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TO:	Cities of South Bend and Raymond
FROM:	Jay Swift, P.E. Frank Chung, P.E.
DATE:	March 24, 2009
SUBJECT:	Regional WWTP Pre-Design Technical Memo No. 15 – Raymond Pump Station No. 1

INTRODUCTION

City of Raymond Pump Station No. 1 serves the Riverdale area north of the Willapa River. The pump station is located southwest of Riverdale Athletic Field and east of Godfrey Street. Figure 1 shows a vicinity map of Pump Station No. 1. The existing pump station consists of a 6-foot diameter pre-cast concrete wet well and a manufactured steel dry well containing two pumps and electrical controls. The station was constructed in the1960s and upgraded in 1986. Two 15 HP Smith & Loveless 4B2A pumps and associated electrical equipment were installed in a 1986 upgrade. Each pump has a design capacity of 475 gpm at 68 feet TDH.

Pump Station No. 1 collects all wastewater from the Riverdale Basin (Basin C) of the City's wastewater collection sewer system, including flows conveyed by Pump Station No. 2. 42 new apartment units are being constructed upstream of Pump Station No. 2, with a projected annual average flow of 6,300 gallons per day, and projected peak hour flow of approximately 25,000 gpd (17.5 gpm) using standard peaking factors. (Impacts to Pump Station No. 2 of this development will be evaluated in a subsequent memo.).

Pump Station No. 1 conveys wastewater directly to the City's Wastewater Treatment Plant (WWTP) through approximately 900 feet of 6-inch CI and 350-foot of 10-inch PVC pressure line. The pressure line is routed through a sensitive wetland area and across a wooden bridge to the WWTP. The pressure line and bridge are in poor condition and must be replaced to prevent the risk of failure.

Two influent sewer lines discharge into Pump Station No. 1. One line is from Manhole No. N-1 to the north of Pump Station No. 1 and the other line connects to manhole No. N-8.6. The manholes upstream of Pump Station No. 1 have experienced overflows during storm events. The possible reasons for overflows were evaluated in the *2007 Regional General Sewer/ Wastewater Facility Plan*. The evaluation included gravity sewer hydraulic calculations and pump station drawdown testing. Based on this evaluation, it was concluded that the maximum capacity of the upstream gravity sewer

lines is 1,239 gpm, while the pump station capacity was 710 gpm with both pumps on. A hydraulic analysis indicated that the theoretical estimated maximum overflow rate from the upstream manholes was 203 gpm. (This value is reasonably corroborated by estimates of overflows (148 gpm) observed during the extreme precipitation event on January 7 - 8, 2009, when more than 12 inches of rain fell in the Raymond area.) The evaluation concluded that the overflows from the upstream manholes likely resulted from insufficient pumping capacity of the pump station, and thus the capacity of Lift Station No. 1 should be increased. The recommended design flow for the pump station upgrade is 1,000 gpm. This design flow provides sufficient capacity for the new apartments upstream of Pump Station No. 2. The recommended pressure line diameter is 8 inches.

Increasing the capacity of the existing Pump Station No. 1 by replacing the existing pumps with larger pumps was considered, but is not recommended for the following reasons:

1. The space of the existing dry well is too small to install larger pumps with larger size suction and discharge pipes and valves.

2. At the 1,000 gpm design flow, the flow velocity in the existing 4-inch discharge piping is 25.6 ft/sec, much greater than the 8 ft/sec maximum recommended velocity in the DOE Orange Book criteria. Consequently, pump station head losses will be approximately 31 feet, necessitating larger horsepower pump motors.

3. The existing side intake pipe of the dry well pump is 6 inches in diameter. At the 1,000 gpm design flow, the flow velocity in the 6-inch intake pipe is 11.4 ft/sec, much greater than the general guideline for velocity in pump intakes of 6 ft/sec.

4. The existing fabricated steel dry well was built in 1960's. It is more than 50 years old and likely has limited remaining useful life.

A second alternative of installing new submersible pumps in the existing wet well was also considered, but is not recommended for the following reasons:

1. The bottom of the existing wet well was filled with concrete to form a cone shape to avoid solids settling. The concrete fillet would have to be removed to provide sufficient room to install the submersible pumps. It may be difficult to remove the existing fillet without damaging the existing wet well structure. Two separate temporary bypass pumping systems would be required, one in Manhole N-1 and one in Manhole N-8.6, to make these modifications to the existing wet well.

2. The existing wet well is a 6-foot diameter pre-cast manhole. It would provide 500 gallons of working storage volume with a lead pump ON/OFF level range of 2.35 feet. Although it is recommended that the new pump station be equipped with Variable Frequency Drives (VFDs), at low influent flow, the pump will operate at a preset minimum speed to maintain minimum pressure line velocity. For an 8-inch force main, the flow rate to maintain 2 ft/sec velocity is 314 gpm. At a flow rate of 314 gpm and with a 500 gallon wet well storage volume, the pump cycle time is 6.4 minutes, significantly below the design minimum pump cycle time of 10 minutes which is desirable for reducing maintenance and maximizing pump life.

The third and the recommended alternative for replacing Pump Station No. 1 is to add a new wet well structure adjacent to the existing wet well and equip it with new submersible pumps. Equipment would be removed from the existing steel fabricated dry well and the structure would be backfilled with CDF and abandoned in place after the new submersible pump station is operational. The existing six-foot diameter wet well will function as a junction manhole and rock trap upstream of the new wet well. Bypass pumping requirements would be simplified and minimized.

The new wet well will be an 8-foot diameter circular concrete structure located on the southeast of the existing wet well as shown on Figure 2. A 12-inch pipe will convey influent from the existing wet well to the new wet well. A pre-cast concrete valve vault containing a check valve and isolation valve on each pump discharge line will be located southwest of the new wet well. Figure 3 presents a plan and section of the proposed Pump Station No.1.

The 100-year flood elevation at the location of Pump Station No. 1 is estimated to be elevation 14.36 feet (all elevations NAVD88) . The ground surface around the pump station is at elevation 11.36 feet. The top slab of the new wet well will be at an elevation 15.36 feet to ensure continued operation during a flood event.

Each of the two submersible centrifugal pumps will have a capacity of 1,000 gpm at a maximum discharge head of 63 feet. The pumps will equipped with variable frequency drives to allow the speed of the pumps to vary with the level in the lift station wet well. The pumps will operate in a lead-lag scenario based on wet well level and the lead pump will be alternated with each pump cycle.

Each pump is equipped with a 25 hp, 240 volt, 60 hz, 3-phase, 1750 rpm motor. The motors will contain both over-temperature switches wired in series with motor circuitry

and leak sensors to detect the presence of moisture within the motor housing. The temperature switches will disable the pumps in the event of motor over-temperature and the leak detection sensors will generate an alarm condition, but will not shut down the pumps.

A local safety disconnect switch and a "hand-off-auto" selector switch will be mounted adjacent to the pump station control panel. Under normal operation the "HOA" switch will be placed in the "auto" position. A pump station control panel containing two pressure level transmitters and pump controller will also be installed adjacent to the pump station wet well. One pressure level transmitter will serve as backup unit. The pressure level transmitters will serve as the primary control device for the pumps.

In addition to the pressure level sensors, two non-mercury type float switches will also be installed in the pump station wet well. The float switches will be located above the pressure level sensor high-level alarm set point elevation. One float switch will be wired directly into the control circuit for Pump No. 1 allowing this pump to continue to function in the event that both the pressure level sensors fail. The second float switch will serve as backup control for Pump No. 2 and will be wired directly to its control circuit. This float switch will also indicate a high-level alarm condition. When the pumps are operated by the float switches, the duration that the pumps stay on after the float switch has opened will be controlled by pump-down timers located in the motor control center. The pump-down timers will be initially set to 60 seconds.

Power to the existing Pump Station No. 1 is provided by PUD No. 2. A portable 50-kW generator located in WWTF is available for standby power to Pump Station No.1.

The design criteria for Pump Station No. 1 are presented as below:

Criteria	**Design**
Pump Type	Submersible Centrifugal
Quantity of pumps	2
Motor Size, hp	25
Capacity each @ TDH of 63 ft, gpm	1,000
Active wet well volume, gallons	900
Wet well diameter, feet	8

It is recommended that a geotechnical evaluation be conducted at the site for the new wet well and recommendations from the geotechnical engineer be incorporated in the final design. HWA Geosciences visited the site in recent weeks and recommended that an additional boring be conducted to a depth of 30 feet to evaluate the subsurface for the

purposes of this evaluation. HWA Geosciences has provided a not-to-exceed cost estimate of $14,421 to perform this additional work.

PRESSURE LINE

The new pressure line will be an SDR 13, 8-inch HDPE line with a working pressure rating of 130 psi. It is expected that the new pressure line will be routed along the existing pressure line. A new pipe bridge will be constructed for the slough crossing. The new pressure line will discharge to the new headworks of the new Regional WWTF.

SCADA

The pump stations that will be modified to convey wastewater to the Regional Wastewater Treatment Plant include Raymond Pump Stations No. 1 and No. 11 and South Bend Pump Station No. 3. These pump stations will be equipped with SCADA (Supervisory Control And Data Acquisition) including telemetry and Human Machine Interface (HMI) software to be able to communicate with the new WWTP. In 2005, Raymond purchased a SCADA / telemetry system that was installed by Pacific County for the City to monitor alarms at ten of its pump stations, including Pump Stations No. 1 and No. 11. The system uses ZETRON Remote Telemetry Units (RTUs), telephone communication and LOOKOUT HMI software. This SCADA system also has the capability, after completion of minor programming modifications, to monitor and record pump run-time and pump cycles.

Pump Station Construction and SCADA Implementation

It is anticipated that Raymond's existing ZETRON RTUs and LOOKOUT SCADA software can be utilized for the upgraded Pump Stations No. 1. It is recommended that the SCADA system programs be modified during construction of the pump station upgrades to accommodate the station modifications.

WWTP Construction and SCADA Implementation

During construction of the WWTP, the Cities should consider standardizing SCADA components. It is anticipated that Raymond's existing ZETRON RTUs and LOOKOUT SCADA software could be utilized for the new regional conveyance system. However, the Cities may select a more common HMI software package for the WWTP instead of the LOOKOUT system, such as Wonderware or RSView. These alternate software packages would also work with the existing ZETRON RTUs.

It is recommended that the Cities make decisions on a SCADA system for the new WWTP after bids for the WWTP are received. This would allow the most recent software to be purchased and programmed, and the software could be selected after the programmable logic controller (PLC) instrumentation is competitively bid and thus be optimal for the PLC systems selected.

As part of the SCADA design and implementation, use of radio communication will be considered.

COSTS

The preliminary cost estimate for the Pump Station No. 1 upgrade (not including the pressure line) is presented in Table 1 below:

TABLE 1

Pump Station No. 1 Cost Estimate

Item	Cost, $
Mobilization/ Demobilization	38,000
Demolition	5,000
Site Work	10,000
Wet Well	66,000
Pumps	54,000
Access Hatches	5,000
Valve Vault	3,000
Hoist	3,000
Piping, Valves	16,000
Electrical and Control	180,000
Subtotal	380,000
Contingency (10%)	38,000
Sales Tax (7.8%)	32,600
Engineering (Construction Management)	45,000
Total Estimated Project Cost	**495,600**