Port Townsend Condition Assessment

Summary Report

September 11, 2019

JACOBS

Contents

1. Introduction

The City of Port Townsend's (City's) Wastewater Treatment Plant (WWTP) was upgraded to secondary treatment in the early 1990s. In the approximately 25 years since completion of that project the WWTP has operated well and has been maintained in good condition. However, as is the case with all WWTP facilities, conditions are harsh on equipment and structures. Additionally, control systems and instruments have a limited useful life and become difficult to maintain, repair, and replace individually. After a period of 25 years, these systems and instruments undergo substantial advancement. Upgrade and replacement of instrumentation and control systems need to be assessed holistically.

Being aware that it is time to plan for targeted rehabilitation and upgrade at the WWTP, the City initiated a high-level task to assess the condition of its WWTP with a focus on three primary areas: (1) mechanical (both building mechanical and process mechanical); (2) corrosion of structures, equipment, and piping; and (3) instrumentation and control. The focus was on these aspects of the WWTP because these were generally understood to be the areas of greatest concern.

This work included a one-day examination of the WWTP by Jacobs Engineering Inc (Jacobs) technical staff. Jacobs' corrosion specialist, WWTP mechanical engineer, and instrumentation and control engineer participated in the one-day examination. After the one-day examination, observations were documented, deficiencies noted, and recommendations (and associated estimated costs) for mitigation developed. Each of these are presented herein.

Note that the WWTP generally appears to be within its design capacity and within its capacity to meet the needs of the City of Port Townsend. However, in addition to the primary focus of this condition assessment, the City should consider addressing longer-term future needs that are beyond the scope of this work and beyond typical planning horizons. Addressing such longer-term future needs would likely require additional property adjacent to the existing WWTP, beyond what the City currently owns. Additional property would enable the City to flexibly address certain future challenges.

Future challenges that would require additional property could include the eventual degradation and deterioration of the WWTP. WWTP environments are inherently corrosive to concrete and steel despite the best efforts and practices to prolong the useful lives of these materials. At some point, new unit process structures will become necessary. Changes in future, more-stringent regulation, such as the currently-contemplated nutrient reduction, could require new or expanded unit processes. Increases in population could eventually increase WWTP flows, which could require additional property for expanded unit processes.

Directly east and to the south of the WWTP are several properties without existing buildings and one that includes a residence. These lots are between Kuhn Street and Landes Street on the east and west, respectively, and between 50th Street and 53rd Street on the south and north, respectively. The City should pro-actively explore the possibility of purchase of these properties for the long-term future and assess whether or not it is feasible and reasonable to hold these properties for many years (even decades) before they might be needed.

2. Observations

The one-day examination of the WWTP was conducted July 15, 2019. WWTP staff guided Jacob's staff through the plant and provided input on the function and performance of various unit processes and facilities. The observations presented herein are presented on a per-facility basis (except for Instrumentation and Control) in three main sections: (1) Mechanical Systems, (2) Instrumentation and Control, and (3) Corrosion.

A copy of the WWTP Site Plan drawing from the 1991 design – marked up as part of the construction project of 1992 through 1994 – is presented in Appendix A for reference as to the location of key facilities. Photographs collected during the July 15, 2019 site visit of key facilities, equipment, and observed deficiencies are presented numerically in Appendix B. These photographs are referenced from the main body of this report.

2.1 Mechanical Systems

Mechanical system where noted for condition, capacity, and function. WWTP staff provided input on condition, recent rebuilds, equipment capacity limitations, and challenging system-operations. Based on discussion with WWTP staff, it appears the overall WWTP is operating well within its design capacity. No overall capacity enhancement appears to be necessary in the near future. A Facility Plan Amendment is required if the WWTP reaches 85% of its design capacity. That is not the case after over 25 years of operation. Overall, the WWTP's mechanical systems are in good condition – reflecting staff's commitment to regular and pro-active maintenance.

2.1.1 Intake Pump Station

The influent pump station receives sewage by gravity from two influent sewers. The primary portion of flow comes by conveyance from the Gaines Street Lift Station. That line flows by gravity to the plant once it reaches the general area of the golf course. An additional gravity conveyance system conveys sewage to the plant from areas to the south and west. The Influent Pumps deliver raw sewage to the elevated headworks channels, located atop the adjacent Headworks Building. Below are observations related to the mechanical systems of the Intake Pump Station.

- Capacity. Most of the time only one of the two duty pumps are in operation. Occasionally, during an extreme rainfall event, the lag pump will come online for a short period of time. If the lag pump were starting more frequently, then we might conclude that the capacity of the pump station might need to be increased.
- Equipment. The original pumps have been replaced one at a time with Flygt pumps with the N-style impeller. The original pumps had corrosion issues. The N impellers and these pumps have proven very reliable in submersible service and in pumping disposable wipes, which present great challenges for all wastewater treatment systems. The pumps are inspected and serviced regularly but have required no repairs to date.
- Notable features. The pump power and control cables are connected with Meltric connector plugs that sit within the wet well gas space. According to WWTP staff the plugs have been in place for several years without any issues. This method of providing a way to disconnect the pump power and remove pump from the wetwell appears to be efficient. It eliminates any obstruction, such as a junction box above the intake pump station that could obstruct traffic in entrance driveway.

2.1.2 MCC and Generator Rooms

The generator is well maintained and has just received a controls upgrade. The system is load tested periodically, run once a month on a regular schedule, and periodically is called to run after an area power failure. It has ample capacity to power the WWTP.

2.1.3 Headworks

Raw sewage from the Influent Pump Station discharges into a covered, open channel and flows to the influent bar screen. Bar screen effluent flows thru the vortex grit unit, Parshall flume, and onto the box where return activated sludge RAS combines with the screened and degritted-influent and is then split between the two oxidation ditches (Photo 1).

- Capacity. The bar screen is functioning well with no comments associated with high water levels upstream of the screen indicating possible capacity issues (Photos 2 and 3). There is a manual bar rack (Photo 4) that can be installed in a parallel channel if the installed screen fails. The Pistagrit vortex grit removal unit (Photo 5) is also functioning well with no significant accumulations of grit downstream to indicate that the unit is overloaded.
- Equipment. The Parkson bar screen replaced the original screening equipment. It was rebuilt approximately 10 years ago and is still in good condition. The screenings compactor is in good condition. According to WWTP staff, no issues have been observed with the screenings compactor tube (Photo 6). The Pistagrit unit has had some wear but that is not unusual in grit service. The air lift tube wore out and has been replaced. The cyclone at the top of the air lift wore out and has been rebuilt. The grit-classifier is located in the grit and screenings dumpster area on the main level of the headworks building; it was replaced at some time since the mid-1990s. It appears to be working well. The Parshall flume and instrumentation appears to provide accurate plant influent flow information.
- Notable features. As seen by the extensive amount of corrosion and liner damage over the RAS/Influent splitter weirs and under the cover of the influent wet well, it appears there is insufficient air flow/change to prevent build-up of corrosive gases. This issue is likely the result of either or both of inadequate blower capacity or ducting capacity.

2.1.4 Odor Control System

- Capacity. As evidenced by severe corrosion and degradation of the concrete liner, either the odor system has insufficient capacity or the distribution of air changes across the system is not adequate. That said, when the system is running, odor complaints from offsite are infrequent. So, there may be enough air moved to contain odors but not enough to reduce condensation and formation of sulfuric acid on gas environment contact surfaces.
- Equipment. The odor control fan needs to be replaced (Photo 7). An evaluation should be conducted to determine the proper size fan for this application. The carbon scrubber vessel (Photo 8) appears to be in good condition. If the evaluation indicates that more surface area or carbon volume is required, it might make sense to install a second, parallel vessel rather than replace the existing with a larger tank.

2.1.5 Oxidation Ditches

Combined influent and Return Activated Sludge (RAS) is split into either of the two oxidation ditches (Photo 9). Dissolved oxygen for biological consumption and mixing energy/lateral movement in the ditches is supplied by large, deck-mounted vertical mixers which have a type of paddle aerator turning below the water surface. The agitation entrains air into the mixer liquor and the energy imparted by the turning paddles, drives flow around the ditch circle. Flow exits the ditch over manually, adjustable side weirs. As the weir invert is raised, the mixing disks are further submerged driving more dissolved oxygen into the mixer liquor. As the speed of the disks are increased, more oxygen is transferred and the rate at which the mixed liquor travels around the ditch increases.

- Capacity. During the summer months, when water temperature is higher, WWTP staff raise the oxidation weirs to the highest levels. The purpose of this is to introduce enough dissolved oxygen in the mixed liquor to reduce the ammonia levels. Oxygen is the limiting factor here. In addition, the mixers are run at a higher speed twice a day. By October, operation of the ditches returns to the normal mode as the waste water cools.

- Equipment. The aerators and oxidation ditch design was done by Eimco. There are large, gearbox assemblies that drive the mixer shaft (Photo 10) that sit in noise enclosures (Photo 11) on the oxidation ditch deck. This equipment has worked well and there is a spare motor on site.

2.1.6 Secondary Clarifiers

Mixed liquor splits to either of two secondary clarifiers. During summer flows, one clarifier can be down for service (Photo 12). There are no process mechanical issues with the secondary clarifiers.

- Capacity. There appear to be no capacity issues.
- Equipment. The clarifier mechanisms are manufactured by Eimco. The original drives and motors are in service. Typically, well-maintained clarifier drives have long life spans (Photo 13).

2.1.7 RAS/WAS/Scum Pumps

The RAS pumps pull settled mixed liquor from the floor of the secondary clarifiers and return to the mixing and splitter box just downstream of the Parshall flume at Headworks. The Waste Activated Sludge (WAS) pumps pull from the bottom of the clarifier and send waste mixed liquor sludge (theoretically the quantity of biomass grown on a daily basis) to the WAS aerobic digester/holding tanks for later dewatering on the belt filter press. The Secondary Scum pump pulls secondary scum from the scum sump between the secondary clarifiers and pumps to the WAS holding tank. No issues with capacity, functionality, or condition were observed (Photo 14).

2.1.8 Chlorine Contact Basins and W3 Pumps

Secondary clarifier effluent enters the Chlorine Contact Basins, has hypochlorite solution diffused into the stream, passes thru the serpentine flow path that is designed to achieve a design contact time and then discharges to the outfall. There is the wide spot just prior to outfall discharge that provides a wet well for vertical turbine, W3 pumps to pull suction. There are no capacity, functionality, or condition issues with this process or equipment (Photos 15 and 16).

2.1.9 Chemical Systems

Hypochlorite is delivered in 12% concentration and stored in a new 6,200 HDPE tank. This is a black tank. The black tank (increased temperature of the hypochlorite) could possibly be contributing to an increase observed in off-gassing and vapor locking of the hypochlorite metering pumps (Photo 17) from prior operations. It also may have nothing to do with it.

A recirculation pump has been added to ensure continuous hypochlorite flow from the tank suction connection, past the pump suction points, and back to the tank. This is a commonly-implemented strategy designed to prevent chemical from sitting in the pipes and off-gassing to the point of accumulating enough gas to break suction. So, this is not a critical issue at this point, but the City may wish to look into this a bit more to see if there’s better strategies to avoid this situation. Typically, ensuring adequate flooded suction and no high points in suction piping is sufficient. But other pump types such as peristaltic and hose pumps are options to consider instead of diaphragm metering pumps (what is currently installed) because these pumps better handle the off-gassing issue.

There are no capacity or equipment issues with the Sodium Bisulfite metering system. Only recently was a chlorine residual limit established but they have been feeding bisulfite for many years as a best practice.

2.1.10 Old Wastewater Plant (Aerobic Digesters)

WAS is pumped to the aerobic digesters (Photo 18) where it is aerated in order to avoid odor issues as well as to facilitate aerobic digestion of the sludge.

- Capacity. There appear to be no capacity issues.
- Equipment. There are likely some missing coarse bubble diffusers in the aeration system. The air is shut off daily for about 4 to 5 hours to allow the sludge to settle and thicken. The tank is decanted back to the

influent pump station and the thickened sludge, around 8,000 mg/L, is pumped to the belt press for dewatering (Photo 19). Approximately 30,000 gallons per day of thickened WAS is delivered to the belt press. The dewatered cake is about 14% solids, suitable for blending with wood chips in the composting process. The cake is hauled out to the landfill where the composting system is located. The composting process generates significant heat rendering a Class A sludge product, available to the public, after a prescribed composting period. These tanks are remnants from the original treatment plant. Likely these tanks would perform poorly in a significant seismic event.

2.1.11 Blower Room

Air is delivered to the aerobic digesters (waste activated sludge [WAS]) via a pair of rotary lobe blowers located in the lower level of the Operations building. They have 60-horsepower motors and produce about 1,200 cfm of air (Photo 20). They operate around 19 hours per day with additional run time in the summer. These blowers are in good condition and have adequate capacity. However, rotary lobe blowers are not particularly efficient from a power-usage standpoint. This could be a consideration with respect to upgrading these blowers, as is discussed in Section 3.

2.1.12 Belt Press

There are no capacity or equipment issues with the belt press or belt press room (Photo 21).

2.2 Instrumentation and Control

The majority of the instrumentation and control systems and instruments remain from the 1990s upgrade of the WWTP to secondary treatment. Equipment, cabinetry, and panels are kept clean and good working order (Photo 22). Control panels are clean, and wiring is still orderly indicating proper care has been taken during maintenance (Photo 23). Overall, the instrumentation and control systems and instruments have been well-maintained and are in good working order.

2.2.1 WWTP SCADA HMI

The WWTP's SCADA HMI system was upgraded within the last two years and does not require any major additional upgrades at this time. Normal maintenance of the application and security updates is important and should be diligently continued.

2.2.2 PLCs, VFDs, and UPSs

However, one of the major issues that is ongoing at the WWTP, and is common to all such facilities, is aging of the instrumentation and control equipment. While many electrical and electronic devices have the capacity to last up to 30 or even 40 years, the accepted lifespan of instruments and controllers is 15 to 20 years. The main reason for this is the rapid pace of technological advancement with these systems and the associated lack of availability of support for systems older than 15 years. The key critical control components for the WWTP are the system programmable logic controllers (PLCs), the variable frequency drives (VFDs), and the control panels' uninterruptable power supply (UPS). All of these have been well maintained but have exceeded their useful expected life (Photos 24, 25, 26). Each of these elements are obsolete and not supported by the original manufacture since about 2010. Each of these elements are considered high value items (over $5,000 each). The PLC and VFD system replacements are not a simple part-swaps and will require engineering to develop the replacement strategy. For these items the replacement should be performed within the next year or two.

2.2.3 Instruments

The more common instrument components are also at end of their useful life spans and some even obsolete. New direct replacement elements are available for most of these with only slight mounting differences. For these types of items, maintenance plans should be created that identify the next repair item to purchase when needed. Then, these items can be changed out with new components when needed. It was noticed that the transmitter for the plant flow flume flow meter FIT-460 has issues with the LCD display. Magnitrol no longer makes replacements for this meter and since plant flowrate is used by other processes it should be considered for a near-term replacement.

2.2.4 Influent Pump Station

The instruments, conduit, and associated support elements inside of the influent structure need to be replaced due to corrosion. The area gas transmitter located inside the wet well shows extreme corrosion and the corresponding reading on the panel meter is off, indicating that it has failed (Photos 27, and 28).

2.2.5 Miscellaneous

- It was observed that the electrical equipment, motor control centers, VFDs, control panels, etc, do not have Arc Flash and PPE requirement labels on them. This was an added requirement in the 2008 NEC.
- Many of the flexible conduit connectors show rust, these should be coated with a rust protectant coating (Photo 30).
- Previous upgrade projects resulted in abandoning some components that are still in place. The network radio antenna's function has been replaced by a new network service to the facility (Photo 31). The new Sodium Hypochlorite tank uses a visual tank measurement, leaving the Milltronics transmitter located in the containment abandoned in place (Photo 32). The sodium bisulfite is metered with manual settings. A Strantrol Dechlor controller that was apparently previously used for metering is de-energized inside of CP1 (Photo 33). There may be other instruments that due to change in process needs have been abandoned in place.

2.3 Corrosion

Overall the WWTP is in relatively good condition from a corrosion standpoint – better condition than most WWTPs of with this number of years in service. The cathodic protection test stations were checked to determine the status of this corrosion protection system for buried pipe. The anodized aluminum handrails, grating, and covers are in very good condition. WWTP staff have done a good job maintaining protective coatings. That stated, there are some corrosion issues that will need corrective action.

2.3.1 Intake Pump Station

The Intake Pump Station (IPS) is exposed to corrosive conditions caused by release of hydrogen sulfide gas. The odor control system removes some of the corrosive atmosphere, but enough hydrogen sulfide remains to cause deterioration of pump station materials over time.

- <u>Concrete</u>. Corrosion of the concrete walls and ceiling has exposed the aggregate. It is estimated that the depth of concrete deterioration is ¾- to 1-inch. No exposed reinforcing steel was observed (Photos 34 and 35).
- <u>Electrical</u>. Electrical and I&C conduit and junction boxes appear to be PVC coated, but these are severely corroded where the PVC coating has deteriorated. These instruments, conduit, and ancillary equipment need to be replaced.
- <u>Pump Guide Rails</u>. The pump guide rails appear to be stainless steel. The rails are in good condition, with some discoloration and minor corrosion in the head space.
- <u>Hatch Covers</u>. The aluminum hatch covers are in good condition.

2.3.2 MCC and Generator Rooms

These facilities are air conditioned and no corrosion issues were observed.

2.3.3 Headworks

The headworks channels and basins are covered and head space air is removed and exchanged with fresh air by an odor control system. A plastic embedded liner ("T-Lock") provides corrosion protection from residual hydrogen sulfide gas. Bar screens are stainless steel.

- Embedded Liner. The embedded liner is generally in good condition (Photo 36). There are several isolated locations in the channels where the liner has failed and concrete is corroding.
  - ✓ Isolated failures were observed at the Parschall Flume (Photo 37).
  - ✓ The embedded liner has failed on a concrete support column in the RAS return basin. It appears that the liner was not completely installed over the cap of the column, and corrosion of the concrete has occurred from the top of the column down, allowing the embedded liner to peel away from the concrete at the corners (Photo 38). The process is turbulent in the RAS return basin, a condition that liberates hydrogen sulfide gas and creates a more corrosive condition.
  - ✓ Liner failure was also observed in the RAS return basin where the embedded liner was terminated next to stainless steel embeds for temporary gates (Photo 39).
- Stainless Steel Bar Screens. The stainless steel bar screens were found to be in good condition.
- Traveling Screen. The traveling screen is fabricated with stainless steel components; no corrosion issues observed.
- Aluminum Channel and Basin Covers. The aluminum covers had a light covering of aluminum corrosion product, a condition normally observed in this application. The covers were in very good condition.
- Gate operator stems and brackets. These appeared to be in good condition.
- Above-Grade Materials, Miscellaneous.
  - ✓ A short section of ductile iron W3 pipe near the traveling screen is not painted (Photo 40).
  - ✓ Moderate corrosion was observed where the pipe was not provided with thermal insulation.
  - ✓ Conduit fittings are corroding.
  - ✓ The painted air intakes for the MCC and generator rooms are in good condition.
  - ✓ A fiberglass box installed to house I&C equipment is starting to deteriorate from UV exposure (Photo 41).
  - ✓ The stainless steel and painted steel electrical enclosures appear to be in good condition.

2.3.4 Odor Control System

- Odor Control Duct.
  - ✓ The stainless steel odor control duct on the top of the headworks appears to be in good condition.
  - ✓ The vertical stainless steel odor control duct has some external staining, and may have some small wall penetrations at a weld due to internal corrosion.
  - ✓ The horizontal stainless steel odor control duct at grade level has numerous pipe wall penetrations due to internal corrosion (Photos 42 and 43). Most, but not all, of the penetrations are at the bottom of the duct.
- Fan. Some surface corrosion was observed on the fan housing.
- Fiberglass Filter Tank. No corrosion issues were observed.

2.3.5 Oxidation Ditches

- No corrosion issues were observed.

2.3.6 Secondary Clarifiers

- The south secondary clarifier was drained and available for visual observation (Photo 44).
- Clarifier Mechanism.
  - ✓ The paint on the secondary clarifier mechanism is maintained on a regular basis by plant staff. There are some areas where minor corrosion is occurring at coating defects (Photo 45). Overall, the paint system is in good condition considering its age.
  - ✓ Carbon steel fasteners on the mechanisms failed and were replaced with stainless steel hardware.
- Concrete.
  - ✓ No corrosion issues observed on submerged concrete or on concrete floor.
  - ✓ Some leaching of the concrete launder has occurred, and some aggregate is exposed (Photo 46). The amount of leaching does not appear to be excessive and is not anticipated to an issue.
- Walkway. The galvanized steel walkway is in good condition.
- Motor and Drive. The paint on the motor and drive is in good condition.
- Fiberglass Weirs and Baffles.
  - ✓ The fiberglass weirs and baffles are in good condition.
  - ✓ Stainless steel hardware is in good condition.
  - ✓ Carbon steel support brackets are corroding (Photo 47).
- Pump Station. Paint on exposed piping and appurtenances appears to be regularly maintained and is in good condition. No corrosion-related issues observed.

2.3.7 Chlorine Contact Basins

- Overflows. The coating on the overflows appears to be in good condition.
- Gate Operator Stems. The gate operator stems are corroding at the water surface.
- Wood Planks. The wood planks above water are showing signs of rot. The condition of the planks below water was not observed.

2.3.8 Chemical Systems

- Hypochlorite.
  - ✓ The original fiberglass hypochlorite tank was replaced with a 6,200 gallon high density polyethylene tank. No corrosion issues were observed on this tank.
  - ✓ Pump Room. No corrosion issues were observed.
- Sodium Bisulfite. No corrosion issues were observed on the tank or in the pump room.

2.3.9 Grit Removal

- Pump and Suction Piping. Some items of the grit removal pump and suction piping on top of the headworks have eroded or corroded and been replaced or repaired by plant staff.

- Grit Room. The grit classifier was replaced about 10 years ago and appears to be in good condition. The grit room is well-ventilated and no corrosion issues were observed.

2.3.10 Belt Press

- Belt Press. The belt press room is well ventilated, and no significant corrosion of exposed metals was observed on the belt press.
- Miscellaneous.
  - ✓ Light Fixtures. The metal housings on the light fixtures are starting to rust.
  - ✓ Steel Door Frame. The base of the steel door frame is corroding.
  - ✓ Platform Columns. The grout used under the base of the aluminum platform columns has deteriorated.
  - ✓ Platforms and Gratings. The aluminum platforms and grating are in good condition.

2.3.11 Blower Room

- No corrosion issues were observed.

2.3.12 Old Wastewater Plant (Aerobic Digesters)

- No corrosion issues were observed.

3. Summary of Recommended Improvements

A summary of recommended improvements is presented herein on a per-facility basis for Mechanical Systems and Corrosion combined within the same subsections. Recommended improvements for Instrumentation and Control are presented separately.

3.1 Mechanical Systems and Corrosion

The following items are recommended for improving plant performance or increasing reliability and reducing maintenance efforts.

3.1.1 Influent Pump Station

A protective coating is recommended for the interior walls and ceiling of the influent pump station. This protective coating is required to mitigate corrosion of the concrete due to hydrogen sulfide gas. A typical corrosion protection coating for this application would include:

- Dewatering and cleaning with high pressure water to remove surface contaminants and loose concrete.
- Abrasive blasting or high-pressure water wash to reach sound concrete.
- Application of cementitious surface restoration product to restore concrete thickness and provide a smooth surface for coating.
- Application of a high performance, high build epoxy coating designed for exposure corrosive conditions associated with hydrogen sulfide gas.

The concrete will continue to deteriorate under the current operating conditions. A protective coating project should be budgeted and scheduled for implementation within the next three to five years.

The electrical and I&C conduit, fittings, and sensors need to be replaced because of corrosion (see Section 3.2, Instrumentation and Control).

In order to accomplish the bypass pumping around this influent pump station, there will have to be a pump around set up for the wetwell. There is a manhole across the drive from the pump station where temporary pumps could draw suction. (Photo 48). The pumps could discharge thru a hose across the drive and then into a rigid pipe to carry the sewage up to the Headworks Building roof, discharging into a headworks open channel. (Photos 49 and 50). This pump around could last for one month in order to accomplish the coatings prep, concrete repair and new coatings process. During this time, access to the plant offices and lab, sludge cake loadout, and the screenings and grit dumpster would have to be maintained. Possibly a lightweight truss bridge could be constructed to carry the temporary pump discharge above truck height across the drive.

This project would require outside consulting services to develop a bidding document to procure a contractor to do this work.

3.1.2 Headworks

The embedded plastic liner needs to be repaired in several areas of the headworks facility. Significant corrosion of the concrete has occurred on the column in the RAS return basin (the last basin of the headworks). These repairs will need to be performed by a specialty contractor. Smaller repair areas on walls will need to be repaired with plastic liner material. The repairs to the column plastic liner can be repaired by restoring the concrete and replacement of the embedded liner or wrapped with carbon fiber.

The repairs to the concrete column should be made within the next two years. It will be necessary to bypass the channels and RAS return basin to make these repairs.

This project would require outside consulting services to develop a bidding document to procure a contractor to do this work. It is assumed that this work would be completed as part of the same construction contract as the Influent Pump Station coating system work.

3.1.3 Odor Control

It may be possible to revise the odor control system to remove more air, increase air changes, and reduce the concentration of hydrogen sulfide gas in the RAS return basin of the Headworks and to the influent pump station. Duct sizes conveying this system should be checked to confirm the ducts are adequately sized. A desktop evaluation of the odor control system would be necessary to assess the potential for improvements. Revising and upgrading the system could reduce corrosion related to hydrogen sulfide.

Some of the WWTP's odor-scrubbed areas do not appear to be experiencing this same hydrogen sulfide corrosion resulting from inadequate air changes and scouring. These areas include: the grit and screenings dumpster room, the screenings channel, and the grit vortex channel.

In addition to modifying the odor control capacity, the odor control duct from the top of the headworks to the filter tank has been penetrated by corrosion and will need to be replaced. At this point, the holes are small. However, they will become larger as corrosion inside the duct continues. The duct should be scheduled for replacement within one to two years. Polymer-lined, stainless steel duct has been used successfully on several recent wastewater treatment plant projects and would be a suitable option for this installation.

3.1.4 Oxidation Ditches

Given the approach WWTP staff undertake during summer to achieve effective sludge oxidation, it appears that oxygen appears to be a limiting factor in the performance and capacity of the oxidation ditches. Given there is no other apparent, current limitation to the WWTP capacity, oxygenation of the sludge appears to potentially be the limiting factor on WWTP capacity. This should be checked to confirm there isn't already a capacity issue that should be addressed. A biological process capacity evaluation is recommended. This is a desktop modeling analysis and should be incorporated into the City's plans within the next 5 years.

As noted earlier, WWTP flows have not risen beyond the levels that trigger an update to the facility planning documents (85% of WWTP capacity per Ecology). But, it is possible that due to reduction in combined storm flows, reduction in infiltration into the sanitary sewer resulting from new and improved sewer piping, and the ever-increasing numbers of low flow and flush fixtures, that the wastewater load (BOD) is increasing. This is likely driving the need to increase oxygenation of the mixed liquor sludge during the summer. If this were determined to be the case, options for increasing oxygenation could be evaluated, which would increase the capacity of the Oxidation Ditches.

3.1.5 Secondary Clarifiers

- The coating on the secondary clarifier mechanisms is over 25 years old. It appears to be in relatively good condition, but epoxy coatings on steel in this environment generally have a service life of 20 to 25 years. Budget for recoating should be set aside for a project to be implemented in the next 5 to 10 years for both of these mechanisms. The actual date for repainting can be determined based on periodic observation of the mechanisms by City staff. There is no need to undertake the recoating until it is determined to be necessary. This project would require outside consulting services to develop a bidding document to procure a contractor to do this work.
- Leaching has occurred on the concrete launders for each of the two secondary clarifiers. It is possible to coat these items with epoxy coating, but it will introduce potential coating maintenance for plant staff. The amount of concrete leaching currently does not warrant installation of a protective coating. However, WWTP staff should monitor and document the pace of corrosion and consider coating the launders in the future if concrete deterioration significantly increases. This project would require outside consulting services to develop a bidding document to procure a contractor to do this work.

- The carbon steel weir support brackets should be replaced with stainless steel. The brackets do not appear to be in imminent risk of failure, so this activity could be scheduled to occur with a mechanism repainting project – in the next 5 to 10 years. This work could be done by City staff.
- Part of a desktop biological process evaluation of the oxidation ditches typically includes a check on secondary clarifier capacity particularly concerning the surface solids loading rate. Often-times the limiting unit process for overall secondary treatment capacity, assuming that you can supply enough oxygen to the biomass, is the ability of the clarifiers to settle the solids from the effluent. Current plant effluent is very high quality. It would be interesting to know in a clarifier study what the maximum mixed liquor concentration could be to the clarifier and still maintain the current effluent quality. This value would translate then back into the pounds of BOD loading that the plant can handle ultimately representing the population that the plant can treat.

3.1.6 Chemical Systems

In reference to the off-gassing issue for the sodium hypochlorite system, the City may feel comfortable with its current strategy to avoid pump-binding, but it may also wish to explore options either internally or as a byproduct of another project at the WWTP.

3.1.7 WAS Blowers

Since the WAS blowers run a significant portion of the day, and have moderate sized motors, they could be good candidates for an energy upgrade project, partially grant-funded by the Washington State Department of Energy Services where an alternate blower would be selected with a greater energy efficiency. Turbo blowers are often touted in the marketplace and indeed are high efficiency machines. There are also hybrid rotary lobes, such as by Aerzen and Kaiser, which are higher efficiency machines than installed now, but they have a greater tolerance for changing discharge pressure resulting from liquid level changes in the sludge storage tanks. The City should consider undertaking an evaluation to assess the need for this replacement and the payback on the investment resulting from lower power cost.

3.1.8 Miscellaneous Corrosion Recommendations

- Some fiberglass enclosures housing various I&C equipment are deteriorating due to UV exposure. The enclosures can be painted to reduce the rate of deterioration and exposure of glass fibers. The procedure would consist of cleaning with biodegradable detergent, light sanding to remove exposed fibers, and painting with two coats of a high-quality latex paint.
- The short section of W3 pipe on the headworks roof that is not insulated should be painted with epoxy.
- The aluminum light standards are in very good condition, but it was noted that screws on the electrical covers are either galvanized or carbon steel. They should be replaced with stainless steel.

3.2 Instrumentation and Control

Recommended improvements, upgrades, and replacements to the instrumentation and control system are presented herein.

3.2.1 Influent Pump Station

Coordinated with the work to recondition the influent wet well, several instruments need to be replaced because of their corroded condition. These include:

- Replace the existing LE & LIT-210 Wet Well Level instrument with a single-sealed unit appropriate for these conditions. An appropriate unit would be Vega's VegaPULS WL61. This replacement would include, as a byproduct, a HART analog Intrinsic Safety Barrier which will allow remote connection and troubleshooting of this new unit.

- Replace the existing LSH & LSL-210 Wet Well low and high-level float switches with new float switches and Intrinsic Safety Barriers, including new 316L stainless steel mounting pole.
- Replace the existing AE & AIT-240 Wet Well Explosive Gas Sensor instrument with a new remote sensor that includes a sample draw system that returns the sample to the wet well. This is typical of current wet well design.
- Replace all conduit inside the wet well, and extending into the buried condition, as applicable, with a new system that includes a handhole outside the pump station where a sealed transition can be made to protected cables (suitable for the wet well environment).

3.2.2 SCADA Programmable Logic Controller (PLC)

The WWTP has an Allen-Bradley PLC5 based control system with a redundant, backup controller and three I/O panels. The PLC5 series of processors and the redundancy module are obsolete as of 2011 with the ControlLogix family of processors identified as their replacement. Allen-Bradley has a migration plan for this upgrade to the ControlLogix family that includes parts to minimize the rewiring of the Input and Output (I/O) modules. Using these will reduce costs and minimize the control system downtime.

An Ethernet Device Level Ring network would replace the Data Highway Plus RemoteIO network that currently connects the three control panel I/O racks together. The Ethernet Device Level Ring network will provide communication path redundancy if there was a problem with one cable segment.

Sequencing of tasks can be done to reduce down times but require multiple control system outages of affected equipment. Manual control of the WWTP would be implemented during these control system outages. These outages would be up to 8 hours duration. Alternatively, a single longer outage maybe possible if the migration adaptor plates that Allen-Bradley offers fit into the existing enclosures.

Prior to undertaking detailed design of this PLC replacement, a preliminary design would be necessary to plan how this work would be implemented. This same preliminary design would enable planning of the other improvements and replacements identified in this section (UPS replacement, VFP replacement, and other minor instrument replacements). The preliminary design to determine project sequencing, phasing, prioritization, and would identify what activities need to be designed by consultant support and what could be accomplished by City staff.

3.2.3 Uninterruptible Power Supplies (UPSs)

Each of the three control panels are equipped with a UPS. Each of these UPSs should be replaced because they are obsolete. Falcon UPS has a UL508 approved UPS designed for critical industrial applications. Their 1.5 KVA unit and maintenance bypass switch would be a good fit for these three systems.

3.2.4 Variable Frequency Drive Replacement

There are seven variable frequency AC drives (VFD) in the plant that are part of the 1990s secondary WWTP upgrade. They are Reliance Electric drives. Reliance Electric was purchased by Allen-Bradley in 1996. These VFDs are installed in large stand-along enclosures. The existing VFDs are Reliance Electric GP-2000 A-C VS Drives with Control Signal Buffer Kits. These components are obsolete and no longer supported. The seven VFDs control the following pump systems.

- Three Influent Pumps – 35 HP
- Three RAS Pumps – 7.5 HP
- One Belt Press Feed Pump – 10 HP

There are two approaches that should be evaluated: (1) retrofit existing enclosures with new VFD and auxiliary components, (2) or replace the entire cabinet with a wall-mounted VFD enclosure.

3.2.5 Flow Meter

The WWTP flow meter, FIT-460 (flume flow meter), needs to be replaced, as it is obsolete and has a broken faceplate. There are several meter alternatives that could be considered. One of note would be using the same instrument that is chosen to replace the influent wet well level transmitter. As an example, the VegaPULS WL61 is well suited for the influent wet well and when combined with the VegaMET creates an instrument that calculates flume or weir flows.

3.2.6 Arc Flash

An Arc Flash Study and hazard identification is required to be completed for the electrical infrastructure at the WWTP. This activity would result in a report and arc flash warning labels for applicable equipment. These Arc Flash requirements are outlined in section 110.16 of the 2017 National Electrical Code (NEC).

4. Summary of Estimated Costs

A summary of estimated initial capital costs for the recommended improvements presented in Section 3 is presented herein on a per-facility basis for Mechanical Systems and Corrosion. Refer to Table 1 below. A summary of estimated costs for the recommended improvements for Instrumentation and Control are presented separately. Refer to Table 2 below.

The estimated initial capital costs presented herein are intended to be used by City for budgeting purposes. Some of the estimated costs are based on undertaking equipment and/or instrument replacement by City staff. Other estimated costs are based on consultant assistance for planning, design, and construction support, in addition to construction costs. These estimated initial capital costs were developed to the “concept level” or “Class 5” level of accuracy as defined by the Association for the Advancement of Cost Engineering International (AACEI). This level of cost estimating is considered accurate to +100/-50 percent.

The estimated costs were prepared based on information available at the time of the estimate. The final cost of the project will depend upon the actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. The purpose of these estimates is to make the best decisions regarding capital expenditures and to provide concept-level guidance for budgeting implementation of mitigation improvements. As a result, the final project costs for each alternative will vary from the estimates presented herein. Because of this variation, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

Table 1. Summary of Estimated Costs for Mechanical and Corrosion Improvements

Item No.	Name	Described in Section	Estimated Cost	Comments
1	New Influent PS Coating System	3.1.1	$225,000	High priority – complete in next 2 years.
2	Headworks Plastic Liner Repair	3.1.2	$150,000	High priority – complete in next 2 years. Estimated cost assumes completing this work as part of the Influent PS Coating work.
3	Odor Control System Evaluation	3.1.3	$30,000	High priority – complete in next 2 years.
4	Odor Control System Duct Repair	3.1.3	$20,000	High priority – complete in next 2 years. This can be completed by City staff directly contacting specialty contractor.
5	Oxidation Ditch Capacity Evaluation	3.1.4	$50,000	Medium priority – compete in next 5 years.
6	Secondary Clarifier Mechanism Recoating	3.1.5	$250,000	Medium priority – complete in next 5 to 10 years.
7	Concrete Launder Coating	3.1.5	$75,000	Medium priority – monitor and complete as needed. Combine with secondary clarifier mechanism recoating.
8	Replace Carbon Steel Weir Supports	3.1.5	$20,000	Medium priority – replace in next 5 to 10 years. Combine with secondary clarifier mechanism recoating.
9	Secondary Clarifier Capacity Evaluation	3.1.5	Included in Item 5	Complete as part of Item 5, Oxidation Ditch Capacity Evaluation
10	Sodium Hypochlorite Off-Gassing	3.1.6	Low – use O&M budget	Low priority – complete if deemed necessary with City staff or as part of another capital project at the WWTP.
11	WAS Blower Evaluation	3.1.7	$20,000	Medium priority – complete when blowers begin to reach their anticipated useful life (next 5 to 10 years).
12	FRP Enclosures of I&C Equipment	3.1.8	Low – use O&M budget	Low priority – complete as desired or contemplate replacement.

13	W3 Pipe on Headworks Roof	3.1.8	Low – use O&M budget	Low priority – complete as desired or contemplate replacement.
14	Screws on Electrical Covers of Aluminum Light Standards	3.1.8	Low – use O&M budget	Low priority – complete when convenient.

Table 2. Summary of Estimated Costs for Instrumentation and Control Improvements

Item No.	Name	Described in Section	Estimated Cost	Comments
1	Influent PS Instrument Replacement	3.2.1	$50,000	High priority – complete within the next 2 years as part of the coating system.
2	PLC Replacement	3.2.2	$450,000	High priority – complete within the next 3 years. This estimate includes predesign, design, installation, equipment, programming, and testing.
3	UPS Replacement	3.2.3	$10,000	This cost is for the equipment, only. Complete this work as part of the PLC replacement project.
4	VFD Replacement	3.2.4	$75,000	High priority – this work needs to be done within the next year because of lack of spare parts and failure experience. This estimate is based on direct contact by City to Rockwell Industrial Engineering Services to rebuild existing VFDs and provide warranty.
5	Flow Meter	3.2.5	$10,000	High priority – complete in next 1 to 2 years. This can be done by City staff.
6	Arc Flash	3.2.6	$30,000	High priority – complete within the next year. This is as safety and code-compliance issue.

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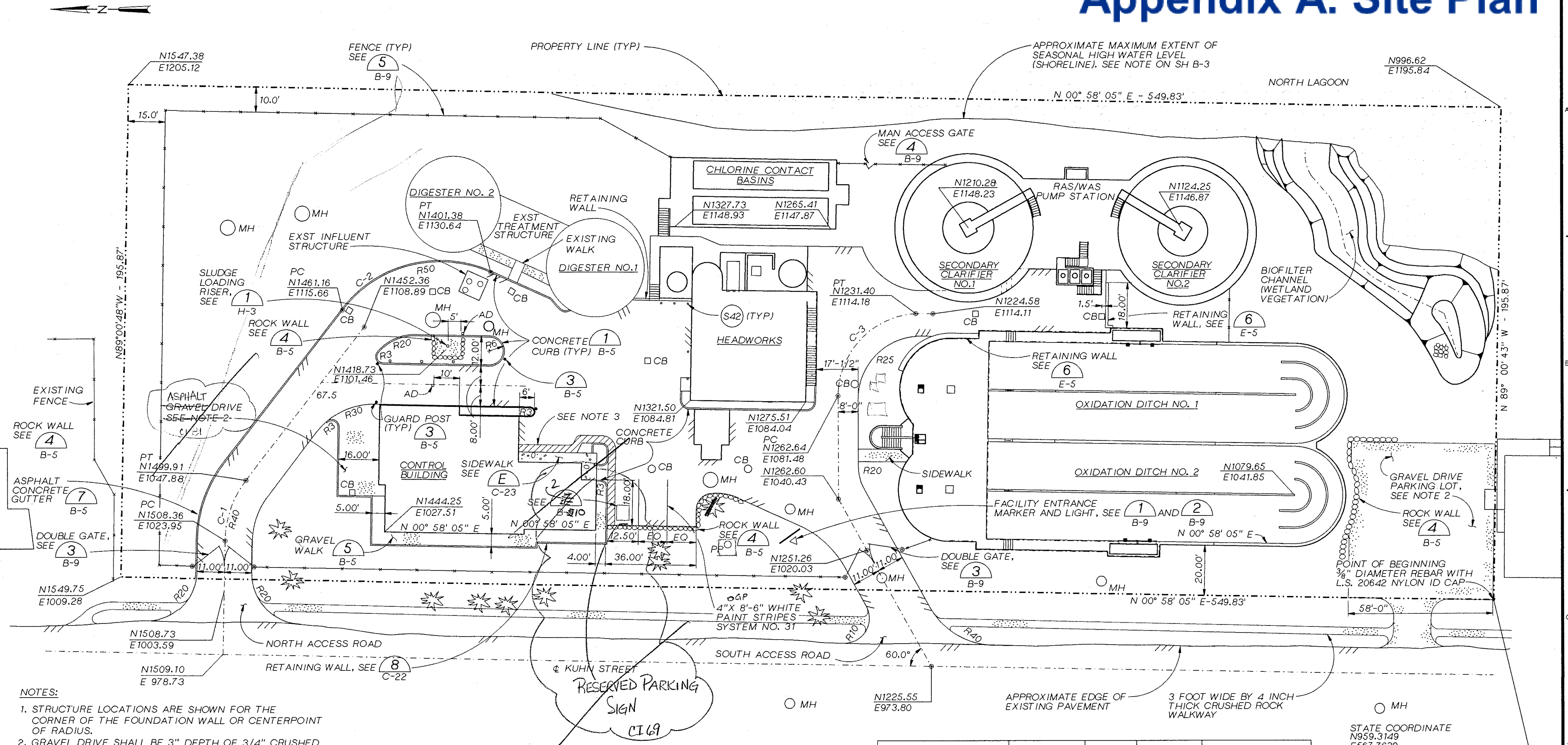
Appendix A. Site Plan



NOTES:

1. STRUCTURE LOCATIONS ARE SHOWN FOR THE CORNER OF THE FOUNDATION WALL OR CENTERPOINT OF RADIUS.
2. GRAVEL DRIVE SHALL BE 3" DEPTH OF 3/4" CRUSHED ROCK, SPECIFIED AS GRANULAR PIPE BASE IN SECTION EARTHWORK, OVER 7" DEPTH COMPACTED CRUSHED SURFACING BASECOURSE.
3. ~~THREE-FOOT WIDE~~ 44" HANDICAPPED ACCESS ROUTE. MARK WITH 4" WHITE SYSTEM NO. 31 PAINT STRIPES.
4. FOR CONTRACTOR'S STAGING AREA, SEE THE SPECIFICATIONS. CI 69

C-1 CURVE DATA	C-2 CURVE DATA	C-3 CURVE DATA
Δ=37°	Δ=75.92	Δ=89.35
L=25.83	L=66.25'	L=49.81'
T=12.55'	T=39.07'	T=33.02'

LEGEND

- PCC PAVEMENT AND SIDEWALKS
- ASPHALT CONCRETE PAVEMENT, SEE 4 B-4
- CRUSHED ROCK SURFACE, SEE 5 B-5 (SIM)
- ROCK WALL, SEE 4 B-5

PLAN
1"= 20'

STRUCTURE	OCCUPANCY	AREA (SQ FT)	STORIES	NO. OF OCCUPANT LOAD
CONTROL BUILDING	B-2	4367	2	22
HEADWORKS/ CARBON TOWER/ HYPOCHLORITE TANK	B4/M2/H2	4685	2 + BASEMENT	2
CHLORINE CONTACT BASINS	M-2	1620	BASEMENT	--
SECONDARY CLARIFIER/ PUMP ROOM	M2/B4	3725	1	--
OXIDATION DITCH	M2	13920	1	--

BRIAN J. EIS, STATE OF WASHINGTON, 25356, REGISTERED PROFESSIONAL ENGINEER

CH2M HILL

DSGN	J. IRISH
DR	P. BAKER
CHK	R. FARRELL
APVD	D. PETERSON

NO. | DATE | REVISION | BY | APVD

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VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CITY OF PORT TOWNSEND
WASTEWATER TREATMENT PLANT
JEFFERSON COUNTY, WASHINGTON

SITEWORK/CIVIL
SITE PLAN

SHEET B-2
DWG NO. 9 OF 158
DATE NOV 1991
PROJ NO. SEA22388.RD

Appendix B. Photos


Photo 1: Oxidation Ditch Influent/RAS Splitter Box


Photo 2: Bar Screen in Channel

Photo 3: Bar Screen Enclosure and Compactor

Photo 4: Manual Bar Rack

Photo 5: Pista Grit Drive Mechanism and Rebuilt Vortex Separator

Photo 6: End of Screenings Compactor Tube and Odor Control Drawoff for Screenings and Grit Room

Photo 7: Odor Control Fan

Photo 8: Carbon Vessel

Photo 9: Oxidation Ditches

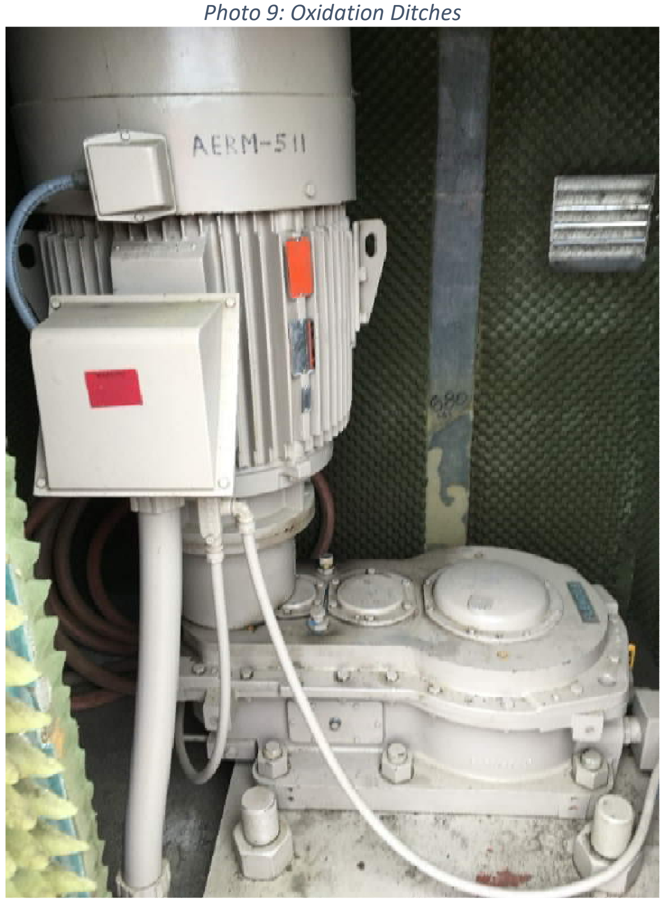

Photo 10: Paddle Aerator Drive

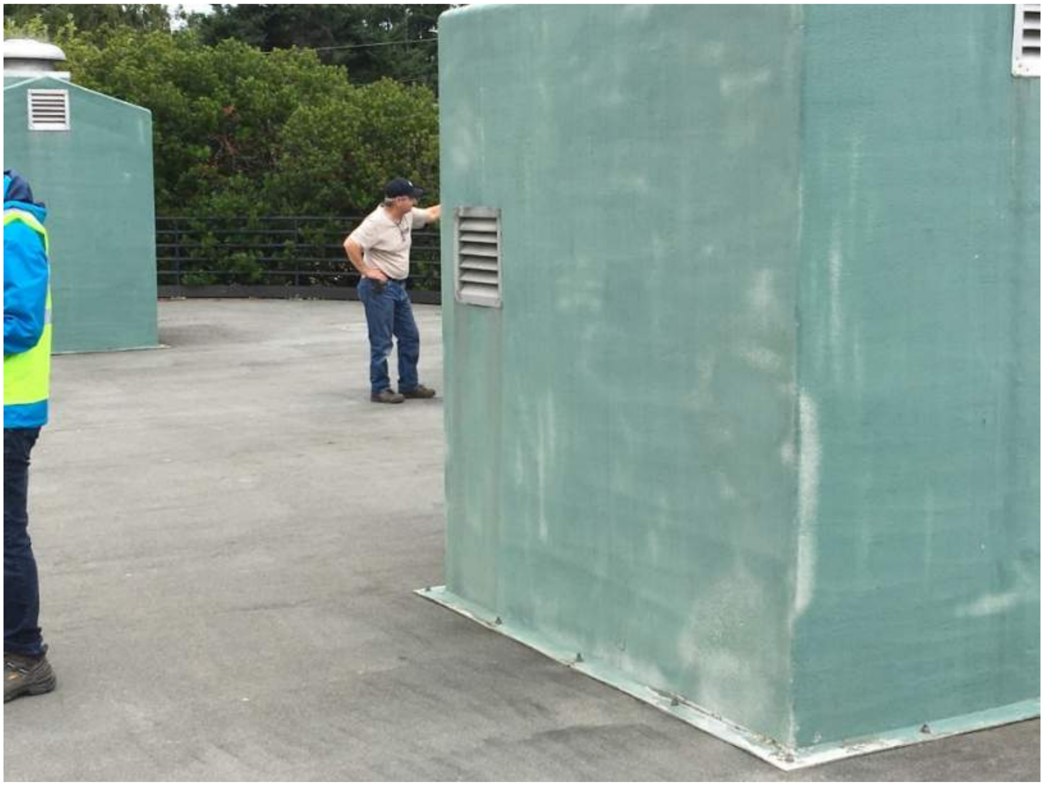

Photo 11: Paddle Drive Enclosures

Photo 12: Secondary Clarifier

Photo 13: Clarifier Drive Mechanism

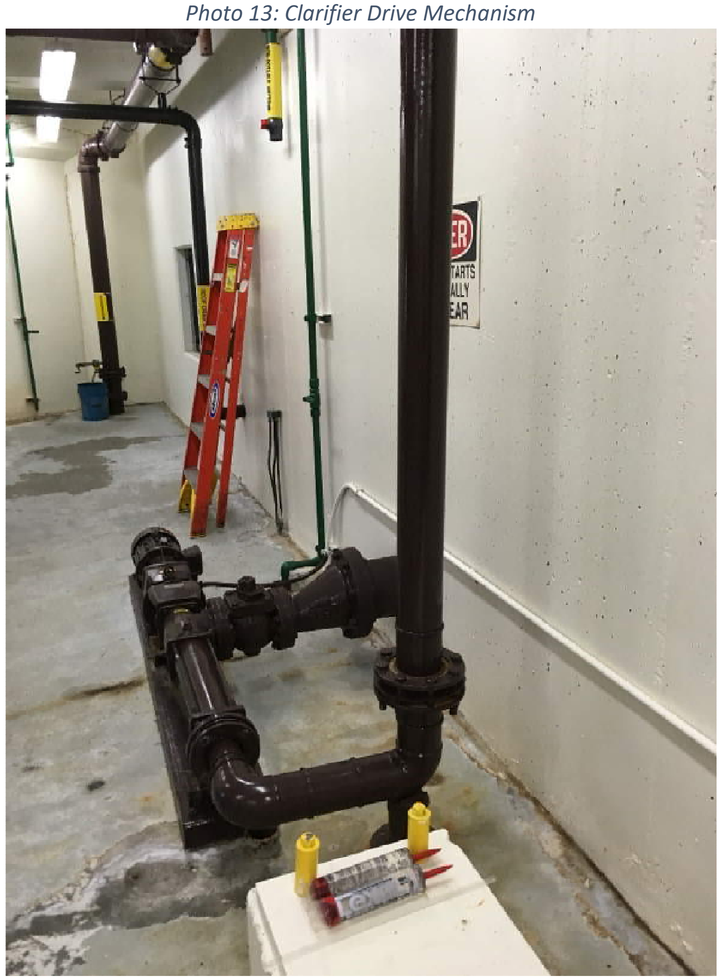

Photo 14: Secondary Scum Pump in RAS/WAS Pump Room

Photo 15: Chlorine Contact Basin

Photo 16: W3 pump and Effluent Sampler

Photo 17: Hypochlorite Metering Pump

Photo 18: WAS Aerobic Digester

Photo 19: Belt Press Feed Pump

Photo 20: Aerobic Digester Blowers

Photo 21: Belt Press

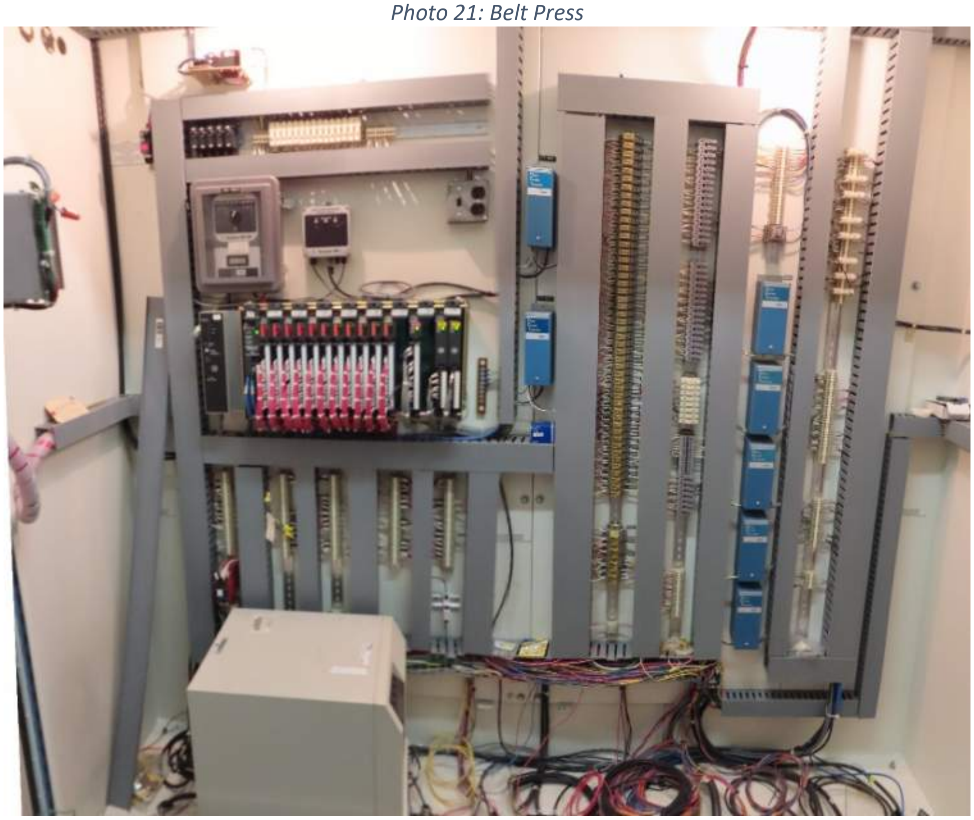

Photo 22. Equipment is clean and in good working conditions

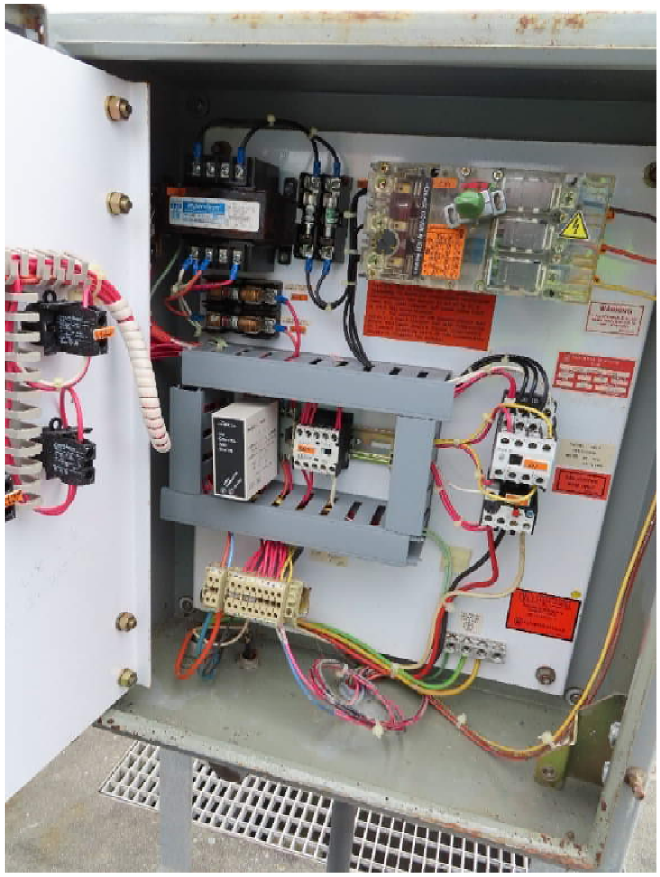

Photo 13. Control panels are clean and in good conditions

Photo 24. Conditions of PLC

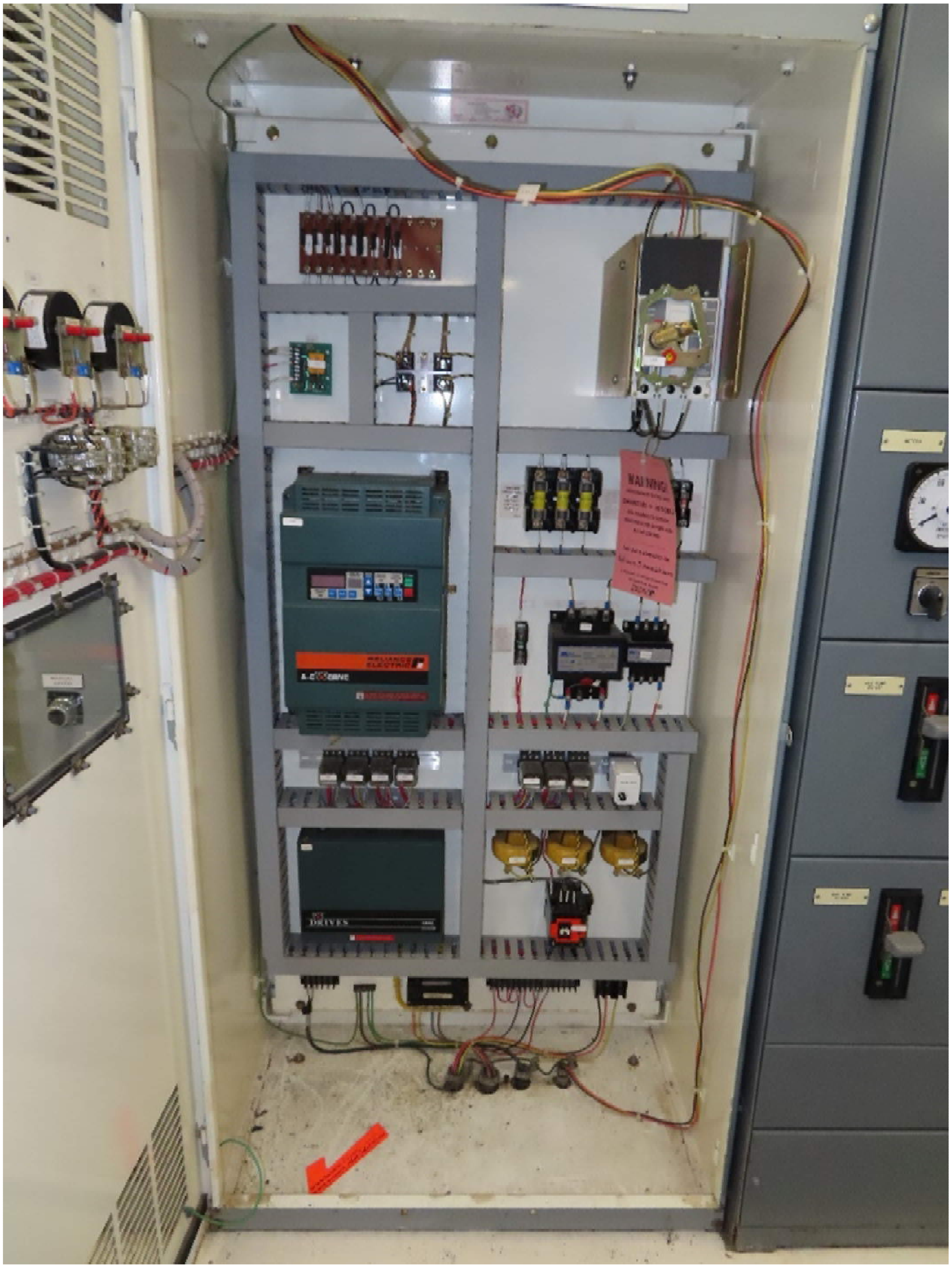

Photo 25. Conditions of VFD

Photo 26. Conditions of UPS

Photo 27. Gas transmitter experiences extreme corrosion

Photo 28. Gas transmitter experiences extreme corrosion

Photo 29. Corrosion of conduits and enclosures located outside

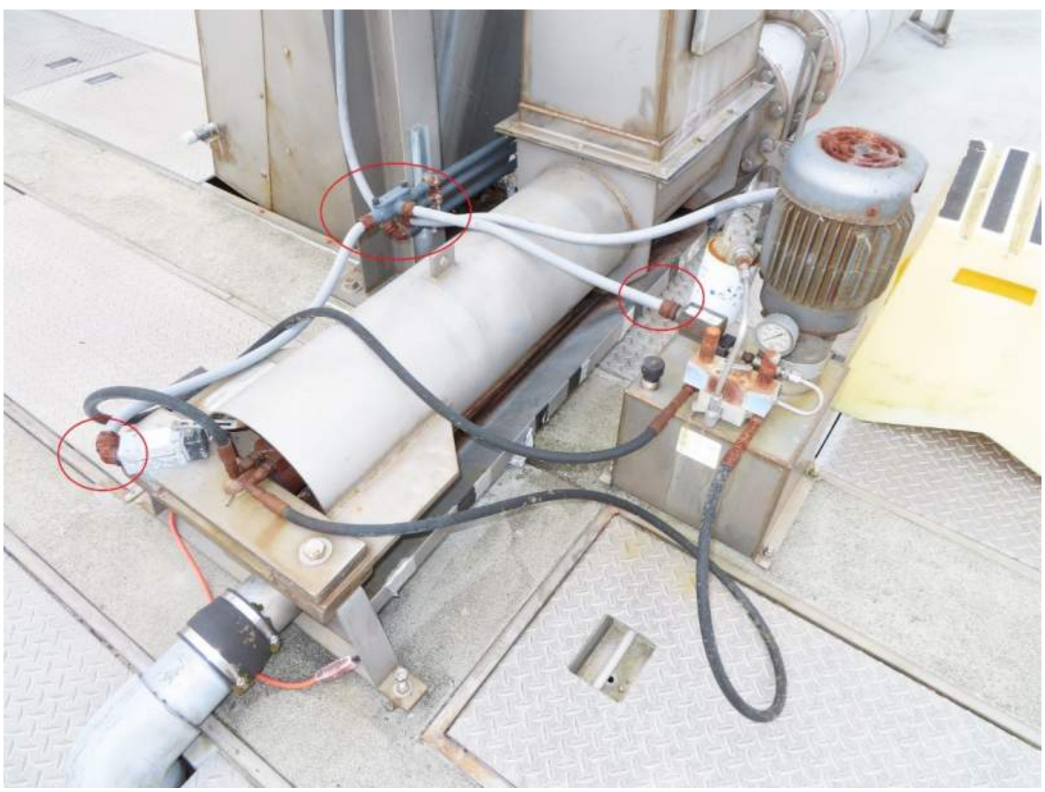

Photo 30. Rusting of flexible conduit connectors

Photo 31. Abandoned network radio antenna

Photo 32. Abandoned the Milltronics transmitter

Photo 33. Deenergized Strantrol Dechlor controller

Photo 34. Influent Pump Station, Port Townsend wastewater treatment plant.

Photo 35. Deteriorated concrete and electrical components, influent wet well. Aluminum covers and stainless steel embeds are in good condition.

Photo 36. Traveling screen and embedded plastic liner in good condition.

Photo 37. Concrete is corroding at base of Parschall Flume where embedded liner is ineffective (arrow).

Photo 38. Embedded liner pulling from concrete at temporary gate groove, RAS return basin.

Photo 39. Failure of embedded liner on corners of concrete support column, RAS return basin.

Photo 40. W3 line corroding wher it is not insulated. Not corrosion on conduit fittings (typical)

Photo 41. Fiberglass box housing instrument panel, subject to UV deterioration (east side of headworks).

Photo 42. Rust staining on concrete floor under stainless steel odor control duct with penetrations caused by internal corrosion.

Photo 43. Typical penetrations in stainless steel odor control duct caused by internal corrosion.

Photo 44. South secondary clarifier, empty at the time of inspection.

Photo 45. Clarifier mechanism rake arm and well. Note coating deterioration on top of well angle (red primer is showing). Some corrosion is occurring on rake arms where coating has failed.

Photo 46. Exposed aggregate in launder, north secondary clarifier.

Photo 47. Corroding carbon steel baffle support bracket, north secondary clarifier.

Photo 48: Potential Influent Pump Station Pump Around Manhole

Photo 49: Influent Pump Station Pump Around Discharge to Pass Over Building Parapet

Photo 50: Route of Pump Around Over Parapet to Channel Upstream of Bar Screen and Odor Control Duct Down to Influent Pump Station.