75th STREET WASTEWATER TREATMENT PLANT UPGRADES PROJECT

Basis of Design Memorandum

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Subject:	**Hydraulic Profile**		
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SCOPE OF DESIGN

Brown and Caldwell has updated the Hydraulic Profile of the 75th Street Wastewater Treatment Plant (WWTP) using our in-house modeling software program PROFILE. The plant is being converted from a trickling filter solids contact process (TF/SC) with nitrifying trickling filters (NTF) to an activated sludge process designed for biological nutrient removal (BNR).

The hydraulic profile started with the existing hydraulic profile for the plant as it is currently configured. The flows for the build-out of the plant (BNR activated sludge) used in the model, have been identified as follows:

- Min Hourly Flow = 10 mgd
- Min Daily Max Flow = 15 mgd
- Max Month Flow = 25 mgd
- Max Daily Flow = 40.5 mgd
- Peak Hourly Flow = 53.5 mgd

The following sections focus on each of the proposed changes:

1. Chlorine contact tanks (CCT) modified to include UV
2. Abandonment of Nitrifying Trickling Filter
3. 4th Secondary Clarifier
4. New Aeration Basins
5. New Secondary Pump Station

CHLORINE CONTACT TANKS (CCT) MODIFIED TO INCLUDE UV

The intent for the UV disinfection system is to retrofit the existing chlorine contact basins. Flow through the existing basin channels will be re-configured to accommodate new UV units, DM-5 Ultraviolet Disinfection. Since UV system hydraulics are very sensitive and have a very low tolerance for water surface fluctuations, it is critical that this system be designed to accommodate the peak hourly flow with no more than 2 inches of headloss across the unit. To accommodate this tight tolerance, a finger weir or automatic weir gates of the requisite length will be used to minimize the head variations seen over an anticipated range of flows. Since the exact type of equipment is unknown at this 30% design point an assumption of 0.1 ft of loss was assumed through the unit.

The existing configuration of the CCTs uses seven passes in a serpentine pattern. The new configuration will use the final 3 passes of the basins, with the UV units in the 1st and 2nd pass and the finger weir in the final pass. The initial 4 passes shall remain as currently used The final weir in the structure will be left at the existing height of 5114.5. It is possible to remove this weir to lower the finger weir elevation if securing adequate head becomes an issue.

To maintain the minimum 2-inch headloss over a finger weir, 500-ft of weir is required, if all the flow passes through one pass. The water surface in the structure is below the top of the walls. If horizontal UV lamp configuration is used, the 2-inch maximum headloss included the height of the water over the weir plate plus the losses through the UV banks. Under this configuration, a finger weir would not be possible and a weir gate will be used.

ABANDONMENT OF NITRIFYING TRICKLING FILTER

The nitrifying trickling filter (NTF) will be abandoned along with the NTF pump station. Secondary effluent will pass through the old pump station to the disinfection area. Flow through the pump station will either pass through the entire pump station or using the control gates, the flow will pass through just a portion of the pump station.

The hydraulic profile was set up using the entire pump station. If head after the secondary clarifiers becomes a concern then the flow can be routed through the initial portion of the pump station. The results of the model show that the pump station does not impart significant headloss.

4TH SECONDARY CLARIFIER

A fourth, 110 ft. diameter, 16 ft. side wall depth secondary clarifier will be built to match the existing 3 units. Similar to the existing units, return activated sludge (RAS) underflow rates from the secondary clarifier system were modeled at 100% of influent flow, up to a maximum rate of 25 mgd. Flow was split equally to each clarifier by the use of cutthroat flumes and under flow conditions all four clarifiers are online.

At peak flow conditions, a free discharge was maintained over the weirs and the launders were not submerged. At peak flow, all four clarifier units were assumed in hydraulic operation.

NEW AERATION BASINS

There will be four new aeration basins. Three will be built in the first phase and one additional basin will be added in the second phase.

For Phase 1, each basin will have the following configuration and dimensions:

- Length: 180 feet
- Width: 81 feet
- Depth: 19 feet (typical aerated zone water depth)
- Configuration: 3-pass plug flow reactor
- Influent channel feeds each basin through downward-opening slide gates.
- Effluent from the basins discharges to an effluent channel over a broad crested weir/wall that cannot be forced to a submerged condition under peak flow conditions.
- The first pass and a portion of the second pass in each basin will have concrete baffle walls with the intent that there will always be cascaded flow over each wall to keep the foam and scum from accumulating. The design basis of the baffle walls is:

Upstream Cell	Downstream Cell	Type	Design Basis
Influent Channel	Pass 1 Zone 1	Submerged Gate	GateHeadloss > 10*Influent Channel Headloss
Pass 1 Zone 1	Pass 1 Zone 2	Notch Weir	Headloss <0.1-ft at Peak Q
Pass 1 Zone 2	Pass 1 Zone 3	Notch Weir	Headloss <0.1-ft at Peak Q
Pass 1 Zone 3	Pass 1 Zone 4	Notch Weir	Headloss>3-in at Min Q
Pass 1 Zone 4	Pass 1 Zone 5	Notch Weir	Headloss <0.1-ft at Peak Q
Pass 1 Zone 5	Pass 2 Zone 6	Notch Weir	Headloss>3-in at Min Q
Pass 2 Zone 6	Pass 2	Full Weir	Headloss>3-in at Min Q
Pass 2	Pass 3	None	
Pass 3	Effluent Channel	Full Weir	Free Discharge at Peak Q

Several recycle flows were included in the hydraulic design of the aeration basins. They are summarized as follows:

- RAS flow rates from the underflow of the secondary clarifiers to the mixing box in Zone 1 of Pass 1 up to 100% of the max month flow, or 25 mgd.
- When the basins are configured to nitrify and denitrify, there is internal mixed liquor (ML) recycle from the end of Zone 8 back to Zone 1 of Pass 1. This can be as much as 300% of the maximum month influent flow to the basins, or an additional 75 mgd.
- In Phase 2, internal recycle for Bio-P will bring flow from the end of the anoxic zone back to the mixing box in Zone 1 of Pass 1 (the head of the anaerobic zone). This can be up to 100% of the max month flow, or 25 mgd.

Under existing conditions, the individual passes of the solids contact tanks can operate in parallel (4 single passes) or with three passes operated in series (or parallel) and the fourth pass used for re-aeration of RAS. For the proposed upgrades, the SCT passes will operate in parallel mode.

The results of the hydraulic profile show that under peak flow conditions, approximately 3.5-ft of headloss is generated through the new Aeration Basins. The top of walls in the basins will be constructed to allow minimum 18-inches of freeboard.

NEW SECONDARY PUMP STATION

This station currently pumps primary effluent to the trickling filters. The use of the existing wet well to house new secondary pump station pumps to pump primary effluent to the new aeration basin influent channel was explored. However, the intake conditions for the new pumps does not appear to be suitable, and timely and costly physical model tests would need to be performed to demonstrate its acceptability.

All four trickling filters will be eliminated as part of the upgrades at the 75th Street WWTP. Consequently, all elements in the hydraulic profile related to the trickling filters were eliminated.

The existing interstage pump station will be taken off line. This pump station was previously used to pump trickling filter effluent into the solids contact tanks.

The new configuration will have primary effluent flowing through the existing pump station wetwell and then through a newly constructed 72-in pipeline to the new secondary pump station, which will be designed with a trench style wet-well. The existing structure has an inlet box which was used to reduce the influent energy. The results of the model runs show that this box contributes some headloss under peak flows. It was left in the model but its removal should be considered.

The model was run through primary clarifier #3 with the assumption the 40% of the total design flow would go through this structure. Exact flow splits should be confirmed with the plant staff. Under peak flow conditions there was still free discharge from the control weirs in the primary clarifiers.

SUMMARY OF HYDRAULIC PROFILE

The results of the upgrades to the hydraulic profile indicate that the peak flow can pass through the 75th Street WWTP with the proposed structural and flow configuration changes discussed above. The hydraulic profile is show on drawings G-00-13 and G-00-14.