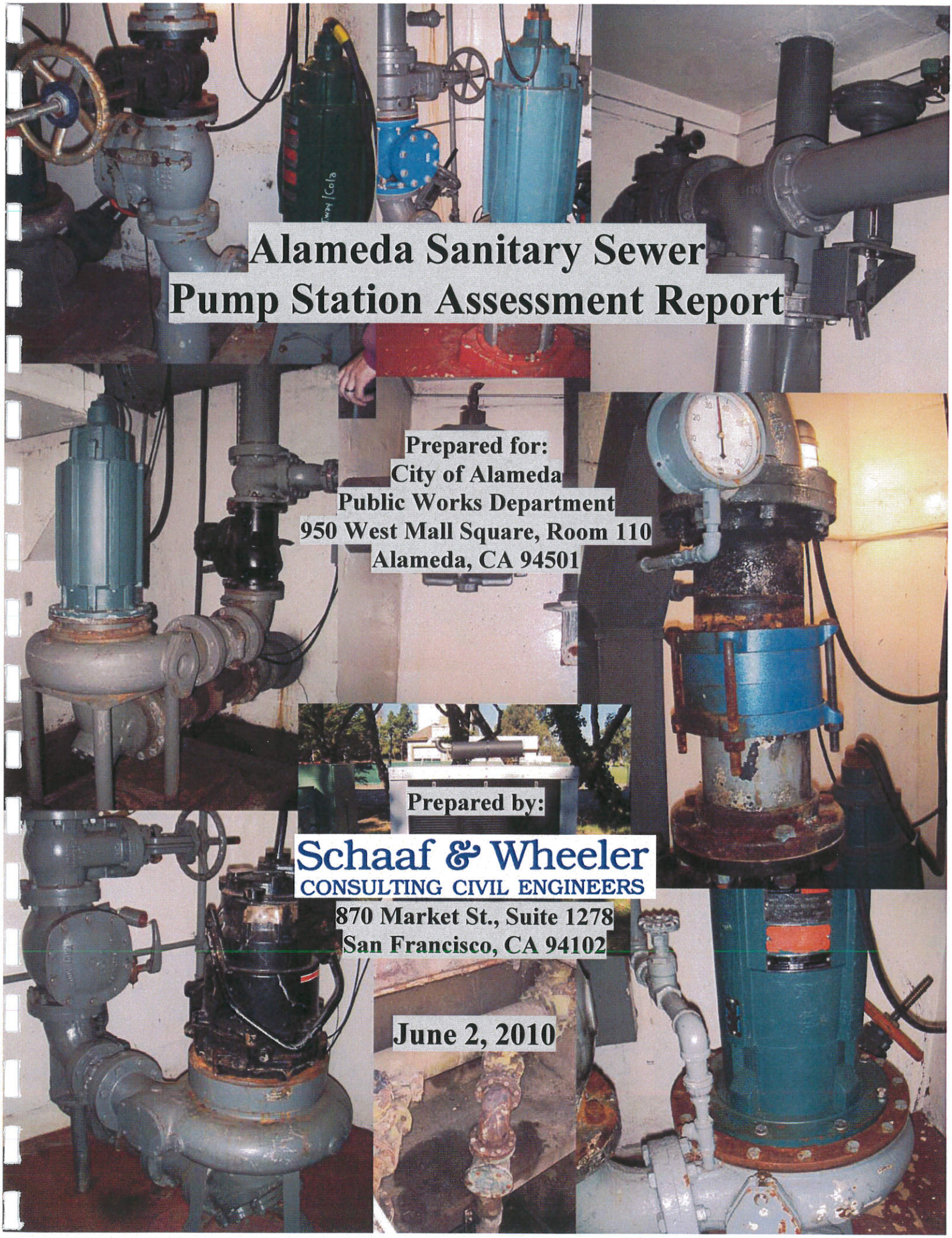

Alameda Sanitary Sewer Pump Station Assessment Report

Prepared for:
City of Alameda
Public Works Department
950 West Mall Square, Room 110
Alameda, CA 94501

Prepared by:

Schaaf & Wheeler
CONSULTING CIVIL ENGINEERS
870 Market St., Suite 1278
San Francisco, CA 94102

June 2, 2010

Alameda Sanitary Sewer
Pump Station Assessment Project

City of Alameda, CA

Prepared

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for

City of Alameda
Public Works Department
Engineering Division
950 West Mall Square, Room 110
Alameda, CA 94501

6/2/10

BENJAMIN L. SHICK, RCE No. 68813 (Date)

Schaaf & Wheeler
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25YR. VS. 50YR.?

From: "Ben Shick" <bshick@swsv.com>
To: PSoo@ci.alameda.ca.us
CC: GJu@rmcwater.com; BHawkins@ci.alameda.ca.us
Date: 2/25/2010 1:06 PM
Subject: RE: Questions on Pump Sta assessment

Paul,

Here are the answers to your questions below:

1. We recommend performing the 50-year rehabilitation first on some of the stations due to the current condition of the wetwell/drywell. For instance, there are structural issues with the BFI station; therefore, we recommend either performing a major rehabilitation on the existing structure, or replacing the structure with a new pump station. As stated in the individual pump station report for BFI: "The existing station is 62-years old and is in poor shape; therefore, we recommend performing the 50-year rehabilitation at this time."

2. The immediate improvements were developed to identify safety issues that we recommend improving if the station is not planned for rehabilitation in the near future. Here is the description of the immediate improvements from the pump station report:

"The immediate improvements are divided into the following three priority categories:
Priority 1 - Identified Safety Hazards
Priority 2 - Identified Code Violations
Priority 3 - Remaining Good Practice Improvements

These improvements should be implemented if the pump stations are not rehabilitated in the very near future."

Let me know if you have any additional questions.

Thank you,

Ben Shick, P.E.
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-----Original Message-----
From: Paul Soo [mailto:PSoo@ci.alameda.ca.us]
Sent: Thursday, February 25, 2010 12:47 PM
To: Ben Shick
Cc: Barbara Hawkins; Gisa Ju
Subject: Questions on Pump Sta assessment

Ben,

Can you comment on some of the questions below. Ifyou have mentioned it before and I forgot or did not catch it then I apologize.

1. Under the Pump Station Rehab Ranking Cost Estimate:
Why are some PSs the 50 yr cost is posted first and others, the 25 yr is posted first?
ex. in Grand/Otis the Rehab Type 25-yr is listed before 50-yr, but the reverse is done for BFI.

2. Define 'immediate' improvements. Are immediate improvements simply

Overview

The City of Alameda (City) engaged the firm of Schaaf & Wheeler to evaluate thirty four (34) sanitary sewer pump stations owned and operated by the City. Each station was visited and evaluated based on the following items:

- An Observable Means of Sanitary Sewer Overflow
- Pump and Piping Condition
- Pumping Capacity
- Pumping Efficiency
- Electrical Code Compliance and SCADA Function
- Structural Condition and Seismic Assessment
- Site Access and Safety

The location of each pump station evaluated is shown in Figure 1. A detailed location map and a system flow diagram are included in Appendix C. This report describes the criteria used to evaluate each station and summarizes the pump station evaluations. Detailed evaluation reports for each pump station are attached to this report.

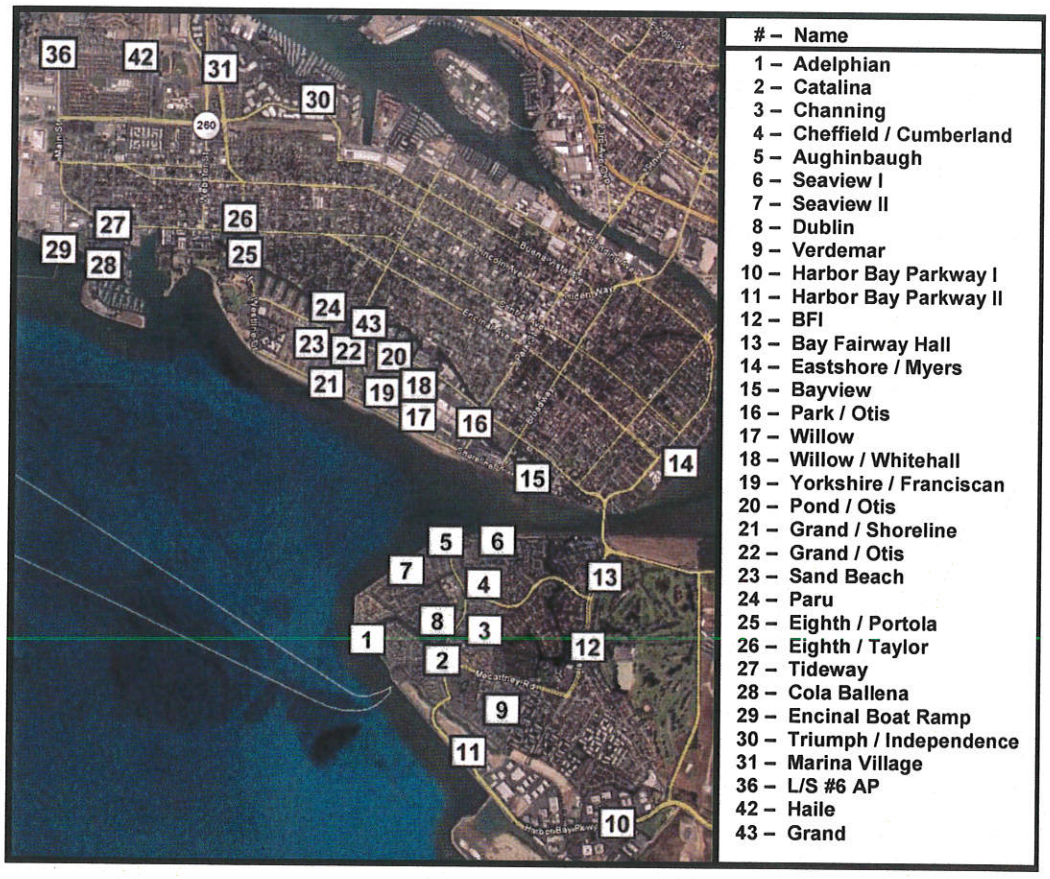


Figure 1: Pump Station Location Map

A rehabilitation cost and recommended schedule has been developed for each pump station. Rehabilitation costs range from $140,000 to $1,050,000, and the total cost to rehabilitate all 34 pump stations is approximately $10,100,000. Numerous recommended immediate improvements have been identified for each pump station. The total estimated cost to implement the immediate improvements at all 34 pump stations is $1,530,000.

Schaaf & Wheeler's project team consists of: Terada Engineering, Inc. to evaluate the power and electrical systems; Finn Design Group to evaluate the structural condition and to perform a seismic assessment; Craig Evans Pump Testing Service to perform pump and flow tests; and Schaaf & Wheeler has evaluated the pump and piping systems, station layouts, and reliability.

Pump Station Evaluation

The following sections describe the pump station assessment performed for each of the 34 pump stations. Analysis of the current condition of each station is limited to visual inspection, pump test data, and information provided by the City. Anticipated service lives may vary; it may be necessary to replace some equipment earlier than noted, and some may last longer than expected.

Several photos and videos were taken during our site visits; these are included in Appendix G in addition to all record drawings that were provided by the City. A comprehensive pump station inventory table is included in Appendix B.

We also looked at the possibility of removing pump stations and replacing them with shallower gravity pipes. Based on the flat topography and the existing pipe alignments of the Alameda Sanitary Sewer System, this option has been deemed infeasible. In most cases upstream gravity pipes would have to be significantly raised and would likely make it infeasible to reconnect the laterals. Such an option would either be physically impossible or economically unjustifiable.

Sanitary Sewer Overflows

Each station was evaluated for its potential risk to cause sanitary sewer overflows (SSOs). The evaluated risk assessment is based on the stations capacity in relation to the peak demand, and observable pump station items such as the presence of a high-level bypass pipe, redundant pumps, and backup power. Stations with insufficient capacity and the lack of a high-level bypass pipe are highly susceptible to overflows. In order to provide adequate protection against SSOs each station should have:

- Adequate capacity for the peak wet weather flow (PWWF)
- Redundant pumping capacity
- Connected to the City's SCADA system
- Standby power (or connection for a portable generator for stations with small inflow loads as described in the individual pump station reports)

Pump and Piping System Assessment

A visual inspection has been performed on the overall condition of the pump station appurtenances. Pump station capacities and reliability are assessed based on pump test data, the number of pumps at each station, and the presence of a high-level bypass pipe and/or backup generator.

Nine of the thirty-four stations assessed are wet well/dry well pump stations. We recommend converting these stations to large wet well pump stations during their next rehabilitation. A discussion on how this conversion could be done is included as Appendix E.

Recommended sanitary sewer pump station design criteria are included as Appendix D. In general, we recommend adding the following items where appropriate during rehabilitation:

- Add a bypass pumping connection unless the discharge manhole is relatively close and a flexible hose can easily be routed from the wet-well or upstream manhole to the discharge manhole without causing access issues with roads or sidewalks.
- Install valve vault and relocate valves to vault
- Add a second pump to all stations with one pump
- Where possible, add a fence surrounding each station
- Rehabilitate wet wells with a coating system or replace if necessary
- Relocate equipment to meet code requirements

We also recommend installing backup generators on all pump stations that have significant influent loads. Bay Fairway Hall, Grand/Shoreline, and Grand pump stations do not have sufficient space to add a backup generator; however, they have small influent loads which provide the City with adequate time before overflows to react to a SCADA signal notifying them of a pump station operation issue. Therefore, a backup generator may not be required at these stations. A connection for a portable backup generator should be added to these stations and the remaining stations where physical constraints limit the ability to install a backup generator. The City should have a sufficient number of backup

generators (portable and permanent) to adequately operate their system during a power outage. Sheffield/Cumberland, Seaview I, Seaview II, Eastshore/Myers, Bayview, Willow, Sand Beach, and Triumph/Independence pump station have a high level gravity bypass pipe that is at an elevation where if used, SSOs will not occur. Therefore, backup generators are not required at these stations.

Variable Frequency Drives

All of the stations assessed have constant speed (C/S) pumps. We recommend the City continue using C/S pumps, as opposed to variable speed (V/S), for each of the thirty-four stations assessed. With V/S operation, variable frequency drive (VFD) units are used to modulate the motor speed and match pump discharge rate to incoming flow; that is above a minimum speed governed by hydraulic considerations.

General advantages to this mode of operation include shorter sewage residence times that help reduce the deposition of solids, putrefaction, odors and corrosive gasses. In new installations, variable speed operation can also reduce the size of the wet well and help keep the wet well pumping level near the influent sewer to reduce turbulence and the release of odorous gases. However, often times with smaller pump stations it is not particularly advantageous to use VFDs. Many engineers subscribe to the theory that if a system could have been made to work with constant speed (C/S) pumps, then the decision to use variable speed was a mistake.

When V/S pumping is used, we recommend having a constant speed backup system for safety. V/S operation can introduce harmonics into the local power grid. Additional electrical equipment and costs are required for the VFD's to minimize the harmonics to an acceptable level. Programming C/S operation is usually less prone to failure. Variable speed operation adds complexity and cost, requires more equipment, needs more maintenance and reduces reliability.

Pump Test and Energy Efficiency Study

Pump tests and energy efficiency studies were performed at most of the pump stations assessed. Pump tests were performed to determine the current operating capacity of each pump station. Two methods were used to determine the pump discharge capacities. An ultrasonic flow meter was used on stations where access to the discharge pipe was available, and a pump drawdown test was performed on the remaining stations. The drawdown tests were performed by recording the time it takes each pump to draw down the wet well a measured

distance. The resulting calculated discharge rate is approximate due to the difficulty of getting accurate volume measurements. The ultrasonic meter is much more accurate; however, it cannot be used on many stations because the discharge pipes are not accessible.

Ultrasonic Flow Meter

A summary of the measured pump capacities is shown in Table 1 and compared to the pump stations' PWWF. Peak wet weather inflow rates represent the maximum contribution of a given pump station's tributary service area including groundwater infiltration and direct stormwater inflow. Existing and future peak dry weather flow (PDWF) and PWWF for 26 of the pump stations are from the City of Alameda Sanitary Sewer System Hydraulic Analysis by RMC dated May 2010. The inflows for the remaining 7 pump stations were estimated based on the sewershed area. Each pump station's "firm capacity" is the capacity of the pump station with the largest pump out of service. The "total capacity" is the capacity of the station with all pumps operational. A description of how the rehabilitation priorities are assigned is included in the "rehabilitation ranking" section of this report.

The measured flow rates for the following pumps were significantly lower than other, same sized pumps, within the same station. The City should consider rebuilding or replacing these pumps in the near future:

- Aughinbaugh Pump #2
- Verdemar Pump #2
- Willow/Whitehall Pump #2

Pump Station						Existing		Future								
#	Name	Pump #	Measured Flow Rate [gpm]	Method of Measurement	Firm Capacity (gpm)	PDWF (gpm)	PWWF (gpm)	PDWF (gpm)	PWWF (gpm)	Insufficient Capacity (Firm < Existing PWWF)	Insufficient Capacity (Firm < Future PWWF)	Lacks Redundancy	Lacks High Level Bypass Pipe	Has Backup Power	Rehabilitation Priority	Rehabilitation Ranking
1	Adelphian	1	105	Volumetric	105	28	76	28	83				X[1]		LOW	28
		2	-	-												
2	Catalina	1	800	Ultrasonic	800	285	542	361	743				X		MED	19
		2	815	Ultrasonic												
3	Channing	1	60	Volumetric	60	28	49	28	56			X	X		MED	13
4	Sheffield/Cumberland	1	44	Volumetric	44	28	62	28	62	X	X	X			LOW	26
5	Aughinbaugh	1	53	Volumetric	28	139	278	139	285	X	X	X	X		HIGH	2
		2	28	Volumetric												
6	Seaview I	1	238	Volumetric	235	28	42	28	56						LOW	24
		2	235	Volumetric												
		3	-	-												
7	Seaview II	1	95	Volumetric	95	21	56	21	56			X			LOW	25
8	Dublin	1	135	Volumetric	120	90	236	90	236	X	X	X	X		HIGH	11
		2	120	Volumetric												
9	Verdemar	1	51	Volumetric	10	69	118	69	118	X	X	X	X[1]		HIGH	10
		2	10	Volumetric												
10	Harbor Bay Parkway I	1	184	Ultrasonic	549***	208	479	625	812		X		X[1]		MED	22
		2	509	Ultrasonic												
		3	-	-												
11	Harbor Bay Parkway II	1	-	-	200	7*	49*	7*	49*				X		LOW	31
		2	-	-												
12	BFI	1	1273	Ultrasonic	1273	715	1604	1389	2153	X	X	X	X	X	HIGH	5
		2	1300	Ultrasonic												
13	Bay Fairway Hall	1	60	Volumetric	60	10*	15*	10*	15*				X		LOW	30
		2	61	Volumetric												
14	Eastshore/Myers	1	135	Volumetric	135	7*	12*	7*	12*			X			MED	15
15	Bayview	1	545	Volumetric	545	35	69	35	83			X			LOW	27
16	Park/Otis	1	-	-	424**	340	799	375	833	X	X	X	X		HIGH	4
		2	-	-												
17	Willow	1	533	Volumetric	533	38*	61*	38*	61*						MED	16
18	Willow/Whitehall	1	60	Volumetric	39	90	160	90	160	X	X	X	X[1]		HIGH	8
		2	39	Volumetric												
19	Yorkshire/Franciscan	1	76	Volumetric	76	35*	56*	35*	56*			X	X		MED	17
20	Pond/Otis	1	67	Volumetric	67	104	139	104	146	X	X	X	X[1]		HIGH	6
21	Grand/Shoreline	1	98	Volumetric	98	12*	19*	12*	19*				X		MED	12
22	Grand/Otis	1	157	Volumetric	157	431	618	431	618	X	X	X	X		HIGH	1
		2	213	Volumetric												
23	Sand Beach	1	43	Volumetric	43	62	97	62	97	X	X	X			HIGH	9
24	Paru	1	-	-	-	-	-	-	-			X			LOW	34
25	Eighth/Portola	1	-	-	462	736	1111	736	1111	X	X	X	X[1]	X	HIGH	3
		2	462	Volumetric												
26	Eighth/Taylor	1	387	Volumetric	386	215	250	215	250				X[1]		MED	21
		2	386	Volumetric												
27	Tideway	1	158	Ultrasonic	158	174	243	174	243	X	X	X	X		HIGH	7
		2	-	-												
28	Cola Ballena	1	132	Ultrasonic	132	21	28	28	42				X		MED	20
		2	132	Ultrasonic												
29	Encinal boat ramp	1	214	Volumetric	214	3*	5*	3*	5*			X	X		MED	14
30	Triumph/Independence	1	218	Volumetric	218	76	90	90	111						LOW	29
		2	226	Volumetric												
31	Marina Village	1	-	-	1458**	236	312	285	375				X		MED	23
		2	-	-												
		3	-	-												
		4	-	-												
36	L/S #6 AP	1	335	Ultrasonic	326	132	243	132	319				X	X	LOW	33
		2	326	Ultrasonic												
42	Haile	1	75	Volumetric	75	14	21	21	28			X	X		MED	18
43	Grand	1	577	Volumetric	577	14	56	14	56				X		LOW	32
		2	667	Volumetric												

1 - Has a high-level bypass pipe but when used it causes significant sewer backups and potential overflows

* PDWF and PWWF were estimated based on the sewershed area, all other DWWF and PWWF are from the 2009 RMC Sanitary Sewer Master Plan

** Data from flow tests performed for the 2009 RMC Sanitary Sewer Master Plan

*** Assumes pump #3 has similar characteristics as pump #2

An energy efficiency study was performed on each pump to determine its operating efficiency. This was done by recording the power input to the motor at the electrical panel and comparing it to the calculated output power. The calculated output power is based on the estimated total dynamic head and the measured flow rate. Significant energy savings can be made by improving the efficiency of the pump station. In many cases this can be done by replacing the pumps with new pumps that are properly sized and trimmed to match the performance characteristics of the discharge system. Estimated annual savings are calculated based on the estimated annual volume of sewage inflow to each station and assuming each station can be improved to have an overall efficiency of 60%. The total energy cost per year to operate a pump is calculated with the following equation:

$$\$/yr = HP * 0.746(kw/hp) * (1/OverallEfficiency) * PumpingTime(hr/yr) * ElectricityCost(\$/kW-hr)$$

Where: HP = Horsepower Output = Q(gpm)*H(ft)/3960

A summary of the existing overall efficiencies and estimated annual savings after rehabilitation is shown in Table 2.

Table 2: Existing Pump Efficiencies and Estimated Annual Savings

Pump Station Name	Pump #	Overall Pumping Efficiency		Savings
		Existing	Improved	[$/yr]
1. Adelphian	1	10%	60%	$180
	2	-		
2. Catalina	1	5%	60%	$2,500
	2	5%	60%	
3. Channing	1	6%	60%	$220
4. Sheffield/Cumberland	1	2%	60%	$740
5. Aughinbaugh	1	1%	60%	$5,200
	2	1%	60%	
6. Seaview I	1	6%	60%	$40
	2	11%	60%	
7. Seaview II	1	90%	90%	$0
8. Dublin	1	4%	60%	$670
	2	8%	60%	
9. Verdemar	1	7%	60%	$200
	2	0%	60%	
10. Harbor Bay Parkway I	1	12%	60%	$180
	2	58%	60%	
	3	-	60%	
11. Harbor Bay Parkway II	1	-		N/A
	2	-		
12. BFI	1	8%	60%	$1,600
	2	9%	60%	
13. Bay Fairway Hall	1	5%	60%	$10
	2	4%	60%	
14. Eastshore/Myers	1	2%	60%	$80
15. Bayview	1	19%	60%	$30
16. Park/Otis	1	-		$0
	2	-		
17. Willow	1	10%	60%	$50
18. Willow/Whitehall	1	3%	60%	$460
	2	1%	60%	
19. Yorkshire/Franciscan	1	5%	60%	$120
20. Pond/Otis	1	8%	60%	$130
21. Grand/Shoreline	1	22%	60%	$10
22. Grand/Otis	1	7%	60%	$710
	2	9%	60%	
23. Sand Beach	1	4%	60%	$390
24. Paru	1	-		N/A
25. Eighth/Portola	1	-		$760
	2	24%	60%	
26. Eighth/Taylor	1	29%	60%	$40
	2	25%	60%	
27. Tideway	1	3%	60%	$1,140
	2	-		
28. Cola Ballena	1	25%	60%	$40
	2	26%	60%	
29. Encinal Boat Ramp	1	15%	60%	$0
30. Triumph/Independence	1	16%	60%	$30
	2	15%	60%	
31. Marina Village	1	-		N/A
	2	-		
	3	-		
	4	-		
36. L/S #6 AP	1	20%	60%	$290
	2	35%	60%	
42. Haile	1	6%	60%	$50
43. Grand	1	27%	60%	$10
	2	22%	60%	
			Total	**$16,000**

Notes:

1. Existing efficiencies and flow rates are determined from Craig Evan's pump testing service, tested January 2009.
2. Sewage generation is based on area and density (10.2 persons per acre) of land tributary and a generation rate of 90 gallons/person/day. Generation rates for Bay Fairway Hall (#13) and Encinal Boat Ramp (#29) are determined based on typi
3. No pump test data was available for Harbor Bay Parkway II, Paru or Marina Village Pump Stations.
4. At each pump station, it is assumed all operating pumps operate for the same duration.
5. Energy costs were assumed to be $0.13 per kilowatt-hour.

Electrical Assessments

Field visits were made to each individual pump station to assess the existing electrical installations. The following general conditions were observed for problems and, if found, they were noted and photographed:

1. Conditions and appearances
2. Violations based on the current electrical code
3. Safety issues
4. Redundancy and reliability

The electrical installation at each station was reviewed in light of the following codes and guideline:

1. 2007 California Electrical Code based on the 2005 National Electrical Code (NEC)
2. NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2008 Edition
3. Wastewater Pumping Station Reliability Recommendations prepared for San Francisco Bay Region California Regional Water Quality Control Board, May 1994

Only the observable portions of the stations were reviewed due to a lack of accessibility and safety issues at some stations. A summary of the electrical assessment is included within each individual pump station report.

Most of the pump stations evaluated are equipped with RTU (Remote Terminal Units) for communication with the City-wide SCADA (Supervisory Control and Data Acquisition) system. The RTU converts signals from the various pump station controls for level, pump, valves etc. and communicates via radio or City network to master SCADA computers. This pump station evaluation project identifies the replacement costs for more conventional items and does not include the SCADA technology dependent items. These electronic communication items require more frequent replacement in order to provide upgraded operating systems and control logic. These costs should be included in City wide upgrades to the SCADA system. There are a few lift stations that do not currently have RTU's, and we recommend adding these during the next rehabilitation of these stations.

Structural and Seismic Assessments

The structural/seismic assessment portion of this project involved a visual survey of the pump station facilities focusing on the general structural condition of the pump stations and their components and the presence of any conditions which would pose a potential hazard in the event of an earthquake. This assessment utilized a probabilistic approach (as opposed to deterministic) to identify structural deficiencies and seismic hazards. Our assessments of the pump stations were based on our experience in the design and anchorage of similar structures and equipment, our knowledge of the governing California Building Code, and our understanding of what is generally necessary to adequately and safely anchor equipment, considering also that these facilities lie within a very seismically active area, approximately 5-10 kilometers west-southwest of the Hayward Fault, and in a geologic zone subject to liquefaction.

The assessment of the general structural condition of each pump station included consideration of the following items:

1. Overall condition of the pump station concrete structure including cracking, deterioration, or spalling of the concrete.
2. Corrosion of metal components of the structure, piping and ductwork, exterior panels and cabinets, and equipment bases, stands, or base plates.
3. Obvious settlement of the structure or the dirt or pavement around the structure.
4. Condition of the hatches, ladders, stairs, and platforms.
5. Condition of non-shrink grout at base plates or other locations.
6. Presence of roots growing into the wetwells through joints in the structure.
7. Deterioration of any wood components.

The assessment of the pump stations and their components for seismic hazards included consideration of the following items:

1. Anchorage of pumps and motors, electrical/control panels and cabinets, emergency generators, SCADA antenna poles, and other equipment.
2. Lateral bracing of suspended equipment, discharge piping, ductwork, electrical conduit, and other miscellaneous piping.

A determination of the potential for liquefaction at each pump station site is difficult to make based only on a visual site survey. A geotechnical exploration, including borings, is usually necessary to determine the site soil types, depths, characteristics, properties, and the potential for those soils to liquefy during an earthquake. As geotechnical explorations at each pump station are not a part of

this project, our visual survey focused on evidence of past settlement either of the pump station structure itself or the surrounding ground or pavement. Additionally, we relied on the Liquefaction Hazard Map of Alameda produced by the U.S. Geologic Survey (USGS) which is helpful in determining sites where a high percentage of the surrounding area is predicted to liquefy during a severe earthquake. While we have not made any recommendations for improvements to any of the pump stations to address the issue of liquefaction, we feel it is important for the City to be aware of this potential hazard.

Access and Site Assessments

The overall access to each pump station has been evaluated along with the ability to expand or add a backup generator to the site. Where access to the site or pump station components is inadequate, we recommend expanding the site and relocating certain pump station items. This is required on many stations to meet code clearance requirements between the wet well and the electrical panels.

Each site's susceptibility to vandalism and the presence of odor was noted. A summary of the each pump station's site assessment is included in individual pump station reports found in Appendix H.

Recommend site items to add during pump station rehabilitation are listed in the recommended sanitary sewer pump station design standards, which is included as Appendix D.

Immediate Recommended Improvements

Several recommended immediate improvements have been identified for each pump station, which are listed in the individual pump station reports. The immediate improvements are divided into the following three priority categories:

Priority 1 – Identified Safety Hazards
Priority 2 – Identified Code Violations
Priority 3 – Remaining Good Practice Improvements

These improvements should be implemented if the pump stations are not rehabilitated in the very near future. Some of the improvements are extensive and should be carefully planned with the pump station rehabilitation so that an unnecessary duplication of improvements can be avoided. For example, if a dry well pump station is going to be converted to a wet well pump station in the near future, a new ventilation system will not be required. This is all dependent on the

level of annual funding available for improvements and when the next pump station rehabilitations will occur. Table 3 provides a summary of the estimated cost of immediate improvements for each pump station. If these improvements are implemented prior to full pump station rehabilitation, the rehabilitation costs may be reduced. A checklist is provided in Appendix A that will help the City keep track of improvements that have been performed and those that need to be implemented.

Table 3: Immediate Improvement Cost Estimate

Pump Station	Priority #1	Priority #2	Priority #3	Total
1. Adelphian	$2,000	$42,000	$8,000	$51,000
2. Catalina	$18,000	$39,000	$20,000	$77,000
3. Channing	$43,000	$0	$6,000	$50,000
4. Sheffield/Cumberland	$3,000	$8,000	$7,000	$18,000
5. Aughinbaugh	$34,000	$7,000	$12,000	$54,000
6. Seaview I	$33,000	$8,000	$12,000	$53,000
7. Seaview II	$33,000	$1,000	$2,000	$35,000
8. Dublin	$2,000	$44,000	$6,000	$52,000
9. Verdemar	$33,000	$8,000	$12,000	$53,000
10. Harbor Bay Parkway I	$14,000	$32,000	$6,000	$52,000
11. Harbor Bay Parkway II	$12,000	$0	$16,000	$28,000
12. BFI	$46,000	$14,000	$20,000	$80,000
13. Bay Fairway Hall	$56,000	$8,000	$0	$64,000
14. Eastshore/Myers	$42,000	$5,000	$8,000	$55,000
15. Bayview	$9,000	$6,000	$15,000	$30,000
16. Park/Otis	$42,000	$0	$12,000	$54,000
17. Willow	$7,000	$0	$13,000	$20,000
18. Willow/Whitehall	$37,000	$0	$14,000	$51,000
19. Yorkshire/Franciscan	$7,000	$39,000	$6,000	$52,000
20. Pond/Otis	$22,000	$6,000	$15,000	$43,000
21. Grand/Shoreline	$16,000	$3,000	$16,000	$35,000
22. Grand/Otis	$43,000	$3,000	$15,000	$60,000
23. Sand Beach	$43,000	$13,000	$6,000	$62,000
24. Paru	-	-	-	-
25. Eighth/Portola	$47,000	$4,000	$12,000	$64,000
26. Eighth/Taylor	$11,000	$2,000	$22,000	$35,000
27. Tideway	$49,000	$4,000	$12,000	$64,000
28. Cola Ballena	$41,000	$3,000	$3,000	$47,000
29. Encinal Boat Ramp	$25,000	$3,000	$9,000	$38,000
30. Triumph/Independence	$39,000	$8,000	$2,000	$48,000
31. Marina Village (Initial)	$0	$0	$16,000	$17,000
36. LS #6	$2,000	$42,000	$5,000	$49,000
42. Haile	$3,000	$10,000	$5,000	$18,000
43. Grand Street	$2,000	$2,000	$17,000	$21,000
Total	$816,000	$364,000	$350,000	$1,530,000

Cost Estimates

The rehabilitation cost estimates for each station have been created to provide expected improvement costs to be used for a long term budgetary analysis, and to assist in the development of an on-going pump station rehabilitation program.

Pumping facilities rely heavily on mechanical and electrical equipment that wear out. On average, pumping equipment can be expected to last anywhere from 20 to 30 years with proper maintenance. Structural facilities should last much longer, at least 50 years, although metal, wood, and even concrete surfaces all require regular care. Therefore, we recommend using a 25-year replacement schedule for all equipment within the pump station and a 50-year replacement schedule for items such as pump station roofs and concrete structure The recommended rehabilitation priority is based on the following items in order of importance: sanitary sewer overflows, pump station capacity, pump station condition and age, and pump station redundancy. We recommend that City maintenance crews monitor the condition of the facilities as several of the stations are well past their recommended 25-year replacement date.

It is important to keep in mind that numerous uncertainties could alter the future costs and replacement methods. This study projects costs more than 50 years into the future, when available technology and relevant regulations are unknown at this time. The rehabilitation costs may increase if electrical service needs to be upgraded, if additional easements are needed, or if the station needs to be relocated due to limited space.

Estimate are based on similar construction projects, published unit costs (prevailing wage rates), and cost index values. All costs include materials and labor and the cost index used at the time of this estimate is the January 2009 San Francisco Construction Cost Index (index value = 9769.42). An additional 55% is added to the estimates of probable construction costs to account for construction contingency (30%), engineering design (10%), project administration, construction management, permitting and other soft costs (15%). Detailed rehabilitation cost estimates are included within each individual pump station report, and a summary of the total costs is given in Table 4.

Annual maintenance costs are not included within this analysis. The City is in a better position to evaluate the efficacy of their ongoing maintenance operations, identify the need for expansion or reduction of their operation and maintenance program, and calculate the associated increase or decrease in cost as

appropriate. However, recommended generalized pump station maintenance schedules are described in Appendix F.

Rehabilitation Ranking

The need to rehabilitate each pump station is designated as either 'high priority,' 'medium priority,' or 'low priority,' based on the findings in this report. High priorities are assigned to pump stations lacking sufficient pumping capacity or exhibiting hazardous structural or health-related conditions. Medium priorities are assigned to those pump stations in serious need of rehabilitation without hazardous conditions present. Low priorities are assigned to pump stations exhibiting only minor problems in relation to the higher priority pump stations. Out of the 34 station assessed, 11 pumps stations receive the high priority designation, 12 pump stations receive the medium priority designation and 11 pump stations receive the low priority designation.

Each pump station is also ranked to create a rehabilitation schedule. A ranking of 1 is the highest priority and a ranking of 34 is the lowest priority. Rankings are based on multiple criteria including capacity in relation to peak demand, safety hazards, code violations, priority (high, medium or low), existence of a high-level bypass pipe, year of construction, and overall condition of the station. The rankings are based on existing flow rates, Harbor Bay Parkway I is the only pump station that has sufficient capacity under existing conditions, but does not have sufficient capacity for future conditions. If the sewershed for Harbor Bay Parkway I is developed, this station should be placed as a high priority pump station. Table 4 shows the priorities, rankings, and cost estimates of each pump station.

Table 4: Pump Station Rehabilitation Priority and Cost Summary

Rehabilitation Ranking	Rehabilitation Priority	PS #	Station Name	Rehab Cost	Rehab Type	Second Rehab Cost	Rehab Type
1	HIGH	22	Grand/Otis	$430,000	25-yr	$540,000	50-yr
2	HIGH	5	Aughinbaugh	$280,000	25-yr	$380,000	50-yr
3	HIGH	25	Eighth/Portola	$390,000	25-yr	$500,000	50-yr
4	HIGH	16	Park/Otis	$470,000	25-yr	$580,000	50-yr
5	HIGH	12	BFI	$1,050,000	50-yr	$460,000	25-yr
6	HIGH	20	Pond/Otis	$350,000	50-yr	$250,000	25-yr
7	HIGH	27	Tideway	$410,000	25-yr	$520,000	50-yr
8	HIGH	18	Willow/Whitehall	$190,000	25-yr	$280,000	50-yr
9	HIGH	23	Sand Beach	$260,000	50-yr	$150,000	25-yr
10	HIGH	9	Verdemar	$230,000	25-yr	$330,000	50-yr
11	HIGH	8	Dublin	$240,000	25-yr	$380,000	50-yr
12	MED	21	Grand/Shoreline	$160,000	25-yr	$250,000	50-yr
13	MED	3	Channing	$230,000	25-yr	$330,000	50-yr
14	MED	29	Encinal Boat Ramp	$220,000	25-yr	$300,000	50-yr
15	MED	14	Eastshore/Myers	$140,000	25-yr	$240,000	50-yr
16	MED	17	Willow	$180,000	25-yr	$280,000	50-yr
17	MED	19	Yorkshire/Franciscan	$210,000	25-yr	$300,000	50-yr
18	MED	42	Haile	$220,000	25-yr	$310,000	50-yr
19	MED	2	Catalina	$450,000	25-yr	$580,000	50-yr
20	MED	28	Cola Ballena	$380,000	25-yr	$500,000	50-yr
21	MED	26	Eighth/Taylor	$280,000	25-yr	$420,000	50-yr
22	MED	10	Harbor Bay Parkway I	$400,000	25-yr	$530,000	50-yr
23	MED	31	Marina Village	$550,000	25-yr	$950,000	50-yr
24	LOW	6	Seaview I	$170,000	25-yr	$270,000	50-yr
25	LOW	7	Seaview II	$180,000	25-yr	$300,000	50-yr
26	LOW	4	Sheffield/Cumberland	$160,000	25-yr	$270,000	50-yr
27	LOW	15	Bayview	$170,000	25-yr	$280,000	50-yr
28	LOW	1	Adelphian	$230,000	25-yr	$310,000	50-yr
29	LOW	30	Triumph/Independence	$200,000	25-yr	$340,000	50-yr
30	LOW	13	Bay Fairway Hall	$170,000	25-yr	$240,000	50-yr
31	LOW	11	Harbor Bay Parkway II	$490,000	50-yr	$310,000	25-yr
32	LOW	43	Grand Street	$200,000	25-yr	$320,000	50-yr
33	LOW	36	L/S #6 AP	$350,000	25-yr	$660,000	50-yr
34	LOW	24	Paru	$50,000	Decommission	-	-
				$10,100,000		**$12,700,000**	

1. Adelphian

Completed	Priority	Improvement	Date Completed
☐	1	Ensure all electrical devices and controls are easily accessible.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	2	Repair the PVC conduit in the wet well.	
☐	2	Clear the panel door from obstruction.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Install individual control circuitry for redundancy	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	

2. Catalina

Completed	Priority	Improvement	Date Completed
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Install an explosion-proof junction box.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Investigate and correct any communication problems between the controls and pump operation.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Install drain system to divert seepage to floor drain.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Replace the panelboard on the dry well deck	
☐	3	Replace the corroded junction box on the dry well deck	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	

3. Channing

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	

4. Sheffield/Cumberland

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof protection for the hatch cover.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Clean electrical panel	

5. Aughinbaugh

Completed	Priority	Improvement	Date Completed
☐	1	Ensure all electrical devices and controls are easily accessible.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Replace cable jacket with electrical taping.	
☐	2	Provide explosion-proof protection for all components for all miscellaneous items.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

6. Seaview I

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Ensure all electrical devices and controls are easily accessible.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

7. Seaview II

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide adequate grounding conductor to the ground rod.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

8. Dublin

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof protection for the hatch cover.	
☐	2	Repair the PVC conduit in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

9. Verdemar

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Install door mounted operating handles on the pump starter/level controller compartment door.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	

10. Harbor Bay Parkway I

Completed	Priority	Improvement	Date Completed
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Relocate the main breaker ahead of the other breakers.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	

11. Harbor Bay Parkway II

Completed	Priority	Improvement	Date Completed
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install a backup high level switch.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	

12. BFI

Completed	Priority	Improvement	Date Completed
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Relocate the receptacle from behind the dry well step rung.	
☐	1	Provide dead-front construction from the opening below the pump control panel.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Provide structural improvements as needed.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Install lighting at the pump station site.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace the corroded junction box on the dry well deck	

13. Bay Fairway Hall

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a SCADA system	
☐	2	Repair the PVC conduit in the wet well.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Clean electrical panel	

14. Eastshore/Myers

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

15. Bayview

Completed	Priority	Improvement	Date Completed
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a backup level switch	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof protection for the hatch cover.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace the panelboard on the dry well deck	

16. Park/Otis

Completed	Priority	Improvement	Date Completed
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Relocate motor starters in the same enclosure as their circuit breaker.	
☐	1	Cover the unused cutout hole in the pump starter panel door.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Install drain system to divert seepage to floor drain.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Replace the corroded junction box on the dry well deck	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

17. Willow

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Cover the unused cutout hole in the pump starter panel door.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

18. Willow/Whitehall

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install door mounted operating handles on the pump starter/level controller compartment door.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install a backup level switch	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

19. Yorkshire/Franciscan

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Cover the unused cutout hole in the pump starter panel door.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Investigate and resolve reported pump operating problems.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace or refurbish the corroded electrical panel.	

20. Pond/Otis

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install a backup level switch	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof junction box.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

21. Grand/Shoreline

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

22. Grand/Otis

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Install or repair supports for the pumps, pipes and electrical panel.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Provide adequate clearance between the receptacle and the floor, in the dry well.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

23. Sand Beach

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a backup level switch	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Install an explosion-proof protection for the hatch cover.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Provide explosion-proof protection for all components for all miscellaneous items.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace or refurbish all severely corroded electrical devices and conduits in the wet well.	
☐	3	Clean electrical panel	

24. Paru

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide a cutout hole in the main breaker door for the intrusion snap switch.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install a backup level switch	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

25. Eighth/Portola

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Secure the SCADA pole.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

26. Eighth/Taylor

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Provide instructions for operators.	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace the corroded junction box on the dry well deck	

27. Tideway

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install a ventilation system with vents, fans and controls.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide adequate grounding conductor to the ground rod.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Install or repair supports for the pumps, pipes and electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Install drain system so groundwater seepage does not drip on electrical equipment.	
☐	3	Provide instructions for operators.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Provide landscaping to pump station site.	

28. Cola Ballena

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install a hazardous gas sensor and alarms in the dry and wet wells	
☐	1	Install an emergency light fixture in the dry well	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Repair the PVC conduit in the wet well.	
☐	2	Install an explosion-proof electrical panel.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate junction boxes, motor cables and conduits for each pump.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	

29. Encinal Boat Ramp

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Install a SCADA system	
☐	1	Repair or reinstall the alarm system.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Replace the corroded junction box on the dry well deck	

30. Triumph/Independence

Completed	Priority	Improvement	Date Completed
☐	1	Relocate the electrical panel so it is a safe distance away from the wet well opening.	
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Provide sufficient workspace in and around the pumps station.	
☐	1	Secure open splices in the wet well junction box.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof junction box.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Provide explosion-proof protection for all components for all miscellaneous items.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide easier access to the bubbler tube.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	

31. Marina Village (Initial)

Completed	Priority	Improvement	Date Completed
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Clean electrical panel	
☐	3	Replace or refurbish the corroded electrical panel.	
☐	3	Replace the corroded junction box on the dry well deck	

36. LS #6

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Install an explosion-proof junction box.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Install an explosion-proof electrical panel.	
☐	2	Provide explosion-proof protection for all components for all miscellaneous items.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	

42. Haile

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	1	Secure open splices in the wet well junction box.	
☐	2	Install explosion-proof conduit seal fittings in wet well.	
☐	2	Repair the PVC conduit in the wet well.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	

43. Grand Street

Completed	Priority	Improvement	Date Completed
☐	1	Maintain a connection between the door mounted operating handles and breakers when the station door is ajar.	
☐	1	Install electric shock and arc flash hazard warning signs to the panel door.	
☐	2	Provide a nameplate and legend plate for the pump lock-out-stop push buttons.	
☐	2	Provide an intrinsically safe relay for the level switch in the wet well.	
☐	3	Install individual control circuits for each pump	
☐	3	Provide separate conduits for each pump motor and seal/high temp switches.	
☐	3	Provide a separate compartment in the electrical panel for each pump starter, level/pump control and bubbler compressor.	
☐	3	Reroute the pump motor cables so pump motors slide easier on the rails.	

City of Alameda - Sanitary Sewer Pump Station Inventory Table

N#	Location	WO#	Type of Pump	Frame	Type	INS. Class	Reliance I.D.	HP	RPM	Volts	Amps	Hz	S.F.	Design	Code	Phase	AMB	Temp Code	Final Conn	Paco S/N	Pump Notes	Record Drawing Date	Has Backup Power	Force Main Size (inches)	High-LevelBypass?	Lacks SCADA System	Access to Discharge Pipe?	Rim/Hatch Elev. (ft) City Datum	Access Notes	Pump Station Description	Station Notes
1	Adelphian	55.31	Submersible	X180TY	CS		C18G2704H	3	1725	115/230	40/20	60									Installed 4/08	July-90		8	Yes		No	105.27			
			Submersible	X180TY	CS		C18G2704H	3	1725	115/230	40/20	60																			
2	Catalina	55.17	Drywell	M620IS			ABS 90081	20	1750	230/460	56/28	60								94C64025	ABS Brand pump impeller diameter 10.5"	October-78		10	No		Yes	103	Drywell - taps on each discharge	Drywell	
		55.17	Drywell	M620IS			ABS E9009	20	1750	230/460	56/28	60									ABS Brand Pump Impeller 10.5"										
3	Channing	55.2	Submersible QD	210TY	CS	F	C21G2701C	3	1160	115/230	42/21	60	1.15		J	1	40	T3C	230V	08-65598		March-84		4	No		No	106.5			
4	Sheffield/Cumberland	55.18	Submersible	X180TY	CS		C18G2703K	3	1725	115/230	40/20	60	1.15		J	1			230V			February-80		4	Yes		No	112.75			
5	Aughinbaugh	55.16	Submersible QD	210TY	P	F	P21G2701HWL	10	1755	230/460	27/13.5	60	1.15	B	J	3	40	T3C	230V			April-79		6	No		No	108.5			
		55.16	Submersible QD	210TY	P	F	P21G2701	10	1755	230/460	27/13.5	60	1.15	B	J	3	40	T3C	230V												
6	Seaview I	55.22	Submersible QD	X210TY	CS	F	17MX212701	3	1160	115/230	43/21	60	1.15		J	1	40C	TC3	230V		CW Rotation. CAPS-SERIES. 460-522MFD 125UAC	September-84		4	Yes		No	107.5			Station only has 2 pumps, 3rd is a backup
		55.22	Submersible QD	210TY	CS	F	C21G27010TK	3	1160	115/230	42/21	60	1.15		J	1	40	TC3	230V												
		55.22	Submersible QD	210TY	CS	F	C21G2701G	3	1160	115/2309	42/21	60	1.15		J	1	40	T3C	230V												
7	Seaview II	55.29	Submersible QD	X160TY	OS	P	C18G2702IT	2	1720	115/230	25/12.5	60	1.15			1	40	T3C	230V			August-79		4	Yes			109.5			
8	Dublin	55.25	Submersible QD	210TY	CS	F	C21G2702G	5	1730	230	30	60	1.15		H	1	40	T3C	230V			December-85		6	No			107			
		55.25	Submerisble QD	210TY	CS	F	C21O2702O	5	1730	230	30	60	1.15		H	1	40	T3C	230V												
9	Verdemar	55.12	Submersible QD	210TY	CF	F	C2162701C	3	1160	230	21	60	1.15		J	1	40C	T3C	230V	95C60052	Rebuilt 2-95	May-67		6	Yes, but causes significant backups			105.8			
		55.12	Submersible QD	210TY	CF	F	P18G2728G	3	1160	230	21	60	1.15		J	1	40C	T3C	230V	95C6103	Rebuilt by Benkisser										
10	Harbor Bay Parkway I	55.19	Drywell Close Connected	H3090303	B	B	63-02857-598	3	855	208	13.2	60	1	B	J	3					Nema. Non. Eff. 75.5 US motors	May-82		8	Yes		Yes	106	Drywell - tapped for gage on suction, flow meter does not work	Drywell	
								3																						
								3																						
11	Harbor Bay Parkway II	55.24	Drywell	T4A3-B			G.R.845187															October-85		6	No		Yes	108	Tight access in drywell	Prefabricated manhole drywell	
		55.24	Drywell	T4A3-B			G.R.845186														Gorman rupp pump										
12	BFI	55.01	Drywell	X320TY	P	F	P32G2700B	30	1165	460	40	60	1.15			3					Gorman rupp pump	August-47	X	12	No		Yes	95	Drywell - taps on pump volute	Drywell	
13	Bay Fairway Hall	55.32	Wetwell					30														?		3	No						
14	Eastshore/Myers	55.11	Submersible QD	X18CTY	F	P	C18C2700F	1	1150	115/230	17.2/8.6	60	1.15		K	1	40C	3C	230V			May-67		4	Yes			102.63			
15	Bayview	55.1	Submersible	210TY	CS	F	C21G2702G	5	1730	230	30	60	1.15		H	1		T3C			CW Rotation.	Dec-63. Convert to Submersible May-68		4	Yes		No	106.51			
16	Park/Otis	55.06	Drywell	X250TY	P	F	P2562702H	20	1750	230/460	66/33	50	1.15	B	G	3			230V	94C69741	Reliance	March-59		8	No		Yes	106	Drywell - tap on 1 pump volute	Drywell	
			Druwell	3152			FLYGT 4670396	20	1750	230/460	50/25	50							230V		Flyght Pump										
17	Willow	55.21	Submersible QD	X210TY	P	F	P21G2701H	10	1755	230/460	27/13.5	60	1.15	B	H	3	40C	T3C	230V	94C69165	Impeller Dia. 7.6"	November-84		4	Yes		No	104.22		Manhole in Street	Station only has 1 pump, 2nd is a backup
				X210TY	P	F	P21G2701H	10	1755	230/460	27/13	60	1.15			3				94C69165	230 final. V/L# L-2520905										
18	Willow/Whitehall	55.07	Submersible QD	X180TY	P	F	C18G2704F	3	1725	115/230	40/20	60	1.15		J	1	40C	T30	230V		New installed 3-95	Mar-59, Modified Apr-86		4	Yes, but causes significant backups		No	105.86			
		55.07	Submersible QD	X180TY	P	F	C18G2704F	3	1725	115/230	40/20	60	1.15		J	1	40C	T30	230V		New installed 3-95										
19	Yorkshire/Franciscan	55.3	Submersible QD	X180TY	CS	F	C18G2703K	3	1725	230	20		1.15			1			230V			November-89		4	No		No	102.8			
20	Pond/Otis	55.08	Submersible QD	X180TY	CS	F	C1862701H	1.5	1150	230	12.5	60	1.15		K	1	40C	T3C	230V			March-59		4	Yes, but causes overflows		No	105.85			
21	Grand/Shoreline	55.27	Submersible QD	X180TY		F	C18G2703K	3	1725	115/230	40/20	60	1.15		3	1			230V	28MU18703	CW Rotation. Small shaft.	April-87		4	No		No	103.32	discharge pipe in manhole	Manhole in street	
22	Grand/Otis	55.05	Drywell	6			Paco 98C65745, Motor-FLYGT 8740033	14	1150	230	38	60				3			230V	ON VOLUTE 86C503888	Flyght pump impeller diameter 9.0"	November-57		8	No		Yes	105	Drywell - tap & plug on pump volute	Drywell	
		55.05	Drywell	6			Paco 87050386, FLYGT 8740034	14	1150	230	38	60				3			230V	ON VOLUTE 87C50388A	Flyght pump impeller diameter 9.0"										
23	Sand Beach	55.09	Submersible QD	X140TY				2	1735	230/460	7.2/3.6				K	3			230V	P17C2711C		November-68		4	Yes			104.5*			
24	Paru	55.04	Submersible		CS		C18G2700J	1	1150	115/230		60										?		4	Yes		Yes	-	Discharge pipe runs along lagoon	Manhole on side of lagoon	Only used for flushing downstream gravity line
25	Eighth/Portola	55.02	Drywell			F	ABS- AFP1042.4-M90/4FM	12.1	1750	230		60				3						April-54	X	8	Yes		Yes	115.3	Drywell - 1 tap on manifold, pressure gage does not work		
			Drywell					12.1																						
26	Eighth/Taylor	55.05	Submersible QD				P18G2703K	7.5	1740	230/460		60				3						April-54		4	Yes		No	116.8	discharge through wetwell	2-level wetwell	
			Submersible QD				P18G2703K	7.5	1740	230/460		60				3															
27	Tideway	55.14	Drywell	X210TY	P	F	2102701H	10	1755	230/460	27/13.5	60	1.15	8	H	3	40C	T30	230V			February-65		8	No		Yes	106.83	Drywell - tap on 1 pipe, pressure gage	Drywell	
			Drywell					10																						
28	Cola Ballena	55.13	Drywell	X210TY	P	F	P2102701H	10	1755	230/460	27/13.5	60	1.15	8	H	3	40C	T30	230V			November-68		6	No		Yes	107.5	Drywell - taps on discharges, pressure	Drywell	
			Drywell					10																						
29	Encinal boat ramp	55.26	Submersible QD (FLYGHT)				8740015	3	1700	230	10	60				1			230V			January-87		4	No	X	No	105.5*	discharge pipe in manhole	Manhole	
30	Triumph/Independence	55.28	Submersible QD	210TY	P	F	P21G2705C	7.5	1150	460/230	23/11.5	60	1.15	B	3	3	40	T3C	460	58-49531-5143		March-88		12	Yes		No	111	discharge pipe in manhole	Manhole	
		55.28	Submersible QD	210TY	P	F	P21G2705G	7.5	12150	230/460	23/11.5	60	1.15	B	3	3	40	T3C	460	58-49531-5143										
31	Marina Village	55.23	Submersible QD	250TY	P	F	1YUB38514A2	10	865	230/460	30/15	60	1.15	B	B	3	40C	T3C	460V			January-86		10	No		No	104.9	discharge through wetwell	2-level wetwell	
		55.23	Submersible QD	250TY	P	F	1YUB38514A1	10	865	230/460	30/15	60	1.15	B	G	3	40C	T3C	460V												
		55.23	Submersible QD	250TY	P	F	1YUB38514A4	10	865	230/460	30/15	60	1.15	B	G	3	40C	T3C	460V	9C67789											
		55.23	Submersible QD	250TY	P	F	ILEGIBLE	10	865	230/461	30/16	60	1.15	B	G	3	40C	T3C	460V												
36	L/S #6 AP	855.06	Submersible				FLYGT NP 3153 180 HT 454	18	1760							3						September-05	X	6	No		Yes	103.6	valve vault	wetwell and valve vault	
		855.06	Submersible				FLYGT NP 3153 180 HT 454	18	1760							3															
42	Haile		Submersible QD				FLYGT DP 3068MT	2.3		230						3						May-06		4	No		No	106.8	discharge through wetwell	Manhole	
43	Grand Street		Submersible				FLYGT NP 3127 HT 3127.090-0760218	10	1735	460		60				3						July-07		6	No		Yes	106.63	valve vault	wetwell w/ valve vault on side of street	
			Submersible				FLYGT NP 3127 HT	10	1735	460		60				3															

* Elevations were approximated based on surrounding manhole rim elevations

June 2, 2010

Figure C1: System Flow Diagram

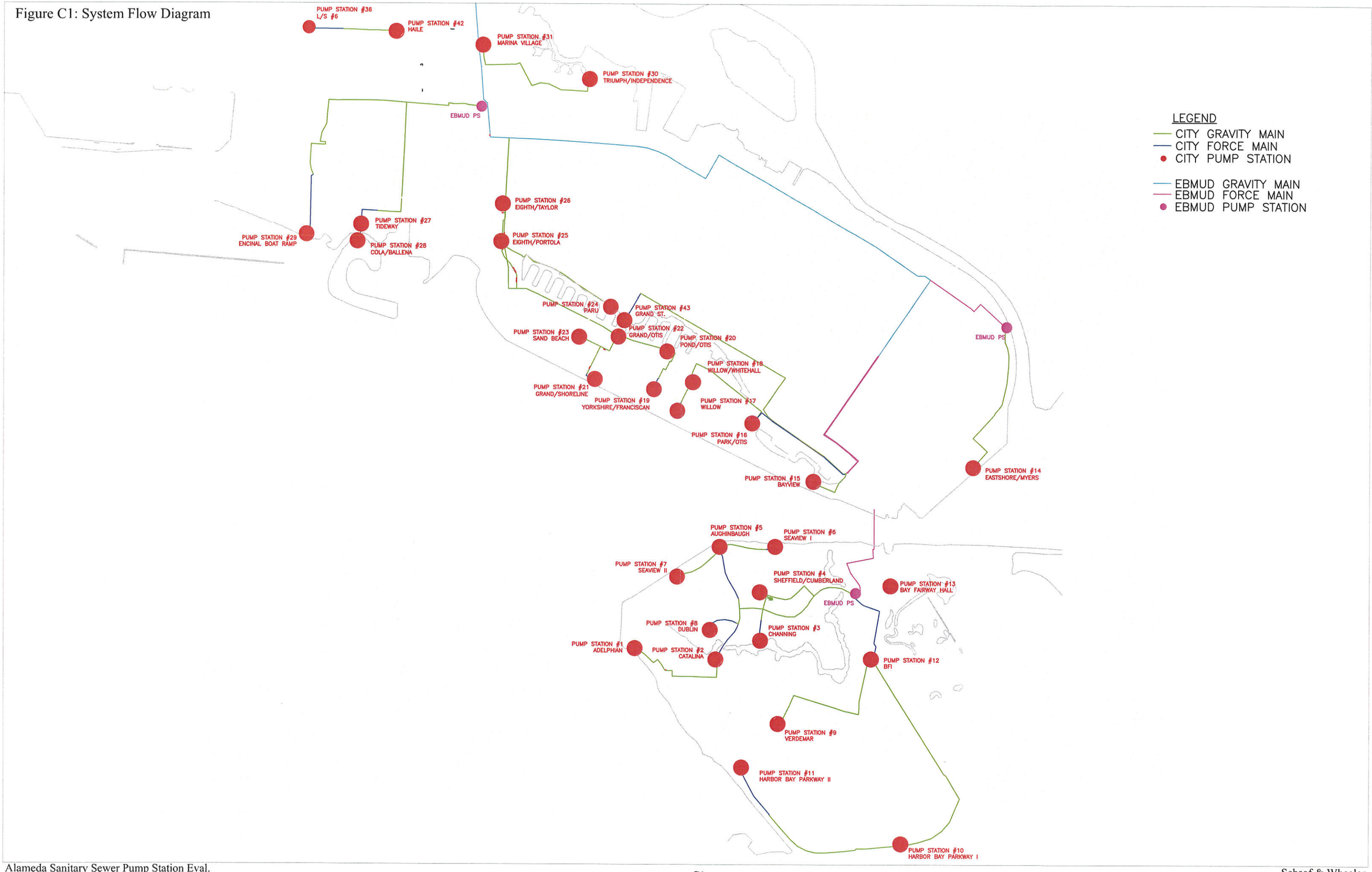
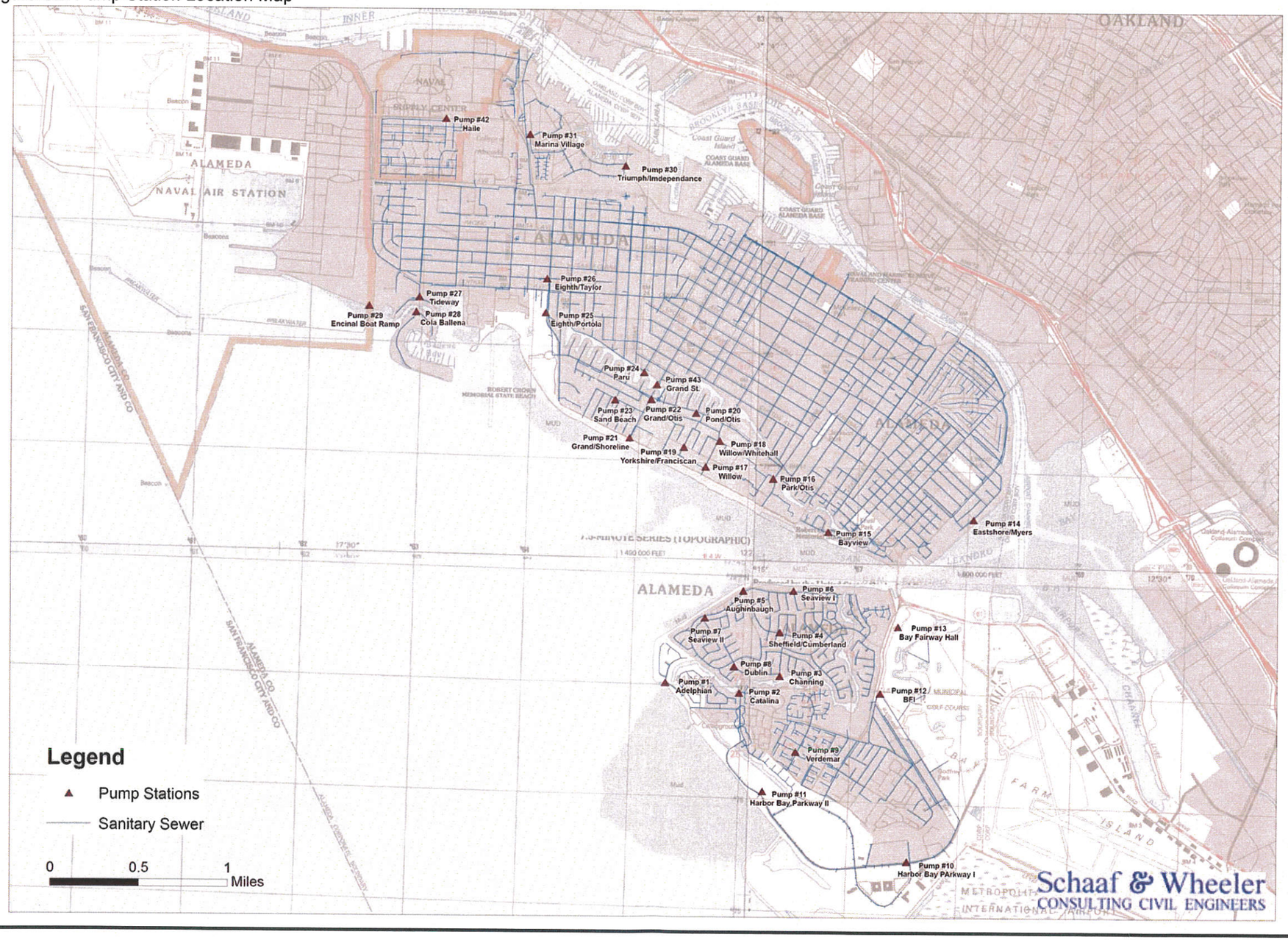


Figure C2: Pump Station Location Map



Recommended Pump Station Design Criteria

The following information is provided by Schaaf & Wheeler to aid the City of Alameda with developing a standard for future sanitary sewer pump station design and construction. The standards outlined herein are limited to smaller pump stations that provide adequate capacity with only one pump in operation, this type of pump station is usually limited by available structure size and overall pump station efficiency. The majority of pump stations required within the City's service area should fall under the following pump station standards.

Pump Station Standards

1. General Design
   - Pump station shall be a duplex station comprised of a precast concrete circular manhole wet well and adjacent valve vault, submersible wastewater pumps, automatic discharge connections, pump guide bars, and access hatch.
   - Lift station shall be fenced or otherwise protected from vandalism.
   - Lift station shall be positioned to facilitate City maintenance access (i.e., do not abut buildings or structures, do not locate wet well in traffic area).

2. Pump Station Structures
   - All structures shall be designed to withstand H-20 loading.
   - Wet well shall be constructed of precast concrete sections installed between a bottom slab and top slab. Precast concrete sections shall be manufactured in compliance with ASTM C478. Top slab shall include a cast in access hatch. The bottom slab shall be designed to account for allowable soil bearing pressure and resist structure uplift due to hydrostatic forces.
   - Wet well shall be lined using one of the following methods (in order of preference) (1) 100% solids aromatic elastomeric polyurethane, Polybrid 705 or equal, (2) 100% solids epoxy coating, Raven 404 or equal, (3) pump manufacturer supplied fiberglass liner, or (4) Ameron T-lock PVC liner.
   - Precast valve vault shall be constructed with adequate clearance to house the pump check valves and isolation valves. An access hatch similar to the wet well shall be provided as part of the precast structure.
   - Access hatches shall be extruded aluminum frames with diamond plate type covers. Access hatches shall be supplied with hold open arm capable of locking hatch in the 90-degree open position, recessed lift handle, heavy-duty lift assist spring, slam lock, rim seal gasket, and hinged safety grate to aid in fall prevention. Design of access hatch shall conform to OSHA Standard 1910.23. All hardware shall be stainless steel Type 316. Hatch shall be rated for minimum 300 PSF loading in non-traffic areas and H-20 loading in light-traffic areas.

- Valve vault shall include an FRP ladder or polypropylene steps to provide adequate access to valves. Ladder or steps shall be installed to conform with OSHA standards.
- Valve vault shall include a floor drain routed to the wet well. The drain pipe shall be provided with a flap gate or be extended 6-inches below the minimum water level in wet wells.
- Sufficient lighting (including back-up battery power) should be provided so that crews may work on equipment during the night. Also, access must be provided that will allow for the removal and reinstallation of all equipment.
- Noise abatement, visual impacts, and odor control must be considered when locating a pump station and designing the equipment housing. This is particularly important where engine units must be installed near residential areas.
- All heating, ventilating and cooling systems should be designed in conformance with city ordinances; uniform building, fire, mechanical, plumbing, and energy codes; the National Electric Code and NFPA; EPA regulations; Occupational Safety and Health Act (OSHA) requirements; and ASHRAE design standards.

3. Sewage Pumps
   - Pump station shall be a duplex system comprised of two pumps, one primary and one back-up. In terms of redundancy and ease of maintenance, all of the pumping units within one particular station should be identical.
   - Pumps shall be submersible centrifugal type with self cleaning semi open impeller design. Pumps shall be for semi-permanent wet well installations with twin guide bars and automatic discharge connections. Pump and motor shall have Factory Mutual explosion-proof rating and be suitable for hazardous locations as defined by the National Electrical Code (NEC) and conform to the latest edition of the NEC.
   - Pumps shall be Flygt Series NP, sized to adequately convey the peak wet weather inflow per City of Alameda Design Requirements. Pump station capacity shall be provided assuming one pump out of service.
   - Pump station depth and pump level settings shall be designed to reduce excessive pump cycling, the pump manufacturer shall be consulted with respects to allowable pump starts per hour.
   - The maximum number of pump starts per hour should be held below the maximum criterion established by pump, motor, or engine manufacturers. In the absence of specific data, pump starts should be limited to six per hour. This criterion is based on general limits set by large electric motor manufacturers; diesel engine suppliers also recommend that engines should run at least five to ten minutes at full operating temperatures each time they are started.
   - All pump accessory hardware including anchor bolts, lifting chain, guide rails, and brackets shall be stainless steel Type 316.

4. Piping and Appurtenances
   - Each pump discharge header shall have a check valve and isolation valve before joining into a single force main.
   - Check valves shall be flanged swing type check valves specifically designed for wastewater service with an exterior lever and adjustable counterweight to initiate valve closure. Valve shall meet or exceed requirements of AWWA C508 and be epoxy coated per AWWA C550.
   - Isolation valves shall be flanged resilient wedge gate valves, OS&Y with handwheel in accordance with AWWA C509 and be epoxy coated per AWWA C550.
   - Pump discharge piping and fittings shall be ductile iron with fusion-bonded epoxy coating and lining in accordance with AWWA C116.
   - All bolts, nuts, and washers used for connecting valves, fittings, pumps, and other appurtenances shall be stainless steel Type 316. All nuts shall be provided with Xylan fluoropolymer coating.
   - Discharge piping within the wet well shall be braced with supports that anchor into the concrete walls every five (5) feet on center of pipe length.
   - All discharge piping and fittings shall be thrust restrained. All buried fittings shall be ductile iron mechanical joint type with thrust restraint glands.
   - Force main shall be C900 PVC Class 150 minimum. Pipe diameter shall be designed to maintain a minimum velocity of 2 feet per second under normal operating conditions, minimum pipe diameter shall be 4-inches.
   - Forcemain shall be designed and constructed without any intermediate high points in the pipe between the pump station and the discharge manhole to avoid the use of air release valves. If an instrument air system is required for a wet well bubbler system, it shall have a duplex compressor arrangement. If one compressor fails, the second will run to supply air. A compressor failure alarm will be provided. Separate low level and high level switches will be provided to detect and alarm either a bubbler system or a programmable logic controller (PLC) pump control failure condition.
   - Gravity inlet pipe shall have a deflector panel or wye pipe fitting to direct influent sewage downward to reduce off-gassing and turbulence.
   - No inflow laterals shall be located between the wet well and the next manhole(s) upstream.

3. Controls
   - All electrical equipment in or open to the wet well must be explosion-proof and should be placed a minimum of one foot above the base flood elevation (BFE). Submersible motors should also be explosion-proof.
   - Control panels must not be located so that they are subject to possible flooding.

- All equipment must be housed in NEMA rated weatherproof enclosures or in buildings.
- Pump supplier shall provide all control equipment to ensure compatibility with the pumps. Control equipment shall be coordinated with the City of Alameda to allow standardization. The main switchboard (MSB) shall be built to NEMA standards.
- Pumps shall have automatic monitoring for motor temperature and leakage detection.
- The motor control panel shall include an automatic sump cleaning module with adjustable cleaning interval.
- Motor control cabinet (MCC) and the magnetic starters shall be built to NEMA standards.
- A minimum of 25 percent spare compartment cubicle spaces will be provided if there is sufficient space for the MCC line-up.
- Primary level sensor shall be pressure transducer, with conductive actuated probes as back-up.
- Maximum operating level in wet well shall be below invert of inlet pipe.
- Controls shall provide the option for automatic lead-lag pump alteration.
- In case of lead pump start failure, lag pump shall be called to start.

4. Supervisory Control and Data Acquisition (SCADA)
   - Provide City of Alameda standard remote terminal unit (RTU).
   - Provide the following alarms and signals through the RTU to the SCADA system: Pump running, pump start/stop failure, high water, power failure, pump monitoring for over-temp and leakage.
   - City of Alameda shall be able to operate the pumps remotely if HOA switch is in the Auto position on the control panel.

5. Power
   - Pump station shall have its own separate power meter. Provide transformer, if needed.
   - Electrical service shall be sized to meet the peak station demands.
   - Permanent emergency diesel electric generator and automatic transfer switch shall be provided as a backup power source whenever normal power is lost. If space limitations preclude the provision of a generator, a manual transfer switch and termination point for a portable diesel electric generator shall be provided.
   - Manual override will be provided for all motor controls so that if there is a failure such as the PLC or the bubbler system, the sewage pumps can be operated manually.
   - Wet well cable termination cabinet shall be provided adjacent to the wet well structure. Within the cabinet shall be an individual terminal block for each pump and level sensor.
   - All cables will be installed in conduits, except for the sewage pump motor cables which will be hung exposed in the pump room.

- Voltage separation will be accomplished in the following manner:
    - 480-volt power and 120 volt control conductors will be installed in common conduits, if cable sizes are compatible for pulling.
    - 24-volt DC signal conductors and manufacturer supplied signal cables will be installed in separate conduits.
    - Fire detection, signal and communication conductors will be installed in separate conduits.
    - Intrinsically safe conductors will be installed in separate conduits.

Drywell Pump Station Conversion

One possible future improvement to an existing drywell pump station would be to convert the pump station into one large wet well pump station. The following is a description of one possible strategy for this type of conversion at the existing Park / Otis pump station. This strategy could be used on several other stations as they have similar layouts.

As no current geotechnical data is available, the general strategy would be to remove enough weight from the pump station structure so as to balance out the added weight of water in what is now the drywell portion of the pump station. Modifications to the pump station top slab would include removal of portions of the top slab to accommodate new hatches which would be used to access the new submersible pumps. The pumps would be raised and lowered on new pump rails that would be supported at the top by new steel beams (see Figure E1).

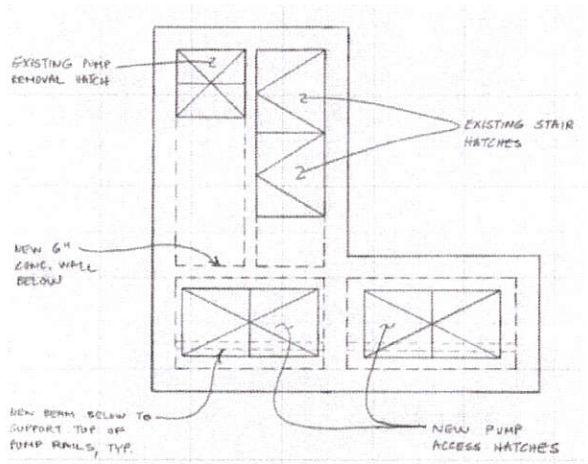


Figure E1: Top Slab Plan

The existing stairways, landing, and a portion of the supporting wall would be removed to save some weight and to provide unobstructed access for the new pumps. A new concrete wall would need to be added, though, to seal off the wet well from the existing stairwells (see Figure E2).

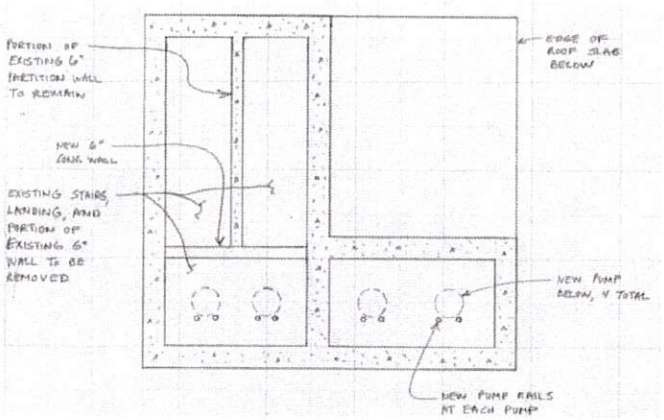


Figure E2: Plan at Elevation 0.00

Additionally, the existing opening from the stairwell to the current drywell area would need to be infilled. New openings would be cut into the wall between the wet well and drywell areas to create one larger wet well area. The existing sloped concrete fillets at the bottom of the wet well would also need to be modified, and new sloped concrete fillets would be added in the current drywell area (see Figure E3).

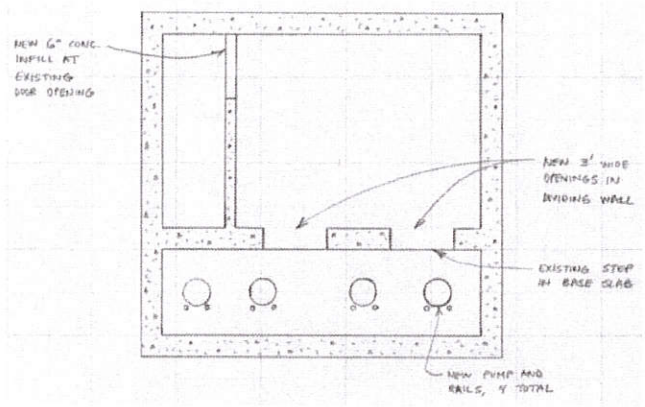


Figure E3: Bottom Slab Plan

Other nonstructural modifications would involve removing all the electrical panels and control cabinets from the current drywell area and relocating them to a location above grade. All existing mechanical components including pumps, motors, blowers and ducting, piping, etc. would, of course, also need to be removed.

This strategy would balance the added weight of water in the current drywell area with the weight of the elements to be removed assuming that the maximum water level is the same as in the current configuration (no more than about 5 feet above the bottom of the existing wet well).

In order to allow for the possibility that the entire pump station could fill up with water, further reductions in structure weight and/or some favorable geotechnical recommendations would be necessary (e.g. higher allowable soil bearing pressure or suitable "short-term" increase). One possible weight-saving strategy would be to remove the dirt from the top of the current drywell roof slab and construct new concrete walls and a top slab that match up with the current walls and top slab. If favorable geotechnical recommendations were not possible, further weight reductions would be necessary and could include the use of lightweight concrete, removal of the top slab and replacement with a lighter concrete slab, and/or removal of additional interior concrete walls.

This description is one possible strategy for converting the existing drywell/wet well pump stations into one large wet well pump station. The feasibility of any pump station conversion strategy, including this one, would be largely subject to the findings and recommendations of a licensed geotechnical engineer after a thorough field investigation.

Pump Station Maintenance

Each pump station should have a bound copy of its site-specific operations and maintenance manual on site; and all personnel need to be familiar with the contents of the manuals. Proper equipment lubrication and maintenance following manufacturer's recommendations (which must be included in the operations and maintenance manual) is essential to efficient operation and longevity.

Manufacturer's maintenance instructions should be followed exactly, particularly when the pump or engine is still under warranty. Flygt recommends having their submersible pumps inspected at least once a year, and they should have a major overhaul in an authorized service shop at least once every third year. If the seals have been replaced an inspection of the oil is recommended after one week of operation. An accurate inspection and overhaul log should be kept for each pump.

A typical schedule of maintenance based on references provided by Cummins/Onan (Sanks, 1989) is provided as Table 1; giving both operating hours and calendar time.

Table 1: Typical Maintenance Frequency for Generator Sets

Maintenance Task	Operating Time	Calendar Time
Inspect fuel, oil level, coolant	8 hr	1 Mo.
Inspect air cleaner, battery	50 hr	1 Yr.
Clean governor linkage, breather, air cleaner	100 hr	1 Yr.
Clean fuel filter, replace oil filter, change crankcase oil, check switchgear	200 hr	1 Yr.
Clean commutator, collector rings, relays, cooling system; inspect brushes, valve clearances, starting and stopping systems, water pump	500 hr	1 Yr.
Check injectors, grind valves (if required), remove carbon, clean oil passages, replace secondary fuel filter, clean generator, grease bearings	1000 hr	2 Yr.

Diesel engines should be operated at full power for at least 15 to 30 minutes after reaching operating temperatures once a month to eliminate carbon deposits.