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report

Evaluation of Wastewater Pumping Stations- FINAL

Town of Saugus, Massachusetts

September 2014

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1.0 INTRODUCTION

1.1 Introduction and Purpose

For many communities in New England (and around the world) with varied topography, pump stations are an integral part of wastewater collection systems. Pump stations use mechanical equipment (pumps) and pressurized piping (force main) to lift fluid from a low elevation point to a higher elevation and transport flows to the gravity portions of the collection system.

The Town of Saugus currently owns and operates eleven (11) wastewater pump stations. The pump stations that are included in this evaluation are shown geographically in Figure 1-1.

In 2006, the Town of Saugus Department of Public Works retained the services of Weston & Sampson (W&S) to conduct a general evaluation of each of the wastewater pump stations then owned and operated by the town. The results and findings of this previous evaluation are presented in a report titled, Town of Saugus, MA – Wastewater Pump Stations Evaluation, June 2006. Additionally, in 2006, as part of complying with the Massachusetts Department of Environmental Protection's Administrative Consent Order, the Town of Saugus retained the services of Camp Dresser & McKee Inc. to prepare a collection system Operation and Maintenance Manual.

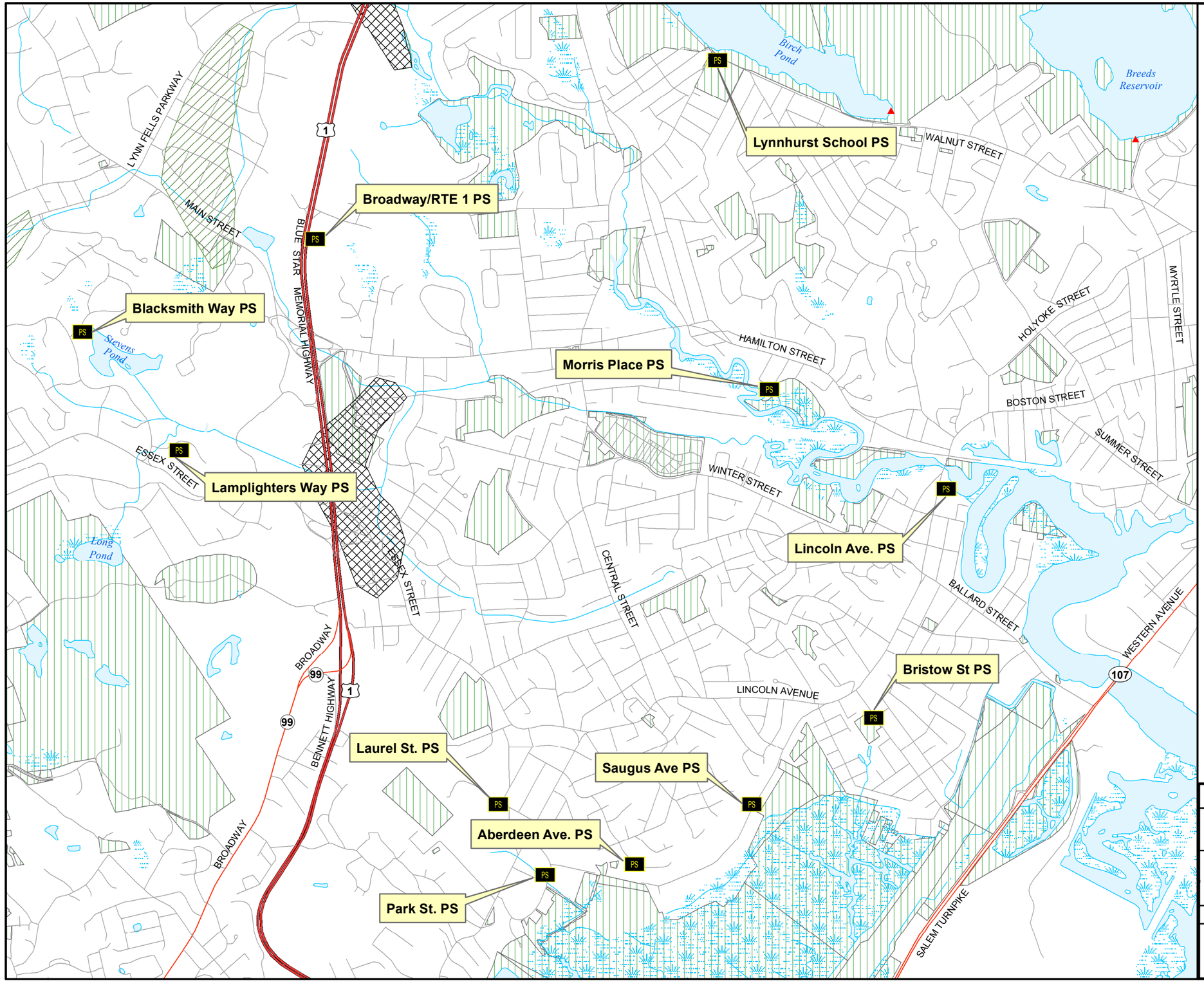
Based on the recommendations in the prior W&S report, two of the pump stations were upgraded or improved. In 2009, the Laurel Street Pump Station was replaced with a new submersible pump station and work was done to upgrade the existing Park Street submersible pump station with a new valve vault/controls. Since the prior evaluation was completed in 2006, the need for an updated capital improvements plan has prompted this current evaluation project.

1.2 Project Approach/Scope of Services

A summary discussion of the tasks performed to accomplish this evaluation follows.

Project team members reviewed available reports, drawings, operation & maintenance manuals, and other pertinent materials that are provided by the town, including:

- *Lincoln Avenue Pumping Station Record Drawings,* Plans by Camp Dresser & McKee Inc., April 1988.
- *Sewer System improvements Project – Saugus Avenue,* Plans by McKenzie Engineering Group Inc., May 2002.
- *Saugus Avenue Pump Station Operation & Maintenance Manual,* Manual by Smith & Loveless Inc., October 2003.
- *Wastewater Pump Stations Evaluation*, Report by Weston & Sampson, Inc., June, 2006.
- *Wastewater Collection System Operation & Maintenance Manual,* Manual by Camp Dresser & McKee Inc., June 2006.
- *Pump Installation at Lincoln Avenue,* Specifications by Camp Dresser & McKee Inc., June 2006.
- *Building and Heating Improvements – Lincoln Avenue Pump Station,* Plans and Specifications by Camp Dresser & McKee Inc., June 2011.
- *Electrical Modifications at Lincoln Avenue Pump,* Specifications by Camp Dresser & McKee Inc., November 2011.
- *Pump Station Replacement and Rehabilitation Project* (Laurel Street PS and Park Street PS), Record Drawings by Weston & Sampson, February 2010.



Legend

- PS — Town Owned Wastewater Pumping Station

Roads

- US Highway
- State Road
- Local Road

Public Water Supplies

- Surface Water

Aquifers

- Medium Yield

Non Pot. Drinking Water Source Area

- Medium Yield
- River, Stream

Water Bodies

- Water
- Wetland
- Protected Open Space

N

1,500 0 1,500

Scale In Feet

FIGURE 1

TOWN OF SAUGUS, MA

WASTEWATER PUMP STATION
LOCATIONS AND
AREA RECEPTORS MAP

JUNE, 2014 SCALE: NOTED

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Path: \\gisdatasrv\gis\DataStore\Client\Saugus MA\Project\2140189 AR\receptorsmap.mxd User: OzereleoZ Saved: 6/24/2014 11:04:42 AM Opened: 6/24/2014 11:08:44 AM

- *Route 1 Pump Station*, Design Drawings by Onsite Engineering, September 2012.

Applicable findings from the information reviewed above are incorporated into this report document, if improvements have not been implemented.

The W&S project team met with the pump station operation staff to briefly interview them and to discuss existing operational problems and concerns, and confirm previously recommended improvements to the stations that have been implemented. Evaluation criteria for each pump station visit was established based upon the available information and industry standards.

Weston & Sampson Engineers, Inc. (W&S) has teamed with several specialized consultants and testing firms to complete this evaluation update as comprehensively as possible. Our team consists of members from Weston & Sampson CMR, Inc., LP Larson (pump vibration testing), SED Associates, Inc. (electrical) and Baker Testing Services, Inc. (steel testing). The field evaluations for each pump station were conducted by W&S, CMR, and SED collectively and were accomplished over a 2-day period on May 8th and 9th, 2014. Representatives from the two testing firms were on-site for the applicable stations on May 15th and 16th, 2014. Pump station operation staff, Tom Dinnoco was also on-site for most of these field visits to provide access to the sites and assist in the operation of equipment.

Each pump station visit included:

- Visual inspection of the exterior conditions at each pump station. Digital photos of each station were taken and are included in the report.
- Review of the level control systems and current pump operating levels.
- Review of pump cycling and wet well draw down, if existing conditions allowed.
- Review of operation of the pumps, motors, compressors, etc.
- Evaluation of concrete structural integrity and identification of structural concerns.
- Vibration analysis of the pumps, motors and drive shafts on each unit, if existing conditions allowed. This testing was performed at the Bristow St., Lincoln Ave., Lynnhurst School and Morris St. Pump Stations.
- Review of the existing stand-by power system including generator and transfer switch-gear at the applicable pumping stations.
- Review electrical TVSS lightning/surge protection needs.
- Performance of ultrasonic thickness gauge testing of steel structures at three (3) pump stations. This testing was performed at the Bristow St., Lynnhurst School and Morris St. Pump Stations.

Based on these comprehensive site visits, a collection of information has been assembled and evaluated to form this report document and the recommendations that follow include:

- Description of each of the Pump Stations and the equipment on each site.
- Detailed descriptions of deficiencies.
- Recommendations to improve efficiency, performance, safety, and reliability.
- Planning level budget costs to design and construct the recommended station improvements, a prioritization of recommendations and a capital plan showing the year by year breakdown for implementation of the recommendations.

1.3 General Technical Information

1.3.1 Pump Station Configuration

The pump stations can be further categorized by their configuration as centrifugal pump stations or submersible pump stations.

A station containing centrifugal pumps is generally more complex than a submersible station. Typically the station is underground and contains the pumps, controls and electrical power distribution equipment. Adjacent to the station is a wet well with a level control system utilizing floats, compressors/bubbler tubes, pressure transducers or ultrasonic sensors to start and stop the pumps. The wet well can be either a separate structure or contained within the pump station. This type of station is preferred over a submersible station for higher flows, higher solids content, and higher elevation lifts. See Figure 1-2 for general arrangement of this type station.

Generally a submersible pump station is comprised of two or more submersible pumps placed directly inside a wet well. Valving (check valves and gate valves) for the discharge piping can either be located inside of the wetwell or in an adjacent valve vault. A valve vault is preferable from a maintenance and safety standpoint, as it limits the need to enter the wet well space. A level control system utilizing floats, compressors/bubbler tubes, pressure transducers or ultrasonic sensors starts and stops the pumps based on the water level in the well. The electrical power distribution panel and control panel is generally contained in an outdoor weather-proof enclosure, above ground and adjacent to the station. See Figure 1-3 for general arrangement of this type station.

Saugus currently has five (5) centrifugal pump stations and six (6) submersible pump stations.

Centrifugal Pump Stations

Bristow Street Pump Station
Lincoln Avenue Pump Station
Lynnhurst School Pump Station
Morris Place Pump Station
Saugus Avenue Pump Station

Submersible Pump Stations

Aberdeen Avenue Pump Station
Blacksmith Way Pump Station
Broadway/Rte. 1 Pump Station
Lamplighters Way Pump Station
Laurel Street Pump Station
Park Street Pump Station

A general summary of components for each wastewater pump station evaluated is included in Table 1-1.

1.3.2 Anticipated Life Cycle

General industry standards, based on information contained in TR-16, Guides for the Design of Wastewater Treatment Works, 2011 Edition, recommends that mechanical operating design life should be 20 years. Life cycle expectancy for structural components of pump stations range based on material of construction. Concrete structures are anticipated to need repair or replacement after 50 years of service, whereas steel structures are likely to need replacement after a 25-year period.

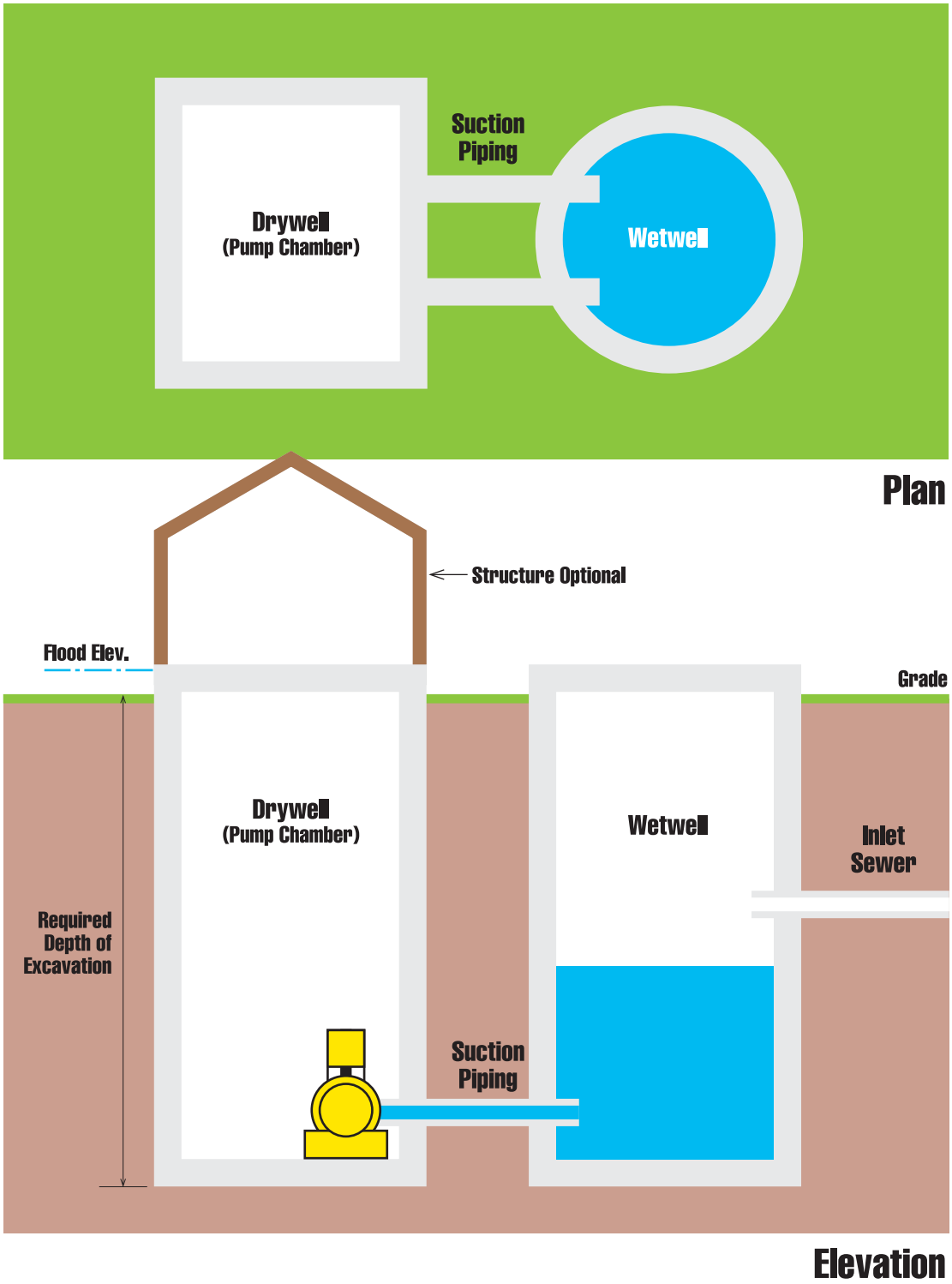

FIGURE 1-2

DRY-PIT/WET-PIT CENTRIFUGAL TYPE FLOODED SUCTION PUMP STATION CONFIGURATION

NOT TO SCALE

P/Graphics 2007/Client Related/Schematics/Pumps/PitPump06.07

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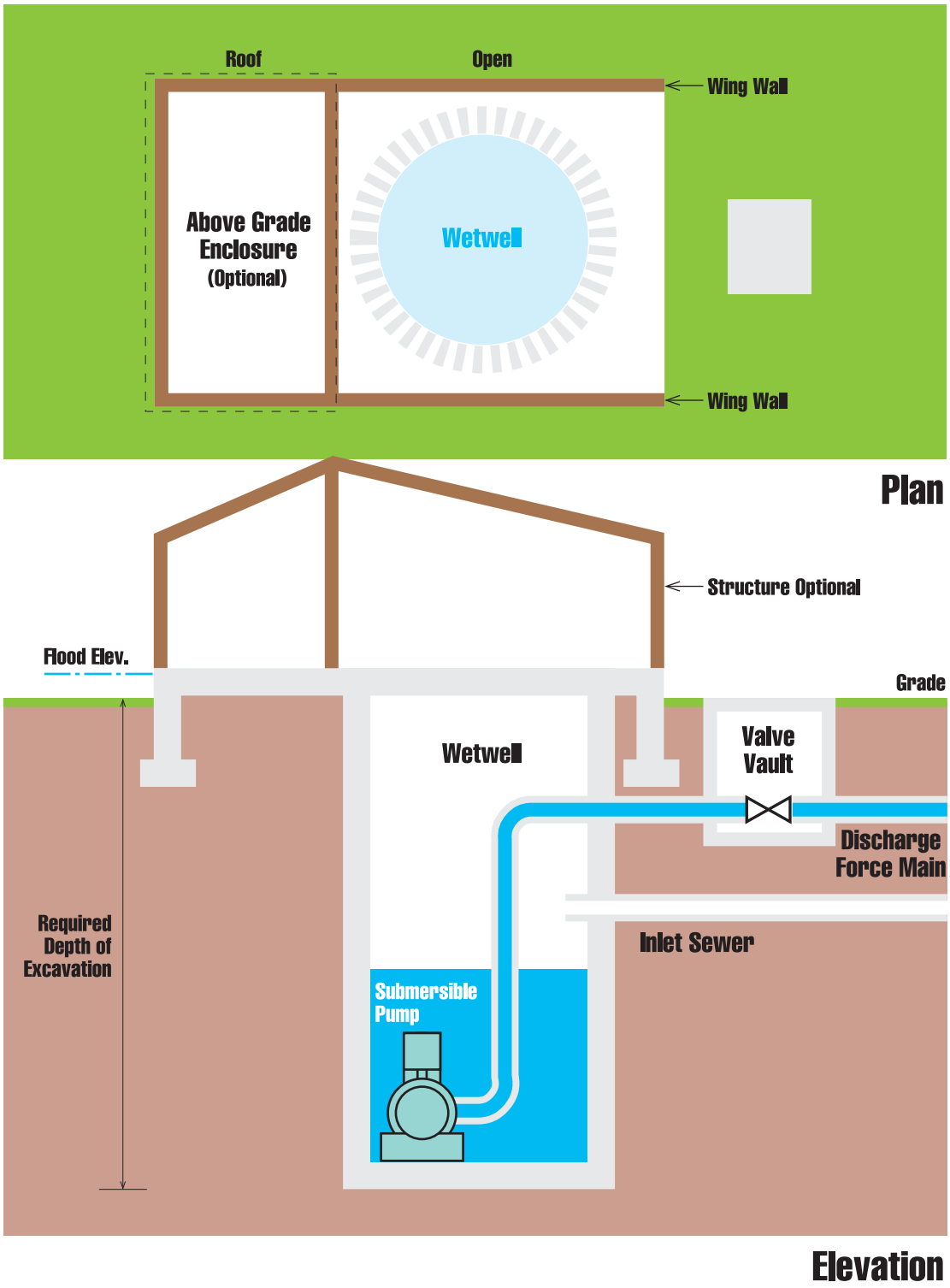

FIGURE 1-3

SUBMERSIBLE TYPE PUMP STATION CONFIGURATION

NOT TO SCALE

P/Graphics 2007/Client Related/Schematics/Pumps/SubmersiblePump06.07

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The actual service life of pump stations is dependent on both environmental and operating factors. The location of the pump station in a coastal area or an area with high groundwater table may cause exterior equipment or below-grade structures to have a shorter service life. Similarly, stations that are not adequately and consistently maintained may need considerable rehabilitation sooner than designed/anticipated. The Saugus Sewer Department staff should continue to perform regular daily maintenance activities and minor repairs at the pump stations and seek assistance for larger/more complex repair and maintenance items.

1.4 Report Format

This report is organized in a manner to ease the reader's ability to locate information. The ordering of pump stations follows that outlined in Table 1-1, with centrifugal pump stations first and submersible pump stations after. Additionally, each pump station evaluation section is formatted consistently presenting:

- Background Information
- A listing of Station Equipment data
- Site Observations (broken down into mechanical, electrical, structural, safety subsections)
- Recommendations (also broken into mechanical, electrical, structural, safety subsections with an additional break-down by implementation priority)
- Estimated Costs for Recommended Improvements

Following each individual pump station evaluation is a report section that provides recommendations that apply system-wide to all or most of the wastewater pump stations.

The final section of this report summarizes the recommendations for all of the wastewater pump stations in order of implementation priority and provides the estimated costs by year to be incorporated into the Department's Capital Plan budgets

TABLE 1-1
SUMMARY TABLE
Town of Saugus - Pump Station Evaluations

September-14

Facility Name	Type of Station	Approximate Year Installed	Approximate Age of PS (years)	Material of Construction	# of Pumps	Capacity (gpm @ TDH)	Motor Horsepower	Control System	Eletrical Service	Stand-by Generator Size (kW)	Tank Size (gallons)	Tank Contents
Bristow Street SPS	Centrifigal	1965	49	Conc./Steel	2	400 @ 37 ft	7.5	Bubbler	3 Ph.- 460 VAC	portable	-	No. 2 Fuel/Diesel
Lincoln Avenue SPS	Centrifigal	1988	26	Concrete	3	6000 @ 99 ft	200	Ultrasonic	3 Ph.- 460 VAC	500	2,000 UST	No. 2 Fuel/Diesel
Lynnhurst School SPS	Centrifigal	1965	49	Steel	2	600 @ 40 ft	10	Bubbler	3 Ph.- 208 VAC	30	162 Gallons	No. 2 Fuel/Diesel
Morris Place SPS	Centrifigal	1980	34	Steel	2	300 @ 30 ft	3	Bubbler	3 Ph.- 208 VAC	portable	-	-
Saugus Avenue SPS	Centrifigal	2003	11	Concrete	2	120 @ 21 ft	2	Float	3 Ph.- 208 VAC	portable	-	No. 2 Fuel/Diesel
Aberdeen Avenue SPS	Submersible	1998	16	Concrete	2	N/A	2.4	Float	1 Ph.- 230 VAC	portable	-	No. 2 Fuel/Diesel
Blacksmith Way SPS	Submersible	1995	19	Concrete	2	N/A	15	Float	3 Ph.- 230 VAC	portable	-	No. 2 Fuel/Diesel
Broadway/Rte. 1 SPS	Submersible	2013	1	Concrete	2	262 @ 41.1 ft	5	Transducer	3 Ph.- 208 VAC	25	gas	-
Lamplighters Way SPS	Submersible	1995	19	Concrete	2	N/A	5	Float	3 Ph.- 208 VAC	portable	-	No. 2 Fuel/Diesel
Laurel Street SPS	Submersible	2009	5	Concrete	2	290 @ 28 ft	7.5	Transducer	N/A	30	150 gallons	No. 2 Fuel/Diesel
Park Street SPS	Submersible	2009	5	Concrete	2	200 @ 42 ft	7.5	Transducer	3 Ph.- 208 VAC	portable	-	No. 2 Fuel/Diesel

Notes:
SPS: Sewer Pumping Station
N/A: Not Available

2.0 BRISTOW STREET PUMP STATION

2.1 Background Information

The Bristow Street PS is located near the intersection of Bristow Street and Barressi Street, inside of Bucchiere Park, in the southeastern section of Saugus. Records from the pump station are not available to establish the exact age of this station. Discussions with Saugus DPW employees indicate that the station is approximately 50 years old. Modifications to the station were completed in 1998. These modifications included the installation of a hydraulically actuated in-line grinder system, pump replacement, wetwell modifications, sump pump and electric heater replacement and the installation of new electrical and mechanical control panels. Available records from the in-line grinder manufacturer (JWC Environmental) indicate that the grinder unit was replaced via the JWC Environmental exchange program in April 2006. The exchange program allows for return of the existing unit to the factory for rebuilding/delivery to different client and installation of a similar re-built unit.

The Bristow Street PS is a below grade, 'dry-pit' type pump station. The station consists of an 8-foot diameter precast concrete vault structure with a 3-foot diameter steel access tube constructed of steel plate. The stations pump chamber is accessed via an aluminum ladder. It is estimated that the floor of the station is approximately 22-feet below grade.

The existing wetwell is constructed of pre-cast concrete manhole sections. The entire wetwell structure is comprised of 6-foot (inside diameter) sections brought to grade, with an aluminum hatch for access. The wetwell access ladder may be broken, and/or made up of two different ladders. The wet well includes a bubbler tube system for level control and pump operation, and a high water alarm float.

The pumping system consists of two vertical centrifugal solids handling pumps that are housed in the steel can structure. Each of the pumps draw flow from the adjacent 6-foot (inside diameter) pre-cast concrete wet well through 6-inch suction lines. The 6-inch discharge lines from each pump are then joined together into one 6-inch diameter force main, which exits the dry pit structure through the ceiling. The pump station force main, which is assumed to be 6-inch diameter, runs north up Bristow Street, approximately 530 linear feet, before discharging to a gravity sewer manhole located at the intersection of Lincoln Avenue and Bristow Street. No detailed record drawings were available for the system.

The Bristow Street PS operates on a fill/draw cycle controlled by a bubbler tube level control system. At the time of our visit, the pumps were set to operate at a liquid elevation of 4.4 feet (above wetwell floor) and turn off at an elevation of 2.0 feet. Low water alarm is unknown, but

documentation at the station indicates the high water alarm elevation to be 5.0 feet. Pump output was observed via the magnetic flow meter (0 to 600 gpm) display inside the control panel. Observations indicate that Pump #1 is pumping at a rate of 240 to 250 gpm, while Pump #2 is pumping at a rate of approximately 255 gpm. The observations from the most recent visit indicate that the pump output has decreased since 2006. In 2006, natural drawdown cycles indicated that Pump #1 was pumping at a rate of 325 gpm, while Pump #2 was pumping at a rate of 385 gpm. It is possible that the magnetic flow meter may need to be calibrated, which could affect the flow output we observed during our visit.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. The town has a portable generator that can be used at the site.

2.2 Station Equipment

Station Manufacturer:	Can-Tex
Number of Pumps:	2

Pump Manufacturer:	Cornell	**Motor Manufacturer:**	U.S. Electric
Model Number:	4NNT-VC16	**Model:**	LVCS TE
Serial Number:	106935/ 106936	**ID Number:**	B08 97087166 001F (Both motors)
Size:	6 X 6	**Horsepower:**	7.5
Rated Capacity:	400 gpm @ 37 ft	**Speed:**	1180
Seals:	Mechanical - 2-inch Double Seal	**Service Factor:**	1.0
Impeller Size:	9.75 inches	**Rating:**	3 ph./208volts/60hz
Run Time (hrs):	18109.1 / 17400.0	**Frame:**	254VP

Grinder Manufacturer:	Muffin Monster
Serial Number:	12225
SO Number	30389

Actuating Controls:	Bubbler: Aquarium Pump (Dual compressors utilized for purging only)
Operating Controls:	MicroMAC 2300

Stand-by Generator Manufacturer:	N/A	**Sump Pump Manufacturer:**	Tag Unreadable
Model:	N/A	**Rated Capacity:**	Tag Unreadable
Serial Number:	N/A		
Size:	N/A	**Heater:**	Ruffneck – XL4 VacuCore
Engine:	N/A	**Dehumidifier:**	N/A
Run Time (hrs):	N/A		
Fuel:	N/A		
Fuel Tank Size:	N/A		

Data Sources:

1 Information taken from equipment tag or nameplate during 2014 site visits.

2.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves and mechanical piping. Additional pump vibration testing on each pump unit was performed at this pump station. General results of this testing is included below; actual data from the tests is included in **Appendix A**. Ultrasonic steel thickness gauge testing of the steel access tube structure was also performed in the pump chamber (base section is concrete). General results of this testing is included below; actual data from the tests is included in **Appendix B**.

Assuming the station has been operational for approximately 16-years following the latest improvements, the running time meters show average daily operating time at approximately 365 min/day. At the rated capacity of the pumps this equates to approximately 146,000 gallons per day of wastewater.

We made the following general observations and identified the following deficiencies about the Bristow Street Pump Station.

2.3.1 General Mechanical

- The wetwell contained a significant amount of grease balls and grease was observed to be covering the high water float.
- The gate box for the bypass connection is filled with trash and debris.
- The Muffin Monster Grinder is near the end of its useful life and should be replaced.

- Pump vibration testing was performed on both pumps by L.P. Larson, Corp. on May 16, 2014. After reviewing the test report and discussing the work with L.P. Larson, the vibration analyst did not observe any signs of excessive vibration during the testing.
- The discharge gate valves are leaking.
- A dehumidifier was not present in the station, and no humidity was observed.
- The station has a powered exhaust fan, but no powered intake fan.
- The magnetic flow meter may need to be calibrated.
- The sump pump should be adjusted to keep the floor of the station dry. Consider replacement of existing unit.
- The seal water (recycled wastewater) filters should be replaced.
- The suction and discharge pressure gauges should be replaced. The discharge gauge on Pump #2 is the only functioning gauge.

2.3.2 Electrical, Controls, Alarms

- A unit heater should be added to the Control Panel side of the outdoor enclosure.
- The electrical equipment does not have nameplates and NEC electrical shock warning labels.
- The alarms annunciator panel does not have UPS back up power supply.
- The outdoor electrical equipment enclosures do not have cooling exhaust fans or the enclosures are not insulated.
- Single level sensing bubbler air compressor. The existing duplex compressors are utilized for line purging only.
- No sewage pumps back up controls plus the sewage pumps manual controls are not electrically independent.
- The SPS telephone dialer alarms are limited and not compliant with TR # 16 SPS alarms requirements.
- Electrical service has “air gap” type transient voltage surge suppressors.
- Automatic transfer switch without “timed neutral” power transfer operation. We could not verify if the ATS had an “out of phase” protection relay.
- Portable E/G power receptacle is located inside the enclosure alongside the NEMA “1” main power disconnect, etc. equipment.
- The water service “back flow preventer” is located inside the electrical enclosure. Note, a water leak could disable the NEMA “1” electrical equipment.
- No exterior mounted GFI/WP receptacles for SPS maintenance power.
- No emergency lighting in the below grade sewage pump station.
- The below grade SPS is not an UL listed “assembly”.

2.3.3 Structural

- The concrete base of the can station appeared to be in good condition.
- The wetwell and access hatch appeared to be in good condition.
- Steel thickness readings from Baker Testing of the access tube indicate that the access tube is in good condition. The access tube is likely constructed of 3/8-inch or greater steel plate as all measurements resulted in 0.366-inches of steel remaining.
- The station should be re-painted to protect the concrete and steel.

2.3.4 Safety Considerations

- An access step and Ladder Up type safety device should be added to safely access the can structure.
- The Control Panel concrete slab is less than 6-inches above finish grade. The control cabinet should be raised to eliminate potential flooding from damaging electrical equipment.
- The wetwell contains an aluminum access ladder, which appears to be broken near the bottom. Consider removing the existing ladder and using a portable ladder to access the wetwell when needed.
- The site is subject to vandalism as it is located in the middle of Bucchiere Park, which is frequented by young adults. A perimeter fence should be added to separate the pump station from the park area.

2.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

2.4.1 General Mechanical

Short-term

- Clean out debris from bypass gate valve box and verify that valve is operable.
- Consider adding lockable/tamper resistant gate box cover.
- Calibrate the magnetic flow meter.
- Add a motorized air intake at the can station.
- Replace the suction and discharge pressure gauges.
- Replace the sump pump.
- Replace the recycled wastewater seal filters on both pumps.

Intermediate

- Replace the existing Muffin Monster in the wetwell.

Long-term

- Consider replacing station with new submersible pump station given age of existing pumps and desire to eliminate operator access to below grade structures.

2.4.2 Electrical, Controls, Alarms

Short-term

- Replace level sensing bubbler/compressor system with pressure transducer system.
- Add intrinsically safe relay switch to the wetwell high level float.
- Add secondary pump controls.
- Add emergency (battery powered) lighting to the below grade can station.
- Add engraved plastic nameplates to all equipment panels (where missing).
- Verify the portable engine/generator receptacle properly “grounds” the engine/generator.
- Relocate the engine/generator power receptacle to the outside of the outdoor electrical enclosure.

Intermediate

- Add a new dedicated standby generator set to the pump station site.

Long-term

- No Recommendations Identified.

2.4.3 Structural

Short-term

- No Recommendations Identified.

Intermediate

- Sand, prime and paint the can station interior steel access tube and concrete base (floor, wall and ceiling).

Long-term

- No Recommendations Identified.

2.4.4 Safety Considerations

Short-term

- Add a Ladder Up type safety device and concrete step at the entry to the can station.
- Verify flood elevations at the site and raise the control panel as necessary to be above the 100-year flood elevation (minimum).

Intermediate

- Provide fencing around perimeter of the site and revise curb cut to improve station access.
- Consider paving the interior portion of the fenced in site around the pump station.

Long-term

- No Recommendations Identified.

2.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Bristow PS - Short-Term (1-2 years)	
General Mechanical	
♦ Clean out debris from bypass gate valve box and verify that valve is operable.	$250.00
♦ Consider adding lockable/tamper resistant gate box cover.	$250.00
♦ Calibrate the magnetic flow meter.	$2,500.00
♦ Add a motorized air intake at the can station.	$1,000.00
♦ Replace the suction and discharge pressure gauges.	$2,000.00
♦ Replace the sump pump	$300.00
♦ Replace the recycled wastewater seal filters on both pumps.	$250.00
Electrical, Controls, Alarms	
♦ Replace level sensing bubbler/compressor system with pressure transducer system.	$5,000.00
♦ Add intrinsically safe relay switch to the wetwell high level float.	$500.00
♦ Add secondary pump controls.	$3,500.00
♦ Add emergency (battery powered) lighting to the below grade can station.	$1,500.00
♦ Add engraved plastic nameplates to all equipment panels (where missing).	$300.00

♦ Verify the portable engine/generator receptacle properly "grounds" the engine/generator.	Included in Gen/Non-Spec. Recomm.
♦ Relocate the engine/generator power receptacle to the outside of the outdoor electrical enclosure.	$3,000.00
Safety Considerations	
♦ Add a Ladder Up type safety device and concrete step at the entry to the can station.	$1,500.00
♦ Verify flood elevations at the site and raise control panel as necessary to be above the 100-year flood elevation (minimum).	$10,000.00
Short-Term Needs Subtotal	***$31,850.00***

Description of Recommendation	***Estimated Cost***
	-
Bristow PS - IntermediateTerm (3-5 years)	
General Mechanical	
♦ Replace the existing Muffin Monster in the wetwell.	$30,000.00
Electrical, Controls, Alarms	
♦ Add a new dedicated standby generator set to the pump station site.	$50,000.00
Structural	
♦ Sand, prime and paint the can station interior steel access tube and concrete base (floor, wall and ceiling).	$7,500.00
Safety Considerations	
♦ Provide fencing around perimeter of the site and revise curb cut to improve station access.	$10,000.00
♦ Consider paving the interior portion of the fenced in site around the pump station.	$7,500.00
Intermediate Needs Subtotal	***$105,000.00***

Description of Recommendation	***Estimated Cost***
	-
Bristow PS - Long-Term (6 - 10 years)	
General Mechanical	
♦ Consider replacing station with new submersible pump station given age of existing pumps and desire to eliminate operator access to below grade structures.	$500,000.00
Long-Term Needs Subtotal	**$500,000.00**
Pump Station Subtotal	***$636,850.00***
General Contractor Overhead & Mark-up (20%)	$127,400.00
Engineering & Contingency (35%)	$222,897.50
Pump Station Total	***$987,200.00***

3.0 LINCOLN AVENUE PUMP STATION

3.1 Background Information

The Weston & Sampson project team visited the Lincoln Avenue Pump Station on May 9, 2014 with Town staff. Recent work on this pump station has been completed by Camp Dresser & McKee and as such, the following background information is culled from the March 1988 *Operation and Maintenance Manual for the Lincoln Avenue Pumping Station*.

"The Lincoln Avenue Pumping Station receives flow by gravity from the Saugus River Interceptor and the Lincoln Avenue Interceptor, which join near the pumping station and enter the pumping station wet well in a 42 inch sewer. The pumping station discharges into a 30 inch force main which runs for approximately two miles to the Lynn Regional Wastewater Treatment Facility".

"The Lincoln Avenue Pumping Station consists of two structures, namely the old pumping station and the new pumping station. In the past, the old pumping station housed the entire pumping facility, plus equipment for the water department. It now houses the electrical controls, standby generator, and heating system for the new pumping facility. The new pumping station is an underground structure with a super structure for access, housing all wastewater handling facilities including the wet well, pumps and piping."

"Wastewater entering the pumping station is directed by slide gates to either a comminutor for solids size reduction, or to a manually cleaned bar screen to remove large solids. The function of the comminutor is to cut up large solids normally found in wastewater into small pieces to easily pass through the pumps. The solids are ultimately removed from the wastewater at the treatment facility. The manually cleaned bar screen is intended to be used when the comminutor is out of service. Solids too large to pass through the spaces between the bars are caught on the bars, and are removed by manually raking the solids upward to the bar screen platform. The screenings are placed in a container for disposal. Wastewater exiting the comminutor or bar screen flows to one or both wet well halves, as controlled by two sluice gates. The wet well is divided in halves to allow servicing of one half, while the other half, and the entire pumping system, may remain in service.

Three wastewater pumps, located in the pump room, draw wastewater from each wet well half into a 24 inch suction header, from which each pump takes an 18 inch suction connection. Each pump discharges through a 20 inch discharge connection to a 30 inch discharge header.

The discharge header runs up to and across the intermediate level, at which point the flow passes through an 18 inch magnetic flow meter, which measures the flow pumped from the station and transmits a flow signal to a flow recorder and totalizer in the Instrument Cabinet. The

flow metering equipment is especially important because the flow measurements will be used as a comparison to the flow metered at the Lynn treatment plant for billing purposes.

A pipeline cleaner launching system is also provided on the intermediate level. The system is used to insert a pipeline cleaning "pig" into the force main to help remove accumulations of solids in the force main.

The wastewater pumps are designed such that two pumps will pump the peak flow, with a third pump on standby. Three pumps should never be operated simultaneously.

The wastewater pumps are designed to operate automatically at variable speed. The speed of the pumps (and thus pumping capacity) will be controlled in accordance with the level of wastewater in the wet well. At low wet well level, one pump will operate at minimum speed, cycling on and off, to provide a fill and draw operation in the wet well. The minimum speed selected for the pump will allow reasonably efficient pump operation and prevent excessive on-off cycling of the pumps.

If the influent wastewater flow rate exceeds the minimum speed capacity of the pump, the wet well level will rise and the pump speed will increase to match the pumping rate to the influent flow rate. This operation will continue with increasing flow until the influent rate exceeds the full speed capacity of one pump. At that flow, the second pump will start and both pumps will operate and adjust their speed (with both pumps at approximately the same speed) to match the pumping rate to the influent flow rate. With decreasing influent flow rate, the pumps will slow down and shut off in a reverse of the above process."

At the time the pump station was constructed the level control system was monitored via a bubbler tube/compressor system. The level control system was upgraded to utilize ultrasonic sensors to monitor the levels in each wet well half. The ultrasonic sensors transmit the level measurements to the pump station control panel which controls the operation of the pumps.

"Standby power is furnished by a diesel engine driven generator located in the old pumping station. Upon failure of the normal power source, the diesel engine will automatically start and transfer load to operate the pumps and all normal loads associated with operation of the pumping station.

The pumping station is equipped with an instrumentation system which includes hazardous gas detection, high water level or flooding detection, flow metering and equipment malfunction alarms. The instrument cabinet is located in the Control Room of the old pumping station and includes a flow recorder and totalizer and a alarm annunciator panel. Alarm conditions are transmitted to remote locations by a telephone alarm dialer.

The pumping station is designed to provide maximum reliability, in the physical design and layout, and selection of equipment. Equipment is selected to provide many years of continuous reliable operation. In addition, all essential systems are provided with standby equipment, or back-up means, to provide for continuous operation of the station. The operating personnel should maintain all back-up systems in proper operating condition, to be available in case they are needed."

During our visit, a means for handling excessive flow events was observed at the Lincoln Avenue Pumping Station. A standby pump is situated in the driveway of the pumping station, which can be utilized to pump flows from the influent manhole structure to a coarse screen filter box for discharge to the Saugus River. Dry chlorine is added to the flow as a means of disinfecting the flow prior to discharge to the river.

3.2 Station Equipment

Station Manufacturer:	Not Available
Number of Pumps:	3

Pump Manufacturer:	Yeomans	**Motor Manufacturer:**	Marathon Electric
Model Number:	12624-6	**Model:**	IJ 508UTDS417AN W
Serial Number:	9810777B(Pump 1) 9809774A(Pump 2) 9810777A(Pump 3)	**Serial Number:**	Not Available
Size:		**Horsepower:**	200
Rated Capacity:	6000gpm @ 99' TDH	**Speed:**	890 RPM
Seals:	Mechanical Seals (potable seal water)	**Service Factor:**	1.15
Impeller Size:	23-15/16 inches	**Rating:**	3phase/460volts/60 Hz
Run Time (hrs):	72918.8 (Pump 1) 77969.9 (Pump 2) 91163.6 (Pump 3)	**Frame:**	508P
Back-up Pump:	Gorman Rupp Prime-Aire		
Model Number:	PA12A60-B-BF6L-T		
Serial Number:	1161807N		
Rated Capacity:	Unknown		
Comminutor Manufacturer:	Franklin Miller	**Bar Rack:**	6.67' H x 3.9' W Manual/60 Degree 1.38-inch (C.O.)
Model:	36-in Dimminutor	**Influent Sluice Gate:**	42-inch (water pressure operated hydraulic cylinder)

Drive Type:	Explosion Proof w/Gear Reducer
Horsepower:	3
Actuating Controls:	Ultrasonic with High Level Float (Back-up)
Operating Controls:	

Stand-by Generator Manufacturer:	Consolidated Power	**Sump Pump Manufacturer/ Horsepower:**	Ebara (Two Units) / 2 HP
Model:	500 DIT	**Model:**	80DLU61.5
Serial Number:	12VFO 2298		
Size:	500 kW	**Heater:**	
Engine:	Detroit Diesel	**Dehumidifier:**	
Run Time (hrs):	365 Hrs.		
Fuel:	Diesel		
Fuel Tank Size:	2,000 gal (UST) / 75 gal (Day Tank)		

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manual by CDM.

3.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection of pumps and motors, check and gate valves, mechanical piping and standby generator. Additional pump vibration testing on each pump unit was performed at this pump station. General results of this testing is included below; actual data from the tests is included in **Appendix A**.

Wetwell drawdown testing was not performed at this station. We made the following general observations and identified the following deficiencies about the Lincoln Avenue Pump Station.

3.3.1 General, Mechanical, HVAC & Plumbing

- Potable water is utilized for generator cooling and pump seals. Potable water service must remain functional at all times in order to have a reliable pumping station.
- Old Building - The Town indicated that the 2,000 gallon UST has to be removed and replaced at the direction of the local fire department.
- Old Building – Old mechanical equipment (pump bases) and continuous piping were observed.
- Old Building – Controls for the pumping station are located in the “old building”, while mechanical equipment is located in the new Building.
- New Wetwell – A comminutor is utilized. The Town does not recall when this unit was last serviced.

- New Wetwell – The sluice gate to the smaller wetwell is frozen in the “open” position.
- New Wetwell – A leak in the water piping (piston up piping) was observed at the water activated influent sluice gate.
- New Wetwell – The ball valve handles on the plumbing in the wetwell are corroding.
- New Wetwell – The brackets for the ultrasonic level sensors appear to be painted steel. They are corroding and need to be replaced,
- New Wetwell – Anchor clips are missing from the grating.
- New Wetwell – A significant amount of grease accumulation was observed in the wetwell. The Town indicated that grease is manually removed
- New Wetwell – A mechanical operator for the influent sluice gate was not observed.
- New Wetwell – A significant amount of potable water was being utilized to break up/mix grease in the wetwell.
- Ventilation Room – The mechanically activated louver in this room needs replacement.
- Ventilation Room – A bacteria enzyme waste digester (Zymox) was observed being added to the flow via a timer based operation.
- Ventilation Room – Old Scot-Air Pacs were observed to be hanging on the walls.
- Discharge Piping Level – Corrosion/pulled apart conduit were observed at solenoid valve H158.
- Discharge Piping Level – The belt guard on the exhaust fan was missing. It appeared to be lying on the floor adjacent to the fan unit.
- Discharge Piping Level – Corroding bolts were observed at the backflow preventer.
- Discharge Piping Level – The backflow preventer did not appear to have an inspection tag.
- Discharge Piping Level – The Town indicated that the existing gas detection system is non-functional.
- Discharge Piping Level – The old bubbler tube level control system has been abandoned, but the equipment remains.
- Discharge Piping Level – A vacuum relief valve (G.A. – Fig. 990 DC, Serial # 100797, Max 250 psi) was observed.
- Pump Room – The valving on the seal water system for Pump #2 is leaking.
- Pump Room – Leaking was observed at the packing on the check valve for Pump #2.
- Pump Room – An intake screen was not present on the exhaust fan.
- Pump Room – There does not appear to be an alarm indicator for “sluice gate” closed in the pump room.
- Pump Room - Pump #2 was removed from service as a result of a motor shaft/keyway issue.
- Pump Room – The booster pump system for the seal water system was non-functional (faulty pressure switches, Pump #1 is non-operational and Pump #2 trips out).
- Pump Room – Spare parts were observed. Spare

parts consisted of woods coupling flanges, wear ring, shaft sleeve and impeller/wear ring assembly.

- Pump vibration testing was performed on two pumps (#1 and #3) by L.P. Larson, Corp. on May 16, 2014. Results of this testing indicate that the bearings on Pump #3 are deteriorating. High Spike Energy Levels and significant noise were observed. Pump #1 vibration testing found no vibration issues.
- HVAC – The heating system for the pump station currently installed consists of a gas-fired condensing boiler located in the Old Building mechanical room and piped to equipment within the Old Building and to the equipment located in the New Building. The equipment installed at this facility consist of an air handling unit installed in the dry side of the pump station building, unit heaters installed in both the pump station (Old) and main building (New) and baseboard radiation installed in the main building. Assuming that an operational temperature of 55°F is being maintained on the dry side of the pump station and from the sizing of the equipment as listed on the drawings reviewed at the site, the total load on the building is approximately 590 MBH. The current boiler has a rated output of 560 MBH, and therefore, cannot meet the facility's heating load on a design day. This has been confirmed by the operator's statement that the building cannot be kept at temperature during the coldest days of the winter.
- HVAC - The boiler appears to be in good operating condition and appears to be less than ten (10) years in age. The system is a sealed combustion unit utilizing PVC piping for its sidewall vent and intake air. Because of the high temperature water that is being used in the system, 180°F, the PVC vent pipe has begun to brown from the heat of the flue gas. This is a common problem in systems of this type when the high temperature water is used for extended periods of time. In this case the manufacturers recommend that CPVC piping or stainless steel piping be utilized.
- HVAC - The air handling unit located on the dry side of the pump station building, although operational, appears to have reached its useful life expectancy. This unit was installed during the 1982 rehab of the facility and later fitted with a hot water coil when the system was converted to hot water. This puts the approximate age of the unit at 32 years, well above the typical 20-25 year life expectancy. The hot water piping serving the coil of this unit is installed in such a manner that does not allow for the full opening of the filter access panel. The panel was modified by the operators so that the filter could be changed. The remainder of the heating equipment located at the pump station building appears to be of the same vintage as the air handling unit.
- HVAC - The main building is provided with unit heaters installed in the electric room, generator room and mechanical room as well as the lower level, which does not appear to have any particular use. The office/conference area of this building is served by baseboard radiation for heat and a small through the wall air conditioning unit for cooling. The air conditioning unit does appear to be properly sized for the area served.
- HVAC - The generator room is currently provided with louvers for intake and exhaust air, which are opened during generator operation. This system does appear to be operational. The fuel supply for the generator consist of an underground fuel storage tank, which is believe to be of a single wall type, and piped to a day tank located in the generator run through single wall piping.
- Plumbing - The Old Building is currently equipped with two (2) toilet rooms. One is located in office/conference room area and one is located in the back electric

room area. The fixtures appear to be original and not of a low flow type but in operational condition. The pump station is not equipped with a toilet room.

- Plumbing - The water service for the facility is four (4) inch in size and is installed on the intermediate level of the pump station building. A two (2) inch pipe is fed from this location underground to the Old Building. The service is provided with a backflow preventer as required by code, but it could not be determined when the backflow preventer was last tested. Besides the toilet fixture previously mentioned, the water service also serves wash down station installed throughout the facility.

3.3.2 Electrical, Controls, Alarms

- Old Building – The door alarm is non-functional.
- The electrical power distribution and VFD motor control equipment is variable age but generally modern. It is unclear if the equipment has been cleaned, tightened or had preventative maintenance testing.
- Some of the lighting is not high efficiency type. Some high efficiency lighting was observed in the Old Building.
- The VFD's do not have Hand-Off-Auto (H-O-A) switches. They are also missing "bypass" motor controllers.
- Some of the power distribution and motor control equipment have engraved nameplates and NEW electrical shock hazard warning labels. Only some of the electrical equipment has NFPA arc flash personal protective equipment warning labels.
- The automatic transfer switches could not be verified to have "out of phase" protection on their "live" to "live" power supply transfers.
- The engine generator circuit breaker is only accessed by opening its front panel cover. The engine generator does not have an NFPA required emergency power off control station.
- There is no computerized power metering of the utility and/or engine/generator power supplies with associated power failure alarm.
- The pump controls utilize non redundant PLC controllers, however, there are no back-up secondary pump controls. Also, there is no PLC operator interface terminal unit HMI.

3.3.3 Structural

- Old Building – A crack in the front entry walk way was observed.
- Old Building - Exterior masonry work appeared to be in sound condition.
- Old Building – The spiral stair case to the lower level and the ladder to the pipe galley area are severely corroded.
- Loading Dock – The beam for the monorail is rusting.
- Loading Dock – Sealant is missing from the railing connection at the stairs.
- Loading Dock – Cracking was observed at the corners of the hatch above the wetwell. Cracks were also observed near the access stairs.
- New Building Exterior – Areas of exposed rebar were observed at the rear of the building.

- New Building Exterior – A crack was observed below the wetwell intake louver.
- New Building Exterior – A crack was observed below the ventilation louver at the rear of the building.
- New Building Exterior – A crack and corroding louver were observed at the rear corner of the building adjacent to the restaurant parking lot.
- Discharge Piping Level – Cracking was observed at the floor drain and aluminum grating near the backflow preventer.
- Pump Room – Paint was observed to be peeling from floors/walls and piping.

3.3.4 Safety Considerations

- The Town indicated that the existing hard wired gas detection system has not been calibrated and may be non-functional.
- Old Building – There is no intake/exhaust in the old wetwell. Low oxygen levels may be present.

3.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

3.4.1 General Mechanical

<u>Short-term</u>

- The fuel storage tank will need to be replaced in order to be compliant with current regulation requiring the removal of all single wall fuel storage tanks and due to its close proximity to the Saugus River. The new fuel delivery system should consist of an aboveground double wall fire rated storage tank and new piping.
- Replace ball valves, which are corroding, on the plumbing inside the wetwell.
- Replace sluice gate operators on wetwell sluice gates.
- Repair leaking water piping (piston “up” piping) at wetwell influent sluice gate.
- The existing comminutor should be rebuilt or replaced.
- Add anchor clips to wetwell grating.
- Consider the addition of a mechanical “bypass” operator for the influent sluice gate which would allow manual operation should the water actuated system fail.
- Replace the ultrasonic level sensor mounting hardware with aluminum or stainless steel.
- Replace the mechanical louver at the ventilation room of the New Building.
- The old Scot Air Pacs should be removed.
- Install belt guard on exhaust fan at Discharge Piping Level.
- Solenoid valve H158 should be replaced and the conduit should be reconnected.
- Replace the corroding bolts at the backflow preventer.
- The backflow preventer should be inspected.
- Rebuild the check valve for Pump #2.
- Replace seal water booster system.
- Add an intake screen to the exhaust fan in the Pump Room.

- Add an alarm indicator for the sluice gate position in the Pump Room.
- Pump #3 should be addressed due to the excessive noise and vibration observed. Replace existing bearings.
- Verify old force main piping is properly disconnected (test pit).

Intermediate

- Demolish/dispose of the old bubbler tube system.
- HVAC - The existing boiler should be replaced with one that is capable of providing the proper output to ensure that the building can be maintained at its design temperatures during the winter time.
- HVAC - The existing air handling units and unit heaters at the facility should be replaced due to their age and failing condition.
- Plumbing - Even though the toilet fixtures are operational, it is recommended that they be replaced with new low flow type in order to reduce the water consumption at the facility.

Long-term

- Perform analysis of hydraulic conditions for pumping system prior to any major pumping modifications.
- Consider replacing the existing pumps with new dry-pit submersible pumps.

3.4.2 Electrical, Controls, Alarms

Short-term

- Repair the alarm contact at the entry door to the Old Building and tie the alarm into the station Control Panel.
- Add an engraved plastic nameplate to the engine generator main circuit breaker enclosure which reads: “DO NOT OPEN UNLESS THE ENGINE GENERATOR IS TURNED OFF”.
- Add an emergency power off (EPO) control station for the standby power engine generator. Locate it at the room entrance door.
- Add NFPA arc flash PPE warning labels for all electrical equipment which have no labels.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

3.4.3 Structural

Short-term

- The cracked sidewalk at the front entry to the Old Building should be repaired.
- The spiral stair case to the lower level of the Old Building and the ladder to the pipe galley area are severely corroded and should be repaired (or the old pumping station should be completely filled in/abandoned).
- The beam for the monorail on the loading dock should be sand blasted and painted.

- Sealant should be replaced at the railing connection for the stairs to the loading dock of the New Building.
- Cracking at the corners of the hatch above the wetwell and near the access stairs to the loading dock should be repaired.
- Areas of exposed rebar at the rear of the New Building should be repaired/patched.
- Three cracks at louvers for the New Building should be repaired.
- The corroded louver at the rear side of the New Building should be replaced.
- Cracking was observed at the floor drain and aluminum grating near the backflow preventer should be repaired
- The entire pump room should be repainted.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

3.4.4 Safety Considerations

Short-term

- Add air handling to the basement areas of the Old Building accessed by Operators.

Intermediate

- Calibrate the existing fixed gas detection system in the New Building. (In the interim, the operators should continue to utilize/calibrate their portable gas detection systems).

Long-term

- No recommendations identified.

3.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Lincoln Avenue PS - Short-Term (1-2 years)	
General Mechanical	
♦ The fuel storage tank will need to be replaced in order to be compliant with current regulation	$25,000.00
♦ Replace ball valves, which are corroding, on the plumbing inside the wetwell.	$1,500.00
♦ Replace sluice gate operators on wetwell sluice gates.	$3,000.00
♦ Repair leaking water piping (piston “up” piping) at wetwell influent sluice gate.	$250.00
♦ The existing comminutor should be rebuilt or replaced.	$50,000.00
♦ Add anchor clips to wetwell grating.	$2,000.00
♦ Consider the addition of a mechanical “bypass” operator for the influent sluice gate which would allow manual operation should the water actuated system fail.	$15,000.00
♦ Replace ultrasonic senor mounting hardware with aluminum or stainless steel	$2,500.00

♦ Replace the mechanical louver at the ventilation room of the New Building.	$10,000.00
♦ The old Scot Air Pacs should be removed.	$500.00
♦ Install belt guard on exhaust fan at Discharge Piping Level.	$150.00
♦ Solenoid valve H158 should be replaced and the conduit should be reconnected	$250.00
♦ Replace the corroding bolts at the backflow preventer	$750.00
♦ The backflow preventer should be inspected	$150.00
♦ Rebuild the check valve for Pump #2	$4,000.00
♦ Replace seal water booster system.	$6,000.00
♦ Add an intake screen to the exhaust fan in the Pump Room	$200.00
♦ Add an alarm indicator for the sluice gate position in the Pump Room	$1,500.00
♦ Pump #3 should be addressed due to the excessive noise and vibration observed. Replace existing bearings	$7,500.00
♦ Verify old force main piping is properly disconnected (test pit)	$10,000.00
Electrical, Controls, Alarms	
♦ Perform Infrared Testing/Cleaning/Tightening/Maintenance at Power Distribution Equipment and VFDs	$5,000.00
♦ Add Computerized Power Meter	$3,000.00
♦ Repair the alarm contact at the entry door to the Old Building and tie the alarm into the station Control Panel	$1,000.00
♦ Add an engraved plastic nameplate to the engine generator main circuit breaker enclosure which reads: “DO NOT OPEN UNLESS THE ENGINE GENERATOR IS TURNED OFF”	$50.00
♦ Add an emergency power off (EPO) control station for the standby power engine generator. Locate it at the room entrance door	$2,000.00
♦ Add NFPA arc flash PPE warning labels for all electrical equipment which have no labels	$1,000.00
♦ Add Secondary Pump Controls	$5,000.00
Structural	
♦ The cracked sidewalk at the front entry to the Old Building should be repaired	$3,000.00
♦ The spiral stair case to the lower level of the Old Building and the ladder to the pipe galley area are severely corroded and should be repaired (or the old pumping station should be completely filled in/abandoned - Price shown is for repair only)	$15,000.00
♦ The beam for the monorail on the loading dock should be sand blasted and painted	$2,500.00
♦ Sealant should be replaced at the railing connection for the stairs to the loading dock of the New Building	$500.00
♦ Cracking at the corners of the hatch above the wetwell and near the access stairs to the loading dock should be repaired	$1,500.00
♦ Areas of exposed rebar at the rear of the New Building should be repaired/patched	$1,500.00
♦ Three cracks at louvers for the New Building should be repaired	$1,500.00
♦ The corroded louver at the rear side of the New Building should be replaced	$5,000.00

♦ Cracking was observed at the floor drain and aluminum grating near the backflow preventer should be repaired	$3,000.00
♦ The entire pump room should be repainted	$20,000.00
Safey Considerations	
♦ Add air handling/ventilation to basement area of Old Building still accessed by operators	$30,000.00
Short-Term Needs Subtotal	***$240,800.00***

Description of Recommendation	***Estimated Cost***
	-
Lincoln Avenue PS - IntermediateTerm (3-5 years)	
Safey Considerations	
♦ Calibrate the existing fixed gas detection system at the New Building. (In the interim, the operators should continue to utilize/calibrate their portable gas detection meters).	$5,000.00
General Mechanical	
♦ Demolish/dispose of the old bubbler tube system	$2,500.00
♦ HVAC - The existing boiler should be replaced with one that is capable of providing the proper output	$50,000.00
♦ HVAC - The existing air handling units and unit heaters at the facility should be replaced due to their age and failing condition	$150,000.00
♦ Plumbing - Even though the toilet fixtures are operational, it is recommended that they be replaced with new low flow type	$1,500.00
Intermediate Needs Subtotal	***$209,000.00***

Description of Recommendation	***Estimated Cost***
	-
Lincoln Avenue PS - Long-Term (6 - 10 years)	
♦ Consider replacing the existing pumps with new dry-pit submersible pumps	$350,000.00
♦ Perform analysis of hydraulic conditions for pumping system prior to any major pumping modifications	$25,000.00
Long-Term Needs Subtotal	***$375,000.00***
Pump Station Subtotal	***$824,800.00***
General Contractor Overhead & Mark-up (20%)	$165,000.00
Engineering & Contingency (35%)	$288,680.00
Pump Station Total	***$1,278,500.00***

4.0 LYNNHURST SCHOOL PUMP STATION

4.1 Background Information

The Lynnhurst School PS is located on the Lynnhurst School property near the corner of Elm Street and Walnut Street in Saugus. Records from the pump station are not available for review, but it is believed that the station was originally constructed in the late 1960's and it was recently upgraded with new pumps, controls, structural improvements and a dedicated standby generator in 2006.

The Lynnhurst PS is a below grade factory prefabricated flooded suction 'can' type station. The station consists of an 8-foot diameter steel can with a 3-foot diameter steel access tube. The stations pump chamber is accessed via an aluminum ladder. The floor of the station is approximately 27-feet below grade.

The existing wet well is constructed of pre-cast concrete manhole sections. The base of the wet well is comprised of 6-foot (inside diameter) sections. The operating range (pump on to pump off) for the pump station is 30-inches, or approximately 530 gallons. The base is topped with 4-foot diameter manhole sections and a 30-inch frame and cover for access.

The pumping system consists of two vertical close coupled solids handling pumps which are housed in the 'can' structure. Each of the pumps draws flow from the adjacent 6-foot (inside diameter) pre-cast concrete wet well through 4-inch suction lines. The 4-inch discharge lines from each pump are then joined together into one 6-inch diameter force main, which exits the pump station and discharges into a sewer manhole located on Elm Street.

The Lynnhurst PS operates on a fill/draw cycle that is controlled by a bubbler tube system. At the time of our visit, the pump (lead) on level was set at 50-inches (above wetwell floor), pump (lead) off level was set at 20-inches, pump (lag) on level was set at 62-inches and pump (lag) off level was set at 34-inches. The pump station also has a back-up high water float switch. The pump station also has an automatic operator to alternate the operation of the pumps during pumping cycles.

4.2 Station Equipment

Station Manufacturer: Can-Tex
Number of Pumps: 2

Pump Manufacturer:	Cornell	**Motor Manufacturer:**	Marathon Electric
Model Number:	4NHTA-VM-10-6	**Model:**	CVN

Serial Number:	140888/140889	**Serial Number:**	256TTDX14078AB L (both motors)
Size:	4X4	**Horsepower:**	10
Rated Capacity:	600 gpm @ 40 ft.	**Speed:**	1165
Seals:	Mechanical Seal	**Service Factor:**	1.15
Impeller Size:	10.94 inches	**Rating:**	3 phase/460volts/60hz
Run Time (hrs):	5022.38 / 5493.19	**Frame:**	256TCVZ

Actuating Controls: Bubbler: Dual Compressor System
Operating Controls:

Stand-by Generator Manufacturer:	Kohler	**Sump Pump Manufacturer:**	Non-Functional Needs Replacement
Model:	30REOZJB	**Rated Capacity:**	N/A
Serial Number:	2086774		
Size:	30 kW	**Heater:**	
Engine:	John Deere	**Dehumidifier:**	Non-Functional Needs Replacement
Run Time (hrs):	139.5		
Fuel:	Diesel (belly)		
Fuel Tank Size:	162 gal		

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.

4.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves, mechanical piping and standby generator. Additional pump vibration testing on each pump unit was performed at this pump station. General results of this testing is included below; actual data from the tests is included in **Appendix A**. Ultrasonic steel thickness gauge testing of the steel access tube structure was also performed in the pump chamber. General results of this testing is included below; actual data from the tests is included in **Appendix B**.

Based upon 8-years of operational time, since the 2006 upgrade, the running time meters show average daily operating time at 215 min/day. At the rated capacity of the pumps this equates to approximately 130,000 gallons per day of wastewater. Forced drawdown testing was performed at this station and showed that the pumps were delivering approximately 360 to 395 gallons per minute of flow Based upon the rated pump capacity, the town may want to consider pulling the pumps to verify that the pumps are not partially jammed.

We made the following general observations and identified the following deficiencies about the Lynnhurst School Pump Station.

4.3.1 General Mechanical

- The Town indicates that a significant amount of rags are found in the collection system, which leads to pump clogging issues.
- Pumps and motors are in good condition (replaced in 2006).
- Pump vibration testing was performed on both pumps by L.P. Larson, Corp. on May 16, 2014. Results of this testing conclude that both pumps tested within the acceptable range based on predetermined alarm levels.
- The dehumidifier was non-functional.
- The sump pump should be replaced.
- The entire station needs to be re-painted (including piping/pumps).
- No plumbing hose station is present.
- The exhaust fan was non-functional (i.e. jammed up).
- Rust was observed on the mechanical piping.

4.3.2 Electrical, Controls, Alarms

- The power supply does not have an electronic surge protection (TVSS) device protector.
- The primary controls are bubblers with two simplex air compressors. There are secondary controls.
- The outdoor electrical enclosure does not have a cooling exhaust fan and filtered air intake.
- The electrical power equipment does not have engraved plastic nameplates and NEC electrical shock hazardous warning labels.
- The below grade pump station does not have emergency (battery operated) lighting.
- The SPS alarms are limited and not TR # 16 compliant.
- The engine/generator does not have a remote “Emergency Power Off” control station.

4.3.3 Structural

- Steel thickness readings from Baker Testing of the access tube and indicate that the access tube is in good condition. The access tube is likely constructed of greater than 1/4-inch steel plate as all measurements resulted in 0.303-inches or greater of steel remaining. Steel thickness testing of the floor, replaced in 2006 with ¼-inch steel plate, shows that 0.24–inches or greater of steel remains.
- The wetwell base section is 6-foot in diameter and it is topped with 4-foot riser sections.

4.3.4 Safety Considerations

- A ladder up safety device was not present at the steel access tube.

4.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

4.4.1 General Mechanical

Short-term

- Replace non-functional exhaust fan.
- Replace non-functional dehumidifier.
- Replace the sump pump.

Intermediate

- No recommendations identified.

Long-term

- Consider replacing the existing can station with a new submersible pump station recognizing the age of the existing station and the previously completed Emergency Repairs and to eliminate the need for operators to access a below grade station.

4.4.2 Electrical, Controls, Alarms

Short-term

- Add electrical equipment nameplates (where missing) and NEC electrical shock hazard warning labels.
- Replace existing float controls with a pressure transducer system.
- Add wet well float switch intrinsically safe relay.
- Add emergency (battery operated) egress lighting to the below grade pump station.
- Add an emergency power off (EPO) control station for the standby power engine/generator.

Intermediate

- No Recommendations Identified.

Long-term

- No Recommendations Identified.

4.4.3 Structural

Short-term

- Sand, prime and paint the entire can station internals (including piping/pumps).

Intermediate

- No Recommendations Identified.

Long-term

- No Recommendations Identified.

4.4.4 Safety Considerations

Short-term

- Install ladder up safety device.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

4.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Lynnhurst PS - Short-Term (1-2 years)	
General Mechanical	
♦ Replace non-functional exhaust fan.	$300.00
♦ Replace the sump pump.	$300.00
♦ Replace non-functional dehumidifier.	$300.00
Electrical, Controls, Alarms	
♦ Add electrical equipment nameplates (where missing) and NEC electrical shock hazard warning labels.	$300.00
♦ Replace existing float controls with a pressure transducer system.	$5,000.00
♦ Add wet well float switch intrinsically safe relay.	$500.00
♦ Add emergency (battery operated) egress lighting to the below grade pump station.	$1,500.00
♦ Add an emergency power off (EPO) control station for the standby power engine/generator.	$2,000.00
Structural	
♦ Sand, prime and paint the entire can station internals (including piping/pumps).	$5,000.00
Safety Considerations.	
♦ Install ladder up safety device.	$750.00
Short-Term Needs Subtotal	***$15,200.00***

Description of Recommendation	***Estimated Cost***
	-
Lynnhurst PS - Long-Term (6-10 years)	
General Mechanical	
♦ Consider replacing station with new subersible pump station given age of existing pumps and desire to eliminate operator access to below grade structures.	$300,000.00
Long-Term Needs Subtotal	***$300,000.00***
Pump Station Subtotal	***$315,200.00***
General Contractor Overhead & Mark-up (20%)	$63,100.00
Engineering & Contingency (35%)	$110,320.00
Pump Station Total	***$488,700.00***

5.0 MORRIS PLACE PUMP STATION

5.1 Background Information

The Morris Street PS is located off of Morris Street in Saugus, adjacent to the Saugus River. Records from the pump station are not available to establish the exact age of this station, though discussions with Saugus DPW employees indicate that the station is at least 25 years old. Based upon the condition of the pumps, it is estimated that the pumps have been replaced and are approximately 10-years old.

The Morris Street PS is a below grade, factory prefabricated 'can' type drypit pump station. The station consists of an 8-foot diameter steel can with a 3-foot diameter steel access tube constructed of steel plate. The stations pump chamber is accessed via an aluminum ladder. The floor of the station is approximately 15-feet below grade.

The existing wet well is constructed of pre-cast concrete manhole sections. The wet well is comprised of 4-foot (inside diameter) sections topped with a 30-inch frame can cover to provide access to the wetwell. The wetwell includes a system of floats used for operation of the pumps and determining high water alarm conditions. The normal operating range (pump on to pump off) for the pump station is approximately 25-inches, or approximately 196 gallons. This pump station is equipped with a piped overflow directly to the Saugus River. The overflow pipe is normally closed off with a gate valve. Per discussions with the Town, it does not appear that this overflow has been properly abandoned and is still operable. The valve, located adjacent to the wetwell, for the overflow pipe should always be in the closed position to prevent sewerage from entering the Saugus River.

The pumping system consists of two vertical centrifugal pumps that are housed in the steel can structure. Each of the pumps draws flow from the adjacent 6-foot (inside diameter) pre-cast concrete wet well through 4-inch suction lines. The 4-inch discharge lines from each pump are then joined together into one 6-inch diameter force main, which exits the steel can through the ceiling. The pump station force main, which is assumed to be 6-inch diameter, runs north from Morris Street onto Hamilton Street approximately 600 linear feet. No detailed drawings were available for the system.

The Morris Street PS operates on a fill/draw cycle controlled by three floats. The three float controlled operations are (in order from highest to lowest elevation):

- Pump on (lag/standby) / High Water Alarm
- Pump on (lead)
- Pump off

The pump station controls provide automatic alternation of the lead pump after each pumping cycle. The control panel is mounted below grade in the drypit structure. The electrical service and manual transfer switch are mounted above grade near the street line.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. According to the operators, the town has a portable generator that can be used at the site.

5.2 Station Equipment

Station Manufacturer: Can-Tex
Number of Pumps: 2

Pump Manufacturer:	Fairbanks Morse	**Motor Manufacturer:**	U.S. Electric Motor
Model Number:	B5442	**Type:**	AV
Serial Number:	K4E1-077803-0/ K4E1-077803-1	**Serial Number:**	64-05085-381/ 64-05085-380
Size:	4X4	**Horsepower:**	3
Rated Capacity:	300 gpm @ 30 ft	**Speed:**	1160
Seals:	Packed Stuffing Box	**Service Factor:**	1.15
Impeller Size:	9 inches	**Rating:**	3 phase/460volts/60hz
Run Time (hrs):	N/A	**Frame:**	213VP

Actuating Controls: Float Control (3 floats)
Operating Controls:

Stand-by Generator Manufacturer:	N/A	**Sump Pump Manufacturer:**	Not Readable
Model:	N/A	**Rated Capacity:**	Not Readable
Serial Number:	N/A		
Size:	N/A	**Heater:**	Q Mark
Engine:	N/A	**Dehumidifier:**	Not Readable
Run Time (hrs):	N/A		
Fuel:	N/A		
Fuel Tank Size:	N/A		

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.

5.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves and mechanical piping. Additional pump vibration testing on each pump unit was performed at this pump station. General results of this testing is included below; actual data from the tests is included in **Appendix A**. Ultrasonic steel thickness gauge testing of the steel structure was also performed on the walls of the pump chamber. General results of this testing is included below; actual data from the tests is included in **Appendix B**.

Running time meters are not installed at this pump station, so it is not possible to determine the estimated daily operation of this pump station.

We made the following general observations and identified the following deficiencies about the Morris Place Pump Station.

The entire station should be replaced with a new submersible pump station in the very near future.

5.3.1 General Mechanical

- A piped overflow to the Saugus River is present. This overflow should be abandoned.
- Pumps and motors are in good condition.
- Pump vibration testing was performed on both pumps by L.P. Larson, Corp. on May 16, 2014. After reviewing the test report and discussing the work with L.P. Larson, the vibration analyst did not observe any signs of excessive vibration during the testing.
- The check valves are missing levers and the gate valves are worn.
- The dehumidifier is not working.
- The ventilation system and lighting systems do not operate on a limit switch which turns them on/off as the station is opened/closed.

5.3.2 Electrical, Controls, Alarms

- The pump control panel is in poor condition.
- The primary pump controls are float switches and control relays. No secondary pump controls.
- The SPS alarms are limited and not TR # 16 compliant.
- The below grade pump station has no emergency (battery operated) lighting.
- The electrical power equipment does not have engraved plastic nameplates and NEC electrical shock warning labels.

5.3.3 Structural

- There are holes completely through portions of the can structure to the adjacent soil.
- The floor of the station is completely delaminated and has pulled away from the seam at the walls.
- The force main sleeve at the ceiling is cracked.
- Steel thickness readings by Baker Testing were not completed on the floor due to the existing condition. See photos in test report. Though testing indicates that the access tube and base walls have somewhere between 0.219 and 0..257-inches of steel remaining (likely 0.25 inches thick to start), there are many locations where 0-inches of steel remains and there are holes completely through the structure. See photos in test report.

5.3.4 Safety Considerations

- The station needs to be completely replaced as a result of the poor condition.

5.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

5.4.1 General Mechanical

Short-term

- Replace the entire station with a new submersible pump station.
- Abandon the piped overflow connection to the Saugus River.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

5.4.2 Electrical, Controls, Alarms

The entire station should be replaced with a new submersible pump station in the very near future. If the town plans on maintaining this station and not replacing it in the near future, the following electrical improvements should take place.

Short-term

- Add intrinsically safe relay switches to the wet well float switches.
- Add emergency (battery powered) lighting to the below grade pump station.
- Add engraved plastic nameplates to all electrical equipment panels (where missing).
- Add secondary pump controls via a new I&C panel.
- Verify the portable E/G receptacle is properly wired to “ground” the portable engine/generator.
- Add two (2) outside duplex receptacles (WP/GFI) for SPS maintenance without opening the enclosure.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

5.4.3 Structural

Short-term

- Replace the entire station with a new submersible pump station.

Intermediate

- No recommendations identified.

Long-term
- No recommendations identified.

5.4.4 Safety Considerations

Short-term
- No recommendations identified.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

5.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Morris Place PS - Short-Term (1-2 years)	
General Mechanical	
♦ Replace the entire station with a new submersible pump station	$450,000.00
♦ Abandon the piped overflow to the Saugus River.	$1,000.00
Electrical, Controls, Alarms	
♦ Add intrinsically safe relay switches to the wet well float switches.	$3,000.00
♦ Add emergency (battery powered) lighting to the below grade pump station.	$1,500.00
♦ Add engraved plastic nameplates to all electrical equipment panels (where missing).	$100.00
♦ Add secondary pump controls via a new I&C panel.	$3,500.00
♦ Verify the portable E/G receptacle is properly wired to "ground" the portable engine/generator.	Included in Gen/Non-Spec. Recomm.
♦ Add two (2) outside duplex receptacles (WP/GFI) for SPS maintenance without opening the enclosure	$1,500.00
Structural	
♦ Replace the entire station with a new submersible pump station.	Included Above
Short-Term Needs Subtotal	***$460,600.00***
Pump Station Subtotal	***$460,600.00***
General Contractor Overhead & Mark-up (20%)	$92,200.00
Engineering & Contingency (35%)	$161,210.00
Pump Station Total	***$714,100.00***

6.0 SAUGUS AVENUE PUMP STATION

6.1 Background Information

The Saugus Avenue Pump Station is a Smith & Loveless – Classic Duplex Wetwell Mounted Pump Station. The station was constructed by Schiavone Developers in 2004. The station consists of two vacuum prime pumps that are driven by 2 horsepower motors. The pumps and motors are located directly above the wetwell structure in a "dog-house" enclosure. The twelve foot diameter wetwell receives flow from two separate 8-inch gravity sewer lines.

Information from the operation and maintenance manual indicates that the station was designed to handle a flow of 120 gallons per minute (gpm) at 21 feet of total dynamic head (TDH). At the time of the site visit, low flow levels were present at the station, which resulted in the in ability to conduct a drawdown test in order to verify pump operation/output. As such, it was not possible to verify that both pumps are operating at or near the design point.

The pumping system consists of two vacuum primed pumps that are housed in the above grade enclosure. Each of the pumps draws flow from the 12-foot (inside diameter) pre-cast concrete wet well below through 4-inch PVC suction lines. The 4-inch discharge lines from each pump have 4-inch wafer check valves and 4-inch plug valves and are then joined together into one 4-inch diameter force main, which exits the station can through the floor of the enclosure and the wall of the wetwell. The pump station force main (4-inch ductile iron), runs down Saugus Avenue approximately 400 linear feet before discharging to a gravity sewer manhole within the paved road surface near #15 Saugus Avenue/Utility Pole #200/41.

The Saugus Avenue PS operates on a fill/draw cycle controlled by five floats. The five float controlled operations are (in order from highest to lowest elevation):

- High Water
- Pump on (lag/standby)
- Pump On (lead)
- Pump Off
- Low Level Alarm

The pump station controls provide automatic alternation of the lead pump after each pumping cycle. The control panel is mounted above grade in the "dog-house" enclosure. The electrical service, manual transfer switch and alarm system autodialer are mounted above grade near the street line.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use

during extended power outages. According to the operators, the town has a portable generator that can be used at the site.

6.2 Station Equipment

Station Manufacturer:	Smith & Loveless
Number of Pumps:	2

Pump Manufacturer:	Smith & Loveless	**Motor Manufacturer:**	
Model Number:	4B2B	**Model:**	
Serial Number:	16-07637-V (Station Package)	**Serial Number:**	
Size:	4 inch	**Horsepower:**	2
Rated Capacity:	120 gpm @ 21 feet	**Speed:**	1200
Seals:	Mechanical Seals	**Service Factor:**	
Impeller Size:	7 3/8 inch	**Rating:**	1 phase/230volts/60hz
Run Time (hrs):	675.72 / 760.82	**Frame:**	

Actuating Controls:	Float Control (five floats)
Operating Controls:	

Stand-by Generator Manufacturer:		**Sump Pump Manufacturer:**	N/A
Model:		**Rated Capacity:**	N/A
Serial Number:	PORTABLE GENERATOR RECEPTACLE		
Size:		**Heater:**	
Engine:		**Dehumidifier:**	N/A
Run Time (hrs):			
Fuel:			
Fuel Tank Size:			

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manual by Smith & Loveless.

6.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection of pumps and motors, check and gate valves, mechanical piping and standby generator receptacle.

Based upon an approximate 9.5 year operational period and the values shown on the run time meters, it is estimated that the pump station operates approximately 25 minutes per day. At the rated capacity of the pumps this equates to approximately 3,000 gallons per day of wastewater. Wetwell drawdown testing was not performed at this station due to the low flow conditions at the time of the visit.

We made the following general observations and identified the following deficiencies about the Saugus Avenue Pump Station.

6.3.1 General Mechanical

- The Town indicates that there are frequent problems with achieving the vacuum prime necessary to operate the station. The check valves often get hung up due to the lack of head pressure on the back side of the check valves.
- Suction lines for the pumps are constructed of PVC. The suction line on Pump #2 is constructed of Schedule 40 PVC, while the other suction line is constructed of Schedule 80 PVC.
- The wetwell has two influent sewer connections.
- The dresser coupling at the ductile iron forcemain connection is skewed.
- A bypass connection does not exist, but is likely not an issue due to the low flow observed at the station.

- The Town indicated that there is a significant grease issue in the collection system.

6.3.2 Electrical, Controls, Alarms

- The portable engine/generator receptacle wiring must be checked to verify it properly “grounds” the E/G.
- The pump control panel is not UL listed plus its float switches do not have intrinsically safe relays. In addition, the panel is of the old style relays type without PLC/OIT control/monitoring equipment and SCADA ready.
- The pump station to the hazardous wet well electrical wiring is not “sealed” with “EYS” type conduit/wires seals. Its existing compressible cable connectors are not UL listed for a hazardous to non-hazardous wiring seal.
- No power or telephone incoming lines surge protection (TVSS) device protection except for old style “air gap” TVSS protectors.
- Missing alarms (i.e., intrusion, personnel emergency, etc.) plus segregate them into “critical process, non-critical process, intrusion and emergency” zones to enable the SPS operators to properly respond.
- Missing multi-phase electrical power supply relay and its power failure alarm.
- No exterior mounted GFI type exterior receptacle at the outdoor electrical enclosure for SPS maintenance.

6.3.3 Structural

- Cast-in-place concrete wetwell is in good condition.
- Some minor rusting was observed at base of the pump enclosure where float cords enter wetwell.

6.3.4 Safety Considerations

- None noted.

6.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

6.4.1 General Mechanical

Short-term

- Replace existing float controls with a pressure transducer system.
- If floats are to remain, add intrinsically safe relay switches to the wetwell float switches.
- Add engraved plastic nameplates to all equipment panels (where missing).
- Replace Schedule 40 PVC suction line with Schedule 80 piping.

Intermediate

- No Recommendations Identified.

Long-term

- Convert station to submersible pump station.

6.4.2 Electrical, Controls, Alarms

Short-term

- Verify the E/G receptacle wiring properly grounds the portable engine/generator.
- Add intrinsically safe wet well float switch relays.
- Add nameplates for all electrical equipment with NEC electrical shock warning labels.
- Add multi-phase electrical power supply relay and connect to the SPS power fail alarm.
- Segregate the telephone alarms dialer panel with its own enclosure; also add tele service TVSS protectors.
- Add “back-up” secondary pump controls (via flood float switch and timing relays).

Intermediate

- No recommendations identified

Long-term

- No recommendations identified.

6.4.3 Structural

Short-term

- Sand/prime/paint areas of rust on the “dog house” enclosure.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

6.4.4 Safety Considerations

Short-term
- No recommendations identified.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

6.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Saugus Avenue PS - Short Term (1-2 years)	
General Mechanical	
♦ Replace existing float controls with a pressure transducer system.	$5,000.00
♦ If floats are to remain, add intrinsically safe relay switches to the wetwell float switches.	$3,000.00
♦ Replace Schedule 40 PVC suction line with Schedule 80 piping.	$1,000.00
♦ Add engraved plastic nameplates to all equipment panels (where missing)	$100.00
Electrical, Controls, Alarms	
♦ Verify the E/G receptacle wiring properly grounds the portable engine/generator.	Included in Gen/Non-Spec. Recomm.
♦ Add nameplates for all electrical equipment with NEC electrical shock warning labels.	$200.00
♦ Add multi-phase electrical power supply relay and connect to the SPS power fail alarm.	$1,500.00
♦ Segregate the telephone alarms dialer panel with its own enclosure; also add tele service TVSS protectors.	$3,000.00
♦ Add “back-up” secondary pump controls (via flood float switch and timing relays).	$3,500.00
Structural	
♦ Sand/prime/paint areas of rust on the "dog house" enclosure.	$1,000.00
Short Term Needs Subtotal	***$18,300.00***

Description of Recommendation	***Estimated Cost***
	-
Saugus Avenue PS - Long-Term (6 - 10 years)	
♦ Convert station to submersible pump station.	$100,000.00
Long-Term Needs Subtotal	***$100,000.00***
Pump Station Subtotal	***$118,300.00***
General Contractor Overhead & Mark-up (20%)	$23,700.00
Engineering & Contingency (35%)	$41,405.00
Pump Station Total	***$183,500.00***

7.0 ABERDEEN AVENUE PUMP STATION

7.1 Background Information

The Aberdeen PS is located off of Aberdeen Avenue in the Cliftondale section of Saugus. Available records indicate that the pump station was constructed in 1998.

The Aberdeen PS is a newer submersible type sewer pump station. The station is made of pre-cast concrete sections with the control panel mounted above grade. The Aberdeen PS site is completely enclosed by a fence.

The existing wet well is constructed of pre-cast concrete manhole sections. The 'active volume' of the wet well is comprised of 6-foot (inside diameter) sections. The wet well includes a system of floats used for operation of the pumps and determining high water alarm conditions. Access to the wetwell is available through a square aluminum access hatch mounted in the pre-cast wetwell cover. Forced (pumps manually turned on) drawdown tests indicate that Pump #1 is pumping at a rate of 123.5 gallons per minute (gpm), while Pump #2 is pumping at a rate of 35.3 gpm. Pump #2 is fitted with a mix flush valve and the low output is likely related to this valve and the short duration (i.e. 30 seconds) drawdown test as a result of low liquid levels in the station at the time of the visit.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the 6-foot (inside diameter) pre-cast concrete wet well and discharge flow through 4-inch ductile iron discharge lines. The 4-inch discharge lines from each pump are then joined together into one 4-inch diameter force main, which exits the pre-cast concrete wetwell through the wall. The pump station force main, which is assumed to be 4-inches in diameter, runs northeast 425 linear feet down Aberdeen Avenue to the intersection of Basswood Avenue.

The Aberdeen Avenue PS operates on a fill/draw cycle controlled by four floats. The four float controlled operations are (in order from highest to lowest elevation):

- Pump on (lag/standby)
- High Water Alarm
- Pump on (lead)
- Pump off

We contacted ITT Flygt Corporation, the local pump supplier for Flygt pumps to obtain information on the existing pumps. Data obtained from the manufacturer's representative indicated that the existing pumps were installed in 1998.

No detailed drawings were available for the system.

The pump station controls should provide automatic alternation of lead pump after each pumping cycle. This control system may not be operating properly, since the run-time meters

indicate that, as of May 9, 2014, Pump #1 has operated for approximately 3,887.1 hours, while Pump #2 has operated for approximately 2,008.3 hours.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. According to the operators, the town has a portable generator that can be used at the site. DPW staff have confirmed that the portable generator has been utilized at the site in the past with success.

7.2 Station Equipment

Station Manufacturer:	Flygt
Number of Pumps:	2

Pump Manufacturer:	Flygt	**Motor Manufacturer:**	Flygt
Model Number:	CP 3085-092	**Model:**	CP 3085-092
Serial Number:	9780038 / 9840204	**Serial Number:**	9780038 / 9840204
Size:	3 1/8 inches	**Horsepower:**	2.4
Rated Capacity:	Unknown	**Speed:**	1710 RPM
Seals:		**Service Factor:**	N/A
Impeller Size:	146 mm (~5.75 inches)	**Rating:**	1 phase/230 volts/47 Amps/60 Hz
Run Time (hrs):	3887.1 / 2008.3	**Frame:**	N/A

Actuating Controls:	Floats (four)
Operating Controls:	

Stand-by Generator Manufacturer:		**Sump Pump Manufacturer:**	N/A
Model:		**Rated Capacity:**	N/A
Serial Number:	PORTABLE GENERATOR RECEPTACLE		
Size:		**Heater:**	N/A
Engine:		**Dehumidifier:**	N/A
Run Time (hrs):			
Fuel:			
Fuel Tank Size:			

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Pump information provided by Xylem/Flygt.

7.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves, mechanical piping and standby generator receptacle.

Based upon 15.5 years of operating time, the running time meters show average daily operating time at 62.5 min./day. The rated capacity of the pumps is unknown for this station. Due to low flow conditions, short duration (30 seconds) forced drawdown testing was performed at this station. Results indicated that Pump #1 was pumping at about 124 gpm. Pump #2 was pumping at about 35 gpm, but this low output is likely based upon the fact that Pump #2 has the mix flush valve installed, which would lower the output significantly on a short duration test.

We made the following general observations and identified the following deficiencies about the Aberdeen Avenue Pump Station.

7.3.1 General Mechanical

- The control panel is a 3 phase panel which has been converted to a single phase electric panel for the 1 phase service.
- The hatch is slightly misaligned, which makes pump removal difficult for the operators.
- A bypass connection does not exist.
- There is no external valve vault and all valves are located in the wetwell structure.
- There are manhole steps located inside the wetwell.

7.3.2 Electrical, Controls, Alarms

- The electrical equipment does not have engraved plastic nameplates and NEC electrical shock warning labels.
- The wet well electrical junction box is non-metallic (current code violation).
- The telephone alarms dialer panel is located inside the pumps control panel enclosure (electrical shock hazard).
- The portable E/G receptacle may not be wired to properly “ground” the portable engine/generator.

7.3.3 Structural

- No structural defects observed.
- The wetwell appears to be in sound condition.

7.3.4 Safety Considerations

- Access to a hazardous environment is required in order to operate the valves.
- Safety grating/netting is not present at the wetwell structure.

7.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

7.4.1 General Mechanical

Short-term

- Replace the existing float controls with a pressure transducer system.
- Remove manhole steps in wetwell and fill holes with concrete.

Intermediate

- Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal.

Long-term

- No recommendations identified.

7.4.2 Electrical, Controls, Alarms

Short-term

- Add engraved plastic nameplates with voltage/phase with NEC electrical shock warning labels to all electrical equipment.
- Verify that the portable engine/generator receptacle properly “grounds” the engine/generator.
- If float system is to remain, add intrinsically safe relay switches to the wetwell float switches.
- Relocate the telephone alarm dialer panel to its own enclosure.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

7.4.3 Structural

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

7.4.4 Safety Considerations

Short-term

- Add safety netting/grating to the wetwell structure.

Intermediate

- Should space exist on the site or within the easement, consider adding an external valve vault.

Long-term

- No recommendations identified.

7.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Aberdeen PS - Short Term (1-2 years)	
General Mechanical	
♦ Replace the existing float controls with a pressure transducer system.	$5,000.00
♦ Remove manhole steps in wetwell and fill holes with concrete.	$500.00
Electrical, Controls, Alarms	
♦ Add engraved plastic nameplates with voltage/phase with NEC electrical shock warning labels to all electrical equipment.	$200.00
♦ Verify that the portable engine/generator receptacle properly "grounds" the engine/generator.	Included in Gen/Non-Spec. Recomm.
♦ If float system is to remain, add intrinsically safe relay switches to the wetwell float switches.	$3,000.00
♦ Relocate the telephone alarm dialer panel to its own enclosure	$1,000.00
Safety Considerations	
♦ Add safety netting/grating device to wetwell	$1,500.00
Short-Term Needs Subtotal	***$11,200.00***

Description of Recommendation	***Estimated Cost***
	-
Aberdeen PS - IntermediateTerm (3-5 years)	
General Mechanical	
♦ Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal	$3,000.00
Intermediate Needs Subtotal	***$3,000.00***

Description of Recommendation	***Estimated Cost***
Aberdeen PS - Long Term Term (6-10 years)	
Safety Considerations	
♦ Should space exist on the site or within the easement, consider adding an external valve vault.	$20,000.00
Long Term Subtotal	***$20,000.00***
Pump Station Subtotal	***$34,200.00***
General Contractor Overhead & Mark-up (20%)	$6,900.00
Engineering & Contingency (35%)	$11,970.00
Pump Station Total	***$53,100.00***

8.0 BLACKSMITH WAY PUMP STATION

8.1 Background Information

The Blacksmith Way PS is located in the western portion of Saugus on Blacksmith Way near the town line with Melrose. The Blacksmith Way PS is also located directly adjacent to Steven's Pond. Information found in the Collection System Operation and Maintenance Manual by CDM indicates that the pump station was built in the 1989.

The Blacksmith Way PS is a newer submersible type sewer pump station. The station wetwell is constructed of pre-cast concrete sections with an above grade control panel. This pump station is also equipped with a large offline overflow tank to increase response time in the event of a station failure.

The existing wet well is constructed of pre-cast concrete manhole sections. The base of the wet well is comprised of 6-foot (inside diameter) sections. The wet well includes a system of floats used for operation of the pumps and determining high water alarm conditions. Access to the wetwell is available through a square aluminum hatch mounted in the pre-cast wetwell cover. Forced drawdown tests indicate that Pump #1 is pumping at a rate of 106 gpm, while Pump #2 is pumping at a rate of 53 gpm.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the 6-foot (inside diameter) pre-cast concrete wet well and discharge flow through 4-inch ductile iron discharge lines. The 4-inch discharge lines from each pump then exit the wetwell through the wall. The pump station force main, which is assumed to be 4-inch diameter and approximately 1,700 linear feet, runs north on Blacksmith Way to Sheffield Way and then west on Sheffield Way to Lewis O'Gray Drive. No detailed drawings were available for the system.

The Blacksmith Way PS operates on a fill/draw cycle controlled by four floats. The four float controlled operations are (in order from highest to lowest elevation):

- Pump on (lag/standby)
- High Water Alarm
- Pump on (lead)
- Pump off

Discussions with DPW staff indicate that the pumps were retrofitted in 2002 to include cutter blade attachments on each submersible pump. In 2013, the existing pumps were replaced with chopper style pumps.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. According to the operators, the town has a portable generator that can be used at the site.

8.2 Station Equipment

Station Manufacturer: Not Available
Number of Pumps: 2

Pump Manufacturer:	Tsurumi	**Motor Manufacturer:**	Tsurumi
Model Number:	100C411-CR62	**Model:**	100C411-CR62
Serial Number:	12371964001, 12371964002	**Serial Number:**	12371964001, 12371964002
Size:	4 inch	**Horsepower:**	15
Rated Capacity:		**Speed:**	1733 RPM
Seals:	Mechanical Seal	**Service Factor:**	
Impeller Size:	9.25 inches	**Rating:**	3 phase/230volts/60hz
Run Time (hrs):	N/A	**Frame:**	N/A

Actuating Controls: Floats (four floats)
Operating Controls:

Stand-by Generator Manufacturer:		**Sump Pump Manufacturer:**	N/A
Model:		**Rated Capacity:**	N/A
Serial Number:	PORTABLE GENERATOR RECEPTACLE		
Size:		**Heater:**	N/A
Engine:		**Dehumidifier:**	N/A
Run Time (hrs):			
Fuel:			
Fuel Tank Size:			

Data Sources:
1 Information taken from equipment tag or nameplate during 2014 site visits.

8.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves and the pump station site layout.

Running time meters are not currently installed at this pumping station. Wetwell drawdown testing (forced) was performed at this station and showed that Pump #1 was pumping at approximately 106 gpm, while Pump #2 is pumping at approximately 53 gpm. The town should pull Pump #2 to evaluate/remediate any potential blockages/pump issues, which would result in decreased pump output.

We made the following general observations and identified the following deficiencies about the Blacksmith Way Pump Station.

8.3.1 General Mechanical

- Grease buildup was observed on the floats and within the wetwell.
- Pump #2 should be pulled and inspected to determine if a clog/blockage exists, which results in the lower pump output observed during forced drawdown testing.
- A bypass connection does not exist, but could easily be added at the valve vault.
- The piston hatches at the wetwell need replacing. One is missing and the other is corroded.
- The town indicated that the existing float control system will be converted to a pressure transducer system in the near future.
- The overflow tank appeared to be empty.
- The Town is unsure of the exact location of the forcemain discharge for the station.

8.3.2 Electrical, Controls, Alarms

- The current configuration has a wetwell hatch located directly in front of the pump station electrical equipment, which when open is dangerous to the pump station operators.
- The electrical utility service is missing a “neutral” conductor. The current wiring appears to be a code violation.
- The portable engine/generator is not properly wired to “ground” the portable engine/generator.
- The alarms system is missing alarms for intrusion, personnel emergency, etc.
- The existing controls utilize float switches and control relays. There is no digital pump controller or secondary pump controls.
- The wetwell to electrical equipment does not have any conduit seals.
- There are no duplex receptacles (WP/GFI) on the outside of the electrical enclosure for pump station maintenance without opening the enclosure.
- The dialer system utilizes a “Verbatim” dialer, while most other stations utilize a “Sensaphone” system.

8.3.3 Structural

- The concrete structures (wetwell, overflow tank and valve vault) appear to be in sound condition.

8.3.4 Safety Considerations

- See Electrical/Controls discussion above.
- The wetwell and overflow tank are very deep structures.

8.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

8.4.1 General Mechanical

Short-term

- The existing float controls should be replaced with a pressure transducer. Since this work is currently moving forward, a cost is not associated with it at this time.
- Add a bypass pumping connection (90 degree bend, 3-inch ball valve and quick connect coupling) inside of the valve vault at the existing cross fitting.
- Replace the pistons on the wetwell access hatch.
- Confirm the location of the forcemain discharge for the station.

Intermediate

- Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal.

Long-term

- No recommendations identified.

8.4.2 Electrical, Controls, Alarms

Short-term

- Add ground connection to the engine/generator power receptacle to properly ground the engine/generator.
- Add engraved plastic nameplates with voltage/phase with NEC electrical shock warnings to all electrical equipment.
- Caulk wet well wiring to the electrical equipment with “DUC SEAL”.
- The control panel should be completely replaced and relocated to an area away from the wetwell access hatch.
- Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

8.4.3 Structural

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

8.4.4 Safety Considerations

Short-term

- Add safety netting/grating device to wetwell hatch.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

8.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Blacksmith Way PS - Short Term (1-2 years)	
General Mechanical	
♦ Confirm the location of the forcemain discharge for the station. (Town to complete)	$0.00
♦ The existing float controls should be replaced with a pressure transducer. Since this work is currently moving forward, a cost is not associated with it at this time.	$0.00
♦ Add a bypass pumping connection (90 degree bend, 3-inch ball valve and quick connect coupling) inside of the valve vault at the existing cross fitting.	$2,500.00
♦ Replace the pistons on the wetwell access hatch	$500.00
Electrical, Controls, Alarms	
♦ Add ground connection to the engine/generator power receptacle to properly ground the engine/generator.	Incl. in Gen/Non-Spec. Recomm.
♦ Add engraved plastic nameplates with voltage/phase with NEC electrical shock warnings to all electrical equipment.	$200.00
♦ Caulk wet well wiring to the electrical equipment with “DUC SEAL”.	$1,500.00
♦ The control panel should be completely replaced and relocated to an area away from the wetwell access hatch	$25,000.00
♦ Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch	$3,500.00
Safety Considerations	
♦ Add safety netting/grating device to wetwell hatch	$1,500.00
Short Term Needs Subtotal	***$34,700.00***

Description of Recommendation	***Estimated Cost***
	-
Blacksmith Way PS - IntermediateTerm (3-5 years)	
General Mechanical	
♦ Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal	$3,000.00
Intermediate Needs Subtotal	***$3,000.00***
Pump Station Subtotal	***$37,700.00***
General Contractor Overhead & Mark-up (20%)	$7,600.00
Engineering & Contingency (35%)	$13,195.00
Pump Station Total	***$58,500.00***

9.0 BROADWAY/RTE. 1 PUMP STATION

9.1 Background Information

The Broadway (Route 1) PS is located on the northbound side of Route 1 (Broadway Street/Newburyport Turnpike) adjacent to the entrance for Golf Country Driving Range and a mobile home park. The station is located within a 40-foot by 30-foot easement granted to the Town by the adjacent trailer park. The station was completely replaced with a new submersible pump station in 2013/2014 as a result of an agreement between the Town of Saugus and the developers of the Wal-Mart parcel, which ties into this station.

The Broadway (Route 1) PS is a newer submersible type sewer pump station. The station wetwell is 8-foot in diameter and is constructed of pre-cast concrete sections with an above grade riser section and access hatch. The discharge valving is installed in an external valve vault in order to limit the need to enter the wetwell space. The station is equipped with a dedicated standby generator to provide power to the station in the event of a service power failure. Controls for the pump station, the automatic transfer switch for the generator, the alarm auto-dialer and the electrical panels/transformer are located in an above grade outdoor weatherproof enclosure.

The rated capacity of the pumps is 262 gallons per minute (gpm) at 41.1 feet of head. Pump cycle observations were made after the pump station was placed on-line. Observations indicate that Pump #1 is delivering flow at approximately 276 (gpm) and Pump #2 (has mix/flush valve) was delivering flow at approximately 250 gpm. The fill rate observed during the cycle observation was approximately 34 gpm and is included in the values presented above.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the 8-foot (inside diameter) pre-cast concrete wet well and discharge flow through 6-inch ductile iron discharge lines. The 6-inch discharge lines from each pump then exit the wetwell through the wall and enter the valve vault. Inside the valve vault each line is provided with a 6-inch check valve and 6-inch gate valve prior to joining together at a 6x6 tee and exiting the valve vault. The valve vault also contains a bypass connection which consists of a 4-inch gate valve and 4-inch quick disconnect coupling.

The Broadway (Route 1) PS operates on a fill/draw cycle controlled by a pressure transducer. Site observations indicate that the normal operating range for the pumps is 9-inches. The following operation levels (depth to water from top of wetwell slab) were observed:

- Pump on - 12’-0”
- Pump off – 12’-9”
- Lag pump on – 11’-7”
- High Water – 11’-5”

In the event of a pressure transducer failure, the station is equipped with a completely redundant back-up float system. The five float controlled operations are (in order from highest to lowest elevation):

- Pump on (lag/standby)
- High water alarm
- Pump on (lead)
- Pump off
- Low level alarm

The pump station controls provide automatic alternation of the lead pump after each pumping cycle when under pressure transducer control. Under back-up float control, Pump #1 will be the lead pump. The pumps will not alternate under back-up float control, but Pump #2 would operate should a high flow condition exist which requires the lag pump to operate.

In addition to monitoring high and low level conditions in the wetwell, the pump station controls monitor; loss of power, loss of phase, pump overload, pump over temperature and pump seal leak. Alarm notifications are delivered to the Town via an autodialer system.

The pump station has a 25-kilowatt dedicated standby generator to provide power to the station in the event of a power failure. The generator is fueled via natural gas and is located inside an acoustical enclosure.

9.2 Station Equipment

Station Manufacturer:	Flygt
Number of Pumps:	2

Pump Manufacturer:	Flygt	**Motor Manufacturer:**	Flygt
Model Number:	NP-3102.190 MT Adaptive 462	**Model:**	N3102.160 18-11-4AL-W 5hp
Serial Number:	3102.190-1350033/ 3102.190-1350034	**Serial Number:**	3102.190-1350033/ 3102.190-1350034
Size:	4 inches	**Horsepower:**	5
Rated Capacity:	262 gpm @ 41.1 feet	**Speed:**	1750 RPM
Seals:		**Service Factor:**	3 phase/460 volts/60 Hz
Impeller Size:	7 3/16 inches	**Rating:**	
Run Time (hrs):	1.2 / 0.9 (station not online)	**Frame:**	

Actuating Controls:	Pressure Transducer
Operating Controls:	VSG New England – Serial No. 121994-001

Stand-by Generator Manufacturer:	Kohler	**Sump Pump Manufacturer:**	N/A
Model:	25REZG	**Rated Capacity:**	N/A
Serial Number:	S6M3273WF		
Size:	25kW/31kVA	**Heater:**	N/A

Engine:	General Motors	**Dehumidifier:**	N/A
Run Time (hrs):	Station not online		
Fuel:	Natural Gas		
Fuel Tank Size:	N/A		

Data Sources:

1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manuals by Onsite Engineering, Inc..
3 Information obtained from Xylem Flygt and Kraft Power.

9.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection of pumps and motors, check and gate valves, mechanical piping and standby generator.

At the time off our visit, the pump station was not online, so wetwell drawdown testing was not performed at this station.

We made the following general observations and identified the following deficiencies about the Broadway/Rte. 1 Pump Station.

9.3.1 General Mechanical

- The station is brand new.

9.3.2 Electrical, Controls, Alarms

- Some wiring in the panel was not contained in protective raceways.

9.3.3 Safety Considerations

- The site is not fenced.

9.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

9.4.1 General Mechanical

Short-term

- Review the pump station operations/conditions following 1-year of operation in order to evaluate needs.

Intermediate

- Allocate money to a miscellaneous improvements budget to repair/modify any observed deficiencies following the warranty period.

Long-term
- No recommendations identified.

9.4.2 Electrical, Controls, Alarms

Short-term
- No recommendations identified.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

9.4.3 Structural

Short-term
- No recommendations identified.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

9.4.4 Safety Considerations

Short-term
- No recommendations identified.

Intermediate
- No recommendations identified.

Long-term
- No recommendations identified.

9.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Broadway PS - Short-Term (1-2 years)	
General Mechanical	
♦ Review the pump station operations/conditions following 1-year of operation to evaluate any needs.	$1,500.00
Short-Term Needs Subtotal	***$1,500.00***

Description of Recommendation	***Estimated Cost***
	-
Broadway PS - IntermediateTerm (3-5 years)	
General Mechanical	
♦ Allocate money to a miscellaneous improvements budget to repair/modify any observed deficiencies following the warranty period.	$5,000.00
Intermediate Needs Subtotal	***$5,000.00***
Pump Station Subtotal	***$6,500.00***
General Contractor Overhead & Mark-up (20%)	$1,300.00
Engineering & Contingency (35%)	$2,275.00
Pump Station Total	***$10,100.00***

10.0 LAMPLIGHTERS WAY PUMP STATION

10.1 Background Information

The Lamplighters Way PS is located in the western portion of Saugus on Lamplighters Way near the town line with Melrose. Information found in the Collection System Operation and Maintenance Manual by CDM indicates that the pump station was built in the 1989.

The Lamplighters Way PS is a newer submersible type sewer pump station. The station wetwell is constructed of pre-cast concrete sections with an above grade control panel. This pump station is also equipped with a large overflow tank to increase response time in the event of a station failure. At the time of our visit, the overflow tank contained raw sewage. It is recommended that the overflow tank be pumped out to provide full capacity in the event of a station failure and to eliminate potential nuisance odor conditions.

The existing wet well is constructed of pre-cast concrete manhole sections. The base of the wet well is comprised of 6-foot (inside diameter) sections. The wet well includes a pressure transducer and back-up high water float for operation of the pumps and determining high water alarm conditions. Access to the wetwell is available through a square aluminum hatch mounted in the pre-cast wetwell cover.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the adjacent 6-foot (inside diameter) pre-cast concrete wet well and discharge flow through 4-inch ductile iron discharge lines. The 4-inch discharge lines from each pump then exit the wetwell through the wall. The pump station force main, which is assumed to be 4-inch diameter, runs west on Lamplighters Way onto Hammersmith Drive approximately 500 linear feet. No detailed drawings were available for the system.

Discussions with DPW staff indicate that the pumps were retrofitted in 2002 to include cutter blade attachments on each submersible pump.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. According to the operators, the town has a portable generator that can be used at the site.

10.2 Station Equipment

Station Manufacturer: Not Available
Number of Pumps: 2

Pump Manufacturer:	Flygt	**Motor Manufacturer:**	Flygt
Model Number:	CP/NP 3102	**Model:**	N3102.181 18-11-4AL-W 5hp

Serial Number:	0240042 464 / 0240043 464	**Serial Number:**	0240042 464 / 0240043 464
Size:	4 inch	**Horsepower:**	5
Rated Capacity:	Unknown	**Speed:**	1720 RPM
Seals:	Mechanical	**Service Factor:**	
Impeller Size:	6.38 inches	**Rating:**	3 phase/200volts/60hz
Run Time (hrs):		**Frame:**	

Actuating Controls: Pressure Transducer
Operating Controls:

Stand-by Generator Manufacturer:		**Sump Pump Manufacturer:**	N/A
Model:		**Rated Capacity:**	N/A
Serial Number:	PORTABLE GENERATOR RECEPTACLE		
Size:		**Heater:**	N/A
Engine:		**Dehumidifier:**	N/A
Run Time (hrs):			
Fuel:			
Fuel Tank Size:			

Data Sources:

1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manuals.
3 Information from Xylem Flygt.

10.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves, mechanical piping and standby generator receptacle.

Running time meters are not currently installed at this pumping station. Wetwell drawdown testing (forced) was performed at this station and showed that both Pump #1 and Pump #2 were pumping at approximately 88 gpm. It should be noted that this is significantly less than the 140 to 160 gpm previously observed during forced drawdown testing in 2006. The town should evaluate the pumps to determine if a blockage or mechanical condition (worn impeller, etc.) is resulting in low pump output.

We made the following general observations and identified the following deficiencies about the Lamplighters Way Pump Station.

10.3.1 General Mechanical

- Pump guide rails (galvanized) are

corroding.
- One hatch piston on the wetwell is missing and one is corroded.
- The town indicated that the operating nut on the overflow drain gate valve (to drain back to wetwell) is stripped and inoperable.
- Wastewater was observed inside the overflow tank.
- The valve vault was completely filled with water at the time of our visit.
- The Town is unsure of the forcemain discharge location.

10.3.2 Electrical, Controls, Alarms

- The current configuration has a wetwell hatch located directly in front of the pump station electrical equipment, which when open is dangerous to the pump station operators.
- The electrical utility service is missing a "neutral" conductor. The current wiring appears to be a code violation.
- The portable engine/generator is not properly wired to "ground" the portable engine/generator.
- The alarms system is missing alarms for intrusion, personnel emergency, etc.
- The existing controls utilize float switches and control relays. There is no digital pump controller or secondary pump controls.
- The wetwell to electrical equipment does not have any conduit seals.
- There are no duplex receptacles (WP/GFI) on the outside of the electrical enclosure for pump station maintenance without opening the enclosure.
- The dialer system utilizes a "Verbatim" dialer, while most other stations utilize a "Sensaphone" system.

10.3.3 Structural

- The concrete structures (wetwell, overflow tank and valve vault) appear to be in sound condition.

10.3.4 Safety Considerations

- The wetwell hatch does not have a netting/grating safety device.
- See Electrical/Controls discussion above.

10.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

10.4.1 General Mechanical

<u>Short-term</u>

- Replace the pistons on the access hatch to the wetwell.
- Replace the corroded galvanized pump rails with new stainless steel guide rail system.

- Pump out wastewater from the overflow tank to prevent possible odor issues.
- Add a bypass connection (90-degree bend, 3-inch ball valve and quick connect coupling) inside the valve vault at the existing cross fitting.
- Add riser to existing manhole frame and cover at valve vault to minimize stormwater from entering the vault.
- Fix inoperable gate valve to overflow chamber.
- Confirm the location of the forcemain discharge location.

Intermediate

- Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal.

Long-term

- No recommendations identified.

10.4.2 Electrical, Controls, Alarms

Short-term

- Add ground connection to the engine/generator power receptacle to properly ground the engine/generator.
- Add a neutral conductor to the existing electrical service.
- Add engraved plastic nameplates with voltage/phase with NEC electrical shock warnings to all electrical equipment.
- Caulk wet well wiring to the electrical equipment with “DUC SEAL”.
- Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch.
- The control panel should be completely replaced and relocated to an area away from the wetwell access hatch

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

10.4.3 Structural

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

10.4.4 Safety Considerations

Short-term

- Add safety netting/grating to wetwell hatch.

Intermediate

- No recommendations identified.
-

Long-term

- No recommendations identified.

10.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Lamplighters PS - Short-Term (1-2 years)	
General Mechanical	
♦ Confirm the location of the forcemain discharge for the station. (Town to complete)	$ -
♦ Replace the pistons on the access hatch to the wetwell.	$500.00
♦ Replace the corroded galvanized pump rails with new stainless steel guide rail system.	$4,000.00
♦ Pump out wastewater from the overflow tank to prevent possible odor issues.	$300.00
♦ Add a bypass connection (90-degree bend, 3-inch ball valve and quick connect coupling) inside the valve vault at the existing cross fitting.	$2,500.00
♦ Add riser to existing manhole frame and cover at valve vault to minimize stormwater from entering the vault.	$750.00
♦ Fix inoperable gate operator at overflow tank.	$10,000.00
Electrical, Controls, Alarms	
♦ Add ground connection to the engine/generator power receptacle to properly ground the engine/generator.	$3,000.00
♦ Add a neutral conductor to the existing electrical service.	$1,500.00
♦ Add engraved plastic nameplates with voltage/phase with NEC electrical shock warnings to all electrical equipment.	$200.00
♦ Caulk wet well wiring to the electrical equipment with “DUC SEAL”.	$1,500.00
♦ Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch	$3,500.00
♦ The control panel should be completely replaced and relocated to an area away from the wetwell access hatch	$25,000.00
Safety Considerations	
♦ Add safety netting/grating to wetwell hatch	$1,500.00
Short-Term Needs Subtotal	***$54,250.00***

Description of Recommendation	***Estimated Cost***
	-
Lamplighters PS - IntermediateTerm (3-5 years)	
General Mechanical	
♦ Add a yard hydrant/hose station at the site to assist the operators with spraying down the pumps prior to removal	$3,000.00
Intermediate Needs Subtotal	***$3,000.00***
Pump Station Subtotal	***$57,250.00***
General Contractor Overhead & Mark-up (20%)	$11,500.00
Engineering & Contingency (35%)	$20,037.50
Pump Station Total	***$88,800.00***

11.0 LAUREL STREET PUMP STATION

11.1 Background Information

The Laurel Street PS is located off of Laurel Street in the southern section of Saugus. The station was completely replaced with a new submersible pump station in 2009 as a result of a capital improvements project initiated by the Town of Saugus Department of Public works. The station was designed by Weston & Sampson and constructed by D'Allesandro Corp.

The Laurel Street PS is a newer submersible type sewer pump station utilizing duplex submersible non-clog Flygt pumps. The station wetwell is 8-foot in diameter and is constructed of pre-cast concrete sections with an above grade riser section and access hatch. The discharge valving is installed in an external valve vault in order to limit the need to enter the wetwell space. The station is equipped with a dedicated standby generator to provide power to the station in the event of a service power failure. Controls for the pump station, the automatic transfer switch for the generator, the alarm auto-dialer and the electrical panels/transformer are located in an above grade outdoor weatherproof enclosure. The pump station site is completely fenced in and paved.

The existing wet well is constructed of pre-cast concrete manhole sections. The base of the wet well is comprised of 8-foot (inside diameter) sections. The wet well includes a system of the pressure transducer and high level float for pump control, pumps/guide rails and discharge piping. Access to the wetwell is available through a square aluminum hatch mounted in the pre-cast wetwell cover.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the 8-foot (inside diameter) pre-cast concrete wet well and discharge flow through 4-inch ductile iron discharge lines. The 4-inch discharge lines from each pump then exit the wetwell through the wall and enter the valve vault. Inside the valve vault each line is provided with a 4-inch check valve and 4-inch gate valve prior to joining together at a 4x4x4 tee, increasing to 6-inch diameter piping and exiting the valve vault. The valve vault also contains a bypass connection which consists of a 3-inch gate valve and 3-inch threaded nipple, adaptor and cap.

The pump station 6-inch diameter force main runs north up Mount Vernon Street to the intersection with Whitney Street and discharges into a gravity sewer manhole on Whitney Street, approximately 800 linear feet from the Laurel Street PS.

The Laurel Street PS operates on a fill/draw cycle controlled by a pressure transducer (previously operated via bubbler tube/compressor system). The pump station controls provide automatic alternation of the lead pump after each pumping cycle when under pressure transducer control. In the event of a pressure transducer failure, the station is equipped with a back-up high level float. At the time of our visit, the following pressure transducer level settings (above wetwell floor) were observed:

- Pump on (lead) – 3.5 feet
- Pump On (lag) – 4.0 feet
- Pumps Off – 3.0 feet
- High Level Alarm – 5.0 feet
- Low level alarm – 2.0 feet

The pump station controls provide automatic alternation of the lead pump after each pumping cycle when under pressure transducer control.

In addition to monitoring high and low level conditions in the wetwell, the pump station controls monitor; loss of power, pump overload, pump over temperature and pump seal leak. Alarm notifications are delivered to the Town via an autodialer system.

The pump station has a 27-kilowatt dedicated standby generator to provide power to the station in the event of a power failure. The generator is fueled via diesel fuel (belly tank) and is located inside an acoustical enclosure.

11.2 Station Equipment

Station Manufacturer:
Number of Pumps: 2

Pump Manufacturer:	Flygt	**Motor Manufacturer:**	Flygt
Model Number:	NP3102.090.0682	**Model:**	NP3102.090.0682
Serial Number:	3102.090.0910101/ 3102.090.0910102	**Serial Number:**	3102.090.0910101/ 3102.090.0910102
Size:	4 inch	**Horsepower:**	5 HP
Rated Capacity:	290 gpm @ 28 feet	**Speed:**	1730 RPM
Seals:	Mechanical seals	**Service Factor:**	
Impeller Size:	6.77 inches (172 mm)	**Rating:**	3phase/208volts/60Hz
Run Time (hrs):	3158.4/3370.8	**Frame:**	

Actuating Controls: Pressure Transducer and back-up high water float
Operating Controls:

Stand-by Generator Manufacturer:	Kohler	**Sump Pump Manufacturer:**	Liberty Pumps Serial # B39651891
Model:	20REOZJC	**Rated Capacity:**	Not listed

Serial Number:	2240858		
Size:	27 kW	**Heater:**	N/A
Engine:	John Deere	**Dehumidifier:**	N/A
Run Time (hrs):	170.9		
Fuel:	Diesel (belly)		
Fuel Tank Size:	150 gal.		

Data Sources:

1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manuals.

11.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves, mechanical piping and standby generator.

Based upon an approximate 5 year operational period and the values shown on the run time meters, it is estimated that the pump station operates approximately 216 minutes per day. At the rated capacity of the pumps this equates to approximately 63,000 gallons per day of wastewater. Initial pump cycling discharge rate observations seemed excessively low, so the pump outputs were evaluated again on June 25, 2014 via forced drawdown testing and resulted in outputs of 235 gpm for Pump #1 and 195 gpm for Pump #2. Observed fill rate of approximately 15 gpm is included in the values above. It appears that Pump #2 is fitted with the mix/flush valve due to the lower output observed.

We made the following general observations and identified the following deficiencies about the Laurel Street Pump Station.

11.3.1 General Mechanical

- The previously installed bubbler tube/compressor system for level control has been replaced with a pressure transducer and back-up high water float.
- A significant amount of grease was observed in the wetwell.
- The overall pump station appears to be in good condition.

11.3.2 Electrical, Controls, Alarms

- The two electric heaters in the outdoor enclosure have exposed wiring and the heating elements do not have a protective metallic shield.
- Not all of the electrical equipment has engraved plastic nameplates and NEC electrical shock warning labels.
- Alarms for intrusion, personnel emergency, etc. are missing (recommended by TR-16).
- Secondary pump controls for enhanced reliability are missing.
- The outdoor electrical enclosure is missing an exhaust fan with filtered air intake and a cooling thermostat.
- The outdoor electrical enclosure is missing insulation.
- No duplex receptacles (WP/GFI) which are mounted outside of the electrical enclosure are present.
- Incandescent lighting is inside the outdoor enclosure.

- Add an engine/generator emergency power off control station.

11.3.3 Structural

- Precast concrete wetwell and valve vault appear to be in sound condition.

11.3.4 Safety Considerations

- Electrical shock and skin burn opportunities are present with the current electrical heaters.
- A "ladder up" type safety device should be added to the valve vault to improve safety/access to the structure.

11.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

11.4.1 General Mechanical

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

11.4.2 Electrical, Controls, Alarms

Short-term

- Add engraved plastic nameplates with voltage/phase and NEC electrical warning labels to all electrical equipment.
- Replace the electric heaters with UL listed assembled heaters with built in thermostats.
- Replace the incandescent lamps with long life LED lamps.
- Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch.
- Add an engine/generator remote emergency power off control station.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

11.4.3 Structural

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified,

Long-term

- No recommendations identified.

11.4.4 Safety Considerations

Short-term

- A "ladder up" type safety device should be added to the valve vault to improve safety/access to the structure.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

11.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Laurel Street PS - Short-Term (1-2 years)	
Electrical, Controls, Alarms	
♦ Add engraved plastic nameplates with voltage/phase and NEC electrical warning labels to all electrical equipment.	$300.00
♦ Replace the electric heaters with UL listed assembled heaters with built in thermostats.	$750.00
♦ Replace the incandescent lamps with long life LED lamps.	$500.00
♦ Add an engine/generator remote emergency power off control station.	$2,000.00
♦ Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch	$3,500.00
Safety Considerations	
♦ Add "ladder up" type safety device to valve vault.	$750.00
Short-Term Needs Subtotal	***$7,050.00***
Pump Station Subtotal	***$7,050.00***
General Contractor Overhead & Mark-up (20%)	$1,500.00
Engineering & Contingency (35%)	$2,467.50
Pump Station Total	***$11,100.00***

12.0 PARK STREET PUMP STATION

12.1 Background Information

The Park Street PS is located off of Laurel Street in the southern section of Saugus. Station improvements were completed in 2009 as a result of a capital improvements project initiated by the Town of Saugus Department of Public works. The improvements consisted of; new pumps/rails, new external valve vault, new control system and installation of a portable generator power receptacle. The project also provided a 27kW diesel fueled trailer mounted standby generator (Kohler Model 20REOZJC). The project was designed by Weston & Sampson and constructed by D'Allessandro Corp.

The Park Street PS is a submersible type sewer pump station utilizing duplex submersible non-clog Flygt pumps. The station wetwell is 6-foot in diameter and is constructed of pre-cast concrete sections with an above grade riser section and access hatch. The discharge valving is installed in an external valve vault in order to limit the need to enter the wetwell space. Controls for the pump station, manual transfer switch, the alarm auto-dialer and the electrical panels/transformer are located in an above grade outdoor weatherproof enclosure. A portable generator receptacle is located on the outside of the weatherproof enclosure.

The existing wet well is constructed of pre-cast concrete manhole sections. The base of the wet well is comprised of 6-foot (inside diameter) sections. The wet well includes the pressure transducer and high level float for pump control, pumps/guide rails and discharge piping. Access to the wetwell is available through a square aluminum hatch mounted in the pre-cast wetwell cover. Pump cycle timing observations utilizing the pressure transducer level indicator showed that Pump #1 was discharging 133 gpm of flow. Low flow to the station at the time of the visit resulted in the inability to monitor the output of Pump #2.

The pumping system consists of two submersible pumps that are mounted in the wetwell. Each of the pumps draws flow from the 6-foot (inside diameter) pre-cast concrete wet well and discharge flow through 4-inch ductile iron discharge lines. The 4-inch discharge lines from each pump then exit the wetwell through the wall and enter the valve vault. Inside the valve vault each line is provided with a 4-inch check valve and 4-inch gate valve prior to joining together at a 4x4x4 tee, increasing to 6-inch diameter piping and exiting the valve vault. The valve vault also contains a bypass connection which consists of a 3-inch gate valve and 3-inch threaded nipple, adaptor and cap.

The 6-inch diameter force main runs north along Park Street approximately 575 linear feet before discharging to a gravity sewer manhole located at the intersection with Palmer Avenue. Flow from the Park Street PS is conveyed via gravity sewer to the Laurel Street PS.

The Park Street PS operates on a fill/draw cycle controlled by a pressure transducer (previously operated via bubbler tube/compressor system). The pump station controls provide automatic alternation of the lead pump after each pumping cycle when under pressure transducer control. In the event of a pressure transducer failure, the station is equipped with a back-up high level float. The pump station controls provide automatic alternation of the lead pump after each pumping cycle when under pressure transducer control. At the time of our visit, the following pressure transducer level settings (above wetwell floor) were observed:

- Pump on (lead) – 2.5 feet
- Pump On (lag) – 3.0 feet
- Pumps Off – 1.5 feet
- High Level Alarm – 3.5 feet
- Low level alarm – Unknown (Assumed to be 1.0)

In addition to monitoring high and low level conditions in the wetwell, the pump station controls monitor; loss of power, pump overload, pump over temperature and pump seal leak. Alarm notifications are delivered to the Town via an autodialer system.

The pump station does not have a dedicated generator set for stand-by power. The electrical service cabinet is equipped with a receptacle for connection of a portable generator for use during extended power outages. The town has a portable generator that can be used at the site.

12.2 Station Equipment

Station Manufacturer:	Not Available
Number of Pumps:	2

Pump Manufacturer:	Flygt	**Motor Manufacturer:**	Flygt
Model Number:	NP3127.090.2877	**Model:**	NP3127.090.2877
Serial Number:	3127.090.0910101/ 3127.090.0910102	**Serial Number:**	3127.090.0910101/ 3127.090.0910102
Size:	4-inch	**Horsepower:**	7.5
Rated Capacity:	200 gpm @ 42 feet	**Speed:**	1740 RPM
Seals:	Mechanical Seals	**Service Factor:**	
Impeller Size:	7.4 inches (188 mm)	**Rating:**	3 phase/208volts/60hz
Run Time (hrs):	622.06 / 908.25	**Frame:**	

Actuating Controls:	Pressure Transducer with Back-up High Water Float
Operating Controls:	

Stand-by Generator Manufacturer:	PORTABLE GENERATOR	**Sump Pump Manufacturer:**	Liberty Pumps Serial # 859678047

Model:	RECEPTACLE	**Rated Capacity:**	Not Listed
Serial Number:			
Size:		**Heater:**	N/A
Engine:		**Dehumidifier:**	N/A
Run Time (hrs):			
Fuel:			
Fuel Tank Size:			

Data Sources:

1 Information taken from equipment tag or nameplate during 2014 site visits.
2 Information taken from Operation & Maintenance manuals.

12.3 Site Observations

During our site visit, visual inspection was conducted for station exterior, electrical panels, breakers, control panels, wetwell walls and interior. Also performed was miscellaneous inspection and operation of pumps and motors, check and gate valves, mechanical piping and standby generator receptacle.

Based upon an approximate 5 year operational period and the values shown on the run time meters, it is estimated that the pump station operates approximately 50 minutes per day. At the rated capacity of the pumps this equates to approximately 10,000 gallons per day of wastewater. Due to the lack of flow into the station at the time of our visit, a forced drawdown test was performed with Pump #1 only. The drawdown test showed that Pump #1 is discharging approximately 132 gpm of flow.

We made the following general observations and identified the following deficiencies about the Park Street Pump Station.

12.3.1 General Mechanical

- The previously installed bubbler tube/compressor system for level control has been replaced with a pressure transducer and back-up high water float.
- A significant amount of grease was observed in the wetwell.
- The overall pump station appears to be in good condition.

12.3.2 Electrical, Controls, Alarms

- The two electric heaters in the outdoor enclosure have exposed wiring and the heating elements do not have a protective metallic shield.
- Not all of the electrical equipment has engraved plastic nameplates and NEC electrical shock warning labels.
- The engine/generator receptacle should be verified that it is properly wired to “ground” the engine/generator.
- Alarms for intrusion, personnel emergency, etc. are missing (recommended by TR-16).
- Secondary pump controls for enhanced reliability are missing.
- The outdoor electrical enclosure is missing an exhaust fan with filtered air intake and a cooling thermostat.
- The outdoor electrical enclosure is missing insulation.
- No duplex receptacles (WP/GFI) which are mounted outside of the electrical enclosure are present.

- Incandescent lighting is inside the outdoor enclosure.

12.3.3 Structural

- Precast concrete wetwell and valve vault appear to be in sound condition.

12.3.4 Safety Considerations

- Electrical shock and skin burn opportunities are present with the current electrical heaters.
- A "ladder up" type safety device should be added to the valve vault to improve safety/access to the structure.

12.4 Recommendations

Based on the completed evaluation, we have provided short-term, intermediate and long-term recommendations. Recognizing the financial constraints on the town, the short-term recommendations will address more immediate needs at the pump station that should be implemented in the next 1-2 year planning period.

Future improvements have been considered as intermediate improvements (to be considered within a 3-5 year planning period) and long-term improvements (to be considered within a 6-10 year planning period).

12.4.1 General Mechanical

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

12.4.2 Electrical, Controls, Alarms

Short-term

- Add engraved plastic nameplates with voltage/phase and NEC electrical warning labels to all electrical equipment.
- Replace the electric heaters with UL listed assembled heaters with built in thermostats.
- Verify that the portable engine/generator receptacle properly "grounds" the engine/generator.
- Replace the incandescent lamps with long life LED lamps.
- Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

12.4.3 Structural

Short-term

- No recommendations identified.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

12.4.4 Safety Considerations

Short-term

- A "ladder up" type safety device should be added to the valve vault to improve safety/access to the structure.

Intermediate

- No recommendations identified.

Long-term

- No recommendations identified.

12.5 Estimated Costs

Description of Recommendation	***Estimated Cost***
	-
Park Street PS - Short Term (1-2 years)	
Electrical, Controls, Alarms	
♦ Add engraved plastic nameplates with voltage/phase and NEC electrical warning labels to all electrical equipment.	$300.00
♦ Replace the electric heaters with UL listed assembled heaters with built in thermostats.	$750.00
♦ Verify that the portable engine/generator receptacle properly "grounds" the engine/generator.	Included in Gen/Non-Spec. Recomm.
♦ Replace the incandescent lamps with long life LED lamps.	$500.00
♦ Add secondary sewage pump controls via a new I&C control panel which includes an intrinsically safe relay for the wetwell high level float switch	$3,500.00
Safety Considerations	
♦ Add "ladder up" type safety device to valve vault.	$750.00
Short-Term Needs Subtotal	***$5,050.00***
Pump Station Subtotal	***$5,050.00***
General Contractor Overhead & Mark-up (20%)	$1,100.00
Engineering & Contingency (35%)	$1,767.50
Pump Station Total	***$8,000.00***

13.0 SYSTEM-WIDE FINDINGS AND RECOMMENDATIONS

13.1 Instrumentation/Electrical

13.1.1 Site Security/Alarms

The existing outside standby generators and electrical enclosures are not monitored for intrusion. The environmental industry standard practice is to have intrusion as one of the process alarms for this equipment. In addition to protecting town property, intrusion systems are also beneficial to reduce the potential for liability with regard to intruder injuries. Note that TR # 16 technical standard also requires "intrusion" as one of the "minimum" SPS alarms.

Each of the pump station's independent alarm panels should have similar/consistent alarms including segregation of the alarms into "CRITICAL PROCESS, NON-CRITICAL PROCESS, EMERGENCY and INTRUSION" for appropriate town response (i.e. – Department of Public Works, Police or Fire Departments). In addition, the POWER FAILURE alarm should be initiated by the alarms control panel and the HIGH LEVEL wet well alarm should be directly connected to the alarms control panel, not the pump station control panel.

Some of the pump station telephone alarms dialer panels are located inside the SPS control panels which expose the operators to line voltage electrical shock hazards. All dialer panels need to be located in their own enclosures.

13.1.2 Standby Generators (E/G)

Some of the new standby generators do not have analog type controls for E/G & automatic transfer switch (ATS) manual operation. It is the industry standard for standby power type ATS's to have manual controls that allow the operators to safely transfer the ATS units or start the E/Gs manually in the event the automatic features are not operating. Note, ATS computerized HMI controls are not "user friendly" for this purpose.

Per NFPA, all standby power engine/generators require remote emergency power off (EPO) control stations in the event the E/G units fail via smoky electrical or fuel fires.

The existing E/Gs do not have fluids containment and acoustical reduction treatments plus their fuel storage capacity should have the industry standard practice of providing 48 hours (full) and 24 hours (half full) fuel capacity. Note, this is based upon TR # 16 which requires 24 hours of sewage flow storage.

All pump station automatic transfer switches should be timed neutral transition types with analog ATS, E/G controls, digital HMI and manual transfer provisions. Note, ATS "out of phase" live to live power transfers can cause equipment damage.

13.1.3 Control Panels

As the town pursues future improvements to pump stations and controls, special attention should be given to establishing a standardized control panel setup that is acceptable to station operators. A standardized system of controls and alarms will ensure operator safety and eliminate confusion that could result from common mode alarms.

As a long-term recommendation, the town should consider the replacement of existing pump manufacturer supplied control panels with locally manufactured pump control panels with remote separate motor starters. New panels should be PLC/OIT types which are SCADA ready with redundant pump controls. Note, locally supplied control panels by New England I&C Suppliers provides parts and service readily available.

13.1.4 Electrical Services

All pump station electrical equipment should be protected by electronic transient voltage surge protectors (TVSS) for both the power and telephone incoming lines. Note, some of the existing SPS locations have "air gap" type of TVSS protection which is not current design technology.

All pump station three-phase power services should be monitored by three-phase voltage relays for single-phase protection. All SPS phases of the electrical power supply services should be monitored by multi-phase voltage relays for single phase, reverse phase, etc. protection. Note, this is a TR # 16 requirement.

All underground pump stations should have their electrical equipment located above ground in electrical equipment enclosures to increase SPS operating reliability and operator safety. Per TR # 16, all SPS equipment must be mounted above the 100 year storm. Note, there is an industry trend to raise the elevation to the 200 year storm level elevation.

While not an electrical code requirement, all power receptacles located in the SPS or building should be "GFI" types for operator protection.

All new pump station electrical equipment should be located in an above ground painted aluminum NEMA "3R" enclosure.

All of the existing electrical power and control equipment requires engraved plastic nameplates which clearly indicate their name, tag, voltage and phase. Also in general NEC electrical shock warning labels are required on the front panel of each piece of electrical power and motor control equipment.

All of the existing electrical power distribution and control equipment requires power system studies in order to produce NFPA arc flash "PPE" warning labels. This would include NEC short circuit AIC labels. In addition, as part of the AF PPE labels, the SPS operators should also have a half day training session on electrical safety issues when operating SPS electrical equipment. Note, the current electrical codes require both of these items for increased operator's electrical safety. Note, the Lincoln SPS has some arc flash PPE labels already installed for the major electrical equipment.

13.2 Industry Standard/Code Compliance

13.2.1 Buildings/Ventilation

In general, the below grade pump stations are not NFPA Standard # 820 compliant since mechanical means of supply and exhaust ventilation are not provided. Note, NFPA Std # 820 is not a Mass State code requirement however TR # 16 has adopted it in their SPS design requirements. This includes having combustible gas detection in the dry sides with exterior alarm warning horn/lights.

All pump station buildings should have motorized ventilation (i.e. – exhaust fans and motor operated dampers) with TR #16 compliant air flow rates including adequate air flow rates for cooling of building equipment. The ventilation rates per installation are indicated in NFPA Standard # 820.

All pump station buildings should have insulation and motor operated dampers that are Massachusetts State Energy Code compliant for heating energy reductions. Pump station lights should be high efficiency and long lasting type.

13.2.2 Equipment

All pump station motors that are rated at greater than 1 Horsepower (HP) should be premium efficiency types for electrical energy reduction. Also in order to save operating costs, variable speed pumping should be investigated as part of any pump station upgrades.

All pump station and buildings electrical equipment should have engraved nameplates to assist the operators and allow for accurate replacement of parts.

All packaged pump station units should be Underwriters Laboratory (UL) listed assemblies since many of the existing below grade pump stations do not meet NEC electrical code requirements (i.e. – working clearances, etc). Note, many of the available "packaged" pump station manufacturers cannot supply UL listed (assembled) pumping stations.

In general all pump stations should have piped sewage bypassing pumping connections. Note, the Town does not have a mechanical sewage pump in their SPS maintenance equipment inventory.

13.3 Maintenance Practices

13.3.1 Current Inspection Schedule

Each of the wastewater pump stations is visited daily 7 days per week for overall system inspection and identification of maintenance tasks. Due to grease levels in the system, grease and floatables are removed from the Lincoln Avenue pump station wetwell on a daily basis.

Standby generators at each pump station site (except those that only have portable generator receptacles) are typically exercised every Tuesday and most units have been serviced annually.

Based on the overall condition of the wastewater pump stations, the current inspection schedule appears to be adequate for reliable system operation. The pump station operators should start to fill out daily Operational Logs for each visit made to the pump station. The logs should document pertinent operating conditions, any observed deficiencies and note the run time hours, if available, for each pump.

In 2014, Massachusetts DEP (MA DEP) re-issued 314 CMR 12.00, *Operation, Maintenance and Pretreatment Standards for Wastewater Treatment Works and Indirect Dischargers*, which included some modifications to inspection frequency requirements for sewer system operators. Prior to 2014, the regulations (314 CMR 12.04 (4)), required "Any person operating a sewer system shall cause the daily inspection of all pumping, ejector or lift stations on intercepting, trunk or main sewers…" The April 25, 2014 revisions of the regulations (314 CMR 12.00 (5)) require "…at a minimum: (a) daily inspections of all pump stations which are designed to pump peak flows of 100,000 gallons per day or greater; (b) weekly inspections of all pump stations which are designed to pump peak flows of less than 100,000 gallons per day,… ".

While the MA DEP regulations require a weekly visit to each small pump station, communities typically inspect pump stations with alarms and/or SCADA systems on a 5 times per week basis during normal working hours (i.e. Monday through Friday). Based upon the regulation change, MA DEP is accepting the increased reliability of alarm and/or SCADA systems to notify on-call emergency personnel of a pump station problem. At this point, due to the current grease issue and the size of the station, we recommend that the Lincoln Avenue PS and the larger stations continue to be visited on a daily basis. We typically recommend daily visits Monday through Friday during normal working hours, for small municipal stations, based upon each pump station having an alarm system.

13.3.2 Operations Staffing Level

A two-person pump station operation team accomplishes the daily inspection process, routine maintenance activities and generator exercising. The sewer foreman provides oversight of the team and scheduling/coordination of additional maintenance and repair needs. Based on discussions with current staff and overall condition of the wastewater pump stations, this staffing level appears to be adequate. However, if future budget constraints do not allow for out-sourcing of non-routine maintenance and repair needs and the stations begin to fall behind needed improvements, an additional person should be added to the pump station operation team considering the number of wastewater pump stations.

The town should continue to include an annual budget for pump station maintenance in the operating budget for the Sewer Department. This budget should be for small work, which can be completed by the operators directly rather than completed by a contractor.

13.4 Safety

13.4.1 General

The Department of Public Works should provide routine safety training and certification to all of its operation and maintenance staff. Providing the knowledge of safety practices to personnel is an important component of maintaining a safe working environment and minimizing the occurrence of town liability claims.

13.4.2 Equipment Requirements

All pump station buildings and dry pit pumping stations should have battery operated egress lighting for operator safety. Multi-level pump stations also require exit lighting fixtures.

All pump station electrical equipment should have NEC electrical shock hazard and OSHA arc flash warning labels

13.4.3 Fall Prevention

Based on the depths of the existing below-grade pump stations and wetwells, operations staff could benefit from the installation of ladder fall prevention systems as an additional safety measure. As a minimum, a portable tripod and hoist fall prevention system should be with the pump station crew and available for use at all times.

Regardless of the type of fall prevention system utilized, the system should be inspected and exercised on a regular basis to ensure functionality when in use.

13.4.4 Gas Monitors

All of the existing below-grade pump stations and wetwells are considered confined spaces that at times are subject to the accumulation of hazardous gases and oxygen deficiency. These gases can be toxic and/or explosive and may lead to the depletion of oxygen within the confined space. The pump stations are equipped with forced ventilation systems, however if any component of this system fails entrance of the confined space could be hazardous.

Gas/oxygen monitors provide the best method for checking the atmospheric conditions to ensure the space is suitable for entry. Pump station operation staff have portable gas monitors available for their use. Stationary gas monitors that are permanently mounted within the confined space are also available for installation within the confined space. Due to the corrosive environments in most of the wastewater pump stations and the ease of calibration, appropriate use of a portable gas monitor to detect oxygen deficiency, combustible gas and toxic gas (generally hydrogen sulfide for wastewater applications) is more reliable and should continue to be used.

13.5 Grease/Rags

A significant amount of grease was observed at several of the pump stations in town. As a result of this, we would recommend that the town enact a Fats, Oils and Grease (FOG) management program. It is our understanding that a FOG management plan is planned for the town and the effectiveness of the program may be monitored through observations of the operators as they visit pump stations once the management plan has been implemented.

As with many communities, the town is seeing and increased issue with rags/wipes entering the sewer system and leading to pump failures or pipeline blockages. In the past, the town has mailed notices of what not to flush into the sewer system to various tributary areas plagued by rags/wipes. It is our understanding that these mailer efforts were effective and the town should continue this effort as needed.

13.6 Cost Estimate

The following is an estimate of costs for recommendations that are not specific to a particular pump station.

Description of Recommendation	***Estimated Cost***
	-
General/Non-Specific - Short Term (1-2 years)	
♦ Find or re-create as-built record drawing files for stations where drawings are unavailable (Assumes Town Staff will perform this effort)	$ -
♦ Consider the purchase of a trailer mounted portable bypass pump for the pump station crew.	$10,000.00
♦ Evaluate existing portable generator/plugs and receptacles at all pump stations with portable power connections (Aberdeen, Blacksmith, Bristow, Lamplighter, Morris, Park and Saugus Ave.) to verify that the portable engine/generator receptacle is properly wired to "ground" the equipment. Correct as needed.	$2,500.00
♦ General Staff Training Budget ($5k per year)	$10,000.00
♦ Implement a Fats, Oils and Grease (FOG) program in the Town of Saugus.	$50,000.00
Short-Term Needs Subtotal	***$72,500.00***

Description of Recommendation	***Estimated Cost***
	-
General/Non-Specific - IntermediateTerm (3-5 years)	
♦ General Staff Training ($5k per year)	$15,000.00
♦ Continued Management of the FOG Program ($5k per year)	$15,000.00
Intermediate Needs Subtotal	***$30,000.00***

Description of Recommendation	***Estimated Cost***
	-
General/Non-Specific - Long Term (6 - 10 years)	
♦ General Staff Training ($5k per year)	$25,000.00
♦ Continued Management of the FOG Program ($5k per year)	$25,000.00
Long-Term Subtotal	***$50,000.00***
Pump Station Subtotal	***$152,500.00***
General Contractor Overhead & Mark-up (20%)	***$30,500.00***
Engineering & Contingency (35%)	$53,375.00
Pump Station Total	***$236,400.00***

14.0 PRIORITIZATION OF RECOMMENDATIONS AND ESTIMATED COSTS

14.1 Prioritization of Recommendations

As discussed within each pump station evaluation section, recommendations have been prioritized for implementation based upon our opinion of the level of need. Recommendations have been categorized into Short Term Needs (recommendations which should be implemented within the next 2 years) Intermediate Needs (recommendations which should be implemented within the next three to five years) and Long Term Needs (recommendations which should be implemented within the next six to ten years).

Short term needs recommendations have been made to; eliminate malfunctioning process equipment, improve operator safety, meet applicable codes and to replace equipment that has reached the end of its useful life. Intermediate and Long term needs are also aimed at improving overall safety, replacing outdated equipment and reestablishing a long period of useful life at each station.

14.2 Estimated Costs for Recommended Improvements

A list of system wide recommendations and estimated costs is included as Table 14-1. Costs provided are estimates based upon past experience. The total cost of all recommendations includes a 35% contingency for engineering and general contingencies during construction. Actual costs may vary as a result of future bidding climates.

Town of Saugus, Massachusetts
Evaluation of Wastewater Pump Stations

Table 14-1: Summary of Cost Estimates for System Wide Recommendations

September 2014

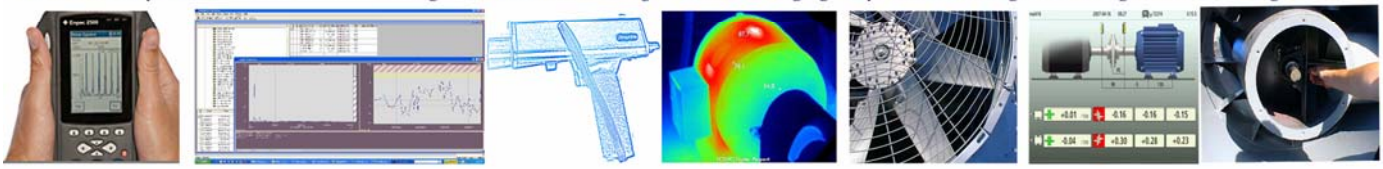
	Subtotal Short-Term Improvements Cost	Subtotal Intermediate Improvements Cost	Subtotal Long-Term Improvements Cost	**Recommended Improvements Subtotal**	General Contractor Overhead & Mark-up (20%)	Engineering & Contingency (35%)	**Cost for All Recommended Improvements**
Bristow Street PS	$ 31,850.00	$ 105,000.00	$ 500,000.00	**$ 636,850.00**	$ 127,400.00	$ 222,900.00	**$ 987,200.00**
Lincoln Avenue PS	$ 240,800.00	$ 209,000.00	$ 375,000.00	**$ 824,800.00**	$ 165,000.00	$ 288,700.00	**$ 1,278,500.00**
Lynnhurst School PS	$ 15,200.00	-	$ 300,000.00	**$ 315,200.00**	$ 63,100.00	$ 110,400.00	**$ 488,700.00**
Morris Place PS	$ 460,600.00	-	-	**$ 460,600.00**	$ 92,200.00	$ 161,300.00	**$ 714,100.00**
Saugus Avenue PS	$ 18,300.00	-	$ 100,000.00	**$ 118,300.00**	$ 23,700.00	$ 41,500.00	**$ 183,500.00**
Aberdeen Avenue PS	$ 11,200.00	$ 3,000.00	$ 20,000.00	**$ 34,200.00**	$ 6,900.00	$ 12,000.00	**$ 53,100.00**
Blacksmith Way PS	$ 34,700.00	$ 3,000.00	-	**$ 37,700.00**	$ 7,600.00	$ 13,200.00	**$ 58,500.00**
Broadway/Rte 1 PS	$ 1,500.00	$ 5,000.00	-	**$ 6,500.00**	$ 1,300.00	$ 2,300.00	**$ 10,100.00**
Lamplighters Way PS	$ 54,250.00	$ 3,000.00	-	**$ 57,250.00**	$ 11,500.00	$ 20,100.00	**$ 88,900.00**
Laurel Street PS	$ 7,050.00	-	-	**$ 7,050.00**	$ 1,500.00	$ 2,500.00	**$ 11,100.00**
Park Street PS	$ 5,050.00	-	-	**$ 5,050.00**	$ 1,100.00	$ 1,800.00	**$ 8,000.00**
Non-Specific Recommendations	$ 72,500.00	$ 30,000.00	$ 50,000.00	**$ 152,500.00**	$ 30,500.00	$ 53,400.00	**$ 236,400.00**
System Wide	$ 953,000.00	$ 358,000.00	$ 1,345,000.00	**$ 2,656,000.00**	$ 531,200.00	$ 929,600.00	**$ 4,116,800.00**

APPENDIX A

Pump Vibration Analysis Report
May 16, 2014
L.P. Larson Corporation

LP Larson Corporation

Vibration Analysis• Predictive Maintenance Programs •Ultrasonic Testing• Thermal Imaging •Dynamic Balancing • Laser Alignment • Millwright Services



VIBRATION ANALYSIS REPORT

Weston & Sampson

At

Saugus Pump Stations
Saugus, MA

May 16, 2014

Analyst: Christian Comeau

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Summary Sheet
of Equipment with Alarmed Points

Date	**May 16, 2014**
Location	**Weston & Sampson, Saugus Water Department, Saugus, MA**

LISTED BY PRIORITY

MACHINE NAME	PRIORITY	COMMENTS
Lincoln Pump Station Pump 3	2	High Spike Energy readings were found on the pump bearings which indicate mechanical deterioration. Recommend replacing pump bearings at earliest convenience.

Priority 1 = Repair action should be taken immediately. See Comments for recommendations.
Priority 2 = Schedule repair at earliest convenience. See Comments for recommendations.
Priority 3 = Problem does not warrant action at this time. Continue to monitor trend closely.

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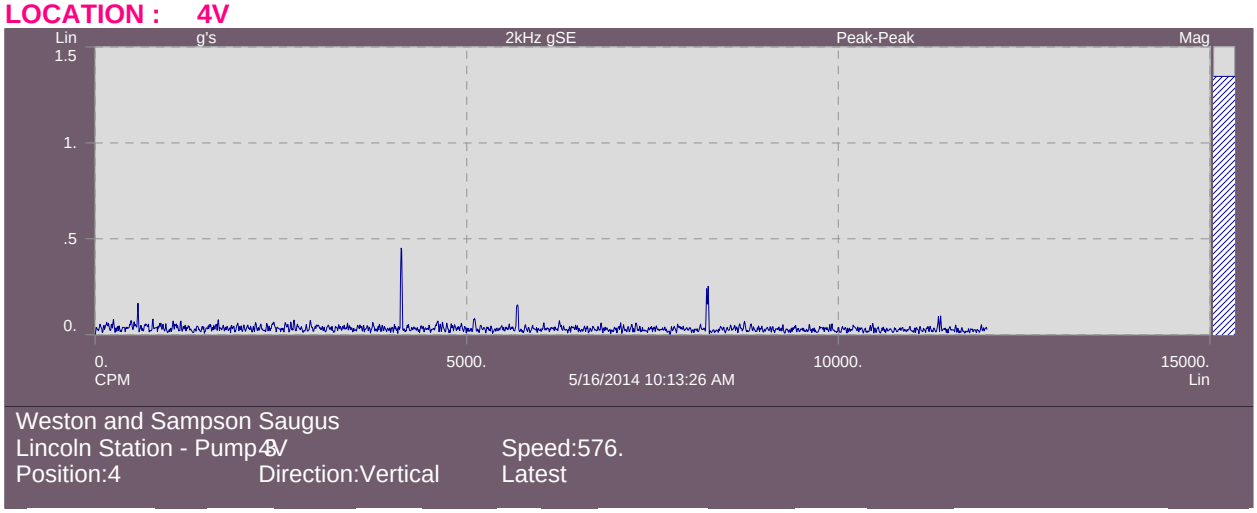
EXCEPTION REPORT

Location	Pos	Direction	Data Type	Units	Filter	Value	Date/Time	Severity
Saugus								
Lincoln Station - Pump 3								
4V	4	Vertical	Magnitude	g's	2kHz gSE	8.59	5/16/2014 10:13 AM	Critical

EXCEPTION REPORT

Saugus
Lincoln Station - Pump 3
POSITION : 4
DIRECTION : Vertical
LOCATION : 4V

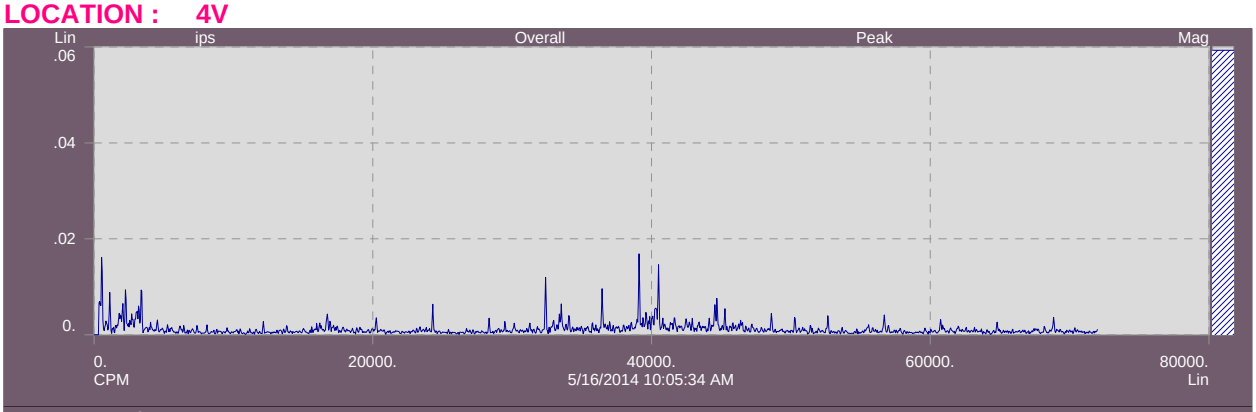


Weston and Sampson Saugus
Lincoln Station - Pump 3V
Position:4 Direction:Vertical Speed:576.
Latest

Data Type	Units	Filter	Det	Baseline	Value	Latest Date/Time	Severity
Magnitude	g's	2kHz gSE	Peak-Peal		8.59	5/16/2014 10:13 AM	Critical

EXCEPTION REPORT

Saugus
Lincoln Station - Pump 3
POSITION : 4
DIRECTION : Vertical
LOCATION : 4V



Weston and Sampson Saugus
Lincoln Station - Pump 3 4V Speed:576.
Position:4 Direction:Vertical Latest

Data Type	Units	Filter	Det	Baseline	Value	Latest Date/Time	Severity
Magnitude	ips	Overall	Peak		.104	5/16/2014 10:05 AM	Critical

LAST MAGNITUDE MEASUREMENT REPORT

Location	Position	Direction	Units	Filter	Value	Date/Time
Saugus						
Bristow Station - Pump 1						
1H	1	Horizontal	ips	Overall	.0377	5/16/2014 7:28 AM
1V	1	Vertical	ips	Overall	.0741	5/16/2014 7:28 AM
2H	2	Horizontal	ips	Overall	.0318	5/16/2014 7:54 AM
2V	2	Vertical	ips	Overall	.0534	5/16/2014 7:54 AM
3H	3	Horizontal	ips	Overall	.0258	5/16/2014 7:54 AM
3V	3	Vertical	ips	Overall	.0412	5/16/2014 7:55 AM
4H	4	Horizontal	ips	Overall	.0267	5/16/2014 7:55 AM
4V	4	Vertical	ips	Overall	.0343	5/16/2014 7:55 AM
Saugus						
Bristow Station - Pump 2						
1H	1	Horizontal	ips	Overall	.255	5/16/2014 7:35 AM
1V	1	Vertical	ips	Overall	.169	5/16/2014 7:35 AM
2H	2	Horizontal	ips	Overall	.205	5/16/2014 7:36 AM
2V	2	Vertical	ips	Overall	.122	5/16/2014 7:36 AM
3H	3	Horizontal	ips	Overall	.123	5/16/2014 7:37 AM
3V	3	Vertical	ips	Overall	.067	5/16/2014 7:57 AM
4H	4	Horizontal	ips	Overall	.0906	5/16/2014 7:58 AM
4V	4	Vertical	ips	Overall	.0572	5/16/2014 7:58 AM
Saugus						
Elm & Walnut Station - Pump 1						
1H	1	Horizontal	ips	Overall	.13	5/16/2014 9:10 AM
1V	1	Vertical	ips	Overall	.228	5/16/2014 9:10 AM
2H	2	Horizontal	ips	Overall	.111	5/16/2014 9:10 AM
2V	2	Vertical	ips	Overall	.147	5/16/2014 9:11 AM
Saugus						
Elm & Walnut Station - Pump 2						
1H	1	Horizontal	ips	Overall	.226	5/16/2014 9:21 AM
1V	1	Vertical	ips	Overall	.138	5/16/2014 9:21 AM
2H	2	Horizontal	ips	Overall	.117	5/16/2014 9:21 AM
2V	2	Vertical	ips	Overall	.126	5/16/2014 9:22 AM
Saugus						
Lincoln Station - Pump 1						
1H	1	Horizontal	ips	Overall	.0455	5/16/2014 9:51 AM
1V	1	Vertical	ips	Overall	.0394	5/16/2014 9:52 AM
2H	2	Horizontal	ips	Overall	.0208	5/16/2014 9:52 AM
2V	2	Vertical	ips	Overall	.0218	5/16/2014 9:52 AM
3H	3	Horizontal	ips	Overall	.0503	5/16/2014 9:53 AM
3V	3	Vertical	ips	Overall	.0365	5/16/2014 9:53 AM
4H	4	Horizontal	ips	Overall	.035	5/16/2014 9:54 AM
4V	4	Vertical	ips	Overall	.0488	5/16/2014 9:54 AM
Saugus						
Lincoln Station - Pump 3						
1H	1	Horizontal	ips	Overall	.16	5/16/2014 10:01 AM
1V	1	Vertical	ips	Overall	.148	5/16/2014 10:02 AM
2H	2	Horizontal	ips	Overall	.0667	5/16/2014 10:02 AM
2V	2	Vertical	ips	Overall	.0868	5/16/2014 10:02 AM
3H	3	Horizontal	ips	Overall	.105	5/16/2014 10:03 AM
3V	3	Vertical	g's	2kHz gSE	5.22	5/16/2014 10:14 AM
3V	3	Vertical	ips	Overall	.0859	5/16/2014 10:04 AM
4H	4	Horizontal	ips	Overall	.116	5/16/2014 10:05 AM
4V	4	Vertical	g's	2kHz gSE	8.59	5/16/2014 10:13 AM
4V	4	Vertical	ips	Overall	.0944	5/16/2014 10:05 AM

LAST MAGNITUDE MEASUREMENT REPORT

Location	Position	Direction	Units	Filter	Value	Date/Time
Saugus						
Morris & Floyd Station - Pump 1						
1H	1	Horizontal	ips	Overall	.184	5/16/2014 8:23 AM
1V	1	Vertical	ips	Overall	.376	5/16/2014 8:23 AM
2H	2	Horizontal	ips	Overall	.151	5/16/2014 8:23 AM
2V	2	Vertical	ips	Overall	.312	5/16/2014 8:24 AM
3H	3	Horizontal	ips	Overall	.154	5/16/2014 8:24 AM
3V	3	Vertical	ips	Overall	.129	5/16/2014 8:30 AM
4H	4	Horizontal	ips	Overall	.0809	5/16/2014 8:36 AM
4V	4	Vertical	ips	Overall	.123	5/16/2014 8:37 AM
Saugus						
Morris & Floyd Station - Pump 2						
1H	1	Horizontal	ips	Overall	.11	5/16/2014 8:37 AM
1V	1	Vertical	ips	Overall	.117	5/16/2014 8:38 AM
2H	2	Horizontal	ips	Overall	.081	5/16/2014 8:38 AM
2V	2	Vertical	ips	Overall	.0801	5/16/2014 8:38 AM
3H	3	Horizontal	ips	Overall	.0515	5/16/2014 8:39 AM
3V	3	Vertical	ips	Overall	.0426	5/16/2014 8:39 AM
4H	4	Horizontal	ips	Overall	.0319	5/16/2014 8:39 AM
4V	4	Vertical	ips	Overall	.0287	5/16/2014 8:40 AM

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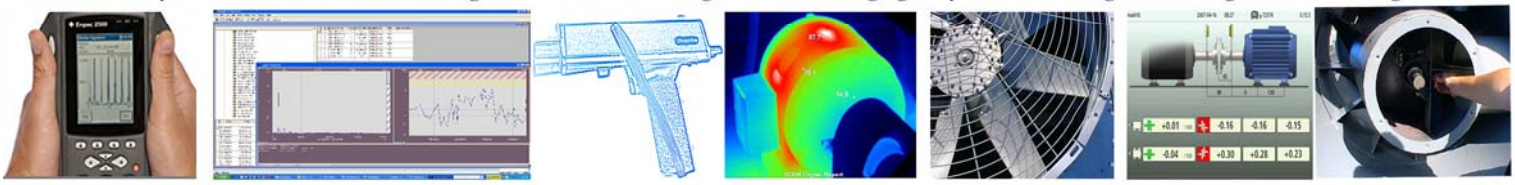
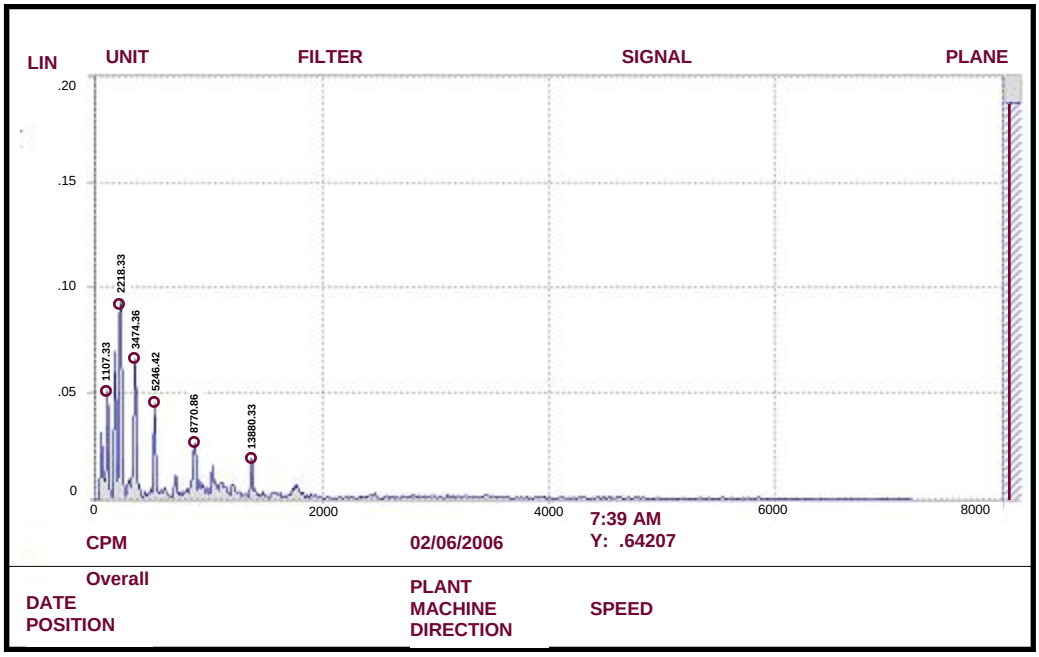


GUIDE TO SPECTRAL REPORT



PLANT *SAMPLE*

DATE *DATE THE SPECTRUM WAS TAKEN*

MACHINE *NAME OF MACHINE BEING MEASURED*

SPEED *OPERATING SPEED (RPM)*

POSITION *MACHINE MEASUREMENT LOCATION (points 1, 2, 3, 4)*

DIRECTION *DIRECTION OF MEASUREMENT (horizontal, vertical, axial)*

LIN *PLOT AXIS SCALE [linear (LIN); logarithmic (LOG); level (dB)]*

UNIT *Y-AXIS UNITS OF MEASUREMENT (mils, ips, g's)*

FILTER *PLOT AXIS FILTER (none, overall, high frequency, 200HZ gSE)*

SIGNAL *PLOT AXIS COORDINATE PLANE (magnitude, phase, real, imaginary)*

CPM *X-AXIS UNITS OF MEASUREMENT (CPM, Orders)*

OVERALL *OVERALL AMPLITUDE READING ACROSS FREQUENCY SPECTRUM (vertical line located within bar on right side of plot)*

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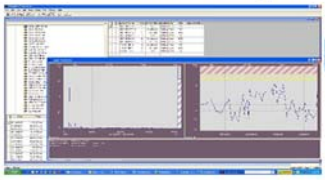
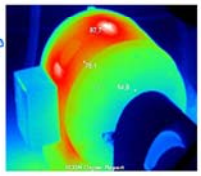
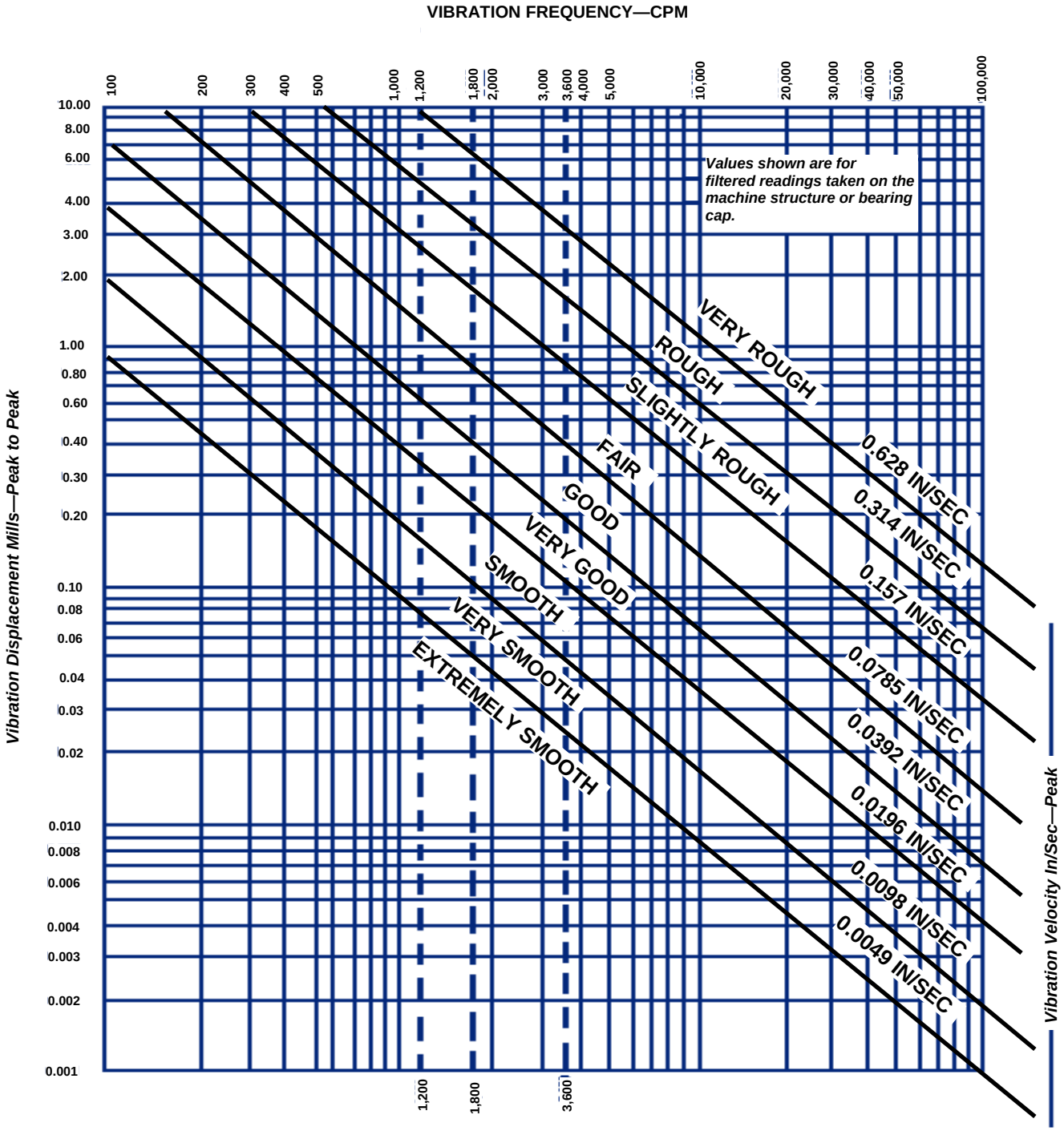





GENERAL MACHINERY VIBRATION SEVERITY CHART



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APPENDIX B

Ultrasonic Steel Testing
May 15, 2014
Baker Testing Services, Inc.

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Rockland, MA 02370

BAKER TESTING SERVICES, INC.

NONDESTRUCTIVE EXAMINATION
METALLURGY AND FAILURE ANALYSIS

(TEL) 781-871-4458
(FAX) 781-871-0123

NON-DESTRUCTIVE TEST REPORT

Customer:	Weston & Sampson Engineers Inc	**Page** 1 **of** 1	**BTS Job No.:** 0514-054
Purchase Order No:	2140189	**Inspection Date:**	5/15/2014
Inspection Method:	Ultrasonic	**Type:**	Manual Thickness Readings
Job Location:	Saugus, MA	**Test Equipment:**	Panametrics Model 37 DLPLUS
Part Identification:	Pump Stations	**Lighting Equipment:**	N/A
Part Name:	Walls, Floor and Door Tube	**Quantity:**	See Below
Part No.:	See Below	**Material:**	Carbon Steel
Specification:	Customer Information	**Thickness:**	Various
Acceptance Std:	Customer Information	**Inspect Procedure:**	BTS UT-9 Rev. 0

Test Data:		
	Transducer -	5 mhz. .312" diameter
	Calibration -	Stepwedge
	Couplant -	Sonotrace 30

Results:

Bristow and Barressi Street Pump Station

Manway Readings

Row	North	West	South	East
1	0.386	0.377	0.386	0.371
2	0.400	0.387	0.371	0.373
3	0.400	0.388	0.391	0.368
4	0.403	0.393	0.367	0.366
5	0.387	0.379	0.388	0.368
6	0.398	0.371	0.371	0.409
7	0.387	0.368	0.368	0.000

Readings were from Bottom to the Top of Manway Tube

Floor was Cement

INSPECTION TECHNICIAN:	**LEVEL:**	**APPROVED SIGNATORY:**	**DATE:**
Chad Britton	II	**QA/QC REPRESENTATIVE**	5/15/2014

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METALLURGY AND FAILURE ANALYSIS

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(FAX) 781-871-0123

NON-DESTRUCTIVE TEST REPORT

Customer: Weston & Sampson Engineers Inc. **Job No.:** 0514-054

Test Date: 5/15/2014 **Test Method:** Ultrasonic

Results:

Lynnhurst Pump Station

Manway Readings

Row	1	2	3	4	5	6	7	8	9
North	0.256	0.265	0.255	0.247	0.276	0.247	0.242	0.251	0.249
West	0.250	0.254	0.250	0.254	0.257	0.251	0.256	0.254	0.249
South	0.250	0.261	0.249	0.241	0.258	0.251	0.250	0.253	0.260
East	0.264	0.258	0.249	0.247	0.256	0.260	0.248	0.251	0.250

Readings were from Bottom to the Top of Manway Tube

Floor Readings

Center	0.247	
North	0.241	
West	0.000	West was Covered
South	0.242	
East	0.240	

Bottom Section of the Tank Walls

North	West	South	East
0.333	0.317	0.322	0.314
0.345	0.332	0.331	0.331
0.316	0.317	0.317	0.311
0.314	0.319	0.312	0.316
0.303	0.315	0.322	0.323

Morris Pump Staion

Manway Readings

Row	1	2	3	4	5	6
North	0.243	0.256	0.240	0.252	0.247	0.219
West	0.245	0.246	0.246	0.246	0.249	0.235
South	0.250	0.225	0.246	0.264	0.247	0.253
East	0.245	0.247	0.252	0.250	0.247	0.246

Bottom Section of the Tank Walls

North	West	South	East
0.227	0.247	0.257	0.240
0.250	0.246	0.251	0.243
0.248	0.249	0.248	0.248

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NONDESTRUCTIVE EXAMINATION
METALLURGY AND FAILURE ANALYSIS

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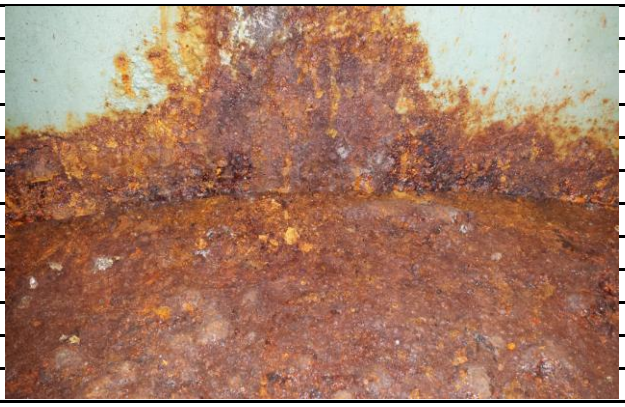
(FAX) 781-871-0123

NON-DESTRUCTIVE TEST REPORT

Customer: Weston & Sampson Engineers Inc. **Job No.:** 0514-054

Test Date: 5/15/2014 **Test Method:** Pictures

Results:



All Pictures above are on Floor of Morris Pump House

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NONDESTRUCTIVE EXAMINATION
METALLURGY AND FAILURE ANALYSIS

(TEL) 781-871-4458
(FAX) 781-871-0123

NON-DESTRUCTIVE TEST REPORT

Customer: Weston & Sampson Engineers Inc. **Job No.:** 0514-054

Test Date: 5/15/2014 **Test Method:** Pictures

Results:

Morris Side Wall in Pump House

Top of Morris Pump House Inside

Southwest of Morris Pump Wall

North Side Of Morris Pump Tube Walls

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BAKER TESTING SERVICES, INC.

NONDESTRUCTIVE EXAMINATION
METALLURGY AND FAILURE ANALYSIS

(TEL) 781-871-4458
(FAX) 781-871-0123

NON-DESTRUCTIVE TEST REPORT

Customer: Weston & Sampson Engineers Inc. **Job No.:** 0514-054

Test Date: 5/15/2014 **Test Method:** Pictures

Results:

West Side Tube Wall

East Wall of House Wall by Floor