INSPECTION & CONDITION SURVEY OF MARINE INFRASTRUCTURE

SUMMARY PRESENTATION

BEL MARIN KEYS COMMUNITY SERVICES DISTRICT

William M. Bruin, P.E., BC.PE

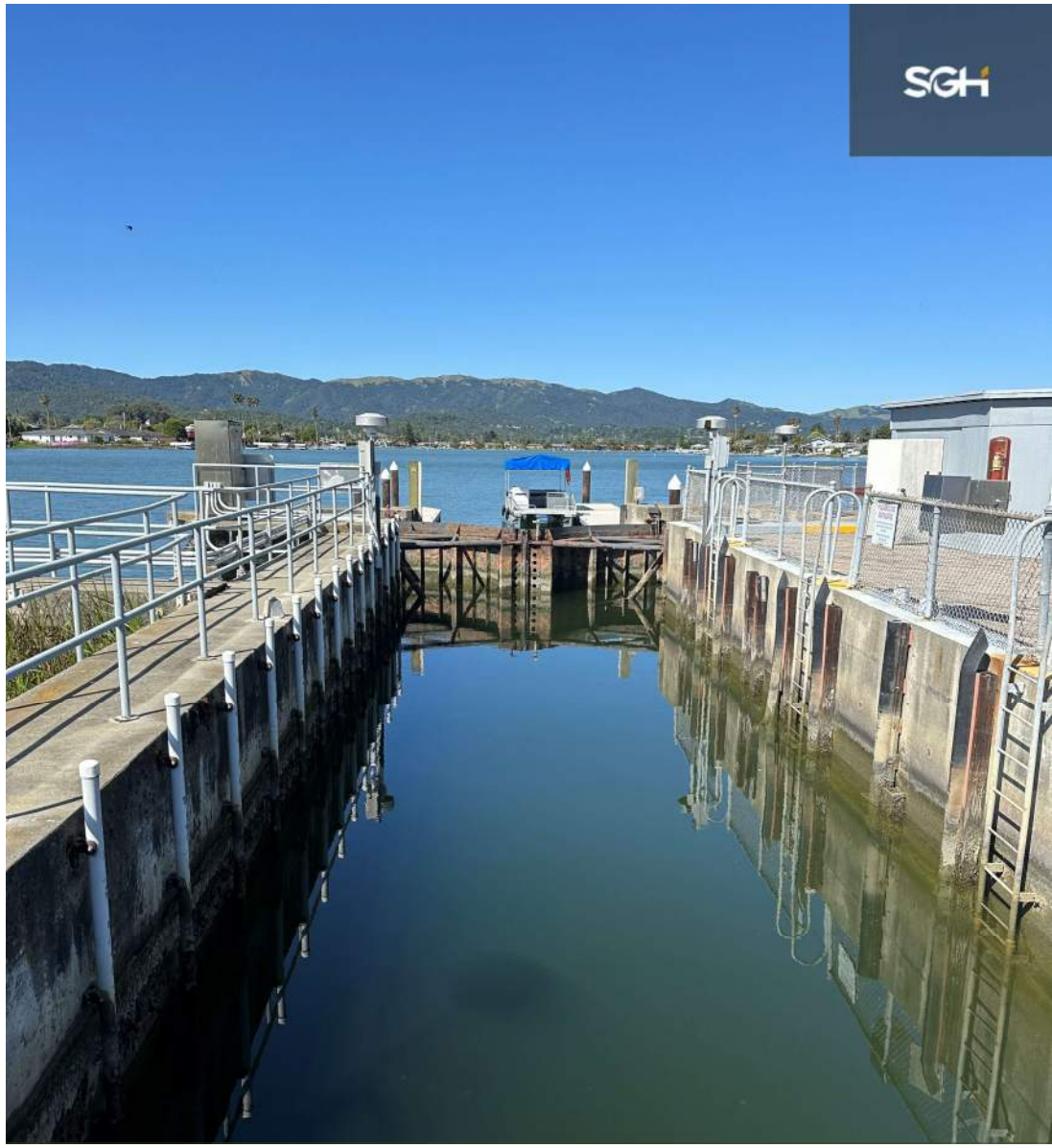
Simpson Gumpertz & Heger Inc.

21 November 2024

INSPECTION SUMMARY

Agenda

- Project and Inspection Overview
- Structural Assessment Findings
- Mechanical Assessment Findings
- Electrical Assessment Findings
- Repair Recommendations



PROJECT OVERVIEW

List of Structures Inspected

- North Lock
- North Lock Seawall
- North Lock Flood Gates
- South Lock
- South Lock Seawall
- Connecting Culvert

INSPECTION SCOPE

Survey Dates

- Above water (AW) - August 14-23, 2024.
- Mechanical and electrical - August 15, 2024.

Inspection Criteria

- ASCE MOP 130 – Waterfront Facilities Inspection and Assessment
  - Element Ratings – by material
  - Overall structure rating

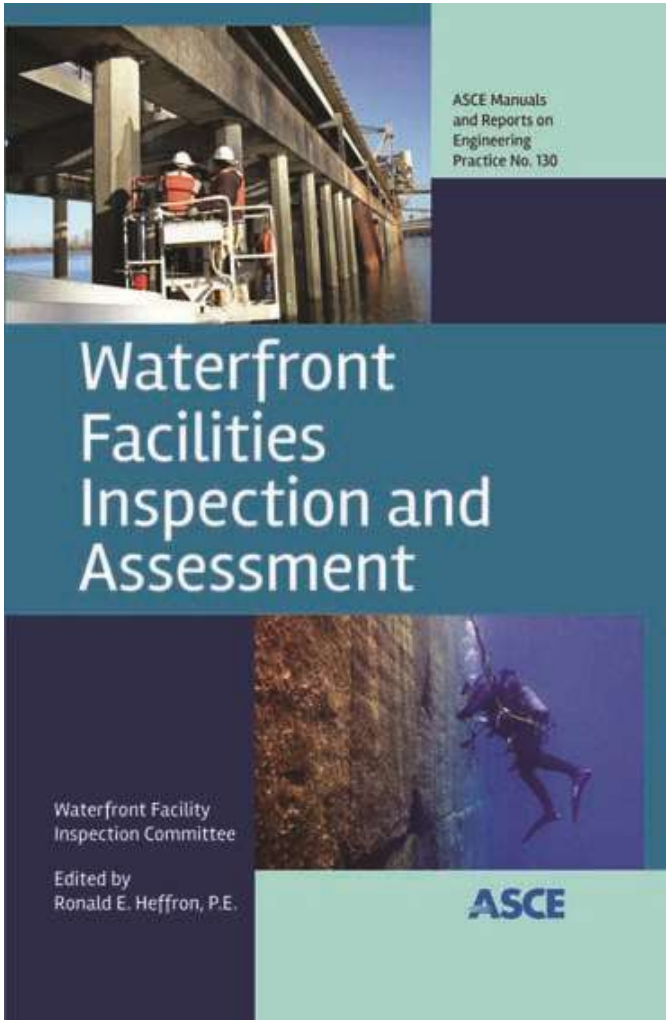
Element Ratings

Minor

Moderate

Major

Severe



INSPECTION FINDINGS

Structure Inspection Condition Assessment Ratings

Marine Structure	Component	2024 AW Condition Rating
North Lock	Concrete	Satisfactory
	South Gates (Lagoon)	Poor
	North Gates (Creek)	Fair
North Lock Seawall	Concrete	Fair
	Piles	Fair
North Lagoon Flood Gates	-	Critical
South Lock	Concrete	Satisfactory
	South Gates (Lagoon)	Poor
	North Gates (Creek)	Satisfactory
South Lock Seawall	Concrete	Satisfactory
	Piles	Fair
Connecting Culvert	-	N/A

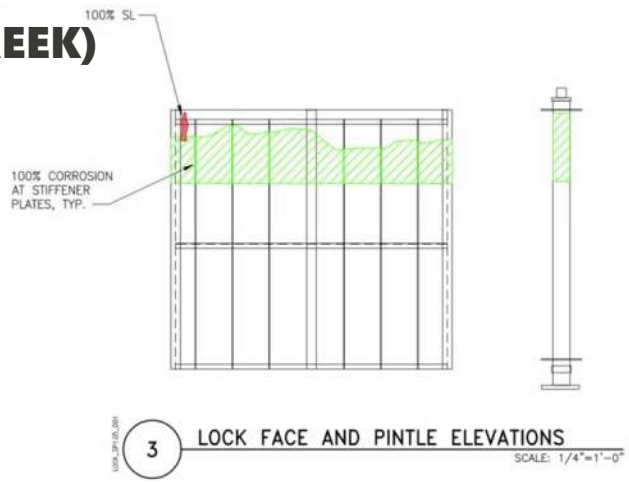
Table 2-14. Condition Assessment Ratings

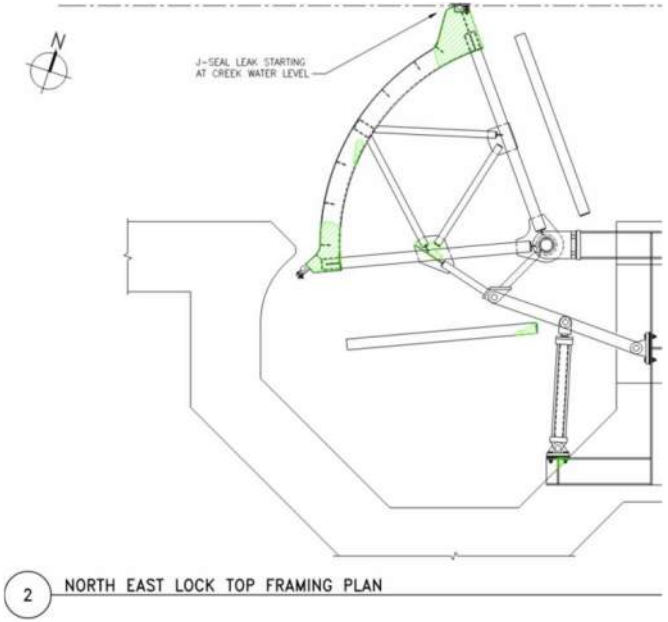
Rating		Description
6	Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5	Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
4	Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3	Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1	Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

NORTH LOCK – NORTH GATES (CREEK)

Rated Fair

- Moderate deterioration observed at gate faces with widespread corrosion above waterline. One area of 100% SL at top of gate NW gate face near middle J-seal
- Middle seam and NW J-seals leaking starting at creek water level

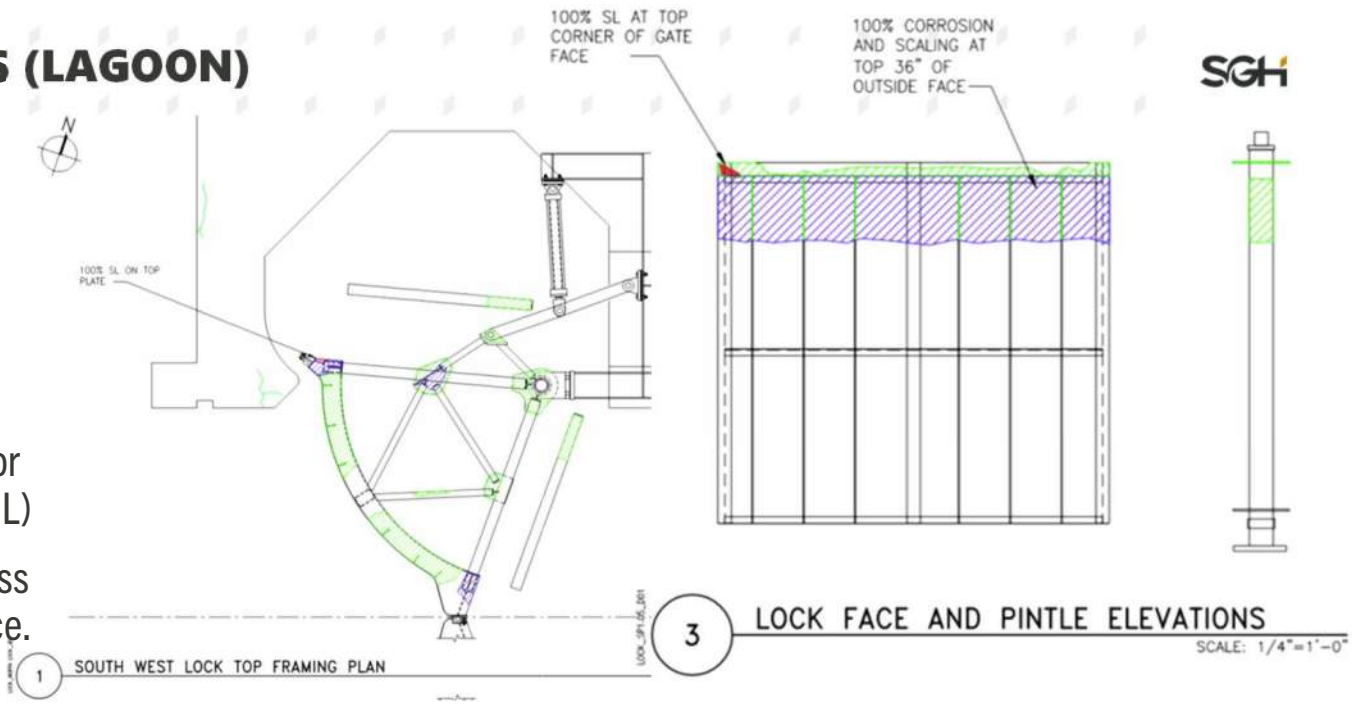




NORTH LOCK – SOUTH GATES (LAGOON)

Rated Poor

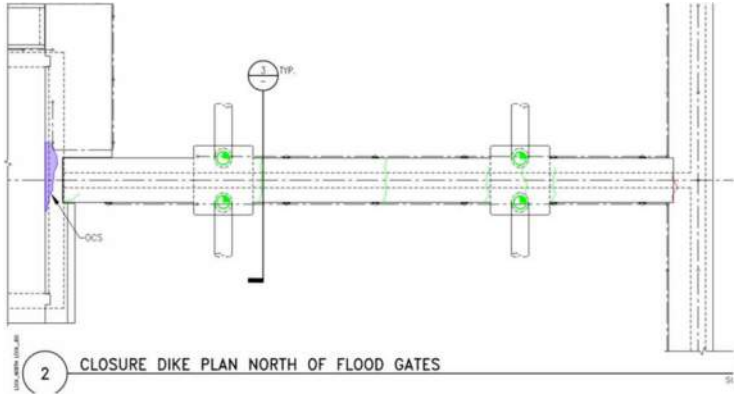
- Widespread advanced deterioration observed on steel members
- Gate faces have major corrosion and blistering above waterline
- Gusset plates and connections have major scaling and blistering with section loss (SL)
- Horizontal steel members rated Minor, less than 50% corrosion around circumference.
- Diagonal and vertical members have moderate corrosion at top ~24 in.

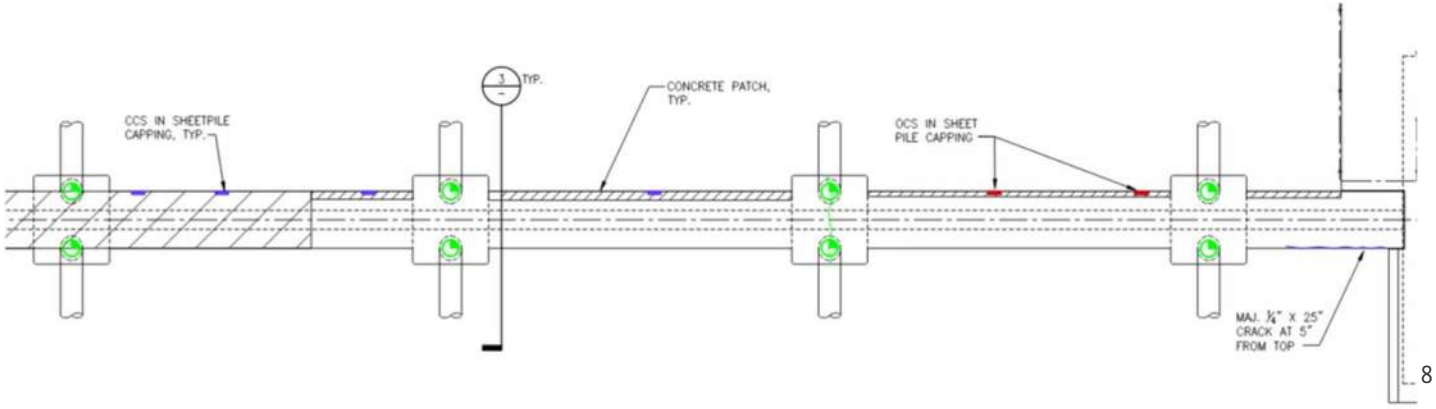


NORTH LOCK SEAWALL

Rated Fair

- All (20) batter piles – Moderate, up to 100% corrosion and scaling around circumference
- Concrete – Moderate, cracking in pile cap.
- Sheet piles – Moderate, >50% corrosion above water level with blistering and scaling especially prevalent at seams.
- Concrete caps over sheet piles on lagoon side - Moderate with few cracks and spalls, both open and closed

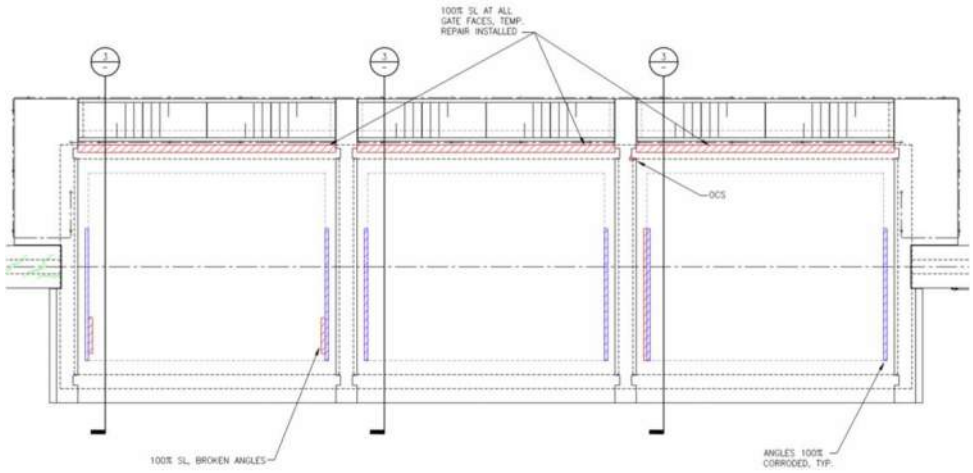




NORTH LAGOON FLOOD GATES

Rated Critical

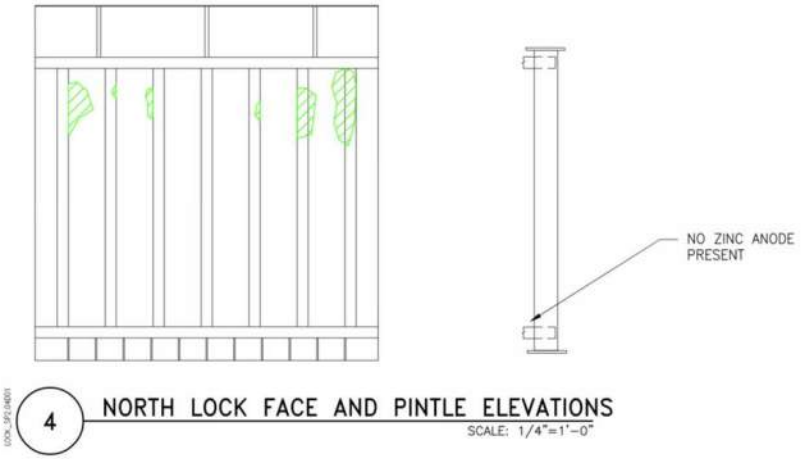
- Very advanced deterioration and breakage has resulted in localized failures at gate faces and arms
- Multiple structural angles on arm mechanism 100% corroded and cracked through
- Gates are inoperable due to structural deterioration and out-of-order mechanical system
- Fish gates installed during previous repair, currently inoperable due to mechanical failure



SOUTH LOCK – NORTH GATES (CREEK)

Rated Satisfactory

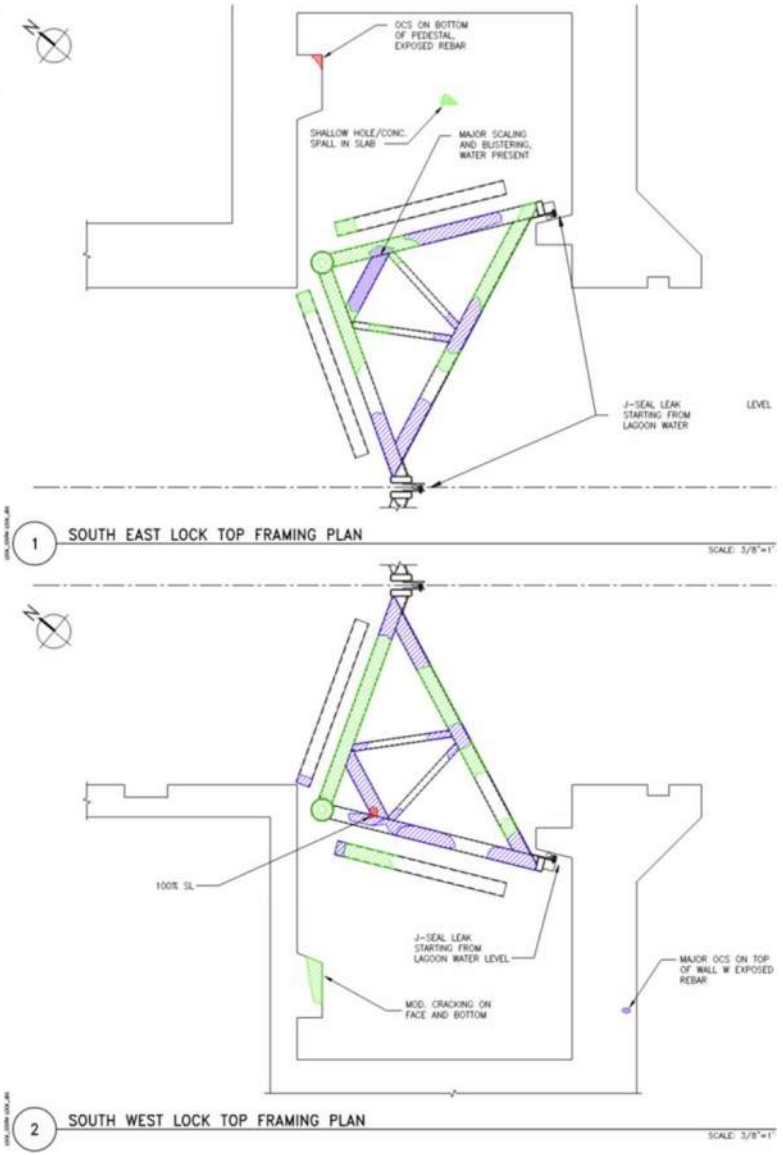
- Limited minor and moderate defects - limited corrosion with no overstressing
- Zinc anodes missing from NW and SE gates



SOUTH LOCK – SOUTH GATES (LAGOON)

Rated Poor

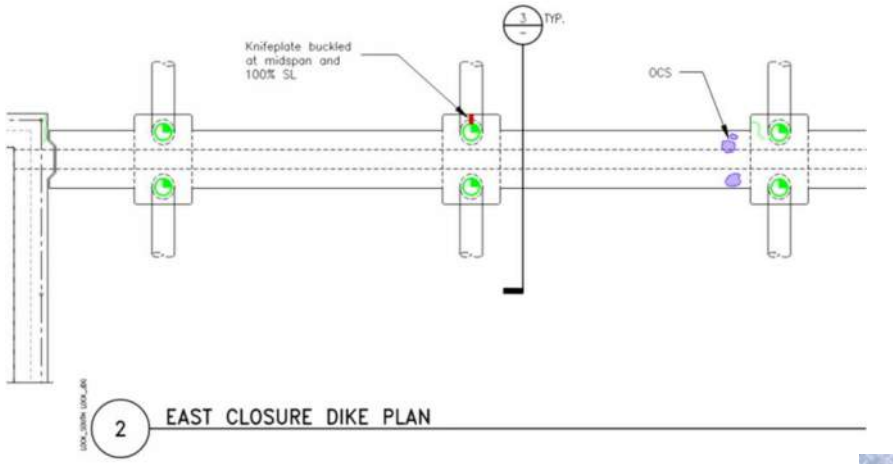
- Corrosion on all gate members with Major and Severe areas specifically at connections and welds
- Areas of 100% SL and water present inside HSS members
- Widespread corrosion gate face and top ~24-in. of vertical and diagonal supports



SOUTH LOCK SEAWALL

Rated Fair

- All (12) batter piles rated Moderate - Up to 100% corrosion and scaling observed. All piles are jacketed in top 36 in.
- Sheet piles rated Moderate - 100% corrosion above water level on creek side with blistering and scaling especially prevalent at seams
- (1) Knifeplate connection of sheet pile to batter pile has 100% SL and buckled at midspan



CONNECTING CULVERT

- Not visible during SGH inspection except for bump in moat between north and south lagoons.
- From “Recirculation Tubes” Memo (2003):
  - 750 ft long x 6 ft diam. concrete culvert 15-21 ft below grade.
  - Inoperative for ~40 years
  - Access filled with rip-rap and dirt and gatehouse demolished

North Lock

- **Fair condition**
- Moderate condition of gate limit switches
- No hydraulic components in obvious need of repair or replacement, should consider rebuilding cylinders as preventative maintenance.

MECHANICAL ASSESSMENT FINDINGS

South Lock

- **Fair condition**
- Small persistent leak in hydraulic tubing behind control panel
- Cylinders are extended in closed gate position exposing rods to weather, protective bellows would extend the life of rods
- Moderate condition of limit switches which require frequent maintenance

ELECTRICAL ASSESSMENT FINDINGS

North & South Locks

- Both in **Poor condition**
- Severe physical condition with obsolete technology.
- Brittle insulation on wiring between control and gate switches
- North Lock has electrical code violations in current control system. No overload protection is provided. Emergency generator may allow back feeding into PG&E grid endangering utility workers
- South Lock control panel broken into several panels with complicated wiring

STRUCTURAL REPAIR RECOMMENDATIONS

Overall

- Replace all gate J-seals
- Replace zinc anodes
- Clean and recoat all steel members not repaired

North Lock

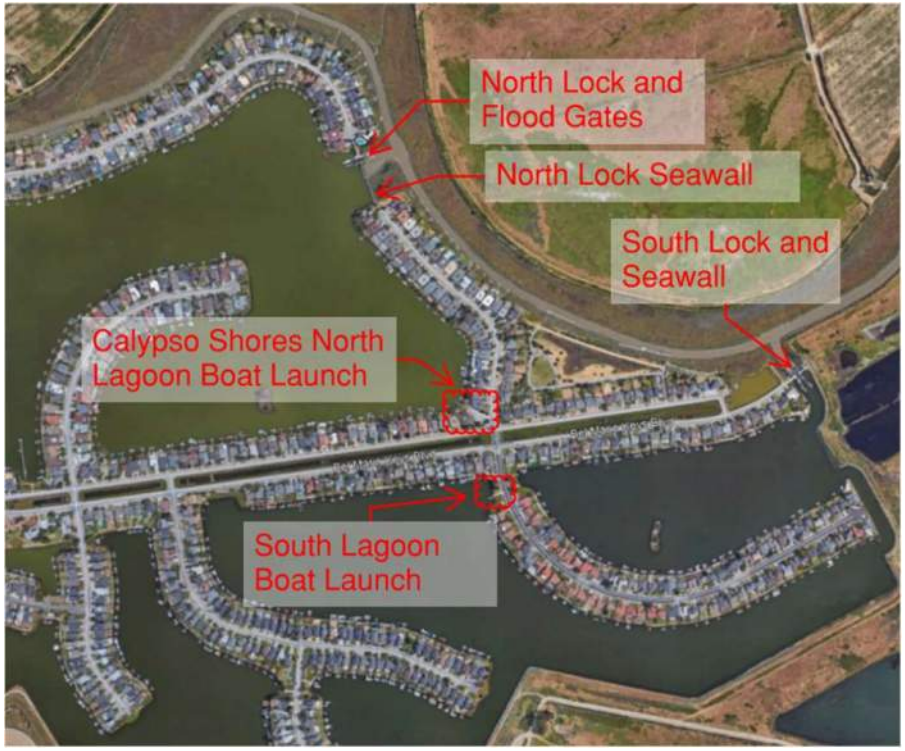
- Repair lagoon side gate faces and deteriorated members and connections

North Lock Seawall

- Clean and recoat deteriorated creek side of sheet piles and batter piles
- Seal concrete cracks and repair localized spalls

North Lock Flood Gates

- Replace gates



STRUCTURAL REPAIR RECOMMENDATIONS (CONTINUED)

South Lock

- Repair/replace lagoon side gate faces and deteriorated members and connections

South Lock Seawall

- Clean and recoat deteriorated creek side of sheet piles and batter piles

Connecting Culvert

- Rebuild the connecting culvert

Suggested Alternative Culvert Alignment

MECHANICAL REPAIR RECOMMENDATIONS

Both Locks

- Disassemble, clean, lubricate linkages, hinges, and cylinders.
- Rebuild hydraulic cylinders and rods.
- Provide functional bellows.
- Replace hydraulic hoses
- Service crane and vehicle bridge at the South Lock should be repaired and made operable if desired.

ELECTRICAL REPAIR RECOMMENDATIONS

Both Locks

- Replace control panels with new control panels, using a programmable logic controller (PLC)
- Replace the control wiring from the control panels to the operating stations and to the gate position limit switches.
- Replace all the gate position limit switches with non-contact proximity switches
- Replace exterior flexible conduits and local junction boxes.

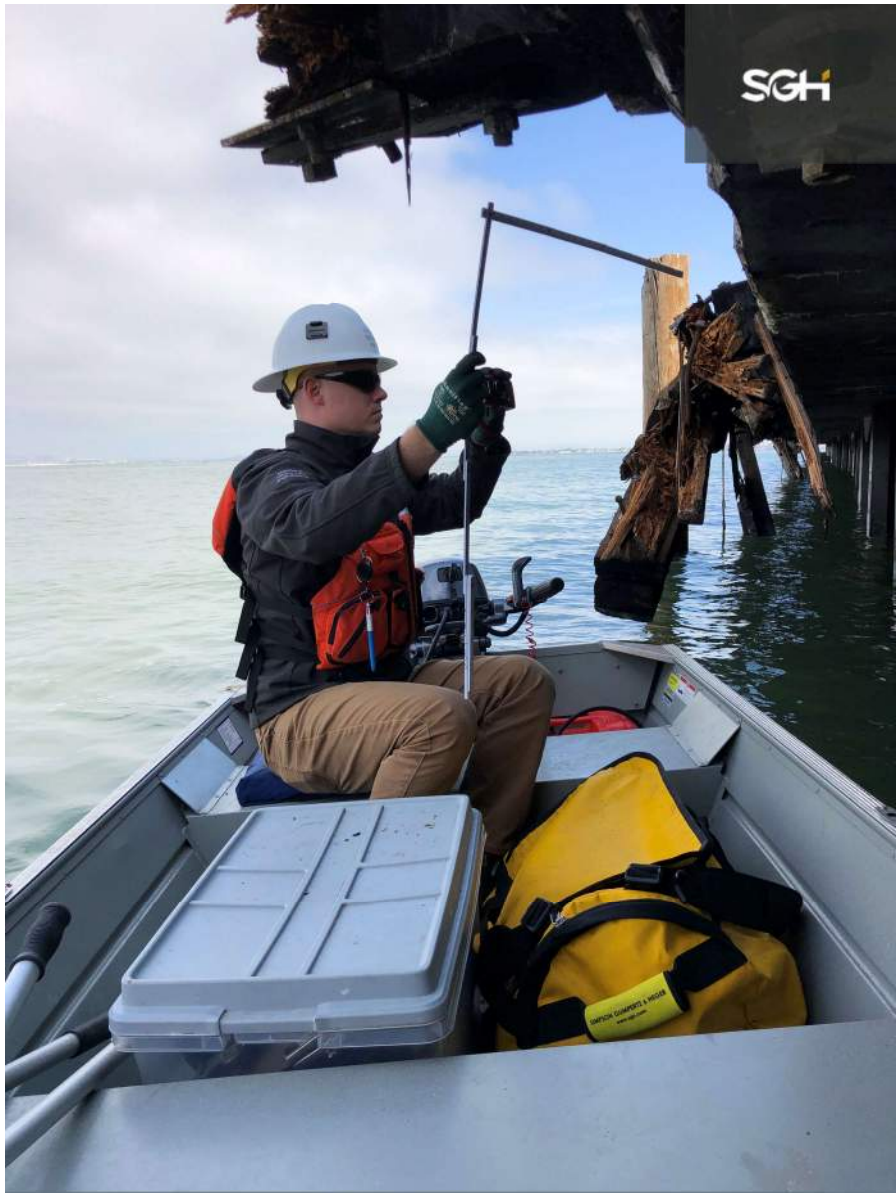
North Lock

- Replace the main power disconnect switch at the North Lock with a “double-throw” manual transfer switch to isolate utility and generator power to the panel.

OTHER RECOMMENDATIONS

Future considerations

- Create an inspection and maintenance plan for all marine structural infrastructure. In accordance with ASCE MOP 130
- Create an inspection and maintenance plan for the levees, their armaments, and other water management infrastructure not included in this survey.
- Conduct a hydrology and sedimentation study of the lagoons to evaluate their water management capabilities and sedimentation migration risks.
- Conduct a climate change study to understand the potential effects of future sea level rise and flooding on lagoon infrastructure.




QUESTIONS?

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