McLaren ENGINEERING GROUP
applied ingenuity

bridge, highway & rail engineering
entertainment engineering
subaqueous investigation
civil & site engineering
structural design
marine facilities
geotechnics
surveying
forensics

March 1, 2013

Alameda County Public Works Agency
951 Turner Court
Hayward, CA 94545

Attn: Gene Mazza, Pump Station Supervisor

Email: gene@awpca.org

Re: Lake Merritt Pump Station Inspection
Oakland, California
MEG File No. 120469

INTRODUCTION

On February 13 and 14, 2013, McLaren Engineering Group (MEG) conducted an underwater inspection of the Lake Merritt Pump Station. The Pump Station is located along 7th and East 8th Streets in Oakland, California along the Lake Merritt Channel between Lake Merritt and the estuary leading to San Francisco Bay. The work was completed as requested by the Alameda County Public Works Agency. The task list assessment determined the current condition of the existing structure, including anodes, gates, channels, valves, trash racks, and bubblers as well as accumulated marine growth, silt and other debris. The findings of this investigation are presented below.

METHODOLOGY

MEG conducted the underwater investigation utilizing a three-person diving inspection team. The three-person diving inspection team consisted of a registered professional engineer-diver team leader, a diver, and a standby diver-tender. The team leader determined the appropriate mode of operations, gave direction to the diver, and documented the observations. The standby diver-tender assisted the team leader in documenting the condition of all inspected elements of the structure. A video and audio recording was made

of all underwater activities and is included as part of this report. The maximum depth of the water during the inspection was approximately 18 ft.

GENERAL OBSERVATIONS

The Lake Merritt Pump Station structure and inspected elements are generally intact and functioning properly with the following exceptions:

Some anodes were unable to be observed inside their PVC housings. Unexamined Horizontal Graphite Anodes (refer to attached diagram for locations):

a. Lakeside #3 (at the divider screen)
b. Gate GS-2 inside the suction channel
c. Gate GD-2 inside the discharge channel
d. Bayside #3 (at the divider screen)

The Trash Racks have localized areas of corrosion where the existing ceramic coating system has failed. Although there is no imminent danger to the trash racks, if the corrosion is left to continue it will eventually degrade these elements.

In the vicinity of the discharge flow on both Lakeside and Bayside, some Trash Rack sections do not return to rest on the toe curb as designed, but rather fall onto an adjacent rack. This permits a fairly large opening between adjacent racks for trash and other debris to transit into the pump impellers.

Sediment and some trash have accumulated primarily in the center of the structure on both the Lakeside and Bayside aprons in the vicinity of the Divider Screen behind the Trash Rack. This debris is of a fairly light and un-compacted consistency.

DETAILED OBSERVATIONS

Marine Growth and Sediment Accumulation: Lakeside

Apron Toe	2-1/2 foot drop to channel bottom at wing walls, 1-1/2 foot drop to channel bottom in center. Marine growth consists of Clams and Mussels, Seaweed and Algae, and other typical marine organisms for this type of estuary.
Apron	Light sediment accumulation, some small spalled spots noted on the concrete surface. No exposed re-bar was observed. Light marine growth, approximately 1" thick. Easily removed by hand. Some localized mussel and mussel shell accumulations.
Apron Wing Walls Right	Light sediment at base of wall. Light marine growth, approximately 1" thick, easily removed by hand.
Apron Wing Walls Left	Light sediment at base of wall. Light marine growth, approximately 1" thick, easily removed by hand.
Pump House Walls	18" - 24" of loose sediment and debris in the vicinity of the divider screen extending out about 8 feet, tapering to zero. Light marine growth, approximately 1" thick, easily removed by hand.
Trash Racks	Random areas of corrosion noted. Light to moderate marine growth, approximately 1/2" thick, easily removed by hand. Some localized areas of mussel accumulation. Flow area is relatively clear. Heaviest marine growth is at mid-water level.
Trash Rack Divider Screen	18" - 24" of loose sediment and debris in the vicinity of the divider screen extending out about 8 feet, tapering to zero. Light marine growth with some localized areas of mussel accumulation.

Marine Growth and Sediment Accumulation: Suction Channel

Floor	Little marine growth - mostly silts and light sediment.
Pump House Wall	1/8" - 3/4" soft marine growth
External Wall	1/8" - 3/4" soft marine growth
Pump Suction 1	Little marine growth. 1/4" loose sediment, some random trash.
Pump Suction 2	Little marine growth. 1/2" loose sediment, no heavy debris.
Pump Suction 3	Little marine growth. 1/2" - 1" loose sediment.
Pump Suction 4	Little marine growth. 1/8" light sediment.
GS-1 Vicinity	Door swing is clear - light marine growth, some sediment.
GS-2 Vicinity	Door swing is clear - light marine growth. Some sediment.

Marine Growth and Sediment Accumulation: Discharge Channel

Floor	Little marine growth - mostly silts and light sediment.
Pump House Wall	1/8" - 3/4" soft marine growth
External Wall	1/8" - 3/4" soft marine growth
Pump Discharge 1	Some small barnacles on the valve in the above water areas.
Pump Discharge 1	Some small barnacles on the valve in the above water areas.
Pump Discharge 1	Some small barnacles on the valve in the above water areas.
Pump Discharge 1	Some small barnacles on the valve in the above water areas.
GD-1 Vicinity	Door swing is clear - light marine growth, some sediment.
GD-2 Vicinity	Door swing is clear - light marine growth, some sediment.

Marine Growth and Sediment Accumulation: Bayside

Apron Toe	20 inch drop to channel bottom at wing walls, 3 foot to channel bottom in center. Mostly mussels and few clams, typical marine algae and seaweed for this type of estuary.
Apron	Light sediment accumulation, some small concrete spalled spots noted. No exposed re-bar was observed. Light marine growth, approximately 1" thick, easily removed by hand. Some localized mussel and mussel shell accumulations.
Apron Wing Walls Right	Light sediment at base of wall. Light marine growth, approximately 1" thick, easily removed by hand.
Apron Wing Walls Left	Light sediment at base of wall. Light marine growth, approximately 1" thick, easily removed by hand.
Pump House Walls	18" – 24" of loose sediment and debris in the vicinity of the divider screen extending out about 8 feet, tapering to zero. Light marine growth, approximately 1" thick, easily removed by hand.
Trash Racks	18" – 24" of loose sediment in the vicinity of the divider screen extending out about 8 feet, tapering to zero. Light marine growth with some localized areas of mussel accumulation. Heaviest accumulation at about mid-water. In the vicinity of the discharge channel the toe of a trash rack has been displaced outward about 6" to 7". The Proximity of the adjacent trash racks will not allow enough room for proper settlement against the curb.
Trash Rack Divider Screen	18" – 24" of loose sediment in the vicinity of the divider screen extending out about 8 feet, tapering to zero. Light marine growth with some localized areas of mussel accumulation/

Gates and Discharge Valves

Lakeside Suction GS-1	Good condition
Bayside Suction GS-2	Good condition
Lakeside Discharge GD-1	Good condition – Some rust/paint bubbles visible
Lakeside Suction GD-2	Good condition
Bypass Valve VC-1	Good condition, open about 1/8"
Discharge Valve VD-1	Good condition, fully closed
Discharge Valve VD-2	Good condition, fully closed
Discharge Valve VD-3	Good condition, fully closed
Discharge Valve VD-4	Good condition, fully closed
Gate Grease Lines	
GS-1	Intact
GS-2	Intact
GS-3	Intact
GS-4	Intact

Anodes

Lakeside #1	90% remaining.
Lakeside #2	90% remaining.
Lakeside #3 (at Divider Screen)	No windows in PVC pipe to allow for visual inspection of anode. Cannot confirm anode is in place.
Lakeside #4	90% remaining. Broken bracket above waterline
Lakeside #5	90% remaining.
GS-1 Lakeside	50% remaining. Broken/loose top bracket.
GS-1 Suction Channel	90% remaining.
GD-1 Lakeside	50% remaining.
GD-1 Discharge Channel	About 2" diameter.
GS-2 Bayside	About 3/4" diameter
GS-2 Suction Channel	Not Inspected
GD-2 Bayside	50% remaining.
GD-2 Discharge Channel	No windows in PVC pipe to allow for visual inspection of anode. Cannot confirm anode is in place.
Bayside #1	90% remaining
Bayside #2	90% remaining
Bayside #3 (at Divider Screen)	No windows in PVC pipe to allow for visual inspection of anode. Can confirm anode is in place by feel.
Bayside #4	Intact with 90% remaining. Strap broken above waterline.
Bayside #5	90% remaining.
Pump 1	
Horizontal Graphite Anode	Intact, good condition.
Zinc Left	90% remaining.
Zinc Right	90 % remaining.
Pump 2	
Horizontal Graphite Anode	Intact, good condition.
Zinc Left	75% remaining.
Zinc Right	75% remaining.
Pump 3	
Horizontal Graphite Anode	Intact, good condition, 6" – 7" sticking out.
Zinc Left	75% remaining.
Zinc Right	50% remaining.

Anodes (cont.)

Pump 4	
Horizontal Graphite Anode	Intact, good condition.
Zinc Left	65% remaining.
Zinc Right	65% remaining

Bubblers

Lakeside	Functioning
Suction Channel	Functioning
Discharge Channel	Functioning
Bayside	Functioning

Pump Suction Elements

Pump 1	
Impeller	No signs of corrosion, feels smooth, access limited.
Heat Exchanger	No signs of corrosion or damage; light marine growth, including some barnacles.
Pump 2	
Impeller	No signs of corrosion, feels smooth, access limited.
Heat Exchanger	No signs of corrosion or damage; light marine growth, including some barnacles.
Pump 3	
Impeller	No signs of corrosion, feels smooth, access limited.
Heat Exchanger	No signs of corrosion or damage; light marine growth, including some barnacles.
Pump 4	
Impeller	No signs of corrosion, feels smooth, access limited.
Heat Exchanger	No signs of corrosion or damage; light marine growth, including some barnacles.

CONCLUSIONS and RECOMMENDATIONS

Repair Recommendations- Planning and implementation should begin "immediately" for the following items. These should be implemented and completed before the end of the year.

1. Clean the marine growth from the underwater structures and inspected elements. Cleaning the marine growth in the near future will help to mitigate further attachment of more difficult to remove calcareous growth (barnacles) and difficult to remove bivalves (mussels and clams). The existing marine growth, while not excessive, is still at a stage where it can be easily removed by hand or machine. This is particularly important for the Pump Heat Exchangers to allow them to operate efficiently.

2. Remove accumulated debris from the structure. This debris is located primarily in the areas of the trash rack divider screens on both Lakeside and Bayside, however debris and silt has accumulated throughout the structure.

3. Change the partially depleted pump-suction channel zinc anodes which have less than 75% remaining. These include the zinc anodes for pumps 3 and 4.

4. Verify the condition of the uninspected Vertical Graphite Anodes. This work may require inspection from the surface or partial removal of the anode.

5. Add larger ports or windows onto the PVC housings of the Horizontal Graphite Anodes noted as being un-inspectable underwater due to small ports in the housings.

6. Repair or replace all broken Anode Housing Brackets as noted.

7. Clean the Trash Racks of accumulated marine growth. While there is some water flow reduction due to the marine growth on the trash racks it is not severely detrimental. Cleaning will allow for better inspection of the overall condition of the protective coating system as well as for locating additional areas of corrosion.

8. Repair the protective coating system on the corroded areas of the Trash Racks. Comparison with photos taken during a routine visit in June 2011 shows a large increase of corroded area.

9. Adjust or Modify the Trash Racks to allow room for flow-current displaced racks to realign into their correct positions.

Investigation Recommendations-These issues can be addressed following routine underwater cleaning of the Pump Station structure.

1. Marine growth and debris on and adjacent to the Pump Station may have obscured or prevented some observations. As such a visual re-inspection of the Pump Station following any routine cleaning is recommended.

2. Locate and monitor the condition of the spalled concrete areas on aprons and re-inspect the structure for any signs of concrete distress. This inspection work, being visual, needs to be initiated within a reasonably short period of time of 90 days or less following marine growth cleaning.

3. To maintain the facility and preserve its useful life, future routine dive inspections should continue to be performed on a cyclical basis of at least two times per year, or at approximately 6 month intervals.

4. Establish measurable criteria for the graphite anodes, both in terms of as-installed diameter and possibly length. Measuring actual diameter against these criteria will provide for better determination of anode replacement intervals.

5. Inspect the effectiveness of the Trash Rack coating system for additional signs of distress and possible coating failure. Determine if an alternative coating system is desirable or if repair to the existing coating system is a cost-effective option.

6. Investigate the Trash Rack Cathodic protection system to determine its effectiveness.

7. Inspect under the Apron Toe, both Lakeside and Bayside, for any indication of undermining by scour. The construction plans show sheet pile under the toe, to prevent undermining, but this was not verified as still being intact during our investigation.

8. Surveying methods are recommended to accurately monitor the dimensions and depths of the channel bottoms, both Bayside and Lakeside adjacent to the pump station over time.

9. Investigate the extent of corrosion on the surface of the Gates. Areas of paint encapsulated rust were noted on some of the gates (GS-2 was clear), and the extent of this corrosion should be quantified to determine the type of remediation required, if any.

10. Investigate methods to reduce the accumulation of detritus and debris in the still-water areas of the Pump Station and also investigate the potential for routine pump cycling to reduce normal silt accumulation.

11. Investigate methods to allow interim underwater viewing of the various underwater areas adjacent to the Pump Station without requiring the deployment of divers.

Should you have any questions or comments, or if you require additional information, please feel free to contact our office at any time.

Very truly yours,

The Office of

McLaren Technical Services, Inc.
d/b/a McLaren Engineering Group

Gregory Bryant, P.E.
Engineer-Diver

California Professional Engineer #M22749, expires 30 September 2014

Attachments: Logs, Photos, Drawings

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Video Recording Inspection Sequence of Events:

Lakeside: 13 February 2012, Morning

1. Apron Edge
2. Apron
3. Trash Rack Toe
4. Trash Rack Middle
5. Trash Rack Air/Water Interface
6. Penetration behind Trash Rack on GS-1 side
7. Divider Screen at Bottom
8. Anode, GS-1 Lakeside
9. GS-1 Gate and Grease Tube
10. Anode GS-1 Suction Channel
11. Anode #2 at Divider Screen
12. Anode #1 at Wing Wall
13. Pump Suction Channel #1
14. Pump Suction Channel #2
15. Bubbler in Suction Channel
16. Pump Suction Channel #3
17. Pump Suction Channel #4
18. Penetration behind Trash Rack on GD-1 side
19. Bubbler at Divider Screen
20. Anode #3 at Divider Screen
21. Anode #4

Video Recording Inspection Sequence of Events (cont.):

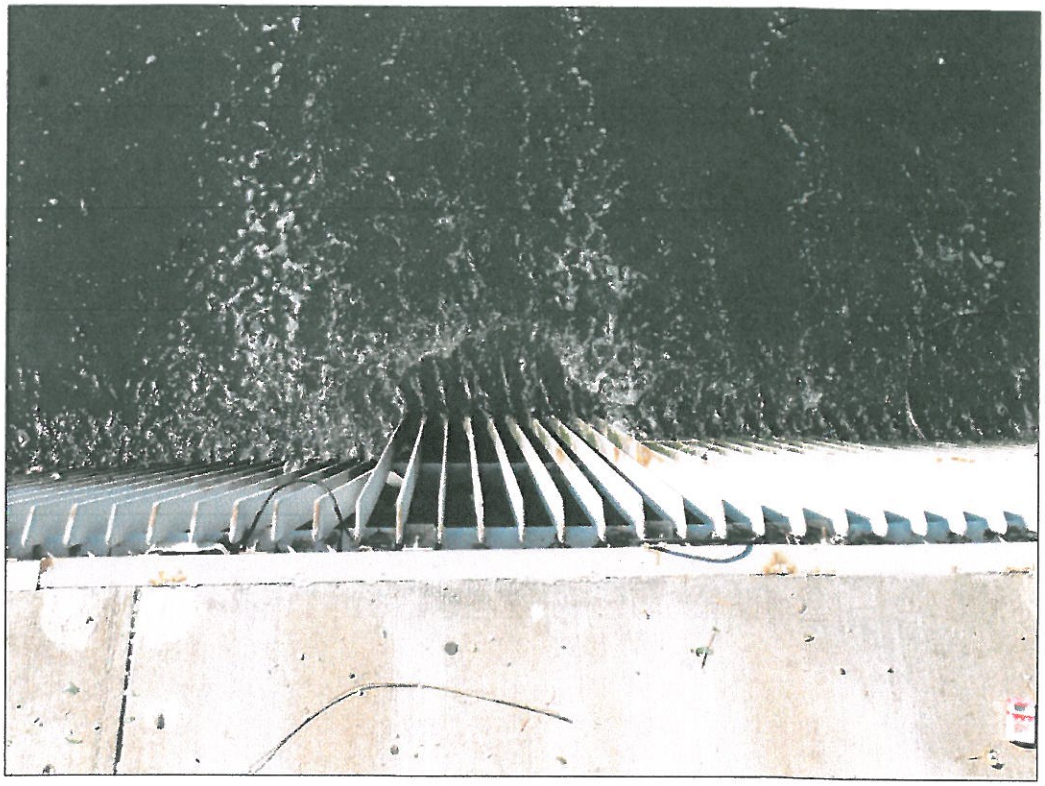
22. Anode # 5 at Wing Wall
23. Anode GD-1 Lakeside
24. GD-1 Gate and Grease Tube
25. Anode GD-1 Discharge Channel
26. Bubbler in Discharge Channel
27. VD-1 Butterfly Gate Valve
28. VD-2 Butterfly Gate Valve
29. VD-3 Butterfly Gate Valve
30. VD-4 Butterfly Gate Valve
31. Anode GD-2 Discharge Channel
32. GD-2 Gate on Inside Face
33. Trash Rack Lakeside Inside Toe

Bayside: 14 February 2012

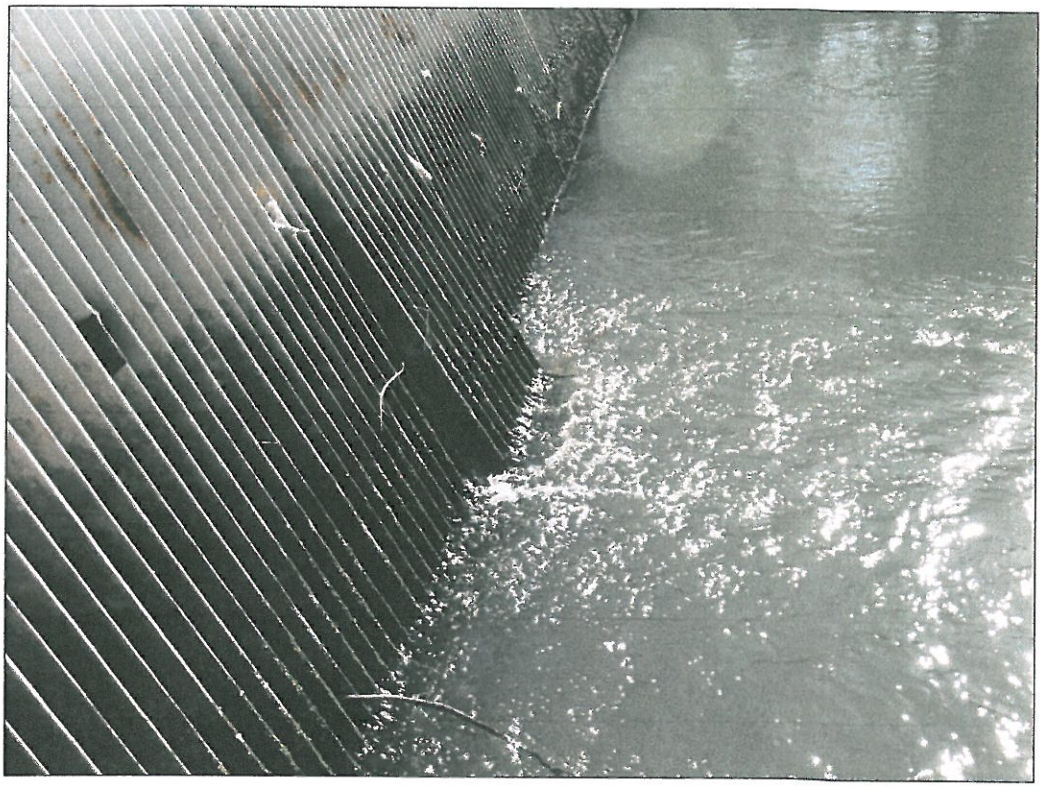
1. Apron Edge
2. Apron
3. Trash Rack Outside Toe
4. Trash Rack Middle
5. Trash Rack Air/Water Interface
6. Penetration behind Trash Rack on GS-2 side
7. Divider Screen at Bottom
8. Anode Bayside #3
9. VC-1 Bypass Butterfly Gate Valve

Video Recording Inspection Sequence of Events (cont.):

10. Anode GS-2 Bayside
11. Anode Bayside #4
12. Anode Bayside #5
13. GS-2 Gate and Grease Tube
14. Inside Toe of Trash Rack
15. Penetration behind Trash Rack on GD-2 side
16. GD-2 Gate and Grease Tube
17. Anode GD-2 Bayside
18. Anode Bayside #1
19. Anode Bayside #2
20. Bubbler Bayside
21. Inside Toe of Trash Rack



Downstream/Bayside Trash Rack Displaced by Discharge Flow

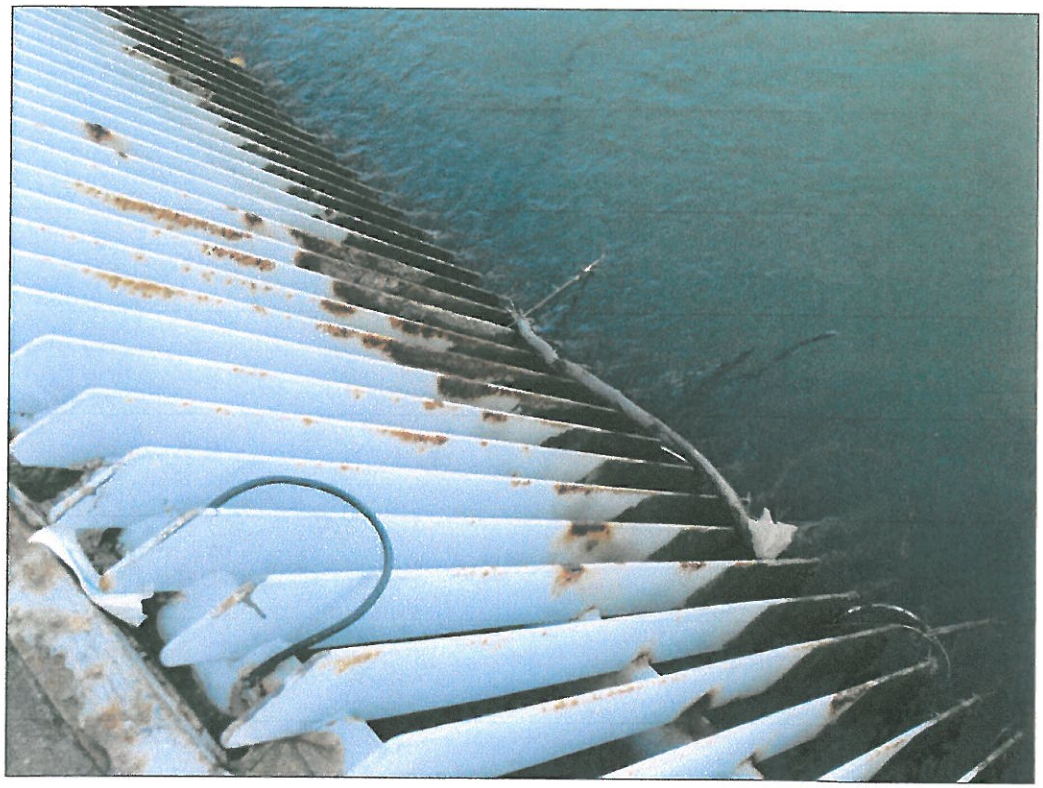


Upstream/Lakeside Trash Rack Displaced by Discharge Flow

Also Areas of Coating Failure

GS-1 Gate and Suction Channel

Typical Location of Gate Graphite Anodes



Upstream Trash Rack – Corrosion Example

Lake Merritt Pump Station
Inspected Component Locations
February 2013