Headworks Flow Metering

Project Purpose:

The purpose of this project is to address issues related the hydraulic design of the existing influent flow metering facilities.

Project History and Status:

Constructed as part of the Plant's Tenth Addition, the Headworks Facility continues to experience numerous operational and maintenance issues. These include the hydraulics of the existing influent flow meters that requires the water level in the screening channels to be artificially raised. This prevents the influent band screens from operating intermittently as screenings accumulate; instead, at least one screen must operate continuously and at higher channel levels. This increases the wear and tear on the equipment and reduces the screening system's hydraulic capacity.

This project was included in the 2016 Liquid Processing Facilities Plan (LPFP). Originally scheduled for construction in 2022-2023, it is proposed that this project be expedited for the following reasons:

- New step screens and changes to the flow meters are proposed in 2022-2023. If the flow meter modifications are done prior to this time period, the channel level in the influent screening channel can be raised and the existing band screens can be operated as originally intended. Depending on how the band screens perform, it may be possible to postpone or cancel the implementation of new screens.

- Operations and Maintenance staff has noticed an increasing amount of rags and other solid material in processes located downstream of the screening units. This suggests that the screens are being frequently bypassed.

- The project will improve the plant flow metering accuracy for customer billing.

The consulting firm of Short Elliiot Hendrickson Inc. was retained by the district in January of 2019 to make improvements to the influent metering system at a not to exceed price of $112,541. Final bidding documents are scheduled to be completed in late June or early July of 2019.

Alternatives:

The following alternatives were evaluated in detail in the 2016 Liquid Processing Facilities Plan:

Alternative IFM0–Maintain the Existing Influent Flow Metering Facilities (No Change)
In the null alternative, the current method of operating the screens to maintain adequate depth in the screening channels to fully submerge the venturis will continue. There are no current capital costs for this alternative. Operating costs included in this analysis are the current maintenance costs of the screens. Note that the operation and maintenance (O&M) costs for the other alternatives are relative to the null alternative, and they include the expected change in maintenance costs and pumping (electrical) costs for the pump stations that discharge directly to the NSWWTP for the various alternatives.

Alternative IFM 1–New Metering Vaults on NSWWTP Site
In this alternative a new metering vault would be constructed in the open space to the west of the Headworks Building to house the venturis for the force mains from Pump Station Nos. 2, 7, 8, and 18. This structure would be approximately 55 feet long, 25 feet wide, and 25 feet deep. The proximity of the influent force mains to the 54-inch effluent force main will require sheeting along the southwest side of the proposed structure to allow construction. A second structure to the south of the Headworks Building would be constructed to house the force main from Pump Station No. 11. This structure would be approximately 25 feet long by 25 feet wide and 25 feet deep. The intent of this alternative would be to reuse the existing venturis in the new metering vaults. These structures are assumed to be ventilated and include a staircase for entry, similar to the access provided to the east end of the grit pump room, to enable these spaces to be accessed without requiring a confined space entry. There is space for an additional force main and venturi in the Headworks Building. No provisions are made in this alternative to accommodate this future force main and, as such, flow from this future force main would need to be measured at the pumping station from which it originates.

Alternative IFM 2–New Influent Flumes
This alternative would include construction of a new building structure west of the existing Headworks Building that would house five Parshall flumes with provisions for a sixth. The building housing the flume would be approximately 50 feet by 55 feet. To maintain 1.5 feet of freeboard at 180 mgd, based on the calculations extended from the hydraulic model, the flumes would be 70 percent submerged at 180 mgd, which is the limit of accuracy for a 4-foot Parshall flume.

The ductile iron force mains would be modified to have the force mains discharge into the flume structure at elevation 15.00 feet for the force mains from Pump Station Nos. 7 and 8, and elevation 21.00 feet for the force mains from Pump Station Nos. 2 and 18. The force main from Pump Station No. 11 would have to be reconfigured slightly to allow it to enter the west end of the flume structure at elevation 25.50.

Alternative IFM 4–Install Venturi Flow Meters at PS Nos. 2, 3, 4, 7, 8, 11, 18

This alternative consists of installing venturi flow meters at individual pump stations to meter flow from each station to NSWWTP:

- A new meter vault at Pump Station No. 2, which is located in Brittingham Park. The vault would be approximately 20 feet long, 16 feet wide, and 12 feet deep. It may be difficult to locate this vault without intruding on the sand volleyball courts in the park.
- A venturi meter for Pump Station No. 3 installed in a manhole adjacent to the pump station. The vault would be approximately 20 feet long, 16 feet wide, and 10 feet deep.
- A new meter vault at Pump Station No. 8 adjacent to the north side of the building where the discharge pipe exits the building. The vault would be approximately 20 feet long, 16 feet wide, and 18 feet deep.
- A new meter vault at Pump Station No. 11 adjacent to the east side of the building where the discharge pipe exits the building. The vault would be approximately 20 feet long, 16 feet wide, and 24 feet deep.
- A new meter vault at Pump Station No. 18 on the east side of the building underneath the asphalt access drive where the discharge pipe exits the building. The vault would be approximately 20 feet long, 16 feet wide, and 24 feet deep.

A venturi meter vault could not be constructed at Pump Station No. 7 given the site constraints and that the flows from this pump station are conveyed in two force mains. The flows could be measured in a vault on the NSWWTP grounds after the point where the two force mains are combined. This vault would be located to the north of the west final clarifiers and would be approximately 20 feet long, 16 feet wide, and 15 feet deep.

Alternative IFM5-Reinstall Venturi Flow Meters at a Lower Elevation

The alternative would involve lowering the elevation at which the influent venturis are installed to allow them to be full at all times, regardless of the water elevation in the screening channels. This would be accomplished by relocating the pipe such that the venturi meter would be lowered approximately four feet. This would result in the venturis being completely submerged whenever there is flow in the screening channels. Two new 45 degree elbows would be connected to the downstream end of the venturi meter to connect the force main piping to the existing wall penetration between the Meter Vault Room and the screening channel (see Figure 2 in appendix for schematic). The existing sluice gates would remain in place to allow isolation of each force main as needed. A grating platform would be constructed over the pipes, covering

most of the room. A walkway would be available along the east wall of the room for personnel access. The samplers would be replaced and relocated on the grating platform. Access stairs or ladders would be installed from the grating level to the floor to provide access to the venturi meters for calibration and maintenance.

The force mains in the yard would be removed back to the 45 degree elbows and re-laid to the Headworks Building at the new venturi elevation. A temporary pipe would be installed at the location of the future force main to accept flow from each of the force mains when they are being re-laid at the new elevation.

Key Risks and Issues

The key social, environmental, and other nonmonetary considerations of each alternative are summarized in Table 1.

Table 1 - Influent Flow Measurements Alternative Nonmonetary Considerations Summary

Alternative	Benefits	Limitations
IFM0–Maintain the Existing Influent Flow Metering Facilities (No Change)	▪ No disruption of current operations.	▪ No reduction of grit accumulation in channels without septage receiving improvements. ▪ No improvement to screening operations or reductions in maintenance.
IFM 1–New Metering Vaults on NSWWTP Site	▪ Better influent screen performance, which should reduce pass-through of material and downstream maintenance concerns. ▪ Reduced accumulation of grit in influent channels. ▪ All construction on NSWWTP grounds.	▪ Construction adjacent to effluent force main presents a risk. ▪ Uses areas on-site that may limit construction in those areas in the future.
IFM 2–New Influent Flumes	▪ Better influent screen performance, which should reduce pass-through of material and downstream maintenance concerns. ▪ All construction on NSWWTP grounds.	▪ Construction adjacent to effluent force main presents a risk. ▪ Uses areas on-site that may limit construction in those areas in the future. ▪ Limits access to the Hypochlorite Room and Mechanical Room.
IFM 4–Install Venturi Flow Meters at PS Nos. 2, 3, 4, 7, 8, 11, 18	▪ Better influent screen performance reducing pass-through of material. ▪ Reduced accumulation of grit in influent channels.	▪ Construction at multiple sites including at pump stations and at NSWWTP. ▪ Decentralizes flow metering operations and potentially makes troubleshooting more difficult. ▪ Potential construction impacts to neighboring residences and entities, including noise, vibration, truck traffic, and dust. ▪ Confined space entry requirements at each metering location.
IFM5-Reinstall Venturi Flow Meters at a Lower Elevation	▪ Better influent screen performance, which should reduce pass-through of material and downstream maintenance concerns. ▪ All construction on NSWWTP grounds. ▪ Reuse of existing equipment and facilities.	▪ None

Economic Analysis

The present worth analysis completed for the Liquid Processing Facilities Plan is presented below.

	IFM0 No Change	IFM1 New Metering Vaults at NSWWTP	IFM2 New Flumes at NSWWTP	IFM4 New Metering Vaults at PS's	IFM5 Relocate Venturis to Lower Elevation
Total Opinion of Capital Cost	**$0**	**$3,180,000**	**$2,894,000**	**$2,919,000**	**$2,096,000**
Annual O&M	$81,000	$53,000	$86,000	$63,000	$52,000
O&M Cost PW	$1,065,000	$697,000	$1,131,000	$828,000	$684,000
Total Opinion of Present Worth	**$1,065,000**	**$3,877,000**	**$4,025,000**	**$3,747,000**	**$2,780,000**

Project Recommendation

The recommended alternative for influent flow measurements is Alternative IFM5, which includes relocating the existing venturi flow meters to a lower elevation. Other than the null alternative that does not address the influent flow measurement issues, Alternative IFM5 has the lowest capital and total present worth opinion of cost, and addresses the issue of screening channel overflow and screen control by providing a much larger variation between the minimum and maximum water level in the screening channels. This alternative also does not require additional space on-site for new metering structures.

Project Schedule:

	Start Date	Completion Date
Planning	2016	2018
Design	2019	2019
Construction	2020	2020

Financial Summary (2019$):

Total Project Cost	
District Staff & Engineering	$370,000
Contractor	$1,855,000
Total	$2,225,000

Fiscal Allocation (2019$):

	2018	**2019**	**2020**
Engineering	$5,000	$30,000	$80,000
Consultant	$0	$165,000	$95,000
Construction	$0	$0	$1,855,000
Total	$5,000	$195,000	$2,030,000

Fiscal Allocation (actual dollars):

	2018	2019	2020
Engineering	$5,000	$30,000	$80,000
Consultant	$0	$165,000	$100,000
Construction	$0	$0	$1,910,000
Total	$5,000	$195,000	$2,090,000

FIGURE 2: METER VAULT ROOM SECTION