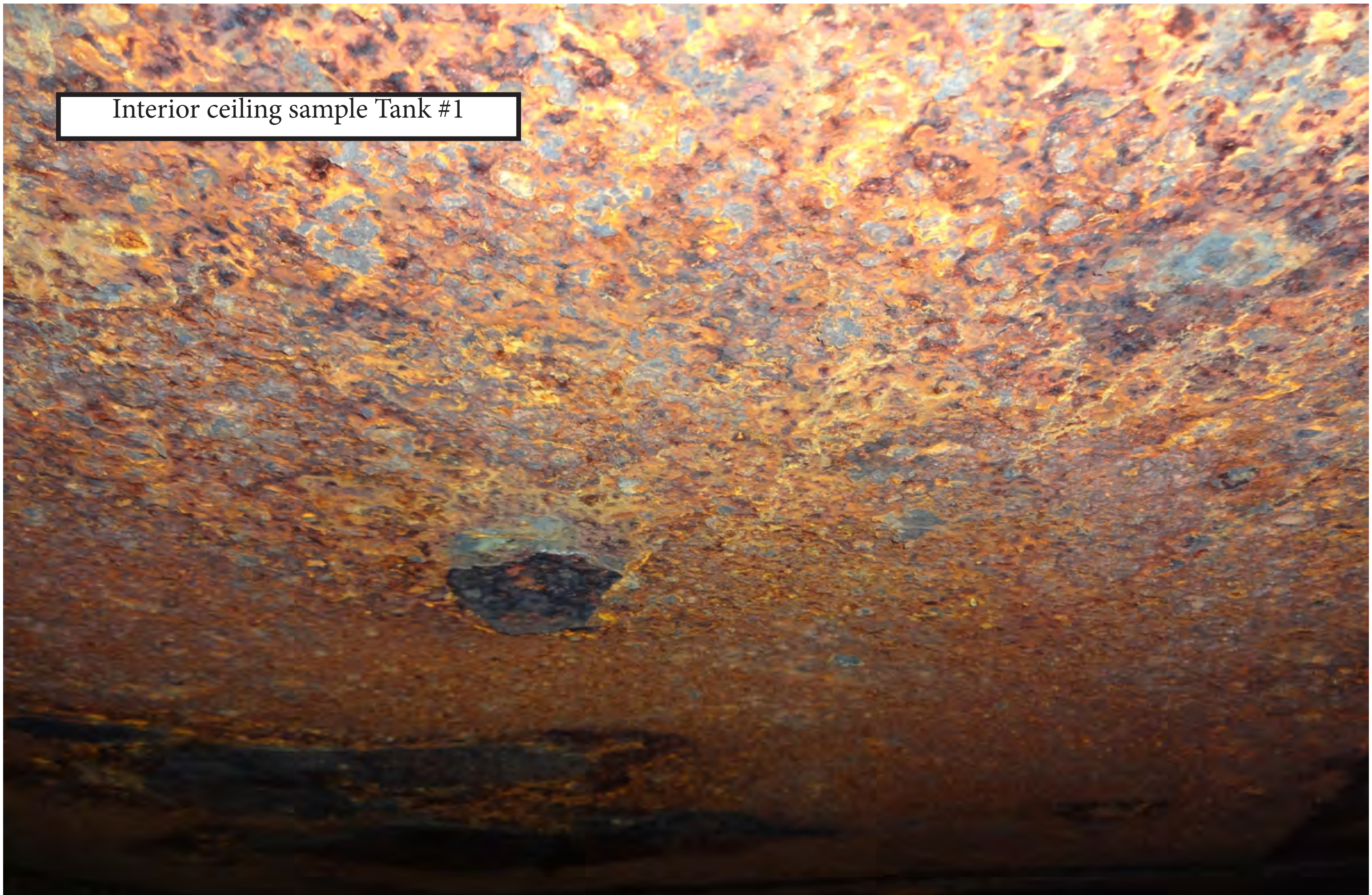

Interior ceiling sample Tank #2


Interior ceiling sample Tank #2
near hatch


Roof of Tank #2


Large hatch to platform on roof of Tank #2.
Lead Based Blue/Gray Paint.

Exterior stair case of Tank #1


Interior ceiling sample Tank #1


Interior ceiling sample Tank #1 with
water level shown

Exterior paint sample Tank #1
5th Ring

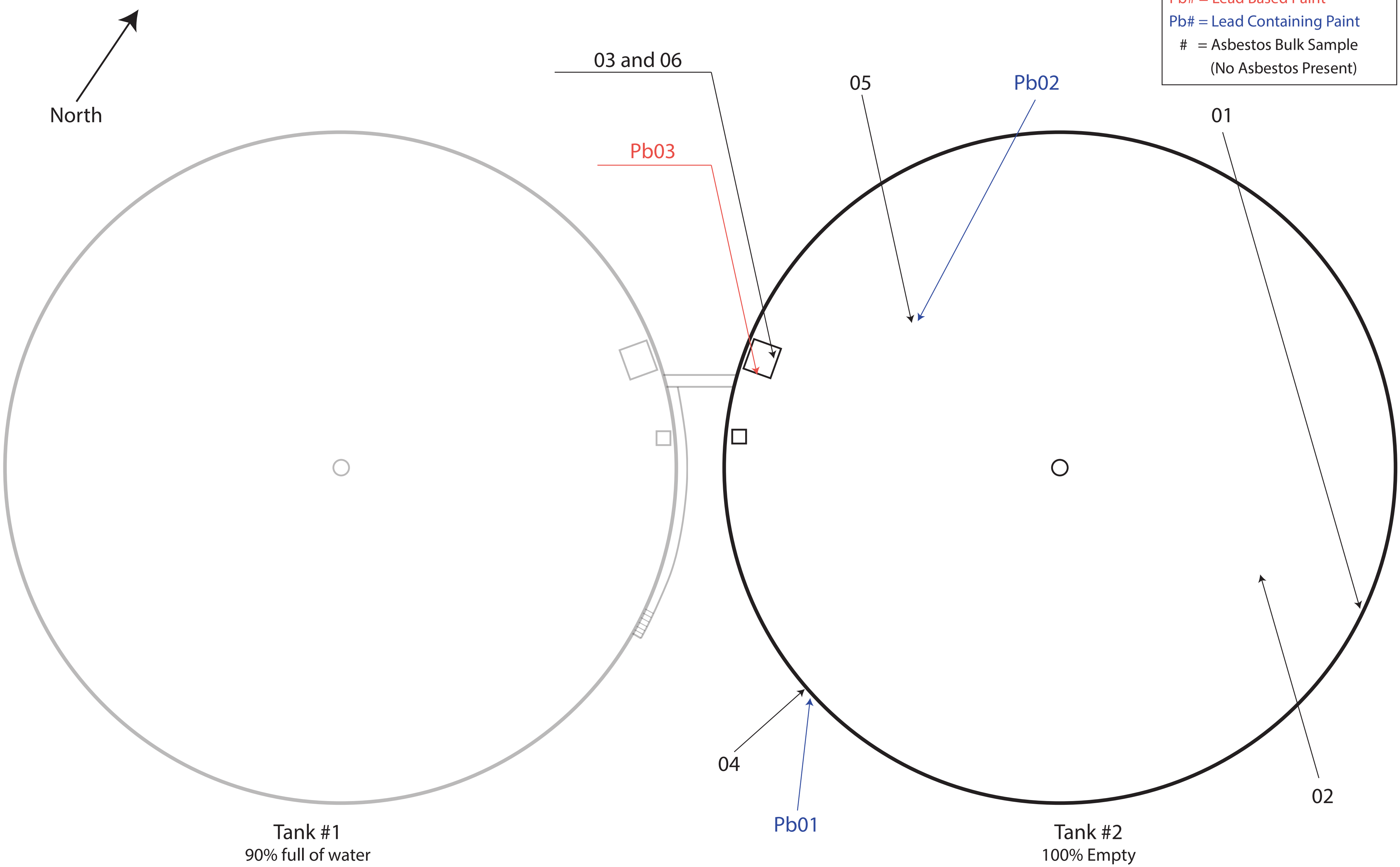
Exterior paint sample Tank #1
1st Ring


Paint sample Pb02 of Tank #1.
Paint on platform support

Tank #2 - Asbestos and Paint Chips Sample Location

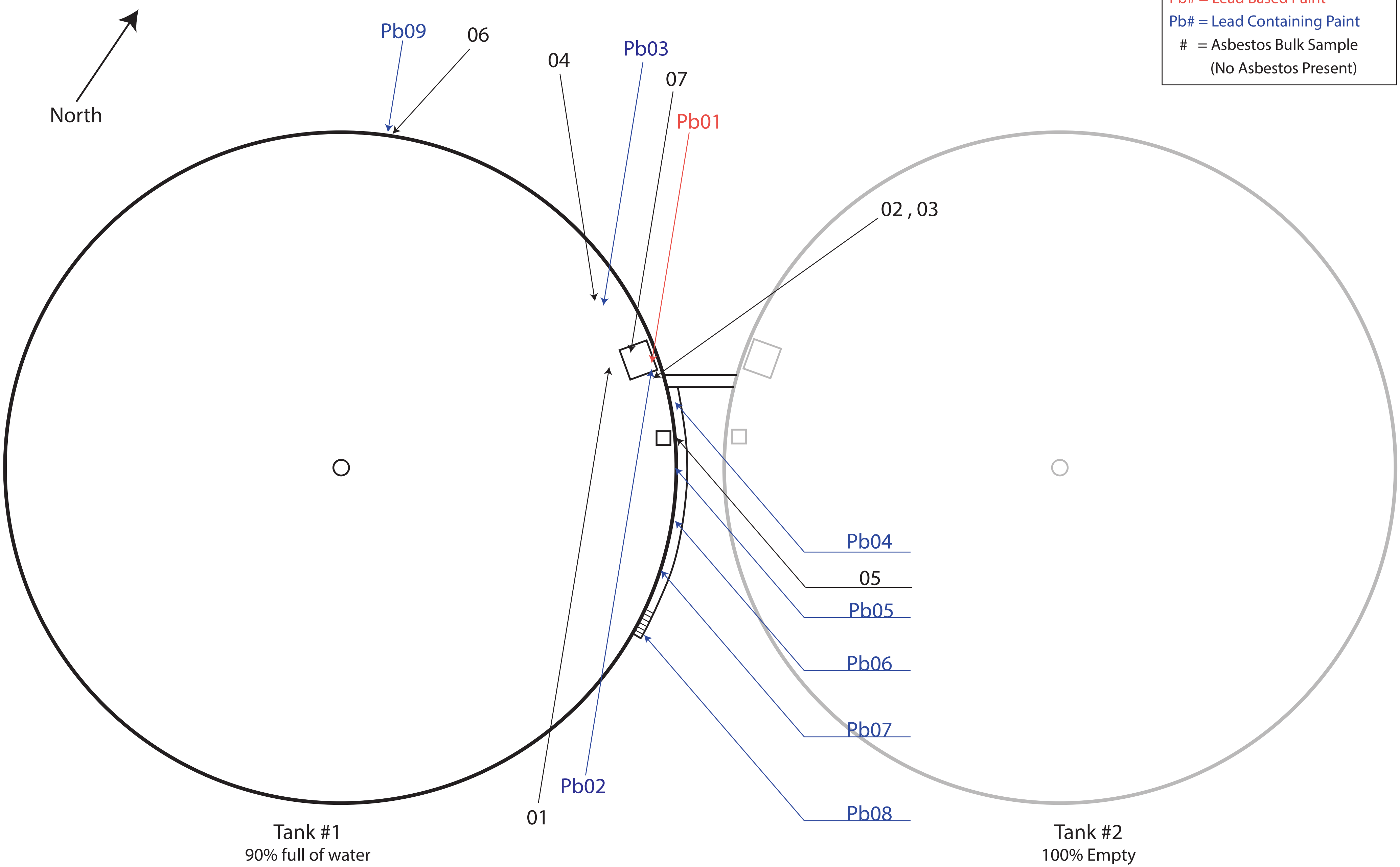
Key

Pb# = Lead Based Paint
Pb# = Lead Containing Paint
\# = Asbestos Bulk Sample
(No Asbestos Present)



ESI	Envirosurvey, Inc 82 Mary Street, San Francsico CA, 94103	Smith Saddle Tanks Fairfax, CA	SAMPLE LOCATION MAPS ARE BASED ON PROVIDED DRAWINGS AND MAY NOT MATCH CURRENT BUILDING LAYOUT	DATE	April 20, 2021	SCALE:	NTS
				DRAWN BY	AJ	ESI JOB NO:	3094
				REVISION NO.		DRAWING:	Based on hand sketch

Tank #1 - Asbestos and Paint Chips Sample Location

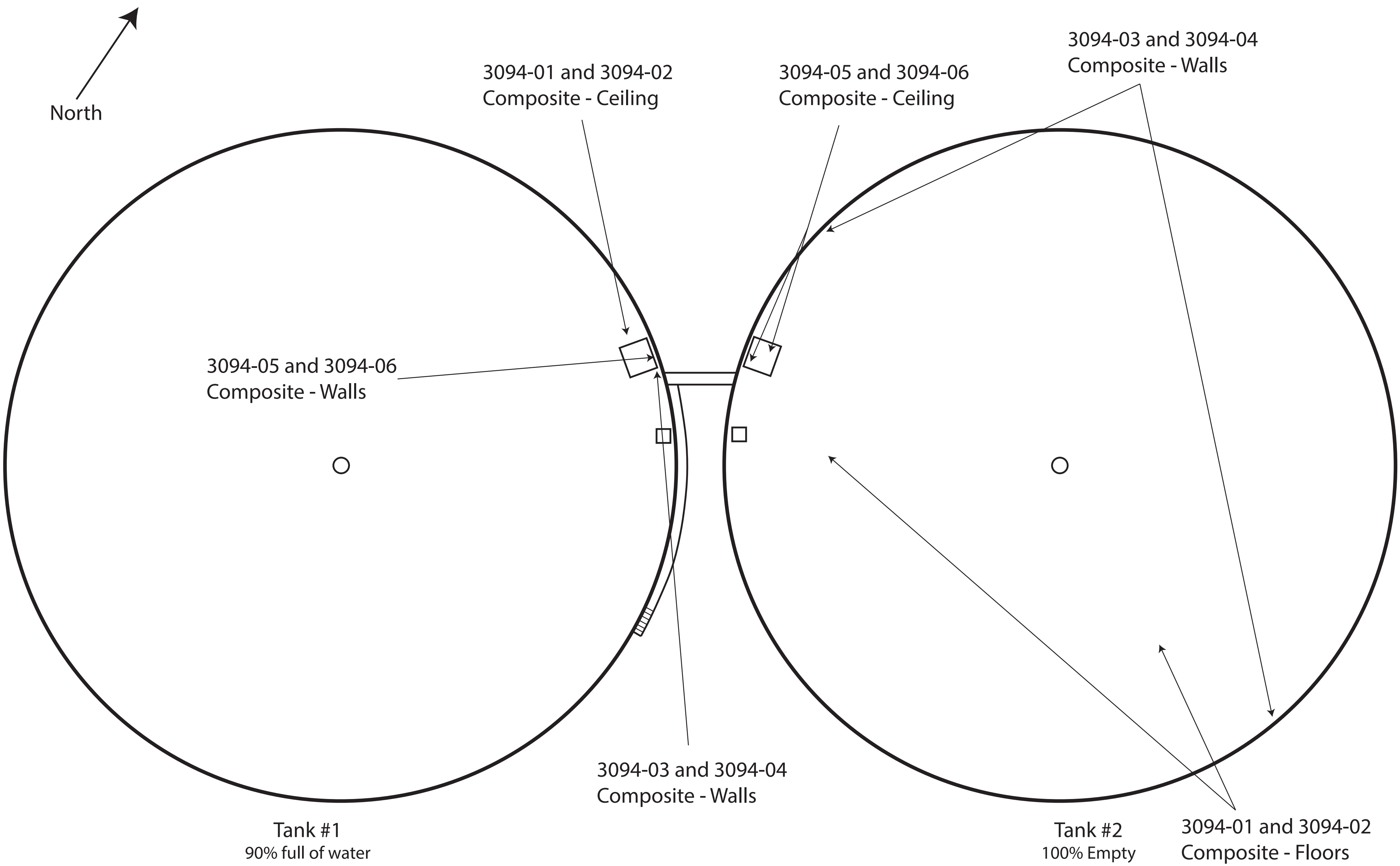


Key

Pb# = Lead Based Paint
Pb# = Lead Containing Paint
\# = Asbestos Bulk Sample
(No Asbestos Present)

ESI	Envirosurvey, Inc 82 Mary Street, San Francsico CA, 94103	Smith Saddle Tanks Fairfax, CA	SAMPLE LOCATION MAPS ARE BASED ON PROVIDED DRAWINGS AND MAY NOT MATCH CURRENT BUILDING LAYOUT	DATE DRAWN BY	April 20, 2021 AJ	SCALE: ESI JOB NO:	NTS 3094
				REVISION NO.		DRAWING:	Based on hand sketch

Tank #1 and #2 - PCBs and Metals Sample Location - Interior Lining



ESI Envirosurvey, Inc 82 Mary Street, San Francsico CA, 94103	Smith Saddle Tanks Fairfax, CA	SAMPLE LOCATION MAPS ARE BASED ON PROVIDED DRAWINGS AND MAY NOT MATCH CURRENT BUILDING LAYOUT	DATE	April 20, 2021	SCALE:	NTS
			DRAWN BY	AJ	ESI JOB NO:	3094
			REVISION NO.		DRAWING:	Based on hand sketch

APPENDIX C

Specifications of Tanks Interior/Exterior Coatings

APPENDIX D

Certified Analytical Results

Chain of Custody Documentation

EMSL Analytical, Inc
464 McCormick Street, San Leandro, CA 94577
Phone/Fax: (510) 895-3675 / (510) 895-3680
http://www.EMSL.com sanleandrolab@emsl.com

EMSL Order: 092103798
CustomerID: ENVI98
CustomerPO:
ProjectID:

Attn: **Alex Zebarjadian**
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103

Phone: (415) 882-4549
Fax:
Received: 3/17/2021 09:15 AM
Collected: 3/16/2021

Project: **3094; MMWD SMITH SADDLES TANKS (TANK #2)**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
3094-PB01	*092103798-0001*	3/16/2021	3/19/2021	0.2424 g	<0.0083 % wt
	Site: PINK/BEIGE PAINT/PRIMER EXTERIOR WALL TANK #2 STEEL SUBSTRATE				
3094-PB02	*092103798-0002*	3/16/2021	3/19/2021	0.167 g	0.016 % wt
	Site: PINK/BEIGE PAINT/PRIMER ROOF TANK #2 STEEL SUBSTRATE				
3094-PB03	*092103798-0003*	3/16/2021	3/19/2021	0.2908 g	0.89 % wt
	Site: BEIGE PAINT/PRIMER STEEL HATCH TANK #2 STEEL SUBSTRATE				

Julian Neagu, Lead Laboratory Manager
or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted.
Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Analytical, Inc San Leandro, CA AIHA-LAP, LLC-ELLAP Accredited #101748

Initial report from 03/19/2021 17:01:50

OrderID: 092103798

092103798

envirosurvey INC.
HEALTH, SAFETY AND ENVIRONMENTAL SERVICES

PAINT CHIPS SAMPLE LOG

82 Mary Street
San Francisco, CA 94103
(415) 882-4549
(Fax) 882-1685

ESI Project #: 3094
Project Name: MMWD Smith Saddles Tanks (Tank #2)
Project Location: Glen Dr. Access Rd, Fairfax CA

Samling Date: 03/16/21
Sampled by: Mazyar Hajiaghai
Analyses requested. FLAA

ITEM	SAMPLE No.	MATERIAL TYPE / BULK SAMPLE LOCATION	Unit No.	MATERIAL CONDITION QUANTITIES /SF.	COMMENTS
	3094-Pb01	Pink/Beige Paint/Primer exterior wall			
		Tank #2 - steel substrate			
	3094-Pb02	Pink/Beige Paint/Primer Roof			
		Tank #2 - steel substrate			
	3094-Pb03	Beige Paint/Primer steel hatch			
		Tank #2 - steel substrate			

SAMPLES SENT TO: ☑ EMSL ☐ Other: ____________

TURN AROUND: ☐ Rush ☐ 24 Hours ☑ 3-5 Days

Relinquished by: Andrew Johnson Signature: [signature] Date/Time: 03/16/21 16:00

Received by: [signature] Signature: ____________ Date/Time: 3/17/21 9:15am PAGE 1 OF 1

E-FX 2

EMSL Analytical, Inc.
464 McCormick Street San Leandro, CA 94577
Tel/Fax: (510) 895-3675 / (510) 895-3680
http://www.EMSL.com / sanleandrolab@emsl.com

EMSL Order: 092103785
Customer ID: ENVI98
Customer PO: 3094
Project ID:

Attention: Alex Zebarjadian
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103

Phone: (415) 882-4549
Fax:
Received Date: 03/17/2021 9:15 AM
Analysis Date: 03/20/2021
Collected Date: 03/16/2021

Project: 3094 - MMWD SMITH SADDLES TANKS (TANK #2) - GLEN DR. ACCESS RD, FAIRFAX CA

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Type
3094-01 *092103785-0001*	TAR INSULATION/ INTERIOR WALLS/ TANK #2	Black Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-02 *092103785-0002*	TAR INSULATION/ INTERIOR FLOOR/ TANK #2	Black Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-03 *092103785-0003*	TAR INSULATION/ INTERIOR CEILING/ TANK #2				Not Analyzed
3094-04-Paint *092103785-0004*	PINK/ BEIGE PAINT/ PRIMER - EXTERIOR WALL - TANK #2 - STEEL SUBSTRATE	Beige Non-Fibrous Homogeneous	5% Cellulose	80% Matrix 15% Non-fibrous (Other)	None Detected
3094-04-Felt *092103785-0004A*	PINK/ BEIGE PAINT/ PRIMER - EXTERIOR WALL - TANK #2 - STEEL SUBSTRATE	White Fibrous Homogeneous	90% Cellulose	10% Non-fibrous (Other)	None Detected
3094-05 *092103785-0005*	PINK/ BEIGE PAINT/ PRIMER - ROOF - TANK #2 STEEL SUBSTRATE	Beige Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-06-Paint *092103785-0006*	PINK/ BEIGE PAINT/ PRIMER - STEEL HATCH - TANK #2 - STEEL SUBSTRATE	Brown/Beige Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-06-Tar *092103785-0006A*	PINK/ BEIGE PAINT/ PRIMER - STEEL HATCH - TANK #2 - STEEL SUBSTRATE	Black Non-Fibrous Homogeneous		5% Ca Carbonate 80% Matrix 15% Non-fibrous (Other)	None Detected

Analyst(s)
David Nguyen (7)

Cecilia Yu, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc San Leandro, CA NVLAP Lab Code 101048-3, WA C884

Initial report from: 03/20/2021 09:34:56

092103785

envirosurvey INC.
HEALTH, SAFETY AND ENVIRONMENTAL SERVICES

BULK MATERIAL SAMPLE LOG

82 Mary Street
San Francisco, CA 94103
(415) 882-4549
(Fax) 882-1685

ESI Project #: 3094
Project Name: MMWD Smith Saddles Tanks (Tank #2)
Project Location: Glen Dr. Access Rd, Fairfax CA

Samling Date: 03/16/21
Sampled by: Mazyar Hajiaghai
Analyses requested PLM

ITEM	SAMPLE No.	MATERIAL TYPE / BULK SAMPLE LOCATION	Unit No.	MATERIAL CONDITION QUANTITIES /SF.	COMMENTS
	3094-01	Tar insulation/interior walls/Tank #2			
	3094-02	Tar insulation/interior floor/Tank #2			
	3094-03	Tar insulation/interior ceiling/Tank #2			
	3094-04	Pink/Beige Paint/Primer exterior wall Tank #2 - steel substrate			
	3094-05	Pink/Beige Paint/Primer Roof Tank #2 - steel substrate			
	3094-06	Beige Paint/Primer Steel hatch Tank #2 - steel substrate			

SAMPLES SENT TO: ☑ EMSL ☐ Other: ______

TURN AROUND: ☐ Rush ☐ 24 Hours ☑ 3-5 Days

Relinquished by: Andrew Johnson Signature: [signature] Date/Time: 03/16/21 15:00

Received by: [signature] Signature: ______ Date/Time: 3/17/21 9:15am PAGE 1 OF 1

E-FY(2)

McCampbell Analytical, Inc.

"When Quality Counts"

Analytical Report

WorkOrder: 2103A66

Report Created for: EnviroSurvey, Inc.

82 Mary Street
San Francisco, CA 94103

Project Contact: Alex Zebarjadian
Project P.O.:
Project: 3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California
Project Received: 03/17/2021

Analytical Report reviewed & approved for release on 03/24/2021 by:

Susan Thompson
Project Manager

The report shall not be reproduced except in full, without the written approval of the laboratory. The analytical results relate only to the items tested. Results reported conform to the most current NELAP standards, where applicable, unless otherwise stated in a case narrative.

Glossary of Terms & Qualifier Definitions

Client: EnviroSurvey, Inc.
Project: 3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California
WorkOrder: 2103A66

Glossary Abbreviation

%D	Serial Dilution Percent Difference
95% Interval	95% Confident Interval
CPT	Consumer Product Testing not NELAP Accredited
DF	Dilution Factor
DI WET	(DISTLC) Waste Extraction Test using DI water
DISS	Dissolved (direct analysis of 0.45 μm filtered and acidified water sample)
DLT	Dilution Test (Serial Dilution)
DUP	Duplicate
EDL	Estimated Detection Limit
ERS	External reference sample. Second source calibration verification.
ITEF	International Toxicity Equivalence Factor
LCS	Laboratory Control Sample
LQL	Lowest Quantitation Level
MB	Method Blank
MB % Rec	% Recovery of Surrogate in Method Blank, if applicable
MDL	Method Detection Limit
ML	Minimum Level of Quantitation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
ND	Not detected at or above the indicated MDL or RL
NR	Data Not Reported due to matrix interference or insufficient sample amount.
PDS	Post Digestion Spike
PDSD	Post Digestion Spike Duplicate
PF	Prep Factor
RD	Relative Difference
RL	Reporting Limit (The RL is the lowest calibration standard in a multipoint calibration.)
RPD	Relative Percent Deviation
RRT	Relative Retention Time
SPK Val	Spike Value
SPKRef Val	Spike Reference Value
SPLP	Synthetic Precipitation Leachate Procedure
ST	Sorbent Tube
TCLP	Toxicity Characteristic Leachate Procedure
TEQ	Toxicity Equivalents
TZA	TimeZone Net Adjustment for sample collected outside of MAI's UTC.
WET (STLC)	Waste Extraction Test (Soluble Threshold Limit Concentration)

Glossary of Terms & Qualifier Definitions

Client: EnviroSurvey, Inc.
Project: 3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California
WorkOrder: 2103A66

Analytical Qualifiers

A	The reported value is determined using a "single point" calibration by GC-ECD as allowed by the method.
S	Surrogate recovery outside accepted recovery limits.
a2	Sample diluted due to cluttered chromatogram.
a3	Sample diluted due to high organic content interfering with quantitative/or qualitative analysis.
c1	Surrogate recovery outside of the control limits due to the dilution of the sample.
h4	Sulfuric acid permanganate (EPA 3665) cleanup

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW3550B
Date Prepared:	03/18/2021	**Analytical Method:**	SW8082
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/02	**2103A66-001A**	**Solid**	**03/15/2021 10:30**	**GC40 03192118.d**	**217634**

Analytes	Result	Qualifiers	RL	DF	Date Analyzed
Aroclor1016	ND		100	200	03/19/2021 11:32
Aroclor1221	ND		100	200	03/19/2021 11:32
Aroclor1232	ND		100	200	03/19/2021 11:32
Aroclor1242	ND		100	200	03/19/2021 11:32
Aroclor1248	ND		100	200	03/19/2021 11:32
Aroclor1254	**480**	A	100	200	03/19/2021 11:32
Aroclor1260	ND		100	200	03/19/2021 11:32
PCBs, total	**480**		100	200	03/19/2021 11:32

Surrogates	REC (%)	Qualifiers	Limits	
Decachlorobiphenyl	393	S	60-130	03/19/2021 11:32

Analyst(s): CN   Analytical Comments: a3,c1,h4

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/04	**2103A66-002A**	**Solid**	**03/15/2021 10:30**	**GC40 03222147.d**	**217634**

Analytes	Result	Qualifiers	RL	DF	Date Analyzed
Aroclor1016	ND		250	500	03/22/2021 22:04
Aroclor1221	ND		250	500	03/22/2021 22:04
Aroclor1232	ND		250	500	03/22/2021 22:04
Aroclor1242	ND		250	500	03/22/2021 22:04
Aroclor1248	ND		250	500	03/22/2021 22:04
Aroclor1254	**2200**	A	250	500	03/22/2021 22:04
Aroclor1260	ND		250	500	03/22/2021 22:04
PCBs, total	**2200**		250	500	03/22/2021 22:04

Surrogates	REC (%)	Qualifiers	Limits	
Decachlorobiphenyl	1049	S	60-130	03/22/2021 22:04

Analyst(s): CN   Analytical Comments: a2,c1

(Cont.)

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW3550B
Date Prepared:	03/18/2021	**Analytical Method:**	SW8082
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/06	**2103A66-003A**	**Solid**	**03/15/2021 10:30**	**GC40 03192138.d**	**217634**

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	5.0	10	03/19/2021 16:12
Aroclor1221	ND	5.0	10	03/19/2021 16:12
Aroclor1232	ND	5.0	10	03/19/2021 16:12
Aroclor1242	ND	5.0	10	03/19/2021 16:12
Aroclor1248	ND	5.0	10	03/19/2021 16:12
Aroclor1254	ND	5.0	10	03/19/2021 16:12
Aroclor1260	ND	5.0	10	03/19/2021 16:12
PCBs, total	ND	5.0	10	03/19/2021 16:12

Surrogates	REC (%)	Limits		
Decachlorobiphenyl	105	60-130		03/19/2021 16:12

Analyst(s): CN Analytical Comments: a3,h4

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW3050B
Date Prepared:	03/18/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/02	2103A66-001A	Solid	03/15/2021 10:30	ICP-MS4 163SMPL.d	217638

Analytes	Result	RL	DF	Date Analyzed
Antimony	ND	0.50	1	03/19/2021 19:41
Arsenic	**1.5**	0.50	1	03/19/2021 19:41
Barium	**21**	5.0	1	03/19/2021 19:41
Beryllium	ND	0.50	1	03/19/2021 19:41
Cadmium	ND	0.50	1	03/19/2021 19:41
Chromium	**2.3**	0.50	1	03/19/2021 19:41
Cobalt	**1.3**	0.50	1	03/19/2021 19:41
Copper	**4.6**	0.50	1	03/19/2021 19:41
Lead	**3.9**	0.50	1	03/19/2021 19:41
Molybdenum	ND	0.50	1	03/19/2021 19:41
Nickel	**3.0**	0.50	1	03/19/2021 19:41
Selenium	ND	0.50	1	03/19/2021 19:41
Silver	ND	0.50	1	03/19/2021 19:41
Thallium	ND	0.50	1	03/19/2021 19:41
Vanadium	**3.9**	0.50	1	03/19/2021 19:41
Zinc	**63**	5.0	1	03/19/2021 19:41

Surrogates	REC (%)	Limits	
Terbium	101	70-130	03/19/2021 19:41

Analyst(s): DB

(Cont.)

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW3050B
Date Prepared:	03/18/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/04	2103A66-002A	Solid	03/15/2021 10:30	ICP-MS4 165SMPL.d	217638

Analytes	Result	RL	DF	Date Analyzed
Antimony	ND	0.50	1	03/19/2021 19:48
Arsenic	**3.7**	0.50	1	03/19/2021 19:48
Barium	**56**	5.0	1	03/19/2021 19:48
Beryllium	ND	0.50	1	03/19/2021 19:48
Cadmium	**0.98**	0.50	1	03/19/2021 19:48
Chromium	**6.0**	0.50	1	03/19/2021 19:48
Cobalt	**3.4**	0.50	1	03/19/2021 19:48
Copper	**16**	0.50	1	03/19/2021 19:48
Lead	**9.5**	0.50	1	03/19/2021 19:48
Molybdenum	**0.83**	0.50	1	03/19/2021 19:48
Nickel	**13**	0.50	1	03/19/2021 19:48
Selenium	**1.2**	0.50	1	03/19/2021 19:48
Silver	ND	0.50	1	03/19/2021 19:48
Thallium	ND	0.50	1	03/19/2021 19:48
Vanadium	**10**	0.50	1	03/19/2021 19:48
Zinc	**940**	5.0	1	03/19/2021 19:48

Surrogates	REC (%)	Limits	
Terbium	101	70-130	03/19/2021 19:48

Analyst(s): DB

(Cont.)

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW3050B
Date Prepared:	03/18/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/Kg

CAM / CCR 17 Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/06	**2103A66-003A**	**Solid**	**03/15/2021 10:30**	**ICP-MS4 167SMPL.d**	**217638**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**27**	0.50	1	03/19/2021 19:55
Arsenic	**85**	0.50	1	03/19/2021 19:55
Barium	ND	5.0	1	03/19/2021 19:55
Beryllium	ND	0.50	1	03/19/2021 19:55
Cadmium	ND	0.50	1	03/19/2021 19:55
Chromium	**430**	0.50	1	03/19/2021 19:55
Cobalt	**94**	0.50	1	03/19/2021 19:55
Copper	**1800**	5.0	10	03/22/2021 15:57
Lead	**8.6**	0.50	1	03/19/2021 19:55
Molybdenum	**95**	0.50	1	03/19/2021 19:55
Nickel	**870**	5.0	10	03/22/2021 15:57
Selenium	ND	0.50	1	03/19/2021 19:55
Silver	**1.1**	0.50	1	03/19/2021 19:55
Thallium	ND	0.50	1	03/19/2021 19:55
Vanadium	**3.7**	0.50	1	03/19/2021 19:55
Zinc	**19**	5.0	1	03/19/2021 19:55

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	102	70-130	03/19/2021 19:55

Analyst(s): DB, MIG

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Received:	03/17/2021 12:35	**Extraction Method:**	SW7471B
Date Prepared:	03/23/2021	**Analytical Method:**	SW7471B
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Unit:**	mg/Kg

Mercury by Cold Vapor Atomic Absorption

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/02	**2103A66-001A**	**Solid**	**03/15/2021 10:30**	**AA1 _15**	**217639**

Analytes	Result	RL	DF	Date Analyzed
Mercury	ND	0.017	1	03/23/2021 15:48

Analyst(s): MIG

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/04	**2103A66-002A**	**Solid**	**03/15/2021 10:30**	**AA1 _26**	**217639**

Analytes	Result	RL	DF	Date Analyzed
Mercury	ND	0.017	1	03/23/2021 16:21

Analyst(s): MIG

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/06	**2103A66-003A**	**Solid**	**03/15/2021 10:30**	**AA1 _27**	**217639**

Analytes	Result	RL	DF	Date Analyzed
Mercury	ND	0.017	1	03/23/2021 16:24

Analyst(s): MIG

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Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Prepared:	03/18/2021	**BatchID:**	217634
Date Analyzed:	03/19/2021	**Extraction Method:**	SW3550B
Instrument:	GC40	**Analytical Method:**	SW8082
Matrix:	Solid	**Unit:**	mg/kg
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Sample ID:**	MB/LCS/LCSD-217634

QC Summary Report for SW8082

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Aroclor1016	ND	0.00510	0.0500	-	-	-
Aroclor1221	ND	0.0110	0.0500	-	-	-
Aroclor1232	ND	0.00630	0.0500	-	-	-
Aroclor1242	ND	0.00670	0.0500	-	-	-
Aroclor1248	ND	0.00400	0.0500	-	-	-
Aroclor1254	ND	0.00680	0.0500	-	-	-
Aroclor1260	ND	0.00610	0.0500	-	-	-
Surrogate Recovery						
Decachlorobiphenyl	0.0489			0.05	98	70-130

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Aroclor1016	0.147	0.147	0.15	98	98	70-130	0.207	20
Aroclor1260	0.146	0.149	0.15	97	100	70-130	2.26	20
Surrogate Recovery								
Decachlorobiphenyl	0.0507	0.0525	0.050	101	105	70-130	3.44	20

Quality Control Report

Client: EnviroSurvey, Inc.
Date Prepared: 03/18/2021
Date Analyzed: 03/19/2021
Instrument: ICP-MS4
Matrix: Soil
Project: 3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California

WorkOrder: 2103A66
BatchID: 217638
Extraction Method: SW3050B
Analytical Method: SW6020
Unit: mg/kg
Sample ID: MB/LCS/LCSD-217638

QC Summary Report for Metals

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Antimony	ND	0.160	0.500	-	-	-
Arsenic	ND	0.150	0.500	-	-	-
Barium	ND	0.570	5.00	-	-	-
Beryllium	ND	0.0730	0.500	-	-	-
Cadmium	ND	0.0940	0.500	-	-	-
Chromium	ND	0.130	0.500	-	-	-
Cobalt	ND	0.0520	0.500	-	-	-
Copper	ND	0.180	0.500	-	-	-
Lead	ND	0.140	0.500	-	-	-
Molybdenum	ND	0.160	0.500	-	-	-
Nickel	ND	0.170	0.500	-	-	-
Selenium	ND	0.150	0.500	-	-	-
Silver	ND	0.120	0.500	-	-	-
Thallium	ND	0.0670	0.500	-	-	-
Vanadium	ND	0.130	0.500	-	-	-
Zinc	ND	3.00	5.00	-	-	-
Surrogate Recovery						
Terbium	518			500	104	70-130

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Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Prepared:	03/18/2021	**BatchID:**	217638
Date Analyzed:	03/19/2021	**Extraction Method:**	SW3050B
Instrument:	ICP-MS4	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/kg
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Sample ID:**	MB/LCS/LCSD-217638

QC Summary Report for Metals

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Antimony	46.5	46.6	50	93	93	75-125	0.163	20
Arsenic	52.0	49.2	50	104	98	75-125	5.55	20
Barium	481	476	500	96	95	75-125	0.952	20
Beryllium	49.8	48.7	50	100	97	75-125	2.31	20
Cadmium	49.7	48.2	50	99	96	75-125	3.08	20
Chromium	50.2	48.1	50	100	96	75-125	4.27	20
Cobalt	48.7	48.3	50	97	97	75-125	0.807	20
Copper	51.3	48.8	50	103	98	75-125	5.13	20
Lead	49.8	48.4	50	100	97	75-125	2.91	20
Molybdenum	49.5	49.3	50	99	99	75-125	0.445	20
Nickel	49.8	47.6	50	100	95	75-125	4.41	20
Selenium	50.0	47.5	50	100	95	75-125	5.09	20
Silver	47.4	46.0	50	95	92	75-125	2.97	20
Thallium	50.2	48.3	50	100	97	75-125	3.84	20
Vanadium	50.0	47.8	50	100	96	75-125	4.44	20
Zinc	503	478	500	101	96	75-125	5.06	20
Surrogate Recovery								
Terbium	501	496	500	100	99	70-130	0.964	20

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Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2103A66
Date Prepared:	03/23/2021	**BatchID:**	217639
Date Analyzed:	03/23/2021	**Extraction Method:**	SW7471B
Instrument:	AA1	**Analytical Method:**	SW7471B
Matrix:	Soil	**Unit:**	mg/Kg
Project:	3094; MMWD-Smith Saddle Tank. S Tank #2 Fairfax, California	**Sample ID:**	MB/LCS/LCSD-217639 2103A66-001AMS/MSD

QC Summary Report for Mercury

Analyte	MB Result	MDL	RL			
Mercury	ND	0.0150	0.0170	-	-	-

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Mercury	0.161	0.157	0.17	97	94	80-120	2.82	20

Analyte	MS DF	MS Result	MSD Result	SPK Val	SPKRef Val	MS %REC	MSD %REC	MS/MSD Limits	RPD	RPD Limit
Mercury	1	0.172	0.164	0.17	ND	103	98	80-120	4.85	20

Analyte	DLT Result	DLTRef Val	%D	%D Limit
Mercury	ND<0.0850	ND	-	-

%D Control Limit applied to analytes with concentrations greater than 25 times the reporting limits.

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CHAIN-OF-CUSTODY RECORD

WorkOrder: 2103A66 **ClientCode: ESSF**

☐ WaterTrax ☐ WriteOn ☐ EDF ☒ EQuIS ☒ Dry-Weight ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag
☒ Detection Summary ☐ Excel

Report to:
Alex Zebarjadian
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103
(415) 882-4549 FAX: (415) 882-1685

Email: alex@envirosurvey.net
cc/3rd Party:
PO:
Project: 3094; MMWD-Smith Saddle Tanks Tank #2 Fairfax, California

Bill to:
Andrew Johnson
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103
andrew@envirosurvey.net

Requested TAT: **5 days;**

Date Received: **03/17/2021**
Date Logged: **03/18/2021**

Lab ID	Client ID	Matrix	Collection Date	Hold	Requested Tests (See legend below) 1	2	3	4	5	6	7	8	9	10	11	12
2103A66-001	3094-01/02	Solid	3/15/2021 10:30	☐	A	A	A	A								
2103A66-002	3094-03/04	Solid	3/15/2021 10:30	☐	A	A	A	A								
2103A66-003	3094-05/06	Solid	3/15/2021 10:30	☐	A	A	A	A								

Test Legend:

1	8082_PCB_Solid	2	CAM17MS_TTLC_Solid	3	HG_S	4	PRDisposal Fee
5		6		7		8	
9		10		11		12	

Project Manager: Angela Rydelius **Prepared by: Lilly Ortiz**

Comments:

NOTE: Soil samples are discarded 60 days after results are reported unless other arrangements are made (Water samples are 30 days).
Hazardous samples will be returned to client or disposed of at client expense.

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WORK ORDER SUMMARY

Client Name: ENVIROSURVEY, INC.
Client Contact: Alex Zebarjadian
Contact's Email: alex@envirosurvey.net

Project: 3094; MMWD-Smith Saddle Tanks Tank #2 Fairfax, California
Comments

Work Order: 2103A66
QC Level: LEVEL 2
Date Logged: 3/18/2021

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ EQuIS ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag

LabID	ClientSampID	Matrix	Test Name	Containers /Composites	Bottle & Preservative	Head Space	Dry-Weight	Collection Date & Time	TAT	Test Due Date	Sediment Content	Hold	SubOut
001A	3094-01/02	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	3/15/2021 10:30	5 days	3/24/2021		☐	
			SW6020 (CAM 17) <Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc>			☐	☐		5 days	3/24/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	3/24/2021		☐	
002A	3094-03/04	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	3/15/2021 10:30	5 days	3/24/2021		☐	
			SW6020 (CAM 17) <Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc>			☐	☐		5 days	3/24/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	3/24/2021		☐	
003A	3094-05/06	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	3/15/2021 10:30	5 days	3/24/2021		☐	
			SW6020 (CAM 17) <Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc>			☐	☐		5 days	3/24/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	3/24/2021		☐	

NOTES: * STLC and TCLP extractions require 2 days to complete; therefore, all TATs begin after the extraction is completed (i.e., One-day TAT yields results in 3 days from sample submission).

- MAI assumes that all material present in the provided sampling container is considered part of the sample - MAI does not exclude any material from the sample prior to sample preparation unless requested in writing by the client.

2103 40

McCampbell Analytical, Inc.
1534 Willo Pass Road
Pittsburg, CA. 94565
((925) 252-9262

CHAIN OF CUSTODY ANALYSIS REQUEST FORM

Project # 2103A06

Custody and Sample Information - Print **ALL** information. Put N/A in blanks not applicable.

Report to:	Bill to:	ESI Project #: 3094
EnviroSurvey Inc. 82 Mary Street San Francisco, CA 94103 phone: (415) 882-4549 fax: (415) 882-1685	SAME	MMWD - SMITH SADDLE TANKS TANK # 2 FAIR FAX, CALIFORNIA.
Sampled by (signature): [signature]	# samples (6)	Date of Shipment: 03/16/2021 · Date results needed: 5 days.

Item No.	Sample Number	Station Location / Description	03/15/21 @ 10:30 Date/Time	Matrix: Water	Matrix: Soil	Matrix: Air	Matrix: Other	# containers	Sample Type g = grab c = composite	PCBs - EPA 8082	CAM 17 Metals - EPA 6000/7000 series	Mercury by Vapor Extraction (SW 846) - EPA 7471 B
1	3094-01 } Compo-site	TANK 2, INT. FLOOR / TAR - East	"						C	✓	✓	✓
2	3094-02	TANK 2, INT. FLOOR / TAR - WEST	"									
3												
4	3094-03 } Composite	TANK 2 - INT / TAR - WALL - EAST	"						C	✓	✓	✓
5	3094-04	TANK 2 - INT / TAR - WALL - WEST	"									
6												
7	3094-05 } Compo-site	TANK 2. INT / TAR - Ceiling	South "						C	✓	✓	✓
8	3094-06	TANK 2. INT / TAR - Ceiling	South "									
9												

Released By: (Signature)	Date / Time Released:	Received By: (Signature)	Date/Time Accepted	Shipped Via:	Condition Noted:
[signature]	LAP 3/17/21 1100	LAP	3/17/21 1100		
LAP	3/17/21 1235	[signature]	3/17/21 1235 D-2nd		

Note: TANK # 2 Interior Insulation Consist of TAR Coating. Exterior Painted over steel.

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http://www.mccampbell.com / E-mail: main@mccampbell.com

Sample Receipt Checklist

Client Name:	**EnviroSurvey, Inc.**	Date and Time Received:	**3/17/2021 12:35**
Project:	**3094; MMWD-Smith Saddle Tanks Tank #2 Fairfax, California**	Date Logged:	**3/18/2021**
		Received by:	Lilly Ortiz
WorkOrder №:	**2103A66** Matrix: Solid	Logged by:	Lilly Ortiz
Carrier:	Lorenzo Perez (MAI Courier)		

Chain of Custody (COC) Information

	Yes	No	NA
Chain of custody present?	✔	☐	
Chain of custody signed when relinquished and received?	✔	☐	
Chain of custody agrees with sample labels?	✔	☐	
Sample IDs noted by Client on COC?	✔	☐	
Date and Time of collection noted by Client on COC?	✔	☐	
Sampler's name noted on COC?	✔	☐	
COC agrees with Quote?	☐	☐	✔

Sample Receipt Information

	Yes	No	NA
Custody seals intact on shipping container/cooler?	☐	☐	✔
Shipping container/cooler in good condition?	✔	☐	
Samples in proper containers/bottles?	✔	☐	
Sample containers intact?	✔	☐	
Sufficient sample volume for indicated test?	✔	☐	

Sample Preservation and Hold Time (HT) Information

	Yes	No	NA
All samples received within holding time?	✔	☐	☐
Samples Received on Ice? (Ice Type: WET ICE)	✔	☐	
Sample/Temp Blank temperature	Temp: 0.2°C		☐
ZHS conditional analyses: VOA meets zero headspace requirement (VOCs, TPHg/BTEX, RSK)?	☐	☐	✔
Sample labels checked for correct preservation?	✔	☐	
pH acceptable upon receipt (Metal: <2; Nitrate 353.2/4500NO3: <2; 522: <4; 218.7: >8)?	☐	☐	✔
UCMR Samples:			
pH tested and acceptable upon receipt (200.8: ≤2; 525.3: ≤4; 530: ≤7; 541: <3; 544: <6.5 & 7.5)?	☐	☐	✔
Free Chlorine tested and acceptable upon receipt (<0.1mg/L)?	☐	☐	✔

Comments:

EMSL Analytical, Inc.

464 McCormick Street San Leandro, CA 94577
Tel/Fax: (510) 895-3675 / (510) 895-3680
http://www.EMSL.com / sanleandrolab@emsl.com

EMSL Order: 092104722
Customer ID: ENVI98
Customer PO: 3094
Project ID:

Attention: Alex Zebarjadian
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103

Phone: (415) 882-4549
Fax:
Received Date: 04/02/2021 9:00 AM
Analysis Date: 04/06/2021
Collected Date: 04/01/2021

Project: 3094 - MMWD SMITH SADDLES TANKS (TANK #1) - GLEN DR. ACCESS RD, FAIRFAX, CA

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
3094-01 *092104722-0001*	COAL TAR PRIMER & ENAMEL/ INTERIOR CEILING/ TANK #1	Rust Non-Fibrous Homogeneous	2% Cellulose	90% Matrix 8% Non-fibrous (Other)	None Detected
3094-02 *092104722-0002*	COAL TAR PRIMER & ENAMEL/ INTERIOR WALL LINING/ TANK #1	Black Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-03 *092104722-0003*	COAL TAR PRIMER & ENAMEL/ INTERIOR WALL LINING/ TANK #1	Black/Rust Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-04-Paint 1 *092104722-0004*	BEIGE PAINT/ ROOT TANK #1/ METAL SUBSTRATE	Beige Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-04-Paint 2 *092104722-0004A*	BEIGE PAINT/ ROOT TANK #1/ METAL SUBSTRATE	Gray Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-05 *092104722-0005*	BEIGE PAINT/ EXTERIOR WALL, 4TH RING, TANK #1/ METAL SUBSTRATE	Gray/Beige Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
Gray and beige paint are inseperable. This is a composite result of both.					
3094-06 *092104722-0006*	BEIGE PAINT/ EXTERIOR WALL, 1ST RING, TANK #1/ METAL SUBSTRATE	Gray/Beige Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
Gray and beige paint are inseperable. This is a composite result of both.					
3094-07-Paint *092104722-0007*	BEIGE PAINT/ HATCH DOOR, TANK #1/ METAL SUBSTRATE	Tan/Black Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected
3094-07-Tar *092104722-0007A*	BEIGE PAINT/ HATCH DOOR, TANK #1/ METAL SUBSTRATE	Black Non-Fibrous Homogeneous		90% Matrix 10% Non-fibrous (Other)	None Detected

Initial report from: 04/06/2021 10:58:43

EMSL Analytical, Inc.
464 McCormick Street San Leandro, CA 94577
Tel/Fax: (510) 895-3675 / (510) 895-3680
http://www.EMSL.com / sanleandrolab@emsl.com

EMSL Order:	092104722
Customer ID:	ENVI98
Customer PO:	3094
Project ID:	

Analyst(s)
Jose Madrid (9)

Cecilia Yu, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc San Leandro, CA NVLAP Lab Code 101048-3, WA C884

Initial report from: 04/06/2021 10:58:43

OrderID: 092104722

envirosurvey INC.
HEALTH, SAFETY AND ENVIRONMENTAL SERVICES

№ 092104722

BULK MATERIAL SAMPLE LOG

82 Mary Street
San Francisco, CA 94103
(415) 882-4549
(Fax) 882-1685

ESI Project #: 3094

Project Name: MMWD Smith Saddles Tanks (Tank #1)

Project Location: Glen Dr. Access Rd, Fairfax CA

Samling Date: 04/01/21

Sampled by: Andrew Johnson/Mazyar H

Analyses requested PLM

ITEM	SAMPLE No.	MATERIAL TYPE / BULK SAMPLE LOCATION	Unit No.	MATERIAL CONDITION QUANTITIES /SF.	COMMENTS
	3094-01	Coal tar primer & enamel / interior lining ceiling / tank #1		5,000,000 gallon tank	deteriorated / rusty
	3094-02	Coal tar primer & enamel / interior wall lining / tank #1		5,000,000 gallon tank	deteriorated / rusty
	3094-03	Coal tar primer & enamel / interior wall lining / tank #1		5,000,000 gallon tank	deteriorated / rusty
	3094-04	Beige paint / roof tank #1 / metal substrate		5,000,000 gallon tank	good condition
	3094-05	Beige paint / exterior wall, 4th ring, tank #1 / metal substrate		5,000,000 gallon tank	good condition
	3094-06	Beige paint / exterior wall, 1st ring, tank #1 / metal substrate		5,000,000 gallon tank	good condition
	3094-07	Beige paint / hatch door, tank #1 / metal substrate		5,000,000 gallon tank	~~good~~ deteriorated condition

SAMPLES SENT TO: ☑ EMSL ☐ Other: ________

TURN AROUND: ☐ Rush ☐ 24 Hours ☑ 3-5 Days

Relinquished by: Andrew Johnson Signature: [signature] Date/Time: 04/01/21

Received by: KO EFX(2) Signature: KO Date/Time: 4/2/21 9:00am PAGE 1 OF 1

EMSL Analytical, Inc
464 McCormick Street, San Leandro, CA 94577
Phone/Fax: (510) 895-3675 / (510) 895-3680
http://www.EMSL.com sanleandrolab@emsl.com

EMSL Order: 092104680
CustomerID: ENVI98
CustomerPO:
ProjectID:

Attn: **Alex Zebarjadian**
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103

Phone: (415) 882-4549
Fax:
Received: 4/2/2021 09:00 AM
Collected: 4/1/2021

Project: **3094 MMWD SMITH SADDLES TANKS TANK #1**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Weight*	*Lead Concentration*
3094-PB01	*092104680-0001*	4/1/2021	4/3/2021	0.2588 g	0.56 % wt
	Site: BEIGE PAINT INTERIOR HATCH DOOR TANK #1				
3094-PB02	*092104680-0002*	4/1/2021	4/3/2021	0.2584 g	0.025 % wt
	Site: BEIGE PAINT INTERIOR WALL TANK #1				
3094-PB03	*092104680-0003*	4/1/2021	4/3/2021	0.2883 g	0.015 % wt
	Site: BEIGE PAINT EXTERIOR ROOF TANK #1				
3094-PB04	*092104680-0004*	4/1/2021	4/3/2021	0.2736 g	0.014 % wt
	Site: BEIGE PAINT EXTERIOR WALL 5TH RING TANK #1				
3094-PB05	*092104680-0005*	4/1/2021	4/3/2021	0.266 g	0.013 % wt
	Site: BEIGE PAINT EXTERIOR WALL 4TH RING TANK #1				
3094-PB06	*092104680-0006*	4/1/2021	4/3/2021	0.2739 g	0.0091 % wt
	Site: BEIGE PAINT EXTERIOR WALL 3RD RING TANK #1				
3094-PB07	*092104680-0007*	4/1/2021	4/3/2021	0.2709 g	0.014 % wt
	Site: BEIGE PAINT EXTERIOR WALL 2ND RING TANK #1				
3094-PB08	*092104680-0008*	4/1/2021	4/3/2021	0.2525 g	0.019 % wt
	Site: BEIGE PAINT STAIRCASE ENCLOSURE TANK #1				
3094-PB09	*092104680-0009*	4/1/2021	4/3/2021	0.2754 g	0.012 % wt
	Site: BEIGE PAINT EXTERIOR WALL 1ST RING TANK #1				

Julian Neagu, Lead Laboratory Manager
or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.
Samples analyzed by EMSL Analytical, Inc San Leandro, CA AIHA-LAP, LLC-ELLAP Accredited #101748

Initial report from 04/03/2021 17:19:41

OrderID: 092104680

092104680

envirosurvey INC.
HEALTH, SAFETY AND ENVIRONMENTAL SERVICES

PAINT CHIPS SAMPLE LOG

82 Mary Street
San Francisco, CA 94103
(415) 882-4549
(Fax) 882-1685

ESI Project #: 3094
Project Name: MMWD Smith Saddles Tanks (Tank #[redacted])
Project Location: Glen Dr. Access Rd, Fairfax CA

Samling Date: 04/01/21
Sampled by: Andrew Johnson
Analyses requested FLAA

ITEM	SAMPLE No.	MATERIAL TYPE / BULK SAMPLE LOCATION	Unit No.	MATERIAL CONDITION QUANTITIES /SF.	COMMENTS
	3094-Pb01	Beige paint / interior hatch door / tank #1 / deteriorated	/ metal substrate		
	3094-Pb02	Beige paint / interior wall / tank #1 / deteriorated	/ metal substrate		
	3094-Pb03	Beige paint / exterior roof / tank #1 / good condition	/ metal substrate		
	3094-Pb04	Beige paint / exterior wall, 5th ring / tank #1 /	good condition	/ metal substrate	
	3094-Pb05	Beige paint / exterior wall, 4th ring / tank #1 /	good condition	/ metal substrate	
	3094-Pb06	Beige paint / exterior wall, 3rd ring / tank #1 /	good condition	/ metal substrate	
	3094-Pb07	Beige paint / exterior wall, 2nd ring / tank #1 /	good condition	/ metal substrate	
	3094-Pb08	Beige Paint / stair case enclosure / tank #1 /	good condition	/ metal substrate	
	3094-Pb09	Beige Paint / exterior wall, 1st ring / tank #1 /	good condition	/ metal substrate	

SAMPLES SENT TO: ☑ EMSL ☐ Other: ________

TURN AROUND: ☐ Rush ☐ 24 Hours ☑ 3-5 Days

Relinquished by: Andrew Johnson Signature: Andrew Date/Time: 4/1/21

Received by: KO FFX(2) Signature: KO Date/Time: 4/2/21 9:00am PAGE 1 OF 1

McCampbell Analytical, Inc.

"When Quality Counts"

Analytical Report

WorkOrder: 2104153

Report Created for: EnviroSurvey, Inc.

82 Mary Street
San Francisco, CA 94103

Project Contact: Alex Zebarjadian
Project P.O.:
Project: 3094; MMWD Smith Saddles Tanks

Project Received: 04/02/2021

Analytical Report reviewed & approved for release on 04/09/2021 by:

Susan Thompson
Project Manager

The report shall not be reproduced except in full, without the written approval of the laboratory. The analytical results relate only to the items tested. Results reported conform to the most current NELAP standards, where applicable, unless otherwise stated in a case narrative.

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http://www.mccampbell.com / E-mail: main@mccampbell.com

Glossary of Terms & Qualifier Definitions

Client: EnviroSurvey, Inc.
Project: 3094; MMWD Smith Saddles Tanks
WorkOrder: 2104153

Glossary Abbreviation

%D	Serial Dilution Percent Difference
95% Interval	95% Confident Interval
CPT	Consumer Product Testing not NELAP Accredited
DF	Dilution Factor
DI WET	(DISTLC) Waste Extraction Test using DI water
DISS	Dissolved (direct analysis of 0.45 μm filtered and acidified water sample)
DLT	Dilution Test (Serial Dilution)
DUP	Duplicate
EDL	Estimated Detection Limit
ERS	External reference sample. Second source calibration verification.
ITEF	International Toxicity Equivalence Factor
LCS	Laboratory Control Sample
LQL	Lowest Quantitation Level
MB	Method Blank
MB % Rec	% Recovery of Surrogate in Method Blank, if applicable
MDL	Method Detection Limit
ML	Minimum Level of Quantitation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
ND	Not detected at or above the indicated MDL or RL
NR	Data Not Reported due to matrix interference or insufficient sample amount.
PDS	Post Digestion Spike
PDSD	Post Digestion Spike Duplicate
PF	Prep Factor
RD	Relative Difference
RL	Reporting Limit (The RL is the lowest calibration standard in a multipoint calibration.)
RPD	Relative Percent Deviation
RRT	Relative Retention Time
SPK Val	Spike Value
SPKRef Val	Spike Reference Value
SPLP	Synthetic Precipitation Leachate Procedure
ST	Sorbent Tube
TCLP	Toxicity Characteristic Leachate Procedure
TEQ	Toxicity Equivalents
TZA	TimeZone Net Adjustment for sample collected outside of MAI's UTC.
WET (STLC)	Waste Extraction Test (Soluble Threshold Limit Concentration)

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Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

Glossary of Terms & Qualifier Definitions

Client: EnviroSurvey, Inc.
Project: 3094; MMWD Smith Saddles Tanks
WorkOrder: 2104153

Analytical Qualifiers

S	Surrogate recovery outside accepted recovery limits.
a3	Sample diluted due to high organic content interfering with quantitative/or qualitative analysis.
c1	Surrogate recovery outside of the control limits due to the dilution of the sample.
h4	Sulfuric acid permanganate (EPA 3665) cleanup

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http://www.mccampbell.com / E-mail: main@mccampbell.com

Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW3550B
Date Prepared:	04/02/2021	**Analytical Method:**	SW8082
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/ 02	2104153-001A	Solid	04/01/2021 10:00	GC40 04062195.d	218657

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	0.50	1	04/07/2021 05:26
Aroclor1221	ND	0.50	1	04/07/2021 05:26
Aroclor1232	ND	0.50	1	04/07/2021 05:26
Aroclor1242	ND	0.50	1	04/07/2021 05:26
Aroclor1248	ND	0.50	1	04/07/2021 05:26
Aroclor1254	ND	0.50	1	04/07/2021 05:26
Aroclor1260	ND	0.50	1	04/07/2021 05:26
PCBs, total	ND	0.50	1	04/07/2021 05:26

Surrogates	REC (%)	Limits	
Decachlorobiphenyl	81	60-130	04/07/2021 05:26

Analyst(s): CN   Analytical Comments: h4

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/ 04	2104153-002A	Solid	04/01/2021 10:00	GC40 04062196.d	218657

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	25	50	04/07/2021 05:40
Aroclor1221	ND	25	50	04/07/2021 05:40
Aroclor1232	ND	25	50	04/07/2021 05:40
Aroclor1242	ND	25	50	04/07/2021 05:40
Aroclor1248	ND	25	50	04/07/2021 05:40
Aroclor1254	ND	25	50	04/07/2021 05:40
Aroclor1260	ND	25	50	04/07/2021 05:40
PCBs, total	ND	25	50	04/07/2021 05:40

Surrogates	REC (%)	Qualifiers	Limits	
Decachlorobiphenyl	164	S	60-130	04/07/2021 05:40

Analyst(s): CN   Analytical Comments: a3,c1,h4

(Cont.)

McCampbell Analytical, Inc.
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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW3550B
Date Prepared:	04/02/2021	**Analytical Method:**	SW8082
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/kg

Polychlorinated Biphenyls (PCBs) Aroclors

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/ 06	**2104153-003A**	**Solid**	**04/01/2021 10:00**	**GC40 04062197.d**	**218708**

Analytes	Result	RL	DF	Date Analyzed
Aroclor1016	ND	0.50	1	04/07/2021 05:54
Aroclor1221	ND	0.50	1	04/07/2021 05:54
Aroclor1232	ND	0.50	1	04/07/2021 05:54
Aroclor1242	ND	0.50	1	04/07/2021 05:54
Aroclor1248	ND	0.50	1	04/07/2021 05:54
Aroclor1254	ND	0.50	1	04/07/2021 05:54
Aroclor1260	ND	0.50	1	04/07/2021 05:54
PCBs, total	ND	0.50	1	04/07/2021 05:54

Surrogates	REC (%)	Limits		
Decachlorobiphenyl	83	60-130		04/07/2021 05:54

Analyst(s): CN   Analytical Comments: h4

McCampbell Analytical, Inc.
"When Quality Counts"
1534 Willow Pass Road, Pittsburg, CA 94565-1701
Toll Free Telephone: (877) 252-9262 / Fax: (925) 252-9269
http://www.mccampbell.com / E-mail: main@mccampbell.com

Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW3050B
Date Prepared:	04/05/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/Kg

Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/ 02	**2104153-001A**	**Solid**	**04/01/2021 10:00**	**ICP-MS4 128SMPL.d**	**218766**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**10**	0.50	1	04/06/2021 11:19
Arsenic	**83**	0.50	1	04/06/2021 11:19
Barium	ND	5.0	1	04/06/2021 11:19
Beryllium	ND	0.50	1	04/06/2021 11:19
Cadmium	ND	0.50	1	04/06/2021 11:19
Chromium	**130**	0.50	1	04/06/2021 11:19
Cobalt	**130**	0.50	1	04/06/2021 11:19
Copper	**520**	2.5	5	04/06/2021 12:46
Lead	ND	0.50	1	04/06/2021 11:19
Molybdenum	**29**	0.50	1	04/06/2021 11:19
Nickel	**520**	2.5	5	04/06/2021 12:46
Selenium	ND	0.50	1	04/06/2021 11:19
Silver	ND	0.50	1	04/06/2021 11:19
Thallium	ND	0.50	1	04/06/2021 11:19
Vanadium	**7.3**	0.50	1	04/06/2021 11:19
Zinc	ND	5.0	1	04/06/2021 11:19

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	103	70-130	04/06/2021 11:19

Analyst(s): JAG

(Cont.)

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW3050B
Date Prepared:	04/05/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/Kg

Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/ 04	**2104153-002A**	**Solid**	**04/01/2021 10:00**	**ICP-MS4 129SMPL.d**	**218766**

Analytes	Result	RL	DF	Date Analyzed
Antimony	**9.9**	0.50	1	04/06/2021 11:23
Arsenic	**83**	0.50	1	04/06/2021 11:23
Barium	ND	5.0	1	04/06/2021 11:23
Beryllium	ND	0.50	1	04/06/2021 11:23
Cadmium	ND	0.50	1	04/06/2021 11:23
Chromium	**120**	0.50	1	04/06/2021 11:23
Cobalt	**130**	0.50	1	04/06/2021 11:23
Copper	**510**	2.5	5	04/06/2021 12:49
Lead	**1.1**	0.50	1	04/06/2021 11:23
Molybdenum	**26**	0.50	1	04/06/2021 11:23
Nickel	**490**	2.5	5	04/06/2021 12:49
Selenium	ND	0.50	1	04/06/2021 11:23
Silver	ND	0.50	1	04/06/2021 11:23
Thallium	ND	0.50	1	04/06/2021 11:23
Vanadium	**6.8**	0.50	1	04/06/2021 11:23
Zinc	**43**	5.0	1	04/06/2021 11:23

Surrogates	REC (%)	Limits	
Terbium	100	70-130	04/06/2021 11:23

Analyst(s): JAG

(Cont.)

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW3050B
Date Prepared:	04/05/2021	**Analytical Method:**	SW6020
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/Kg

Metals

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/ 06	2104153-003A	Solid	04/01/2021 10:00	ICP-MS4 130SMPL.d	218766

Analytes	Result	RL	DF	Date Analyzed
Antimony	**13**	0.50	1	04/06/2021 11:26
Arsenic	**130**	0.50	1	04/06/2021 11:26
Barium	ND	5.0	1	04/06/2021 11:26
Beryllium	ND	0.50	1	04/06/2021 11:26
Cadmium	ND	0.50	1	04/06/2021 11:26
Chromium	**88**	0.50	1	04/06/2021 11:26
Cobalt	**190**	0.50	1	04/06/2021 11:26
Copper	**690**	2.5	5	04/06/2021 12:53
Lead	ND	0.50	1	04/06/2021 11:26
Molybdenum	**9.3**	0.50	1	04/06/2021 11:26
Nickel	**420**	0.50	1	04/06/2021 11:26
Selenium	ND	0.50	1	04/06/2021 11:26
Silver	ND	0.50	1	04/06/2021 11:26
Thallium	ND	0.50	1	04/06/2021 11:26
Vanadium	**5.5**	0.50	1	04/06/2021 11:26
Zinc	ND	5.0	1	04/06/2021 11:26

Surrogates	REC (%)	Limits	Date Analyzed
Terbium	103	70-130	04/06/2021 11:26

Analyst(s): JAG

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Analytical Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Received:	04/02/2021 15:10	**Extraction Method:**	SW7471B
Date Prepared:	04/07/2021	**Analytical Method:**	SW7471B
Project:	3094; MMWD Smith Saddles Tanks	**Unit:**	mg/Kg

Mercury by Cold Vapor Atomic Absorption

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-01/ 02	**2104153-001A**	**Solid**	**04/01/2021 10:00**	**AA1 _44**	**218210**

Analytes	Result	RL	DF	Date Analyzed
Mercury	ND	0.017	1	04/07/2021 16:51

Analyst(s): MIG

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-03/ 04	**2104153-002A**	**Solid**	**04/01/2021 10:00**	**AA1 _45**	**218210**

Analytes	Result	RL	DF	Date Analyzed
Mercury	**0.035**	0.017	1	04/07/2021 16:54

Analyst(s): MIG

Client ID	Lab ID	Matrix	Date Collected	Instrument	Batch ID
3094-05/ 06	**2104153-003A**	**Solid**	**04/01/2021 10:00**	**AA1 _46**	**218210**

Analytes	Result	RL	DF	Date Analyzed
Mercury	**0.063**	0.017	1	04/07/2021 16:57

Analyst(s): MIG

Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Prepared:	04/02/2021	**BatchID:**	218657
Date Analyzed:	04/05/2021 - 04/06/2021	**Extraction Method:**	SW3550B
Instrument:	GC22	**Analytical Method:**	SW8082
Matrix:	Soil	**Unit:**	mg/kg
Project:	3094; MMWD Smith Saddles Tanks	**Sample ID:**	MB/LCS/LCSD-218657

QC Summary Report for SW8082

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Aroclor1016	ND	0.00510	0.0500	-	-	-
Aroclor1221	ND	0.0110	0.0500	-	-	-
Aroclor1232	ND	0.00630	0.0500	-	-	-
Aroclor1242	ND	0.00670	0.0500	-	-	-
Aroclor1248	ND	0.00400	0.0500	-	-	-
Aroclor1254	ND	0.00680	0.0500	-	-	-
Aroclor1260	ND	0.00610	0.0500	-	-	-
Surrogate Recovery						
Decachlorobiphenyl	0.0499			0.05	100	70-130

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Aroclor1016	0.156	0.158	0.15	104	105	70-130	0.867	20
Aroclor1260	0.146	0.146	0.15	97	97	70-130	0.0800	20
Surrogate Recovery								
Decachlorobiphenyl	0.0516	0.0497	0.050	103	99	70-130	3.66	20

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Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Prepared:	04/02/2021	**BatchID:**	218708
Date Analyzed:	04/05/2021 - 04/06/2021	**Extraction Method:**	SW3550B
Instrument:	GC22	**Analytical Method:**	SW8082
Matrix:	Soil	**Unit:**	mg/kg
Project:	3094; MMWD Smith Saddles Tanks	**Sample ID:**	MB/LCS/LCSD-218708

QC Summary Report for SW8082

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Aroclor1016	ND	0.00510	0.0500	-	-	-
Aroclor1221	ND	0.0110	0.0500	-	-	-
Aroclor1232	ND	0.00630	0.0500	-	-	-
Aroclor1242	ND	0.00670	0.0500	-	-	-
Aroclor1248	ND	0.00400	0.0500	-	-	-
Aroclor1254	ND	0.00680	0.0500	-	-	-
Aroclor1260	ND	0.00610	0.0500	-	-	-
Surrogate Recovery						
Decachlorobiphenyl	0.0453			0.05	91	70-130

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Aroclor1016	0.160	0.158	0.15	107	106	70-130	1.40	20
Aroclor1260	0.157	0.153	0.15	105	102	70-130	2.61	20
Surrogate Recovery								
Decachlorobiphenyl	0.0514	0.0504	0.050	103	101	70-130	2.07	20

Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Prepared:	04/05/2021	**BatchID:**	218766
Date Analyzed:	04/05/2021	**Extraction Method:**	SW3050B
Instrument:	ICP-MS3	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/kg
Project:	3094; MMWD Smith Saddles Tanks	**Sample ID:**	MB/LCS/LCSD-218766

QC Summary Report for Metals

Analyte	MB Result	MDL	RL	SPK Val	MB SS %REC	MB SS Limits
Antimony	ND	0.160	0.500	-	-	-
Arsenic	ND	0.150	0.500	-	-	-
Barium	ND	0.570	5.00	-	-	-
Beryllium	ND	0.0730	0.500	-	-	-
Cadmium	ND	0.0940	0.500	-	-	-
Chromium	ND	0.130	0.500	-	-	-
Cobalt	ND	0.0520	0.500	-	-	-
Copper	ND	0.180	0.500	-	-	-
Lead	ND	0.140	0.500	-	-	-
Molybdenum	ND	0.160	0.500	-	-	-
Nickel	ND	0.170	0.500	-	-	-
Selenium	ND	0.150	0.500	-	-	-
Silver	ND	0.120	0.500	-	-	-
Thallium	ND	0.0670	0.500	-	-	-
Vanadium	ND	0.130	0.500	-	-	-
Zinc	ND	3.00	5.00	-	-	-
Surrogate Recovery						
Terbium	495			500	99	70-130

(Cont.)

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Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Prepared:	04/05/2021	**BatchID:**	218766
Date Analyzed:	04/05/2021	**Extraction Method:**	SW3050B
Instrument:	ICP-MS3	**Analytical Method:**	SW6020
Matrix:	Soil	**Unit:**	mg/kg
Project:	3094; MMWD Smith Saddles Tanks	**Sample ID:**	MB/LCS/LCSD-218766

QC Summary Report for Metals

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Antimony	45.0	45.9	50	90	92	75-125	2.05	20
Arsenic	47.7	47.6	50	95	95	75-125	0.105	20
Barium	441	445	500	88	89	75-125	0.835	20
Beryllium	44.5	45.2	50	89	90	75-125	1.67	20
Cadmium	45.6	46.0	50	91	92	75-125	0.873	20
Chromium	45.6	45.6	50	91	91	75-125	0.0219	20
Cobalt	42.8	43.4	50	86	87	75-125	1.46	20
Copper	48.0	47.6	50	96	95	75-125	0.816	20
Lead	46.1	46.6	50	92	93	75-125	0.928	20
Molybdenum	45.2	45.8	50	90	92	75-125	1.47	20
Nickel	47.8	47.4	50	96	95	75-125	0.841	20
Selenium	47.9	47.5	50	96	95	75-125	0.839	20
Silver	44.7	45.3	50	89	91	75-125	1.22	20
Thallium	43.7	44.0	50	87	88	75-125	0.661	20
Vanadium	45.7	45.9	50	91	92	75-125	0.459	20
Zinc	475	474	500	95	95	75-125	0.148	20
Surrogate Recovery								
Terbium	485	495	500	97	99	70-130	2.00	20

Quality Control Report

Client:	EnviroSurvey, Inc.	**WorkOrder:**	2104153
Date Prepared:	04/07/2021	**BatchID:**	218210
Date Analyzed:	04/07/2021	**Extraction Method:**	SW7471B
Instrument:	AA1	**Analytical Method:**	SW7471B
Matrix:	Soil	**Unit:**	mg/Kg
Project:	3094; MMWD Smith Saddles Tanks	**Sample ID:**	MB/LCS/LCSD-218210

QC Summary Report for Mercury

Analyte	MB Result	MDL	RL			
Mercury	ND	0.0150	0.0170	-	-	-

Analyte	LCS Result	LCSD Result	SPK Val	LCS %REC	LCSD %REC	LCS/LCSD Limits	RPD	RPD Limit
Mercury	0.161	0.154	0.17	96	92	80-120	4.63	20

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(925) 252-9262

CHAIN-OF-CUSTODY RECORD

WorkOrder: 2104153 **ClientCode: ESSF**

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ EQuIS ☐ Dry-Weight ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag
☐ Detection Summary ☐ Excel

Report to:
Alex Zebarjadian
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103
(415) 882-4549 FAX: (415) 882-1685

Email: alex@envirosurvey.net
cc/3rd Party:
PO:
Project: 3094; MMWD Smith Saddles Tanks

Bill to:
Andrew Johnson
EnviroSurvey, Inc.
82 Mary Street
San Francisco, CA 94103
andrew@envirosurvey.net

Requested TAT: 5 days;

Date Received: 04/02/2021
Date Logged: 04/02/2021

Lab ID	Client ID	Matrix	Collection Date	Hold	Requested Tests (See legend below) 1	2	3	4	5	6	7	8	9	10	11	12
2104153-001	3094-01/ 02	Solid	4/1/2021 10:00	☐	A	A	A	A								
2104153-002	3094-03/ 04	Solid	4/1/2021 10:00	☐	A	A	A	A								
2104153-003	3094-05/ 06	Solid	4/1/2021 10:00	☐	A	A	A	A								

Test Legend:

1	8082_PCB_Solid	2	CAM17MS_TTLC_S	3	HG_S	4	PRDisposal Fee
5		6		7		8	
9		10		11		12	

Project Manager: Angela Rydelius

Prepared by: Agustina Venegas

Comments:

NOTE: Soil samples are discarded 60 days after results are reported unless other arrangements are made (Water samples are 30 days).
Hazardous samples will be returned to client or disposed of at client expense.

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WORK ORDER SUMMARY

Client Name: ENVIROSURVEY, INC.
Project: 3094; MMWD Smith Saddles Tanks
Work Order: 2104153
Client Contact: Alex Zebarjadian
QC Level: LEVEL 2
Contact's Email: alex@envirosurvey.net
Comments
Date Logged: 4/2/2021

☐ WaterTrax ☐ WriteOn ☐ EDF ☐ Excel ☐ EQuIS ☑ Email ☐ HardCopy ☐ ThirdParty ☐ J-flag

LabID	ClientSampID	Matrix	Test Name	Containers /Composites	Bottle & Preservative	Head Space	Dry-Weight	Collection Date & Time	TAT	Test Due Date	Sediment Content	Hold	SubOut
001A	3094-01/ 02	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	4/1/2021 10:00	5 days	4/9/2021		☐	
			SW6020 (CAM 17)			☐	☐		5 days	4/9/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	4/9/2021		☐	
002A	3094-03/ 04	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	4/1/2021 10:00	5 days	4/9/2021		☐	
			SW6020 (CAM 17)			☐	☐		5 days	4/9/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	4/9/2021		☐	
003A	3094-05/ 06	Solid	SW7471B (Mercury)	2 / (2:1)	4OZ GJ, Unpres	☐	☐	4/1/2021 10:00	5 days	4/9/2021		☐	
			SW6020 (CAM 17)			☐	☐		5 days	4/9/2021		☐	
			SW8082 (PCBs Only)			☐	☐		5 days	4/9/2021		☐	

NOTES: * STLC and TCLP extractions require 2 days to complete; therefore, all TATs begin after the extraction is completed (i.e., One-day TAT yields results in 3 days from sample submission).

- MAI assumes that all material present in the provided sampling container is considered part of the sample - MAI does not exclude any material from the sample prior to sample preparation unless requested in writing by the client.

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(925)-252-9269

CHAIN OF CUSTODY ANALYSIS REQUEST FORM

2104153

Project # ________

Custody and Sample Information - Print **ALL** information. Put N/A in blanks not applicable.

Report to:	Bill to:	ESI Project #: 3094
EnviroSurvey Inc. 82 Mary Street San Francisco, CA 94103 phone: (415) 882-4549 fax: (415) 882-1685	SAME	MMWD Smith Saddles Tanks Tank #1 Fairfax, CA
Sampled by (signature): [signature]	# samples: 6	Date of Shipment: 04/02/21 — Date results needed: 3-5 day

Item No.	Sample Number	Station Location / Description	Date/Time 04/01/21 @10:00	Water	Soil	Air	Other	# containers	Sample Type g = grab c = composite	Mercury by Vapor Extraction (SW 846) EPA 7471B	Cam 17 Metals - EPA 6000/7000	PCBs EPA Method 8082
1	3094-01 } composite	Tank 1, ceiling, coal tar primer & enamel	"				✓	→				
2	3094-02	Tank 1, ceiling, coal tar primer & enamel	"				✓	→	C	✓	✓	✓
3												
4	3094-03 } composite	Tank 1, wall lining, coal tar primer & enamel	"					→				
5	3094-04	PLATFORM WALLS / SUPPORT.	"					→	C	✓	✓	✓
6												
7	3094-05 } composite	Tank 1, wall lining coal tar primer & enamel	"					→				
8	3094-06	TANK Interior wall	"					→	C	✓	✓	✓
9												

Released By: (Signature)	Date / Time Released:	Received By: (Signature)	Date/Time Accepted	Shipped Via:	Condition Noted:
[signature]	04/01/21 @ 14:00	IAP	4/2/21 1040		
IAP	4/2/21 1510	[signature]	4/2/2021/1510		

Note: TANK #1 Interior TAR Insulation appeared old / Deteriorated.

2.0C° WET

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Sample Receipt Checklist

Client Name:	**EnviroSurvey, Inc.**	Date and Time Received	**4/2/2021 15:10**
Project:	**3094; MMWD Smith Saddles Tanks**	Date Logged:	**4/2/2021**
		Received by:	Agustina Venegas
WorkOrder №:	**2104153** Matrix: Solid	Logged by:	Agustina Venegas
Carrier:	Lorenzo Perez (MAI Courier)		

Chain of Custody (COC) Information

	Yes	No	NA
Chain of custody present?	☑	☐	
Chain of custody signed when relinquished and received?	☑	☐	
Chain of custody agrees with sample labels?	☑	☐	
Sample IDs noted by Client on COC?	☑	☐	
Date and Time of collection noted by Client on COC?	☑	☐	
Sampler's name noted on COC?	☑	☐	
COC agrees with Quote?	☐	☐	☑

Sample Receipt Information

	Yes	No	NA
Custody seals intact on shipping container/cooler?	☐	☐	☑
Shipping container/cooler in good condition?	☑	☐	
Samples in proper containers/bottles?	☑	☐	
Sample containers intact?	☑	☐	
Sufficient sample volume for indicated test?	☑	☐	

Sample Preservation and Hold Time (HT) Information

	Yes	No	NA
All samples received within holding time?	☑	☐	☐
Samples Received on Ice?	☑	☐	
(Ice Type: WET ICE)			
Sample/Temp Blank temperature	Temp: 2°C		☐
ZHS conditional analyses: VOA meets zero headspace requirement (VOCs, TPHg/BTEX, RSK)?	☐	☐	☑
Sample labels checked for correct preservation?	☑	☐	
pH acceptable upon receipt (Metal: <2; Nitrate 353.2/4500NO3: <2; 522: <4; 218.7: >8)?	☐	☐	☑
UCMR Samples:			
pH tested and acceptable upon receipt (200.8: ≤2; 525.3: ≤4; 530: ≤7; 541: <3; 544: <6.5 & 7.5)?	☐	☐	☑
Free Chlorine tested and acceptable upon receipt (<0.1mg/L)?	☐	☐	☑

Comments

Appendix G

Opinion of Probable Construction Costs

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KENNEDY/JENKS CONSULTANTS

OPINION OF PROBABLE CONSTRUCTION COST

BASIS OF ESTIMATE

PROJECT INFORMATION

Client:	Marin Municipal Water District
Project:	Smith Saddle Tanks Rehabilitation Project
KJ Job No.:	2168002*00
Estimate Date:	4.30.2021
Prepared By:	JLH
Reviewed By:	DB
Estimate Type:	Conceptual
AACEI Class Level Estimate :	4

PROJECT DESCRIPTION:

The scope of work for this project includes alternatives analysis for Rehabilitation of (2) 5 MG Steel Water Storage Tanks
Alt 1. Rehabilite Existing Welded Steel Tanks, recoat.
Alt 2. Demo and replace with Welded Steel tanks
Alt 3. Demo and replace with Concrete tanks.
Each alternative includes required associated sitework, access road improvements, electrical and controls.

ESTIMATE DOCUMENTS:

DRAWINGS:

DOCUMENTS: Inspection report by ___ dated ___ , Geotechnical Report by ___ dated ____

COSTS PROVIDED BY OTHERS:

Recoating costs provide by subconsultant, Bay Area Coating Consultants, inc.

SOURCE OF COST DATA:

RS Means Costworks 2021 data, Tank constructor budget cost estimates , similar projects.

ESTIMATE ASSUMPTIONS:

The followings assumptions were made in the preparation of this estimate:

Regular working hours will be allowed.
Groundwater is assumed to be below the bottom of the tank overexcavation.
No significant dewatering or dewatering water treatment is included.
Assumes native material will be suitable for backfill above the bedding zone
Assumes the following work will be subcontracted to speciality subcontractor:
Tank construction and coatings
Assumes no special or deep foundation (pile or piers) is required (pending geotechnical evaluation)
One tank at a time will be rehabiliated with the other tank remaining in service.

SPECIFIC INCLUSIONS:

SPECIFIC EXCLUSIONS:

The estimate does not include the following:

Containmentated Soils Removal or Disposal
Owner's Construction Management Expenses or Facilities
Independent or Special Inspections
Service connection fees (Power, Water, etc.)
No landscaping has been included.
PLC / SCADA Programming Design / Modifications (if required) by owner.

MAJOR CHANGES FROM PREVIOUS ESTIMATE:

N/A.

DESIGN CONTINGENCY:

A estimating contingency of 25% has been included.

Note: This allowance is intended to provide a Design Contingency allowance. It is not intended to provide for a Construction Contingency for change orders during construction or to cover unforeseen conditions.

ESCALATION:

An escalation factor has been included to account for a midpoint of construction in approximately ____. The owner is cautioned that the project cost should be adjusted for any changes in the project schedule.

Current ENR CCI	11698	(Jan 2021)
Annual Inflation Escalation Factor:	3.5%	
Time Until Project Midpoint (Months)	24	

* from estimate (or data) date until the projects midpoint of construction.

ACCURACY:

The level of accuracy is commensurate with levels developed by the AACE, the Association for the Advancement of Cost Engineering International. At increasing levels of design completion, the narrower the range between upper and lower limits and the greater the accuracy of the estimate. This estimate is considered a Class 4 feasbility or study level estimate in accordance with AACEI guidelines. Typically this level of estimate has an expected accuracy range of +20 to +50% on the high side to -15 to -30% on the low side. This estimate is based upon competitive bidding, which assumes receipt of multiple bids from five or more General Contractors. Without competitive bidding, pricing can vary significantly from the prices assumed in this estimate.
The enclosed Engineer's Estimate of Probable Construction Cost is only an opinion of possible items that maybe considered for budgeting purposes. This Project Estimate is limited to the conditions existing at issuance and is not a guaranty of actual construction cost or schedule. Uncertain market conditions such as, but not limited to, local labor or contractor availability, wages, other work, material market fluctuations, price escalations, force majeure events and developing bidding conditions, etc. may affect the accuracy of this review. Kennedy/Jenks is not responsible for any variance from this Project Estimate or actual prices and conditions obtained.

OTHER COMMENTS:

Marin Municipal Water District
Smith Saddle Tanks Rehabilitation Project
Summary Table

		Estimated Range of Probable Cost		
		+50%	Total Est.	-30%
Alt 1	**Rehabilitate Existing Tanks**	27,900,000	**18,600,000**	13,020,000
Alt 2	**Replace Existing Tanks with new Welded Steel Tanks**	35,400,000	**23,600,000**	16,520,000
Alt 3	**Replace Existing Tanks with new Prestressed Concrete Storage Tanks**	32,400,000	**21,600,000**	15,120,000

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No.: 2168002*00

Building: Alternative No. #1

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @ _________% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Current at ENR 11698
Escalated to ENR #REF!
Mos. to Midpoint 24

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION			MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	General Requirements			129,940	-	17,800	147,740
2	Existing Conditions			-	129,239	40,477	169,716
3	Concrete			-	-	-	-
5	Metals			59,032	53,617	43,386	156,036
9	Finishes			380,348	1,096,075	5,521,800	6,998,223
26	Electrical/ Instrumentaton			-	-	150,000	150,000
31	Earthwork						-
32	Site Improvements			200,110	124,676	173,550	498,335
33	Utilities			882,602	771,616	1,091,841	2,746,059
	Subtotals			1,652,032	2,175,223	7,038,854	10,866,109
	Division 1 Costs	@	10%		217,522	703,885	921,408
	Subtotals			1,652,032	2,392,745	7,742,740	11,787,517
	Taxes - Materials	@	8.25%	136,293			136,293
	Subtotals			1,788,324	2,392,745	7,742,740	11,923,809
	Taxes - Labor	@			-		-
	Subtotals			1,788,324	2,392,745	7,742,740	11,923,809
	Contractor MU on Sub	@	12%			929,129	929,129
	Subtotals			1,788,324	2,392,745	8,671,869	12,852,938
	Contractor OH&P	@	15%	268,249	358,912		627,160
	Subtotals			2,056,573	2,751,657	8,671,869	13,480,099
	Bonds and Insurance		3.0%				404,403
	Subtotal						13,884,502
	Estimate Contingency	@	25%				3,471,125
	Subtotal						17,355,627
	Escalate to Midpt of Const.	@	3.5%				1,214,894
	Estimated Bid Price						18,570,521
	Total Estimate						18,570,530

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$27,855,795	**$18,570,530**	**$12,999,371**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Current at ENR 11698 Jan 2021
Escalated to ENR ______
Months to Midpoint of Construct ______

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
DIVISION 1 - GENERAL REQUIREMENTS												
		General Requirements										incl in Div 1 adder on summary she
		Project Management and Coord										incl in Div 1 adder on summary she
		Field Office	24	MONTH								incl in Div 1 adder on summary she
		Builders Risk Insurance (1.5%)		LS								See Bonds and insurance on sumr
		Performance Bond (2.5%)		LS								"
		Clear and Grubbing		AC								
		Mobilization and Demobilizatoin	1	LS								incl in Div 1 adder on summary she
		Mob/Demob - 50 ton	1	EA								
		Site Demo										
		Survey										incl in Div 1 adder on summary she
		Construction Layout, 3 persons	1	DAY								incl in Div 1 adder on summary she
01 21		**Allowances**										
		Tank #1										
		Floor Plates 50% of area	8,900	SF	7.30	64,970			1	8,900	73,870	Means 05 12 23.65 2100
		Tank #2										
		Floor Plates 50% of area	8,900	SF	7.30	64,970			1	8,900	73,870	Means 05 12 23.65 2100
SUBTOTAL - DIVISION						129,940				17,800	147,740	
DIVISION 2 - EXISTING CONDITIONS												
02 41		**Demolition**										
		Demo Welded Steel Tank #1 Components										
		Structural Members	257	EA			146.56	37,665			37,665	Means 05 05 05.10 0240
		Fabricated Items										
		Roof Plate	68	TON			244.00	16,616	104	7,082	23,699	Means 05 05 05.10 0390
		Columns	21	TON			244.00	5,214	104	2,222	7,436	Means 05 05 05.10 0390
		Shell	21	TON			244.00	5,124	104	2,184	7,308	Means 05 05 05.10 0390
		Floor		TON			244.00		104			Means 05 05 05.10 0390
		Shoring and Bracing										
		Cutting										
		Loading										
		Hauling										
		Dumping										
		Demo Welded Steel Tank #2										
		Demo Welded Steel Tank #1										
		Structural Members	257	EA			146.56	37,665			37,665	Means 05 05 05.10 0240
		Fabricated Items										
		Roof Plate	68	TON			244.00	16,616	104	7,082	23,699	Means 05 05 05.10 0390
		Columns	21	TON			244.00	5,214	104	2,222	7,436	Means 05 05 05.10 0390
		Shell	21	TON			244.00	5,124	104	2,184	7,308	Means 05 05 05.10 0390
		Floor		TON			244.00		104			Means 05 05 05.10 0390
		Shoring and Bracing										
		Cutting										

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR ____
Months to Midpoint of Construct ____

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Loading										
		Hauling										
		Dumping										
02 83		Lead Paint Worker Protection during cutting/han	2	LS					8,750	17,500	17,500	
SUBTOTAL - DIVISION								129,239		40,477	169,716	
DIVISION 3 - CONCRETE												
SUBTOTAL - DIVISION												
DIVISION 5 - METALS												
05 12		**Intermediate Platform**		LBS								8,085.31
		Stringers C 8 x 11.5	30	LF	9.15	275	39.55	1,187	28	834	2,295	Means 05 12 23.40 0672
		Platform Grating 1 1/4" x 3/16"	50	SF	24.93	1,246	14.42	721	10	483	2,450	Means 05 53 13.70 0422
		Guardrail	32	LF	25.63	820	43.75	1,400	35	1,120	3,340	Means 05 73 23.50 0550
05 12		**Tank#1 Stair Landing**		LBS								53,095.40
		Metal Grating Stairs, 4'-0" wide	20	RISER	430.00	8,600	61.36	1,227	89	1,773	11,600	05 51 19.50 0100
		For circular stairs add	20	RISER	43.00	860	6.14	123	8.86	177	1,160	
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,110	43.75	20,675	35	16,540	49,324	Means 05 73 23.50 0550
05 12		**Tank#2 Stair Landing**		LBS								53,095.40
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,110	43.75	20,675	35	16,540	49,324	Means 05 73 23.50 0550
		Tank #1 &2										
		24" Dia. Center Vent, Alum	2	EA	8,000.00	16,000	500.00	1,000	2,000	4,000	21,000	Advance Steel Tank AST Quote
		12" Dia. Peripheral Roof Vent	16	EA	250.00	4,000	250.00	4,000			8,000	Add Tax and Freight
SUBTOTAL - DIVISION						59,032		53,617		43,386	156,036	
DIVISION 9 - FINISHES												
		Tank #1										
		Dehumidification Equipment	1	LS			140,000.00	140,000			140,000	Simpson, Larry Quote 4/21/21
		Exterior Full Containment	1	LS	100,000.00	100,000	100,000.00	100,000			200,000	Simpson, Larry Quote 4/21/21
		Remove Hot Mop Enamel	1,920	MH			145.00	278,400			278,400	Simpson, Larry Quote 4/21/21
		Shop Coating										
		Scaffolding and/or Lift										
		Interior Surface Prep Blasting	43,450	SF					5	217,250	217,250	columns, shell, Floor only (new roo
		Interior Coating										
		Roof	17,800	SF					25	436,100	436,100	FDT Estimate 4/13/2021

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ______ % Complete
- [ ] Construction
- [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Roof Framing	5,000	LF					25	122,500	122,500	FDT Estimate 4/13/2021
		Columns	3,900	SF					25	95,550	95,550	FDT Estimate 4/13/2021
		Shell	21,750	SF					25	532,875	532,875	FDT Estimate 4/13/2021
		Floor	17,800	SF					25	436,100	436,100	FDT Estimate 4/13/2021
		Exterior Surface Prep Blasting										
		Roof, near white blast SSPC-SP10	17,800	SF	2.28	40,584			5.00	89,000	129,584	incl Blastox
		Shell, near white blast SSPC-SP10	21,750	SF	2.28	49,590			5.00	108,750	158,340	incl Blastox
		Exterior Coating (zinc)										
		Roof	17,800	SF					18	320,400	320,400	BACC Estimate 4/8/2021
		Shell	21,750	SF					18	391,500	391,500	BACC Estimate 4/8/2021
		Clean and Wash Down interior	66,250	SF			0.07	4,638			4,638	05 01 10 51 6215
		Hydrotest/ Disinfect Tank Interior	1	LS			25,000.00	25,000			25,000	
		Tank #2										
		Dehumidification Equipment	1	LS			140,000.00	140,000			140,000	Simpson, Larry Quote 4/21/21
		Exterior Full Containment	1	LS	100,000.00	100,000	100,000.00	100,000			200,000	Simpson, Larry Quote 4/21/21
		Remove Hot Mop Enamel	1,920	MH			145.00	278,400			278,400	Simpson, Larry Quote 4/21/21
		Shop Coating										
		Scaffolding and/or Lift										
		Interior Surface Prep Blasting	43,450	SF					5	217,250	217,250	columns, shell, Floor only (new roo
		Interior Coating										
		Roof	17,800	SF					25	436,100	436,100	FDT Estimate 4/13/2021
		Roof Framing	5,000	LF					25	122,500	122,500	FDT Estimate 4/13/2021
		Columns	3,900	SF					25	95,550	95,550	FDT Estimate 4/13/2021
		Shell	21,750	SF					25	532,875	532,875	FDT Estimate 4/13/2021
		Floor	17,800	SF					25	436,100	436,100	FDT Estimate 4/13/2021
		Exterior Surface Prep Blasting										
		Roof, near white blast SSPC-SP10	17,800	SF	2.28	40,584			5.00	89,000	129,584	incl Blastox
		Shell, near white blast SSPC-SP10	21,750	SF	2.28	49,590			5.00	108,750	158,340	incl Blastox
		Exterior Coating										
		Roof	17,800	SF					18	320,400	320,400	BACC Estimate 4/8/2021
		Shell	21,750	SF					19	413,250	413,250	BACC Estimate 4/8/2021
		Clean and Wash Down Interior	66,250	LS			0.07	4,638			4,638	
		Hydrotest/ Disinfect Tank Interior	1	LS			25,000.00	25,000			25,000	
SUBTOTAL - DIVISION						380,348		1,096,075		5,521,800	6,998,223	

DIVISION 26 - ELECTRICAL

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Electrical	2	LS					75,000	150,000	150,000	half of new tank allowances , more
		Exterior and Site Lighting										
		Intrumentation and Controls										
		SCADA										
		Access Control										
		Intrusion Detection										
		Video Surveillance										

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type: [x] Conceptual [ ] Preliminary (w/o plans) [ ] Design Development @ ____ % Complete [ ] Construction [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR ____
Months to Midpoint of Construct ____

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
SUBTOTAL - DIVISION										150,000	150,000	

DIVISION 32 - SITE IMPROVEMENTS

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Improve Access Rd. Radius:										
		Regrade Access Road to 15%	9,000	SF			$0.50	4,500			4,500	31 22 13 200 0150
		Retaining Wall 6' High	60	LF	$110.00	6,600	$150.00	9,000			15,600	G2040 210 3200
		Finish Grading Access Road	4,000	SY			$1.18	4,738			4,738	Means 31 22 16.10 0200
32 11		Aggregate Base Course- Access Road	867	CY	28.00	24266.67	15.00	13000.00			37,267	assumes 6" additional rock (some
		Pave Access Road	630	TN					135.00	85050.00	85,050	
		Liquid Asphalt Coat Access Road	4,000	SY			$3.00	12,000			12,000	
		Access Road V-Ditch	3,000	LF			$5.00	15,000			15,000	
		Site Drainage Culvert	800	LF	$1.45	1,160	$2.68	2,144	$1.62	1,296	4,600	Means 33 31 13.25 2000
											-	
		Regrade Road Around Tanks 2%	1,067	SY			$1.18	1,263			1,263	
		Widen Road Around Tanks	1,067	SY			$0.50	533			533	
		Pave Tank Ring Road	416	TN					135.00	56192.78	56,193	
32 11		Aggregate Base Course- Ring Road	590	CY	28.00	16509.42	15.00	8844.33			25,354	
		Site Paving	4,500	SF	$0.82	3,690	$0.29	1,305	$0.17	765	5,760	Means 02740 315 0600
		Site AB Course	500.00	SY	$5.30	2,650	$1.50	750	$0.88	440	3,840	Means 02700 200 0050
		Excavate SD around Tanks	1,100	LF			$8.00	8,800			8,800	
		24" x 24" Catch Basin HDPE	8	EA	$423.95	3,392	$135.00	1,080	$81.00	$648	5,120	NDS Catalog/Means 33 44 13.13
		24" x 24" Grate, Galavanized	8	EA	$923.82	7,391	$173.50	1,388	$106.50	$852	9,631	NDS Catalog/Means 33 44 13.13
		10" HDPE Storm Drain	1,100	LF	$17.35	19,085	$4.10	4,510			23,595	Ewing Irrigation/Means 33 31 13.2
		Pipe Bollards	12	EA	$965.00	11,580	$113.00	1,356	$122.00	1,464	14,400	Means 32 17 13.13 1500
		2'-0" High Retaining Wall	1,714	SF	$13.50	23,139	$3.88	6,650	$3.12	5,348	35,137	Means 32 32 23.13 7140
		Annular Ring & Subgrade Grout										
		Tank #1 &2										
		Remove asphalt annular ring	13	CF			$37.50	488	$20.50	267	754	Means 31 43 13.13 0200
		Form annular ring	473	SFCA	$2.31	1,092	$2.76	1,305	$1.78	842	3,239	Means 03100 430 0010
		Grout annular ring	351	CF	$24.00	8,426	$7.85	2,756	$6.15	2,159	13,341	Means 31 43 13.13 0200
		Grout voids beneath floor plate	2,964	CF	$24.00	71,129	$7.85	23,265	$6.15	18,227	112,622	Means 31 43 13.13 0200
SUBTOTAL - DIVISION						200,110		124,676		173,550	498,335	

DIVISION 33 - UTILITIES

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
33 11		**Water Utility Distribution Piping**									-	
		Tank No. 1 & 2 Replace Connection Piping In	2	LS					100,000	200,000	200,000	allowances incl trenching
		24" Inlet Pipe		LF							-	
		Pipe Supports		EA							-	
		30" Outlet Pipe		LF							-	
		8" Drain		LF							-	
		24"Intertie		LF							-	
33 16		**Repair Water Utility Storage Tanks**										460,087 lbx x $0.70 = $322,060 st
		Tank #1										1,204,828.02

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
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Estimate Type:
- [x] Conceptual
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- [ ] Design Development @ ______ % Complete
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Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Engineering										
		Roof										
		1/4" Roof Plate	186,601	LBS	0.72	134,353			1	186,601	320,954	Means 05 12 23.65 2100
		Continuous fillet, 1/4", 0.3 lb/LF	6,500	LF	0.22	1,430	3.88	25,220	2	14,625	41,275	Means 05 05 21.90 1300
		Continuous fillet, 1/8", 0.1 lb/LF	6,500	LF	0.65	4,225	11.67	75,855	7	44,070	124,150	Means 05 05 21.90 1500
		Erection and Welding										
		Roof Framing	68,139	LBS								
		Outer Rafters, C7x9.8	1,600	LF	7.80	12,480	35.65	57,040	25	39,280	108,800	Means 05 12 23.40 0670
		Intermediate Rafters, C7x9.8	1,440	LF	7.80	11,232	35.65	51,336	25	35,352	97,920	Means 05 12 23.40 0670
		Inner Rafters, C7x9.8	930	LF	7.80	7,254	35.65	33,155	25	22,832	63,240	Means 05 12 23.40 0670
		Center Rafters, C7x9.8	284	LF	7.80	2,215	35.65	10,125	25	6,972	19,312	Means 05 12 23.40 0670
		Continuous fillet, 1 pass, 1/8" thick, 0.1#/LF	8,508	LF	0.22	1,872	3.88	33,011	2	19,143	54,026	Means 05 05 21.90 1300
		Outer Girders, C15x33.9	352	LF	51.00	17,952	8.00	2,816	9	3,168	23,936	Means 05 12 23.75 0520
		Middle Girdres, C18x42.7	230	LF	70.00	16,100	8.00	1,840	11	2,530	20,470	Means 05 12 23.75 0540
		Inner Girders, C18x42.7	120	LF	70.00	8,400	8.00	960	11	1,320	10,680	Means 05 12 23.75 0540
		Erection and Bolting										
		10" Schedule 40 Columns	1,421	LF	71.88	102,134	5.75	8,171	10	14,032	124,338	Means 05 12 23.17 1900
		Column Base & Top Plates		LBS								
		Column Baseplate Stiffeners		LBS								
		Erection and Welding										
		Shell										
		Ring No. 6 (0.250 in)	2,898	SF	7.30	21,158			1	2,029	23,187	Means 05 12 23.65 2100
		Continuous fillet, 2 passes/1/8" thick,	562	LF	0.44	247	7.76	4,361	5	2,529	7,137	Means 05 05 21.90 1300
		Continuous fillet, 2 passes/1/4" thick,	472	LF	1.52	717	26.50	12,508	15	7,307	20,532	Means 05 05 21.90 2010
		Erection and Welding										
		Ring No. 5 (0.375 in)	3,782	SF	10.95	41,418			1	3,972	45,390	Means 05 12 23.65 2100
		Continuous fillet, 2 pass/3/16" thick, (	576	LF	0.86	495	15.58	8,974	9	5,219	14,688	Means 05 05 21.90 1400
		Continuous fillet, 4 pass/1/2" thick, 0	1,050	LF	1.52	1,596	26.50	27,825	15	16,254	45,675	Means 05 05 21.90 2010
		Erection and Welding										
		Floor										
		Annual Floor Ring (1/2")	2,445	SF	14.60	35,696			1	3,423	39,119	Means 05 12 23.65 2100
		Continuous fillet, 4 pass/1/2" thick, 0	1,050	LF	1.52	1,596	26.50	27,825	15	16,254	45,675	Means 05 05 21.90 2010
		Floor Ring Bar/Angle		LBS								
		Placement and Welding										
		Continuous fillet, 4 pass/1/2" thick, 0	1,050	LF	1.52	1,596	26.50	27,825	15	16,254	45,675	Means 05 05 21.90 2010
		Tank #2										
		Engineering										
		Roof										
		1/4" Roof Plate	186,601	LBS	0.72	134,353			1	186,601	320,954	Means 05 12 23.65 2100
		Continuous fillet, 1/4", 0.3 lb/LF	6,500	LF	0.22	1,430	3.88	25,220	2	14,625	41,275	Means 05 05 21.90 1300
		Continuous fillet, 1/8", 0.1 lb/LF	6,500	LF	0.65	4,225	11.67	75,855	7	44,070	124,150	Means 05 05 21.90 1500
		Erection and Welding										
		Roof Framing	68,139	LBS								
		Outer Rafters, C7x9.8	1,600	LF	7.80	12,480	35.65	57,040	25	39,280	108,800	Means 05 12 23.40 0670
		Intermediate Rafters, C7x9.8	1,440	LF	7.80	11,232	35.65	51,336	25	35,352	97,920	Means 05 12 23.40 0670
		Inner Rafters, C7x9.8	930	LF	7.80	7,254	35.65	33,155	25	22,832	63,240	Means 05 12 23.40 0670
		Center Rafters, C7x9.8	284	LF	7.80	2,215	35.65	10,125	25	6,972	19,312	Means 05 12 23.40 0670
		Continuous fillet, 1 pass, 1/8" thick, 0.1#/LF	8,508	LF	0.22	1,872	3.88	33,011	2	19,143	54,026	Means 05 05 21.90 1300
		Outer Girders, C15x33.9	352	LF	51.00	17,952	8.00	2,816	9	3,168	23,936	Means 05 12 23.75 0520
		Middle Girdres, C18x42.7	230	LF	70.00	16,100	8.00	1,840	11	2,530	20,470	Means 05 12 23.75 0540

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #1

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @
- [ ] Construction
- [ ] Change Order

% Complete

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Inner Girders, C18x42.7	120	LF	70.00	8,400	8.00	960	11	1,320	10,680	Means 05 12 23.75 0540
		Erection and Bolting										
		10" Schedule 40 Columns	1,421	LF	71.88	102,134	5.75	8,171	10	14,032	124,338	Means 05 12 23.17 1900
		Column Base & Top Plates		LBS								
		Column Baseplate Stiffeners		LBS								
		Erection and Welding										
		Shell										
		Ring No. 6 (0.250 in)	2,898	SF	7.30	21,158			1	2,029	23,187	Means 05 12 23.65 2100
		Erection and Welding										
		Continuous fillet, 2 passes/1/8" thick	562	LF	0.44	247	7.76	4,361	5	2,529	7,137	Means 05 05 21.90 1300
		Ring No. 5 (0.375 in)	3,782	SF	10.95	41,418			1	3,972	45,390	Means 05 12 23.65 2100
		Continuous fillet, 2 pass/3/16" thick,	576	LF	0.86	495	15.58	8,974	9	5,219	14,688	Means 05 05 21.90 1400
		Erection and Welding										
		Floor										
		Annual Floor Ring (1/2")	2,445	SF	14.60	35,696			1	3,423	39,119	Means 05 12 23.65 2100
		Continuous fillet, 4 pass/1/2" thick, 0	1,050	LF	1.52	1,596	26.50	27,825	15	16,254	45,675	Means 05 05 21.90 2010
		Floor Ring Bar/Angle		LBS								
		Placement and Welding										
		Appurtenances - Tank #1										
		14" Overflow Nozzle & Reinf.	4	LF	105.00	420	72.03	288	47	188	896	
		Overflow Weir Box	123	SF	7.30	894			1	86	980	Means 05 12 23.65 2100
		8" Drain Nozzle and Reinf.	4	LF	68.50	274	47.50	190	30	120	584	
		24" Intertie Nozzle & Reinf.	4	LF	210.00	840	144.06	576	94	376	1,792	
		Interior Ladder	46	VLF	120.00	5,520	36.92	1,698	37	1,706	8,924	Means 05 51 33.13 0300
		39" Sqr. Roof Access Hatch	2	EA	$1,360.00	$2,720					$2,720	Quote 12/13/10
		Appurtenances - Tank #2										
		24" Shell Manhole & Reinf.	4	LF	210.00	840	144.06	576	94	376	1,792	
		14" Overflow Nozzle & Reinf.	4	LF	105.00	420	72.03	288	47	188	896	
		Overflow Weir Box	123	SF	7.30	894			1	86	980	Means 05 12 23.65 2100
		8" Drain Nozzle and Reinf.	4	LF	68.50	274	47.50	190	30	120	584	
		24" Intertie Nozzle & Reinf.	4	LF	210.00	840	144.06	576	94	376	1,792	
		Interior Ladder	46	VLF	120.00	5,520	36.92	1,698	37	1,706	8,924	Means 05 51 33.13 0300
		39" Sqr. Roof Access Hatch	2	EA	$1,360.00	$2,720					$2,720	Quote 12/13/10
		Cathodic Protection System										
		Tank #1 &2										
		Impressed Current CP System	2	LS	8,000.00	16,000	8,000.00	16,000			32,000	Quote Corrpro 4/16/2021 Milt
		Impressed CP Shell & Columns		LS								Bob Ryder suggests $15,000 to
		Impressed CP Floor		LS								$25,000 per tank.
		Sacrificial Anode CP System		LS								
SUBTOTAL - DIVISION						882,602		771,616		1,091,841	2,746,059	

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building: Alternative No. #2

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No.: 2168002*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @ ________% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Current at ENR 11698
Escalated to ENR
Mos. to Midpoint 24

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION			MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	General Requirements			-	-	-	
2	Existing Conditions			570,960	570,960	65,000	1,206,920
3	Concrete			71,087	87,233	13,300	171,620
5	Metals			62,682	51,992	44,262	158,936
9	Finishes			-	-	4,670,050	4,670,050
26	Electrical/ Instrumentaton			-	-	300,000	300,000
31	Earthwork			47,941	59,254	-	107,195
32	Site Improvements			119,462	96,862	222,066	438,391
33	Utilities			3,233,000	3,283,000	200,000	6,716,000
	Subtotals			4,105,133	4,149,302	5,514,678	13,769,112
	Division 1 Costs	@	10%		414,930	551,468	966,398
	Subtotals			4,105,133	4,564,232	6,066,145	14,735,510
	Taxes - Materials	@	8.25%	338,673			338,673
	Subtotals			4,443,806	4,564,232	6,066,145	15,074,183
	Taxes - Labor	@			-		-
	Subtotals			4,443,806	4,564,232	6,066,145	15,074,183
	Contractor MU on Sub	@	12%			727,937	727,937
	Subtotals			4,443,806	4,564,232	6,794,083	15,802,121
	Contractor OH&P	@	15%	666,571	684,635		1,351,206
	Subtotals			5,110,377	5,248,867	6,794,083	17,153,327
	Bonds and Insurance		3.0%				514,600
	Subtotal						17,667,926
	Estimate Contingency	@	25%				4,416,982
	Subtotal						22,084,908
	Escalate to Midpt of Const.	@	3.5%				1,545,944
	Estimated Bid Price						23,630,852
	Total Estimate						23,630,860

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$35,446,290	**$23,630,860**	**$16,541,602**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #2

Prepared By:).Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
DIVISION 1 - GENERAL REQUIREMENTS												
		General Requirements										
		Project Management and Coord										incl in Div 1 adder on summary sh
		Field Office	24	MONTH								incl in Div 1 adder on summary sh
		Builders Risk Insurance (1.5%)		LS								incl in Div 1 adder on summary sh
		Performance Bond (2.5%)		LS								See Bonds and insurance on sum
		Clear and Grubbing		AC								"
		Mobilization and Demobilizatoin	1	LS								incl in Div 1 adder on summary sh
		Mob/Demob - 50 ton	1	EA								
		Site Demo										
		Survey										incl in Div 1 adder on summary sh
		Construction Layout, 3 persons	1	DAY								incl in Div 1 adder on summary sh
SUBTOTAL - DIVISION												
DIVISION 2 - EXISTING CONDITIONS												
		Demolition of E Tank 1	468	TON	610.00	285,480	610.00	285,480			570,960	Feige Bid Schedule 2/16/18
		Demolition of E Tank 2	468	TON	610.00	285,480	610.00	285,480			570,960	Feige Bid Schedule 2/16/18
02 42		Demo Electrical Items	2	EA					5000.00	10000.00	10,000	
02 83		Lead Paint Worker Protection during cutting/	2	LS					17500.00	35000.00	35,000	
02 56		Site Containment / protections during cutting	2	EA					10000.00	20000.00	20,000	
											-	
SUBTOTAL - DIVISION						570960.00		570960.00		65000.00	1,206,920	
DIVISION 3 - CONCRETE											-	
		Tank #1 &2									-	
03 11		Ringwall Footing Forms	4,728	SFCA	3.00	14184.29	2.76	13049.55	1.78	8416.01	35,650	Means 03100 430 0010
03 15		Anchor Bolts, Galv. 1-1/2" x18"	56	EA	56.20	3147.20	59.56	3335.47			6,483	Means 03 15 19.10 0200
03 21		Reinforcing Steel	5	TON	1105.00	5449.20	1637.82	8076.75			13,526	Means 03 21 11 600 0500
03 21		Mechanical Connectors	240	EA	10.10	2424.00	39.55	9492.00	20.35	4884.00	16,800	Means 03 21 0 700 1220
03 61		Cement/Sand Grout	1,891	SF	8.94	16907.67	24.15	45676.25			62,584	Means 03 62 13 500 0300
03 31		Concrete Ready Mix	175	CY	161.46	28274.02					28,274	Means 03 31 13 35 0350
03 31		Placing Concrete	175	CY			39.72	6954.68			6,955	Means 03 31 13.70 1950
03 39		Concrete Curing	47	CSF	14.81	700.23	13.72	648.51			1,349	Means 03 39 23 13 0300
											-	
											-	
SUBTOTAL - DIVISION						71086.62		87233.21		13300.01	171,620	
DIVISION 5 - METALS											-	Stairs 1 tank only (same as existin
											-	
											-	
05 12		Intermediate Platform		LBS							-	8,085.31

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #2

Prepared By:).Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR ____
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Stringers C 8 x 11.5	30	LF	9.15	275	39.55	1,187	28	834	2,295	Means 05 12 23.40 0672
		Platform Grating 1 1/4" x 3/16"	50	SF	24.93	1,246	14.42	721	10	483	2,450	Means 05 53 13.70 0422
		Guardrail	32	LF	25.63	820	43.75	1,400	35	1,120	3,340	Means 05 73 23.50 0550
05 12		**Tank#1 Stair Landing**		LBS							-	97,755.40
		Metal Grating Stairs, 4'-0" wide	70	RISER	430.00	30,100	61.36	4,295	89	6,205	40,600	05 51 19.50 0100
		For circular stairs add	70	RISER	43.00	3,010	6.14	430	8.86	620	4,060	
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,110	43.75	20,675	35	16,540	49,324	Means 05 73 23.50 0550
05 12		**Tank #2 Stair Landing**		LBS							-	#REF!
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,110	43.75	20,675	35	16,540	49,324	Means 05 73 23.50 0550
											-	
											-	
SUBTOTAL - DIVISION						62682.40		51992.13		44261.58	158,936	

DIVISION 9 - FINISHES

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
											-	
		Tank #1									-	
		Interior Coating									-	
		Roof	17,800	SF					24.50	436100.00	436,100	FDT Estimate 4/13/2021
		Roof Framing	5,000	LF					24.50	122500.00	122,500	FDT Estimate 4/13/2021
		Columns	3,900	SF					24.50	95550.00	95,550	FDT Estimate 4/13/2021
		Shell	21,750	SF					24.50	532875.00	532,875	FDT Estimate 4/13/2021
		Floor	17,800	SF					24.50	436100.00	436,100	FDT Estimate 4/13/2021
		Setup Exterior Coating & Blasting									-	
		Exterior Coating (zinc)									-	
		Roof	17,800	SF					18.00	320400.00	320,400	BACC Estimate 4/8/2021
		Shell	21,750	SF					18.00	391500.00	391,500	BACC Estimate 4/8/2021
											-	
		Tank #2									-	
		Interior Coating									-	
		Roof	17,800	SF					24.50	436100.00	436,100	FDT Estimate 4/13/2021
		Roof Framing	5,000	LF					24.50	122500.00	122,500	FDT Estimate 4/13/2021
		Columns	3,900	SF					24.50	95550.00	95,550	FDT Estimate 4/13/2021
		Shell	21,750	SF					24.50	532875.00	532,875	FDT Estimate 4/13/2021
		Floor	17,800	SF					24.50	436100.00	436,100	FDT Estimate 4/13/2021
		Exterior Coating									-	
		Roof	17,800	SF					18.00	320400.00	320,400	BACC Estimate 4/8/2021
		Shell	21,750	SF					18.00	391500.00	391,500	BACC Estimate 4/8/2021
											-	
SUBTOTAL - DIVISION										4670050.00	4,670,050	

DIVISION 26 - ELECTRICAL -

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #2

Prepared By:).Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ____
- [ ] **Construction**
- [ ] **Change Order**

% Complete

Current at ENR 11698 Jan 2021
Escalated to ENR ____
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Electrical	2	LS					150000.00	300000.00	300,000	
		Exterior and Site Lighting									-	
		Intrumentation and Controls									-	
		SCADA									-	
		Access Control									-	
		Intrusion Detection									-	
		Video Surveillance									-	
SUBTOTAL - DIVISION										300000.00	300,000	
DIVISION 31 - EARTHWORK											-	
		Tank #1 &2									-	
		Excavation for Ring Wall Fdn	315	CY			8.25	2599.98			2,600	assumes 3.5
		Load / Haul/ Dispose Excess Material	315	CY			15.00	4728.10			4,728	
		Finish Grading Tank Pad	3,951	SY			2.17	8578.08			8,578	Means 31 22 16.10 0100
		Subgrade Compacting Tank Pad	3,951	SY			2.00	7902.42			7,902	
32 11		Aggregate Base Course Under Tank (place	1,712	CY	28.00	47941.35	15.00	25682.87			73,624	assumes 12" under tank
											-	
		Excavating Trench 24" Inlet	506	BCY			9.44	4773.71			4,774	Means 31 23 16.13 0050
		Backfill Trench 24" Inlet	58	BCY			12.49	728.61			729	Means 31 23 16.13 3060
		Compaction Trench 24" Inlet	58	BCY			2.93	170.89			171	Means 31 23 23.23 8500
		Excavating Trench 30" Outlet	97	BCY			9.44	918.02			918	Means 31 23 16.13 0050
		Backfill Trench 30" Outlet	58	BCY			12.49	728.61			729	Means 31 23 16.13 3060
		Compaction Trench 30" Outlet	58	BCY			2.93	170.89			171	Means 31 23 23.23 8500
		Excavating Trench 8" Drain	97	BCY			9.44	918.02			918	Means 31 23 16.13 0050
		Backfill Trench 8" Drain	58	BCY			12.49	728.61			729	Means 31 23 16.13 3060
		Compaction Trench 8" Drain	58	BCY			2.93	170.89			171	Means 31 23 23.23 8500
											-	
		Excavating Trench 24" Intertie	24	BCY			9.44	229.51			230	Means 31 23 16.13 0050
		Backfill Trench 24" Intertie	15	BCY			12.49	182.15			182	Means 31 23 16.13 3060
		Compaction Trench 24" Intertie	15	BCY			2.93	42.72			43	Means 31 23 23.23 8500
											-	
											-	
											-	
											-	
											-	
SUBTOTAL - DIVISION 31						47941.35		59254.07			107,195	
DIVISION 32 - SITE IMPROVEMENTS											-	
											-	
32 12		**Asphalt Flexible Paving Under Tank**		SY							-	
		Tank #1									-	
		Pave Inside Ring	259	TN					135.00	35005.25	35,005	
		Tank #2									-	
		Pave Inside Ring	259	TN					135.00	35005.25	35,005	
		Improve Access Rd. Radius:									-	
		Regrade Access Road to 15%	9,000	SF			$0.50	4,500			4,500	31 22 13 200 0150
		Retaining Wall 6' High	60	LF	$110.00	6,600	$150.00	9,000			15,600	G2040 210 3200

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #2

Prepared By:).Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @
- [ ] Construction
- [ ] Change Order

______ % Complete

Current at ENR 11698 Jan 2021
Escalated to ENR ______
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Finish Grading Access Road	4,000	SY			$1.18	4,738			4,738	Means 31 22 16.10 0200
32 11		Aggregate Base Course- Access Road	867	CY	28.00	24266.67	15.00	13000.00			37,267	assumes 6" additional rock (some
		Pave Access Road	630	TN					135.00	85050.00	85,050	
		Liquid Asphalt Coat Access Road	4,000	SY			$3.00	12,000			12,000	
		Access Road V-Ditch	3,000	LF			$5.00	15,000			15,000	
		Site Drainage Culvert	800	LF	$1.45	1,160	$2.68	2,144	$1.62	1,296	4,600	Means 33 31 13.25 2000
											-	
		Regrade Road Around Tanks 2%	1,067	SY			$1.18	1,263			1,263	
		Widen Road Around Tanks	1,067	SY			$0.50	533			533	
		Pave Tank Ring Road	416	TN					135.00	56192.78	56,193	
32 11		Aggregate Base Course- Ring Road	590	CY	28.00	16509.42	15.00	8844.33			25,354	
		Site Paving	4,500	SF	$0.82	3,690	$0.29	1,305	$0.17	765	5,760	Means 02740 315 0600
		Site AB Course	500.00	SY	$5.30	2,650	$1.50	750	$0.88	440	3,840	Means 02700 200 0050
		Excavate SD around Tanks	1,100	LF			$8.00	8,800			8,800	
											-	
		24" x 24" Catch Basin HDPE	8	EA	$423.95	3,392	$135.00	1,080	$81.00	$648	5,120	NDS Catalog/Means 33 44 13.13
		24" x 24" Grate, Galavanized	8	EA	$923.82	7,391	$173.50	1,388	$106.50	$852	9,631	NDS Catalog/Means 33 44 13.13
		10" HDPE Storm Drain	1,100	LF	$17.35	19,085	$4.10	4,510			23,595	Ewing Irrigation/Means 33 31 13.2
		Pipe Bollards	12	EA	$965.00	11,580	$113.00	1,356	$122.00	1,464	14,400	Means 32 17 13.13 1500
		2'-0" High Retaining Wall	1,714	SF	$13.50	23,139	$3.88	6,650	$3.12	5,348	35,137	Means 32 32 23.13 7140
											-	
											-	
SUBTOTAL - DIVISION 32						119462.25		96862.45		222065.97	438,391	

DIVISION 33 - UTILITIES

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
											-	
33 11		**Water Utility Distribution Piping**									-	
		Tank No. 1 & 2 Replace Connection Pipin	2	LS					100,000	200,000	200,000	
		24" Inlet Pipe		LF							-	
		Pipe Supports		EA							-	
		30" Outlet Pipe		LF							-	
		8" Drain		LF							-	
		24"Intertie		LF							-	
											-	
		Appurtenances - Tank #1&#2									-	included with steel tank costs
		Appurtenances - Tank #1									-	
		14" Overflow Nozzle & Reinf.	4	LF							-	
		Overflow Weir Box	123	SF							-	Means 05 12 23.65 2100
		8" Drain Nozzle and Reinf.	4	LF							-	
		24" Intertie Nozzle & Reinf.	4	LF							-	
		Interior Ladder	46	VLF							-	Means 05 51 33.13 0300
		39" Sqr. Roof Access Hatch	2	EA							-	Quote 12/13/10
											-	
		Appurtenances - Tank #2									-	
		24" Shell Manhole & Reinf.	4	LF							-	
		14" Overflow Nozzle & Reinf.	4	LF							-	

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #2

Prepared By:).Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ______ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Current at ENR 11698 Jan 2021
Escalated to ENR ______
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Overflow Weir Box	123	SF							-	Means 05 12 23.65 2100
		8" Drain Nozzle and Reinf.	4	LF							-	
		24" Intertie Nozzle & Reinf.	4	LF							-	
		Interior Ladder	46	VLF							-	Means 05 51 33.13 0300
		39" Sqr. Roof Access Hatch	2	EA							-	Quote 12/13/10
		Center Vents	2	EA							-	incl in steel tank cost
		. Peripheral Roof Vent	16	EA							-	incl in steel tank cost
		24" Shell Manhole & Reinf.	2	EA							-	incl in steel tank cost
											-	
		Cathodic Protection System									-	
		Tank #1&2									-	
		Impressed Current CP System	2	LS	8000.00	16000.00	8000.00	16000.00			32,000	Quote Corrpro 4/16/2021 Milt
		Impressed CP Shell & Columns		LS							-	
		Impressed CP Floor		LS							-	
		Sacrificial Anode CP System		LS							-	
											-	
33 16		**New Welded Steel Tanks**									-	
		Tank No. 1	5,000,000	GAL	0.32	1608500.00	0.32	1608500.00			3,217,000	RS Means Gordian San Rafael
		Tank No. 2	5,000,000	GAL	0.32	1608500.00	0.32	1608500.00			3,217,000	RS Means Gordian San Rafael
		Hydrotest/ Disinfect Tank Interior	2	LS			25000.00	50000.00			50,000	
											-	
SUBTOTAL - DIVISION '33						3233000.00		3283000.00		200000.00	6,716,000	

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building: Alternative No. #3

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No.: 2168002*00

Estimate Type:

- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** ________% Complete
- [ ] **Construction**
- [ ] **Change Order**

Current at ENR 11698
Escalated to ENR
Mos. to Midpoint 24

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION			MATERIALS	INSTALLATION	SUB-CONTRACTOR	TOTAL
1	General Requirements			-	-	-	-
2	Existing Conditions			570,960	570,960	65,000	1,206,920
3	Concrete			-	-	-	-
5	Metals			62,695	52,013	44,278	158,986
9	Finishes			-	-	-	-
26	Electrical/ Instrumentaton			-	-	300,000	300,000
31	Earthwork			52,477	99,720	1,945	154,141
32	Site Improvements			119,462	96,862	151,458	367,783
33	Utilities			4,900,000	4,950,000	450,000	10,300,000
	Subtotals			5,705,593	5,769,556	1,012,681	12,487,830
	Division 1 Costs	@	10%		576,956	101,268	678,224
	Subtotals			5,705,593	6,346,511	1,113,949	13,166,054
	Taxes - Materials	@	8.25%	470,711			470,711
	Subtotals			6,176,305	6,346,511	1,113,949	13,636,765
	Taxes - Labor	@			-		-
	Subtotals			6,176,305	6,346,511	1,113,949	13,636,765
	Contractor MU on Sub	@	12%			133,674	133,674
	Subtotals			6,176,305	6,346,511	1,247,623	13,770,439
	Contractor OH&P	@	15%	926,446	951,977		1,878,422
	Subtotals			7,102,751	7,298,488	1,247,623	15,648,862
	Bonds and Insurance		3.0%				469,466
	Subtotal						16,118,328
	Estimate Contingency	@	25%				4,029,582
	Subtotal						20,147,909
	Escalate to Midpt of Const.	@	3.5%				1,410,354
	Estimated Bid Price						21,558,263
	Total Estimate						21,558,270

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$32,337,405	**$21,558,270**	**$15,090,789**

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #3

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
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- [ ] Change Order

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
DIVISION 1 - GENERAL REQUIREMENTS												
		General Requirements										incl in Div 1 adder on summary sh
		Project Management and Coord										incl in Div 1 adder on summary sh
		Field Office	24	MONTH								incl in Div 1 adder on summary sh
		Builders Risk Insurance (1.5%)		LS								See Bonds and insurance on sumr
		Performance Bond (2.5%)		LS								"
		Clear and Grubbing		AC								
		Mobilization and Demobilizatoin	1	LS								incl in Div 1 adder on summary sh
		Mob/Demob - 50 ton	1	EA								
		Site Demo										
		Survey										incl in Div 1 adder on summary sh
		Construction Layout, 3 persons	1	DAY								incl in Div 1 adder on summary sh
SUBTOTAL - DIVISION												
DIVISION 2 - EXISTING CONDITIONS												
		Demolition of E Tank 1	468	TON	610.00	285,480	610.00	285,480			570,960	Feige Bid Schedule 2/16/18
		Demolition of E Tank 2	468	TON	610.00	285,480	610.00	285,480			570,960	Feige Bid Schedule 2/16/18
02 42		Demo Electrical Items	2	EA					5,000	10,000	10,000	
02 83		Lead Paint Worker Protection during cutting/handling	2	LS					17,500	35,000	35,000	
02 56		Site Containment / protections during cutting	2	EA					10,000	20,000	20,000	
SUBTOTAL - DIVISION						570,960		570,960		65,000	1,206,920	
DIVISION 3 - CONCRETE												
SUBTOTAL - DIVISION												
DIVISION 5 - METALS												
05 12		**Intermediate Platform**		LBS								8,085.31
		Stringers C 8 x 11.5	30	LF	9.15	275	39.55	1,187	28	834	2,295	Means 05 12 23.40 0672
		Platform Grating 1 1/4" x 3/16"	50	SF	24.93	1,246	14.42	721	10	483	2,450	Means 05 53 13.70 0422
		Guardrail	32	LF	25.63	820	43.75	1,400	35	1,120	3,340	Means 05 73 23.50 0550
05 12		**Tank#1 Stair Landing**		LBS								97,780.42
		Metal Grating Stairs, 4'-0" wide	70	RISER	430.00	30,100	61.36	4,295	89	6,205	40,600	
		For circular stairs add	70	RISER	43.00	3,010	6.14	430	8.86	620	4,060	
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,116	43.75	20,685	35	16,548	49,350	Means 05 73 23.50 0550
05 12		**Tank #2 Stair Landing**		LBS								#REF!
		Landing Grating	45	SF	24.93	1,122	14.42	649	10	435	2,205	Means 05 53 13.70 0422
		Guardrail	15	LF	25.63	384	43.75	656	35	525	1,566	Means 05 73 23.50 0550
05 52		Metal Railings - Guardrail - Tank	473	LF	25.63	12,116	43.75	20,685	35	16,548	49,350	Means 05 73 23.50 0550

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #3

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

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Escalated to ENR
Months to Midpoint of Construct 24

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
SUBTOTAL - DIVISION						62,695		52,013		44,278	158,986	
DIVISION 9 - FINISHES												
SUBTOTAL - DIVISION												
DIVISION 26 - ELECTRICAL												
		Electrical	2	LS					150,000	300,000	300,000	
		Exterior and Site Lighting										
		Intrumentation and Controls										
		SCADA										
		Access Control										
		Intrusion Detection										
		Video Surveillance										
SUBTOTAL - DIVISION										300,000	300,000	
DIVISION 31 - EARTHWORK												
		Tank #1 &2										
		Excavation for Spread Footing	315	CY			8.25	2599.98			2599.98	assumes 3.5
		Load / Haul/ Dispose Excess Material	315	CY			15.00	4728.10			4728.10	
		Excavation for Tank Pad	1,353	CY			10.00	13,530			13,530	assumes 3.5' under
		Finish Grading Tank Pad	4,164	SY			$2.17	9,040			9,040	Means 31 22 16.10 0100
		Subgrade Compacting Tank Pad	4,164	SY			2.00	8,328			8,328	
32 11		6 mil polyethlene sheet under tanks	4,164	SY	0.72	2,998	0.41	1,686			4,685	
32 11		30 mil liner under tanks	4,164	SY	0.44	1,832	1.16	4,818	0.24	999	7,649	
32 11		Underdrain piping under tanks	945	LF	5.00	4,726	14.85	14,035	1	945	19,706	
32 11		Aggregate Base Course (place & Compact)	902	CY	28.00	25,262	15.00	13,533			38,795	assumes 6" under tank
		Excavating Trench 24" Inlet	506	BCY			$9.44	4,774			4,774	Means 31 23 16.13 0050
		Backfill Trench 24" Inlet	58	BCY			$12.49	729			729	Means 31 23 16.13 3060
		Compaction Trench 24" Inlet	58	BCY			$2.93	171			171	Means 31 23 23.23 8500
		Excavating Trench 30" Outlet	97	BCY			$9.44	918			918	Means 31 23 16.13 0050
		Backfill Trench 30" Outlet	58	BCY			$12.49	729			729	Means 31 23 16.13 3060
		Compaction Trench 30" Outlet	58	BCY			$2.93	171			171	Means 31 23 23.23 8500
		Excavating Trench 8" Drain	97	BCY			$9.44	918			918	Means 31 23 16.13 0050
		Backfill Trench 8" Drain	58	BCY			$12.49	729			729	Means 31 23 16.13 3060
		Compaction Trench 8" Drain	58	BCY			$2.93	171			171	Means 31 23 23.23 8500
		Excavating Trench 24" Intertie	24	BCY			$9.44	230			230	Means 31 23 16.13 0050
		Backfill Trench 24" Intertie	15	BCY			$12.49	182			182	Means 31 23 16.13 3060
		Compaction Trench 24" Intertie	15	BCY			$2.93	43			43	Means 31 23 23.23 8500
		Concrete Encasement for pipes under tanks	59	BCY	$300.00	17,659	$300.00	17,659			35,317	allowance qty
SUBTOTAL - DIVISION						52,477		99,720		1,945	154,141	
DIVISION 32 - SITE IMPROVEMENTS												

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #3

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct 24

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ____ % Complete
- [ ] Construction
- [ ] Change Order

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
		Improve Access Rd. Radius:										
		Regrade Access Road to 15%	9,000	SF			$0.50	4,500			4,500	31 22 13 200 0150
		Retaining Wall 6' High	60	LF	$110.00	6,600	$150.00	9,000			15,600	G2040 210 3200
		Finish Grading Access Road	4,000	SY			$1.18	4,738			4,738	Means 31 22 16.10 0200
32 11		Aggregate Base Course- Access Road	867	CY	28.00	24266.67	15.00	13000.00			37,267	assumes 6" additional rock (some
		Pave Access Road	630	TN					135.00	85050.00	85,050	
		Liquid Asphalt Coat Access Road	4,000	SY			$3.00	12,000			12,000	
		Access Road V-Ditch	3,000	LF			$5.00	15,000			15,000	
		Site Drainage Culvert	800	LF	$1.45	1,160	$2.68	2,144	$1.62	1,296	4,600	Means 33 31 13.25 2000
											-	
		Regrade Road Around Tanks 2%	1,067	SY			$1.18	1,263			1,263	
		Widen Road Around Tanks	1,067	SY			$0.50	533			533	
		Pave Tank Ring Road	412	TN					135.00	55595.48	55,595	
32 11		Aggregate Base Course- Ring Road	590	CY	28.00	16509.42	15.00	8844.33			25,354	
		Site Paving	4,500	SF	$0.82	3,690	$0.29	1,305	$0.17	765	5,760	Means 02740 315 0600
		Site AB Course	500.00	SY	$5.30	2,650	$1.50	750	$0.88	440	3,840	Means 02700 200 0050
		Excavate SD around Tanks	1,100	LF			$8.00	8,800			8,800	
		24" x 24" Catch Basin HDPE	8	EA	$423.95	3,392	$135.00	1,080	$81.00	$648	5,120	NDS Catalog/Means 33 44 13.13 3
		24" x 24" Grate, Galavanized	8	EA	$923.82	7,391	$173.50	1,388	$106.50	$852	9,631	NDS Catalog/Means 33 44 13.13 1
		10" HDPE Storm Drain	1,100	LF	$17.35	19,085	$4.10	4,510			23,595	Ewing Irrigation/Means 33 31 13.2
		Pipe Bollards	12	EA	$965.00	11,580	$113.00	1,356	$122.00	1,464	14,400	Means 32 17 13.13 1500
		2'-0" High Retaining Wall	1,714	SF	$13.50	23,139	$3.88	6,650	$3.12	5,348	35,137	Means 32 32 23.13 7140
SUBTOTAL - DIVISION						119,462		96,862		151,458	367,783	
DIVISION 33 - UTILITIES												
33 11		**Water Utility Distribution Piping**								-	-	
		Tank No. 1 & 2 Replace Connection Piping includir	2	LS					100,000	200,000	200,000	
		24" Inlet Pipe		LF						-	-	
		Pipe Supports		EA						-	-	
		30" Outlet Pipe		LF						-	-	
		Pipe Supports		EA						-	-	
		8" Drain		LF						-	-	
		24"Intertie		LF						-	-	
		Pipe Supports		EA						-	-	
										-	-	
		Appurtenances - Tank #1&#2	2	LS					125,000	250,000	250,000	DN Tanks Quote 3/16/2021
		14" Overflow Nozzle & Reinf.	2	EA								inc
		Overflow Weir Box	2	EA								
		8" Drain Nozzle and Reinf.	2	EA								
		24" Intertie Nozzle & Reinf.	2	EA								
		Interior Ladder	92	RUNGS								incl
		39" Sqr. Roof Access Latch	2	EA								inc
		Roof Guardrail		LF								incl 100 ' included
		Center Vent	2	EA								inc
		Perimeter Vents	16	EA								incl
		24" Shell Manhole & Reinf.	2	EA								

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Marin Municipal Water District - Smith Saddle Tanks Rehabilitation

Building, Area: Alternative No. #3

Prepared By: D.Barraza/JLH
Date Prepared: 4.28.2021
KJ Proj. No. 2168002*00

Current at ENR 11698 Jan 2021
Escalated to ENR
Months to Midpoint of Construct 24

Estimate Type:
- [x] Conceptual
- [ ] Preliminary (w/o plans)
- [ ] Design Development @ ______ % Complete
- [ ] Construction
- [ ] Change Order

Spec. Section	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total	Source
33 16		**New Prestressed Concrete Tanks**										
		Tank No. 1	5,000,000	GAL	0.49	2,450,000	0.49	2,450,000			4,900,000	DN Tanks Quote 3/16/2021
		Tank No. 2	5,000,000	GAL	0.49	2,450,000	0.49	2,450,000			4,900,000	DN Tanks Quote 3/16/2021
		Hydrotest/ Disinfect Tank Interior	2	LS			25000.00	50000.00			50,000	
SUBTOTAL - DIVISION						4,900,000		4,950,000		450,000	10,300,000	

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Appendix H

Estimated Construction Schedule

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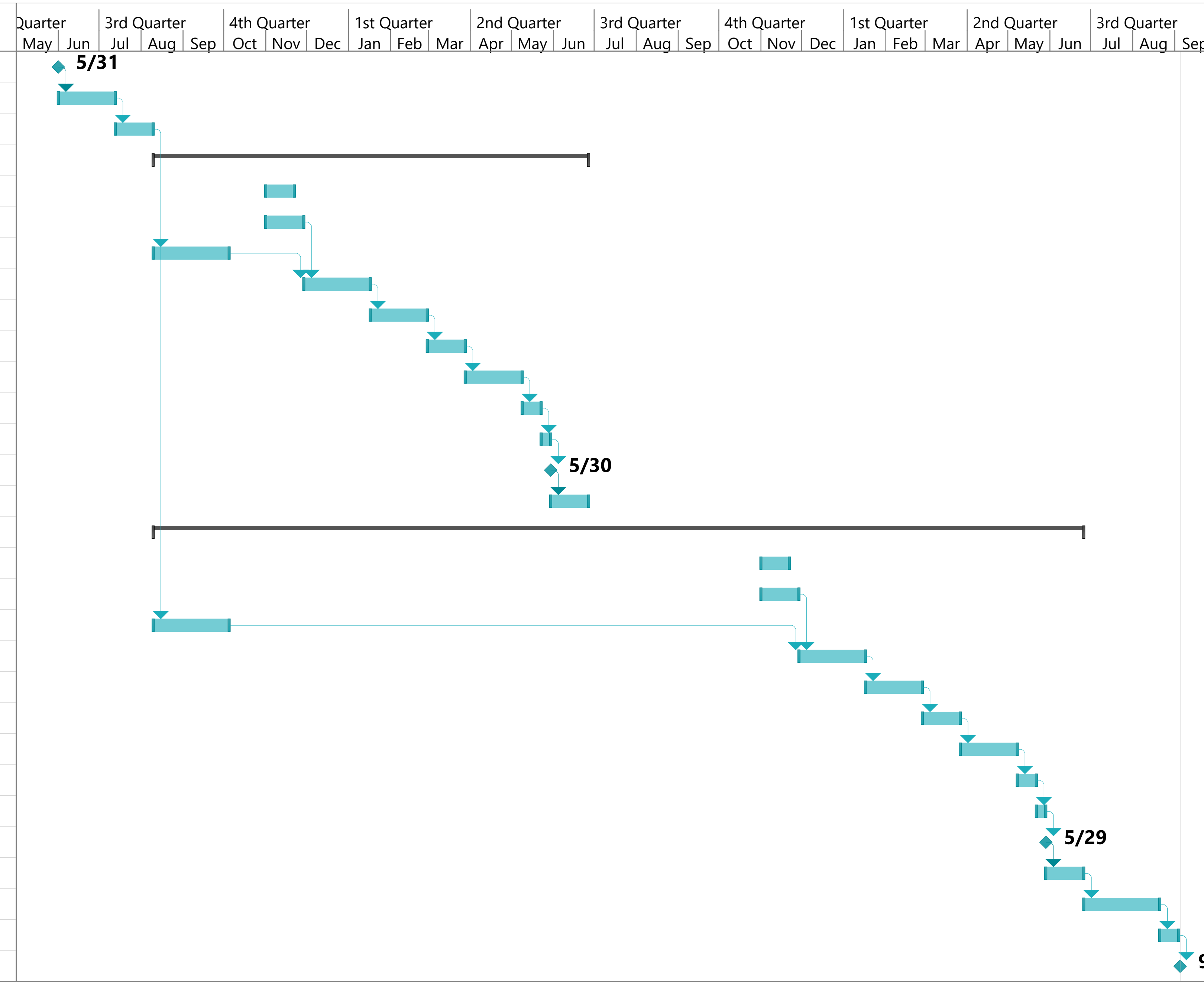
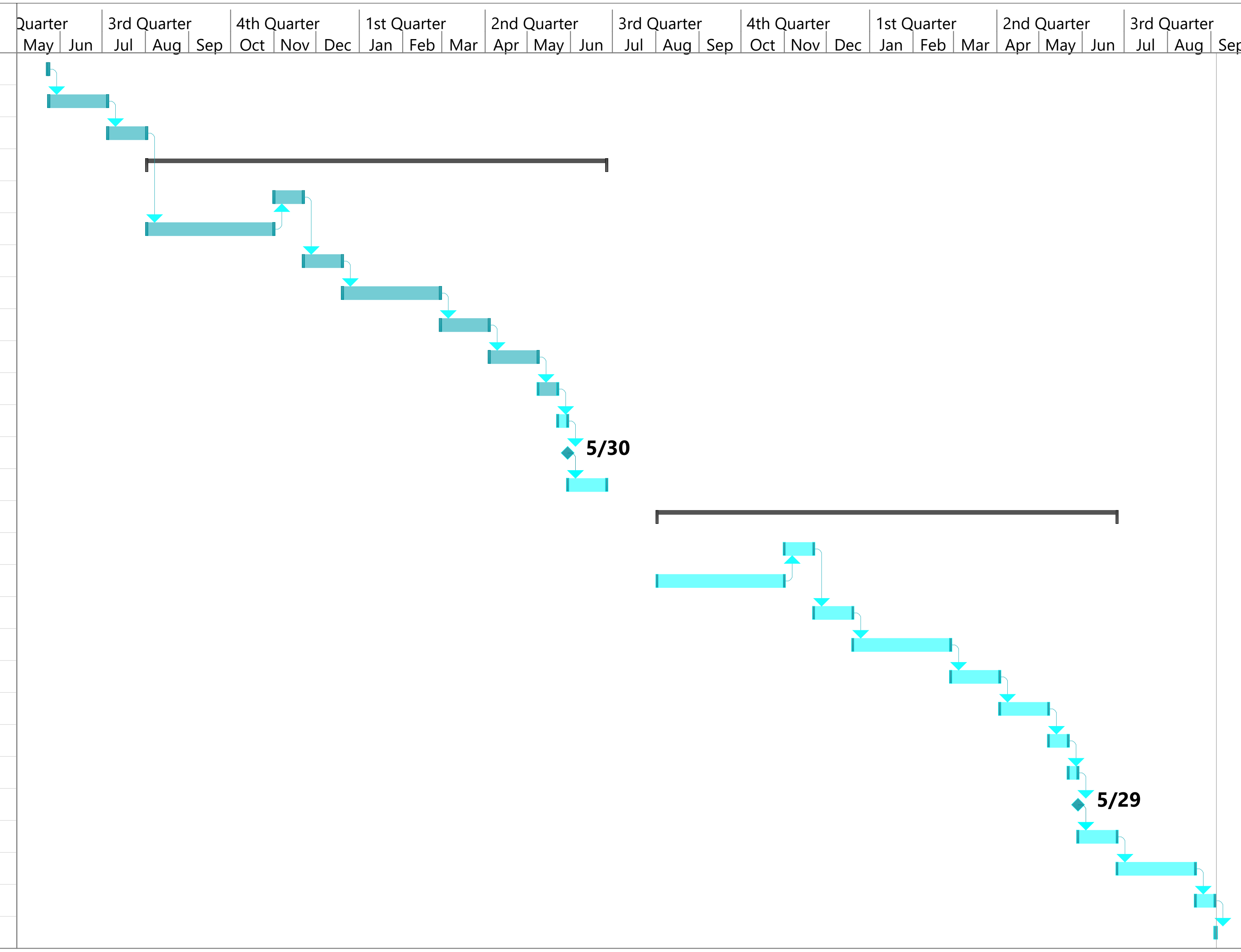
ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Notice to Proceed	1 day	Tue 5/31/22	Tue 5/31/22	
2			Submit Shop Drawings	30 days	Wed 6/1/22	Tue 7/12/22	1
3			Review & Approve Submittals	20 days	Wed 7/13/22	Tue 8/9/22	2
4			**Tank No. 2 (East)**	**229 days**	**Wed 8/10/22**	**Mon 6/26/23**	
5			Foundation & Subgrade	15 days	Tue 11/1/22	Mon 11/21/22	
6			Demo Roof, Shell & Columns	20 days	Tue 11/1/22	Mon 11/28/22	
7			Fabricate & Deliver Materials	40 days	Wed 8/10/22	Tue 10/4/22	3
8			Field Construction & Appurtenanc	35 days	Tue 11/29/22	Mon 1/16/23	6,7
9			Chip and Blast Interior	30 days	Tue 1/17/23	Mon 2/27/23	8
10			Contain, Blast Exterior	20 days	Tue 2/28/23	Mon 3/27/23	9
11			Field Painting	30 days	Tue 3/28/23	Mon 5/8/23	10
12			Cathodic Protection	10 days	Tue 5/9/23	Mon 5/22/23	11
13			Clean and Disinfect	5 days	Tue 5/23/23	Mon 5/29/23	12
14			Tank 2 Operational	0 days	Tue 5/30/23	Tue 5/30/23	13
15			Electrical & Sitework	20 days	Tue 5/30/23	Mon 6/26/23	14
16			**Tank No. 1 (West)**	**490 days**	**Wed 8/10/22**	**Tue 6/25/24**	
17			Foundation & Subgrade	15 days	Wed 11/1/23	Tue 11/21/23	
18			Demo Roof, Shell & Columns	20 days	Wed 11/1/23	Tue 11/28/23	
19			Fabricate & Deliver Materials	40 days	Wed 8/10/22	Tue 10/4/22	3
20			Field Construction & Appurtenanc	35 days	Wed 11/29/2	Tue 1/16/24	18,19
21			Chip and Blast Interior	30 days	Wed 1/17/24	Tue 2/27/24	20
22			Contain, Blast Exterior	20 days	Wed 2/28/24	Tue 3/26/24	21
23			Field Painting	30 days	Wed 3/27/24	Tue 5/7/24	22
24			Cathodic Protection	10 days	Wed 5/8/24	Tue 5/21/24	23
25			Clean and Disinfect	5 days	Wed 5/22/24	Tue 5/28/24	24
26			Tank 1 Operational	0 days	Wed 5/29/24	Wed 5/29/24	25
27			Electrical & Sitework	20 days	Wed 5/29/24	Tue 6/25/24	26
28			Access Road & Site Improvements	40 days	Wed 6/26/24	Tue 8/20/24	27
29			Punchlist	10 days	Wed 8/21/24	Tue 9/3/24	28
30			Project Complete	1 day	Wed 9/4/24	Wed 9/4/24	29



Project: Alt1_SmithSaddleTanks
Date: Mon 5/17/21

Task	Project Summary	Manual Task	Start-only
Split	Inactive Task	Duration-only	Finish-only
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks
Summary	Inactive Summary	Manual Summary	External Milestone
Deadline	Progress	Manual Progress	

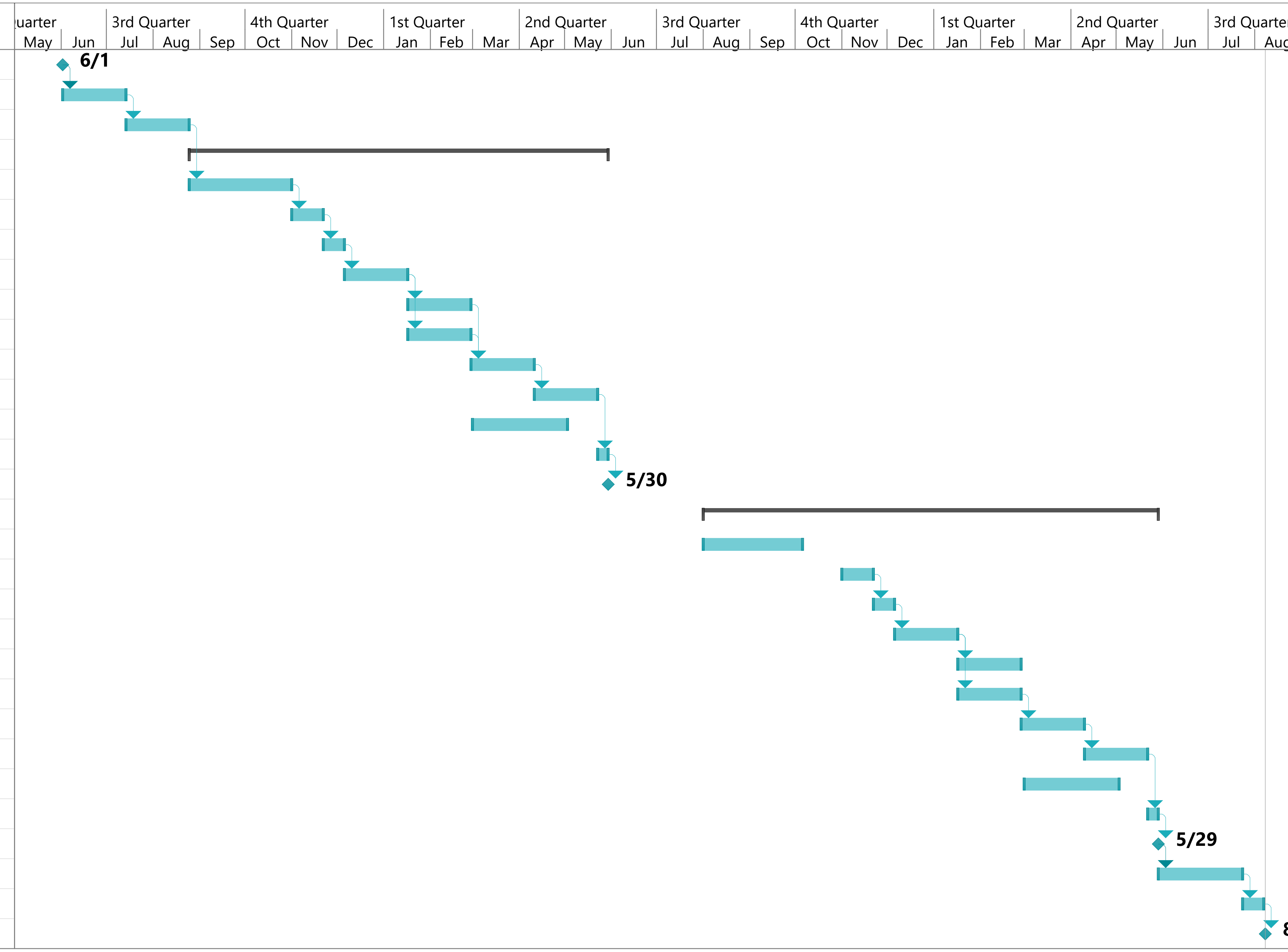
ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
1			Notice to Proceed	1 day	Mon 5/23/22	Mon 5/23/22	
2			Submit Shop Drawings	30 days	Tue 5/24/22	Mon 7/4/22	1
3			Review & Approve Submittals	20 days	Tue 7/5/22	Mon 8/1/22	2
4			**Tank No. 2 (East)**	**235 days**	**Tue 8/2/22**	**Mon 6/26/23**	
5			Demo Welded Steel Tank	15 days	Tue 11/1/22	Mon 11/21/2	6
6			Fabrication & Shop Prime	65 days	Tue 8/2/22	Mon 10/31/2	3
7			Foundation	20 days	Tue 11/22/22	Mon 12/19/2	5
8			Field Construction & Appurtenances	50 days	Tue 12/20/22	Mon 2/27/23	7
9			Blast & Paint Interior	25 days	Tue 2/28/23	Mon 4/3/23	8
10			Paint Exterior	25 days	Tue 4/4/23	Mon 5/8/23	9
11			Cathodic Protection	10 days	Tue 5/9/23	Mon 5/22/23	10
12			Clean & Disinfect	5 days	Tue 5/23/23	Mon 5/29/23	11
13			Tank 2 Operational	0 days	Tue 5/30/23	Tue 5/30/23	12
14			Electrical & Sitework	20 days	Tue 5/30/23	Mon 6/26/23	13
15			**Tank No. 1 (West)**	**235 days**	**Wed 8/2/23**	**Tue 6/25/24**	
16			Demo Welded Steel Tank	15 days	Wed 11/1/23	Tue 11/21/23	17
17			Fabrication & Shop Prime	65 days	Wed 8/2/23	Tue 10/31/23	
18			Foundation	20 days	Wed 11/22/2	Tue 12/19/23	16
19			Field Construction & Appurtenances	50 days	Wed 12/20/2	Tue 2/27/24	18
20			Blast & Paint Interior	25 days	Wed 2/28/24	Tue 4/2/24	19
21			Paint Exterior	25 days	Wed 4/3/24	Tue 5/7/24	20
22			Cathodic Protection	10 days	Wed 5/8/24	Tue 5/21/24	21
23			Clean & Disinfect	5 days	Wed 5/22/24	Tue 5/28/24	22
24			Tank 2 Operational	0 days	Wed 5/29/24	Wed 5/29/24	23
25			Electrical & Sitework	20 days	Wed 5/29/24	Tue 6/25/24	24
26			Access Road & Site Improvements	40 days	Wed 6/26/24	Tue 8/20/24	25
27			Punchlist	10 days	Wed 8/21/24	Tue 9/3/24	26
28			Project Complete	1 day	Wed 9/4/24	Wed 9/4/24	27



Project: Alt2_SmithSaddleTanks
Date: Mon 5/17/21

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

ID		Task Name	Duration	Start	Finish	Predecessors
1		Notice to Proceed	1 day	Wed 6/1/22	Wed 6/1/22	
2		Submit Shop Drawings	30 days	Thu 6/2/22	Wed 7/13/22	1
3		Review & Approve Submittals	30 days	Thu 7/14/22	Wed 8/24/22	2
4		**Tank No. 2 (East)**	**198 days**	**Thu 8/25/22**	**Tue 5/30/23**	
5		Fabricate & Deliver Materials	48 days	Thu 8/25/22	Mon 10/31/2	3
6		Demo Welded Steel Tank	15 days	Tue 11/1/22	Mon 11/21/2	5
7		Rough Grading Tank Subgrade	10 days	Tue 11/22/22	Mon 12/5/22	6
8		Form/Reinf/Place Tank SOG	30 days	Tue 12/6/22	Mon 1/16/23	7
9		Form/Reinf/Place Tank Wall	30 days	Tue 1/17/23	Mon 2/27/23	8
10		Form/Reinf/Place Tank Column	30 days	Tue 1/17/23	Mon 2/27/23	8
11		Shore/Form/Reinf Place Roof	30 days	Tue 2/28/23	Mon 4/10/23	9,10
12		Prestressing & Shotcrete	30 days	Tue 4/11/23	Mon 5/22/23	11
13		Site Piping Improvements	45 days	Wed 3/1/23	Tue 5/2/23	
14		Clean, Disinfect, & Hydro Tank	5 days	Tue 5/23/23	Mon 5/29/23	12
15		Tank 2 Operational	0 days	Tue 5/30/23	Tue 5/30/23	14
16		**Tank No. 1 (West)**	**216 days**	**Tue 8/1/23**	**Wed 5/29/24**	
17		Fabricate & Deliver Materials	48 days	Tue 8/1/23	Thu 10/5/23	
18		Demo Welded Steel Tank	15 days	Wed 11/1/23	Tue 11/21/23	
19		Rough Grading Tank Subgrade	10 days	Wed 11/22/2	Tue 12/5/23	18
20		Form/Reinf/Place Tank SOG	30 days	Wed 12/6/23	Tue 1/16/24	19
21		Form/Reinf/Place Tank Wall	30 days	Wed 1/17/24	Tue 2/27/24	20
22		Form/Reinf/Place Tank Column	30 days	Wed 1/17/24	Tue 2/27/24	20
23		Shore/Form/Reinf Place Roof	30 days	Wed 2/28/24	Tue 4/9/24	22
24		Prestressing & Shotcrete	30 days	Wed 4/10/24	Tue 5/21/24	23
25		Site Piping Improvements	45 days	Fri 3/1/24	Thu 5/2/24	
26		Clean, Disinfect, & Hydro Tank	5 days	Wed 5/22/24	Tue 5/28/24	24
27		Tank 1 Operational	0 days	Wed 5/29/24	Wed 5/29/24	26
28		Access Road & Site Improvements	40 days	Wed 5/29/24	Tue 7/23/24	27
29		Punchlist	10 days	Wed 7/24/24	Tue 8/6/24	28
30		Project Complete	1 day	Wed 8/7/24	Wed 8/7/24	29



Project: Alt3_SmithSaddleTanks
Date: Mon 5/17/21

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

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Item Number: 06
Meeting Date: 07-20-2021
Meeting: Board of Directors

Informational Item

TO: Board of Directors

FROM: Terrie Gillen, Board Secretary

THROUGH: Paul Sellier, Acting General Manager for Ben Horenstein

DIVISION NAME: Communications & Public Affairs Department

ITEM: Future Meeting Schedule and Agenda Items

SUMMARY
Review of the upcoming Board of Directors and Committee meetings.

DISCUSSION
Below are the upcoming meetings of the Board of Directors and/or Committees:

- CANCELLED - Friday, July 22, 2021
  Finance & Administration Committee/Board of Directors (Finance & Administration) Meeting
  9:30 a.m.

- Tuesday, August 3, 2021
  Board of Directors' Regular Bi-Monthly Meeting
  7:30 p.m.

- Tuesday, August 17, 2021
  Board of Directors' Regular Bi-Monthly Meeting
  7:30 p.m.

- Wednesday, August 18, 2021
  Communications & Water Efficiency Committee/Board of Directors (Communications & Water Efficiency) Meeting
  9:30 a.m.

FISCAL IMPACT
None

ATTACHMENT(S)
None