

PREPARED FOR: Western Wake Partners
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DATE: July, 2005
SUBJECT: Western Wake Regional Wastewater Management Facilities
 Western Wake Water Reclamation Facility
 PER Technical Memorandum No. 09 – Hydraulic Design

INTRODUCTION

This Technical Memorandum (TM) is one in a series of TMs being prepared for the Preliminary Engineering Report for the Western Wake Regional Wastewater Management Facilities project. The purpose of this TM is to present the preliminary engineering information and criteria to be used in the hydraulic design of the Western Wake Water Reclamation Facility (WRF) and to provide a preliminary hydraulic profile showing the relationship of each facility with the existing grade at the proposed site.

PROCESS REQUIREMENTS

Plant influent flows to be used for the hydraulic design are presented in Table 9-1. Hydraulic peak flows are based on a peaking factor of 3.1 times the annual average flow, which is consistent with the findings of the Town of Cary *2003 Wastewater Collection System Master Plan*.

**TABLE 9-1
DESIGN PLANT INFLUENT FLOWS**

	PLANT STARTUP	PHASE 1	PHASE 2
Annual Average Flow (AAF), mgd	8.5	15.3	25.4
Maximum Monthly Flow (MMF), mgd	10	18	30
Peak Instantaneous Flow (PF), mgd	26.3	47.3	78.8

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The key objectives of the hydraulic design are as follows:

- ❖ Provide adequate flow measurement for process control and regulatory reporting
- ❖ Avoid submergence of all weirs at peak flow, assuming all units are in operation
- ❖ Provide positive flow distribution to all process units
- ❖ Provide for ease of future expansion
- ❖ Avoid trapping of scum/foam in the system
- ❖ Maintain adequate velocities to prevent settling of solids in pipes and in channels where mixing is not provided
- ❖ Provide flexibility to operate with several alternative BNR processes and the associated internal recycle flows
- ❖ Effectively mix recycle flows with the main process flow stream

ALTERNATIVES EVALUATION

In order to establish the preliminary hydraulic profile, the following alternatives were evaluated:

Future Primary Clarifiers: Preliminary discussions with the Western Wake Partners have indicated that there is no intention to construct primary clarifiers in the current project or for future plant expansions. Therefore, the preliminary hydraulic profile included herein does not show additional head between the preliminary and secondary treatment facilities for future clarifiers. However, there is value in keeping this option open for the future which must be weighed against the economic cost. In order to allow space in the profile for future primary clarifiers, the screening and grit removal facilities must be raised approximately 2.5 feet, thus increasing the cost of plant influent pumping over the life of the facility. The 20-yr present worth cost of the additional influent pumping is estimated to be \$69,000 based on the following assumptions:

Power cost	\$0.07/kW-hr
Plant startup AAF	8.5 mgd
2030 AAF	25.5 mgd
Interest Rate	5.875%
Inflation Rate	2.5%

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Based on the relatively low cost of additional pumping, it is recommended that the Western Wake Partners consider leaving space in the profile for future primary clarifiers.

Post Aeration: Cascade aeration and diffused aeration were considered for post aeration of plant effluent to maintain dissolved oxygen concentrations compliant with the anticipated NPDES permit requirements. The two alternatives are evaluated in TM No. 15, Effluent Disinfection/Reaeration. For the purposes of establishing a preliminary hydraulic profile, it is assumed that diffused air will be used for post aeration at the Western Wake WRF.

REGULATORY COMPLIANCE REQUIREMENTS

Current regulations require that plant effluent flow be continually monitored. Effluent flow measurement will be provided downstream of the UV disinfection facilities and reuse facilities and upstream of the effluent pump station. Effluent flow measurement will be by means of an effluent Parshall flume with an ultrasonic level sensor.

PROPOSED FACILITIES

Flow Measurement: Effluent flow measurement will be provided as discussed above. The effluent Parshall flume will be sized for the future expanded plant peak flow condition of 79 mgd and, for the Phase 1 project, will have a smaller flume, sized for the peak flows anticipated within 10 years of plant startup (approximately 47 mgd), nested in the larger flume. Designing for this combination of flows would result in a flume with a 5-ft throat width nested in a flume with a 7-ft throat width. A similar flume configuration should be incorporated into the plant influent structure to measure plant influent flow for process control. All major sidestreams and recycle flows should also be measured.

Flow Distribution: Positive flow distribution to the process units will be accomplished through the use of distribution channels/boxes with control devices (weirs or orifices) leading to each process unit. Distribution structures and control devices will be designed to obtain 95 percent distribution (i.e., the flow to each individual unit is within 5 percent of the other units).

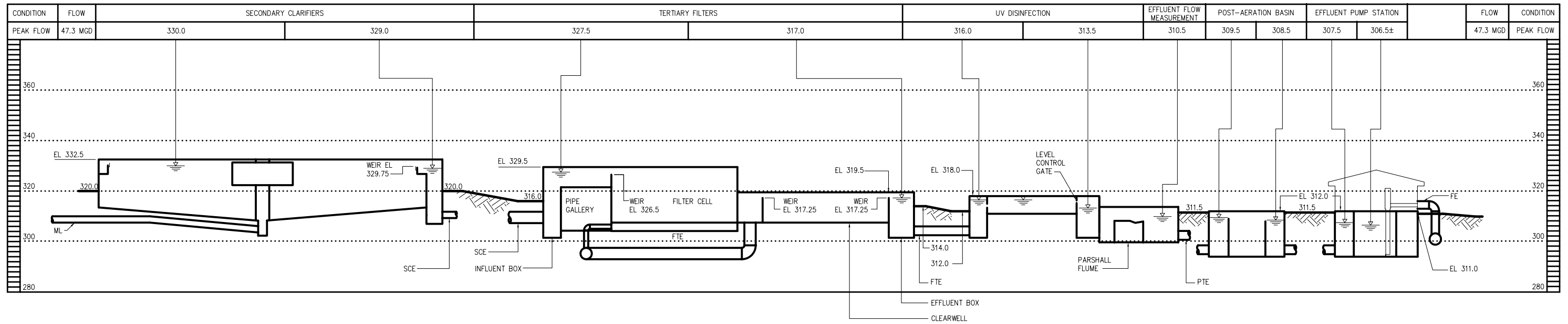
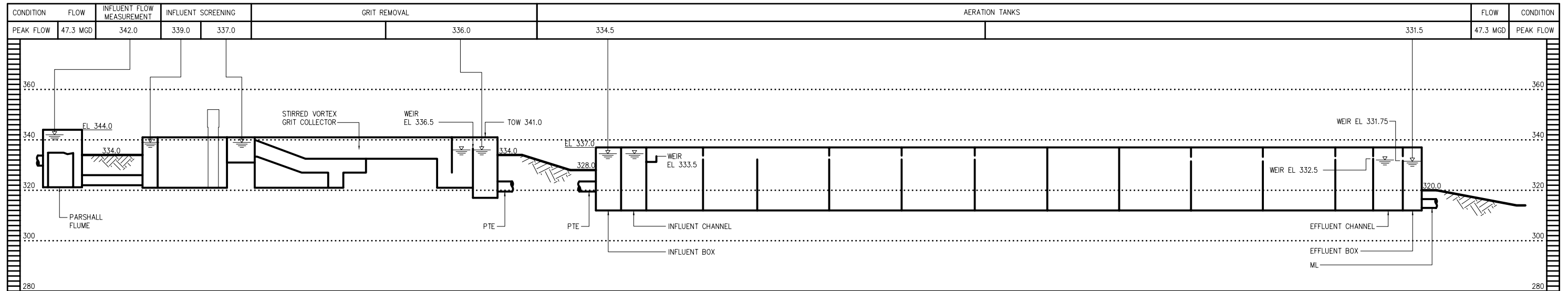
Preliminary Hydraulic Profile: Table 9-2 and Figure 9-1 show the preliminary hydraulic profile for the Western Wake WRF and the height/depth of structures relative to the ground elevation based on the proposed plant layout.

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TABLE 9-2
PRELIMINARY HYDRAULIC PROFILE
(ALL VALUES IN FEET)

PROCESS	WSE IN	WSE OUT	HEAD LOSS	EXISTING GRADE	TOP SLAB ELEVATION	BOTTOM SLAB ELEVATION
Influent Flow Measurement	342.00	340.00	2	340.00	345.00	322.00
<i>Piping Between Structures</i>			1			
Influent Screenings	339.00	337.00	2	339.00	341.00	322.00
Grit Removal	337.00	336.00	1	339.00	341.00	322.00
<i>Piping Between Structures</i>			1.5			
Aeration Tanks	334.50	331.50	3	320.00	337.00	312.00
<i>Piping Between Structures</i>			1.5			
Secondary Clarifiers	330.00	329.00	1	322.00	332.50	313.50
<i>Piping Between Structures</i>			1.5			
Tertiary Filters	327.50	317.00	10.5	318.00	329.50	309.50
<i>Piping Between Structures</i>			1			
UV Disinfection	316.00	313.50	2.5	314.00	318.00	310.00
<i>Piping Between Structures</i>			1			
Effluent Flow Measurement	313.50	310.50	3	314.00	316.00	306.00
<i>Piping Between Structures</i>			1			
Post Aeration Basin	309.50	308.50	1	316.00	312.00	293.00
<i>Piping Between Structures</i>			1			
Effluent Pump Station	307.50	306.00	1.5	312.00	312.00	293.00
TOTAL			37			

WSE = WATER SURFACE ELEVATION



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PRELIMINARY HYDRAULIC PROFILE
PEAK FLOW