

***APPENDIX B***  
***PRELIMINARY ENGINEERING REPORT***

***Table of Contents***  
***Introduction***

# Contents

## Introduction

### Raw Wastewater Pumping and Conveyance Facilities

TM 01	West Cary Pump Station Site Selection .....	1-1
TM 02	West Cary Pump Station, Force Mains, and Gravity Sewer.....	2-1
TM 03	Beaver Creek Pump Station Site Selection .....	3-1
TM 04	Beaver Creek Pump Station and Force Mains .....	4-1

### Western Wake Water Reclamation Facility

TM 05	Water Reclamation Facility Site Selection.....	5-1
TM 06	Influent Wastewater Characteristics/Effluent Limits .....	6-1
TM 07	Not Used	
TM 08	Process Design/Mass Balance Pretreatment Evaluation .....	8-1
TM 09	Hydraulic Design .....	9-1
TM 10	Preliminary Treatment Facility .....	10-1
TM 11	BNR Process Tanks .....	11-1
TM 12	Secondary Clarifiers/RAS Pumping Facilities .....	12-1
TM 13	Blowers and Blower Building .....	13-1
TM 14	Effluent Filters .....	14-1
TM 15	UV Disinfection Facilities and Post Aeration Facilities .....	15-1
TM 16	Waste Activated Sludge Pumping/Thickening Facilities.....	16-1
TM 17	Foreign Solids Receiving/Aerated Holding Tanks/Biosolids Loading Facilities ...	17-1
TM 18	Biosolids Dewatering Facilities .....	18-1
TM 19	Scum Digestion Facilities .....	19-1
TM 20	Filtrate/Centrate Treatment Facilities .....	20-1
TM 21	Chemical Storage and Feed Facilities.....	21-1
TM 22	Non-potable On-site Reuse .....	22-1
TM 23	Standby Power Facilities and Electric Utility Service .....	23-1
TM 24	Odor Control Facilities.....	24-1
TM 25	Operations and Maintenance .....	25-1

### Effluent Pumping and Conveyance Facilities

TM 26	Effluent Pump Station.....	26-1
TM 27	Effluent Force Main .....	27-1
TM 28	Effluent Discharge Structure Site Selection .....	28-1
TM 29	Effluent Discharge Structure .....	29-1

## General

TM 30	Site Development and Utilities .....	30-1
TM 31	Not Used	

TM 32	Cost Estimate Methodology .....	32-1
TM 33	Instrumentation and Controls .....	33-1

# Western Wake Regional Wastewater Management Facilities Preliminary Engineering Report

## INTRODUCTION

### BACKGROUND

The Western Wake Partners (Partners) are the towns of Apex, Cary, Morrisville, and Holly Springs. The proposed project has been designated the Western Wake Regional Wastewater Management Facilities Project (Project). The Project is comprised of the following major facilities:

- 1) West Cary Pump Station (PS)
- 2) Force Main (FM) – West Cary PS to West Reedy Branch Gravity Sewer
- 3) Reedy Branch Gravity Sewer – West Cary FM to Beaver Creek PS
- 4) Beaver Creek PS
- 5) Force Main – Beaver Creek PS to Western Wake Water Reclamation Facility (WRF)
- 6) Western Wake WRF
- 7) Effluent Disposal System – Effluent Pump Station (EPS), Pipeline, and Outfall

Wastewater flows from Cary, Morrisville, and RTP South will enter into the system at the West Cary Pump Station. Wastewater flow from Apex will enter the system at two points along the alignment of the Reedy Branch Gravity Sewer from the West Cary PS to the Beaver Creek PS. The two points of entry for Apex will be along Reedy Branch and Beaver Creek. Wastewater flow from Holly Springs will enter into the system at the Effluent Pump Station located at the Western Wake WRF. The combined effluent from the Partners will be discharged to the Cape Fear River downstream of Buckhorn Dam.

The Project is being implemented by the Partners to provide wastewater service for planned growth and development and to comply with regulatory mandates issued by the North Carolina Environmental Management Commission (EMC) and the Department of Environment and Natural Resources (NC DENR). In accordance with the regulatory mandates, the proposed Project must be operational and discharging effluent to the Cape Fear River by January 1, 2011.

The proposed Project will be implemented in two phases:

## **DRAFT**

Preliminary Engineering Report – Introduction  
Western Wake Regional Wastewater Management Facilities

The Phase 1 facilities, which must be operational by January 1, 2011, will provide treatment capacity of 18 million gallons per day (mgd) at the WRF, and a discharge capacity of 24 mgd to the Cape Fear River below Buckhorn Dam. The capacity of these facilities will meet the needs of the Project Partners until 2020.

The Phase 2 facilities, which are projected to be online by July 1, 2020, will provide treatment capacity of 30 mgd at the WRF and a discharge capacity of 38 mgd to the Cape Fear River below Buckhorn Dam. The capacity of these facilities will meet the needs of the Project Partners until 2030.

## **PURPOSE**

The purpose of this Preliminary Engineering Report (PER) is to present the preliminary design features for Phase 1 of the selected alternative for the Western Wake Regional Wastewater Management Facilities Project. As described in Section 4.0 of the Draft Environmental Impact Statement (EIS) for the Project, the alternative that was selected to meet the wastewater needs of the Towns of Apex, Cary, Holly Springs, and Morrisville includes a new Western Wake Water Reclamation Facility (WRF) to treat wastewater flow from the Towns of Apex, Cary, and Morrisville. The Town of Holly Springs will continue to treat its wastewater at the Utley Creek Wastewater Treatment Plant (WWTP) and discharge treated effluent to the effluent disposal system serving the Western Wake WRF.

The facilities for the proposed Project are described in detail in this PER and are summarized in the following sections. Each facility is described in a Technical Memorandum (TM), which includes an analysis of alternatives, the preliminary design for the selected alternative, and the capital cost estimate for the selected alternative.

## **RAW WASTEWATER TRANSMISSION FACILITIES**

Raw wastewater transmission facilities will be constructed to convey raw wastewater from the western Cary service area and the Cape Fear River portion of the Apex service area to the new Western Wake WRF. The raw wastewater transmission facilities will consist of two new regional pump stations and associated force mains and gravity sewers. The West Cary Pump Station, force mains, and Reedy Branch gravity sewer will convey raw wastewater from the White Oak Creek subbasin to the second regional pump station located in the Beaver Creek subbasin. The West Cary Pump Station is described in TM 01 and TM 02.

The Beaver Creek Pump Station will convey raw wastewater from the Apex White Oak Creek and Beaver Creek service areas, plus raw wastewater from the West Cary Pump Station and water treatment plant residuals from the Cary/Apex Water Treatment Plant (WTP), to the

Western Wake WRF. The Beaver Creek Pump Station and the Beaver Creek Force Main are described in TM 03 and TM 04.

## **WESTERN WAKE WATER RECLAMATION FACILITY**

### ***WRF Site Selection***

The new Western Wake WRF will be constructed along U.S. 1 near New Hill to serve the Cape Fear River portion of the Apex service area, the Haw River portion of the Morrisville service area, the western Cary service area, and RTP South. A total of 29 potential sites for the WRF were identified and investigated prior to selecting the final site near along U.S. 1 near New Hill. The site selection process is described in TM 05.

### ***Influent Characteristics***

Influent characteristic data for the Western Wake WRF was developed based on data from North Cary WRF, South Cary WRF, Apex's Middle Creek WWTP, industrial discharge characteristics from the Wake County portion of Research Triangle Park (RTP South), and raw wastewater sampling at representative pumping stations within the Cary service area. Influent characteristics and proposed effluent limits for the Western Wake WRF are presented in TM 06.

### ***Process and Hydraulic Design***

The biological treatment process will provide biological nutrient removal (BNR) treatment, which will be capable of accommodating multiple modes of operation for biological nutrient removal via non-proprietary processes. Speculative limits from the Department of Environment and Natural Resources (DENR) have indicated that effluent biochemical oxygen demand (BOD) will be 5 mg/L and effluent ammonia will be 1 mg/L. The Western Wake WRF preliminary design is based on these limits. The process design and mass balance are described in TM 08.

The initial Western Wake WRF design capacity will be 18.0 million gallons per day (mgd) (maximum monthly flow (MMF)). Annual average flow (AAF) is estimated at 15.3 mgd. A peaking factor of 3.1 times AAF, or 47.3 mgd, was used for consistency with the findings of the Town of Cary 2003 Wastewater Collection System Master Plan. The hydraulic design is described in TM 09.

### ***Preliminary Treatment Facility***

The preliminary treatment facility will include fine screens and grit removal facilities to remove particulate matter. In addition, the facility will include a flow measurement device to measure influent wastewater flows. The preliminary treatment facility is described in TM 10.

### ***BNR Tanks***

The BNR process tanks will consist of three parallel trains of aeration basins and clarifiers, each capable of accommodating a maximum month loading rate of 6.0 mgd. The arrangement of individual cells, equipment selection, slide gate placements, and alternate locations for internal sludge recycle will allow plant operators to select from a variety of processes. The BNR tank design will also provide flexibility to be operated with sidestream biological phosphorus removal configurations. The BNR process tanks are further described in TM 11.

### ***Secondary Clarifiers and RAS/WAS Pump Station***

Three secondary clarifiers will be constructed for removal of solids. Each clarifier will be sized for a maximum monthly loading rate of 6.0 mgd. The clarifiers will be equipped with inboard launders, internal baffles, full width scum skimming, and a rotating weir for scum removal. A return activated sludge (RAS)/waste activated sludge (WAS) pump station will be constructed to pump RAS from the clarifiers to the BNR process basins. The RAS/WAS pump station will be configured to allow isolation of each process train. The clarifiers and RAS/WAS Pump Station are described in TM 12.

### ***Blower Building***

A blower building will be provided for the biological treatment process aeration system. The blower room will contain five centrifugal blower units with space for future units. The building will also include an electrical room for the treatment facility switchgear and power control center equipment. The blower building is discussed in TM 13.

### ***Effluent Filters***

Deep bed tertiary effluent filters with denitrification capability will be provided to meet the anticipated effluent limits and to condition plant flows for effective ultraviolet (UV) disinfection. The filters will consist of individual filter cells, a pipe gallery, clearwells, mudwells, and an electrical building. The effluent filters are described in detail in TM 14.

### ***Disinfection and Post Aeration***

Ultraviolet (UV) disinfection facilities will be provided for disinfection of the final effluent from the Western Wake WRF. Flow measurement for the effluent will also be provided in the UV facility. A post aeration facility will be provided to increase the dissolved oxygen concentration of the final effluent. The UV disinfection facility and post aeration facility are discussed in TM 15.

### ***Biosolids Handling Facilities***

Biosolids handling facilities will include a biosolids thickening and dewatering building that will house gravity belt thickeners, all appurtenances for transferring thickened biosolids to the

aerobic holding tanks, and centrifuges for dewatering solids. Aerated holding tanks will be provided for digestion of the solids. Dewatered biosolids will be transported by truck to off-site composting facilities for ultimate disposal. The biosolids handling facilities are described in TM 16, TM 17, and TM 18.

### ***Scum Digester***

A scum digester will be provided to receive scum from the BNR process basins and the clarifiers. A digested-scum return pumping station will be provided to return effluent to the preliminary treatment facility. The preliminary design of the scum digestion facilities is described in TM 19.

### ***Centrate/Filtrate Treatment Facilities***

A storage tank will be provided for equalization prior to future centrate/filtrate treatment facilities. The centrate/filtrate treatment facilities preliminary design is included in TM 20.

### ***Chemical Storage and Feed Facilities***

Chemical storage and feed facilities will be provided for methanol or acetic acid, ferric chloride or aluminum sulfate, sodium hydroxide, sodium hypochlorite and polymer. The chemical storage and feed facilities are described in TM 21.

### ***Reuse Water Facilities***

Reuse water facilities will be provided to supply on-site non-potable water needs. All reuse water will receive initial disinfection through the UV disinfection facilities, and sodium hypochlorite facilities will provide additional disinfection to ensure reuse water complies with reuse disinfection standards. Reuse water pumps and a hydro-pneumatic storage tank will be provided. The reuse water facilities are described in TM 22.

### ***Standby Power Facilities and Electric Utility Service***

Standby generators will be installed for the Western Wake WRF processes. The standby power facilities and electric utility service options are described in TM 23.

### ***Odor Control Facilities***

Odor control will be provided for the Preliminary Treatment Facility and aerated sludge holding tanks at the Western Wake WRF. The proposed odor control facilities are described in TM 24.

### ***Operations and Maintenance Building***

An operations and maintenance building will be provided to house plant operations and maintenance staff, a main control room, laboratory spaces, storage rooms, and maintenance shops. Preliminary design for the Operations and Maintenance Building is described in TM 25.

### ***Site Development and Utilities***

The preliminary overall site characteristics and layout of the proposed Western Wake WRF are presented in TM 30. TM 30 describes site utilities, access, site conditions, and erosion and stormwater control at the WRF site.

### ***SCADA and Plant Communications***

The treatment processes and all mechanical equipment related to the treatment processes will be operated by programmable logic controllers, which will be linked to control computers located in the Plant Control Room of the Operations Building using a Supervisory Control and Data Acquisition (SCADA) system. The plant instrumentation, control, and management system is described in TM 33.

## **EFFLUENT DISPOSAL FACILITIES**

### ***Effluent Pump Station***

An effluent pump station will be constructed on the WRF site to consolidate the effluent from the Western Wake WRF and Utle Creek WWTP and pump it into a single effluent force main. The effluent pump station is described in TM 26.

### ***Effluent Force Main***

An effluent force main will be constructed to convey the consolidated Western Wake WRF and Utle Creek WWTP effluent to the Cape Fear River for discharge. The effluent force main is described in TM 27.

### ***Effluent Discharge Structure***

An effluent discharge structure will be constructed at the Cape Fear River to discharge the consolidated Western Wake WRF and Utle Creek WWTP effluent into the Cape Fear River. Effluent will be discharged into the Cape Fear River by a multi-port diffuser. The site selection process for the effluent discharge structure is discussed in TM 28, and the preliminary design for the effluent discharge structure is described in TM 29.

## **OVERALL CONSTRUCTION COST ESTIMATE**

The total preliminary construction cost estimate for the Western Wake Regional Wastewater Management Facilities project is presented in Table 1. Table 2 contains a summary of the technical memoranda, descriptions of the facilities and selected alternatives, costs, and cost table references. An overview of the methodology used for estimating the capital and operation and maintenance costs of the treatment and conveyance systems is presented in TM 32.

**TABLE 1**  
**WESTERN WAKE REGIONAL WASTEWATER MANAGEMENT FACILITIES**  
**PRELIMINARY COST ESTIMATE (2005 DOLLARS)**

Facility Description	Cost
<b>Raw Wastewater Pumping and Conveyance Facilities</b>	
West Cary Pump Station (31 mgd PF)	\$ 7,086,600
West Cary Force Main (31 mgd PF)	\$ 7,235,300
Reedy Branch Gravity Sewer (33.2 mgd PF)	\$ 13,115,000
Beaver Creek Pump Station (40 mgd PF)	\$ 14,996,500
Beaver Creek Force Main (40 mgd PF)	\$ 14,729,100
<b>Raw Wastewater Pumping and Conveyance Subtotal</b>	<b>\$ 57,162,500</b>
<b>Western Wake Water Reclamation Facility (18.0 mgd MMF)</b>	
Preliminary Treatment Facility	\$ 2,925,800
BNR Process Tanks and Related Pumping Facilities	\$ 22,200,000
Secondary Clarifiers and RAS/WAS Pumping Station	\$ 6,661,000
Blowers and Blower Building	\$ 3,200,000
Effluent Filters	\$ 6,749,000
Effluent Disinfection/Post Aeration	\$ 2,380,000
Thickening Facilities	\$ 3,622,300
Solids Receiving/Aerated Sludge Holding Tanks	\$ 4,200,000
Centrifuge Dewatering Facilities	\$ 1,421,200
Scum Digestion Facilities	\$ 285,000
Centrate/Filtrate Treatment Facilities	\$ 582,750
Chemical Storage and Feed Facilities	\$ 1,008,000
Re-use Water Facilities	\$ 271,000
Plant Drain Pump Station	\$ 350,000
Standby/Emergency Power Facility	\$ 3,747,000
Odor Control Facilities	\$ 1,572,000
Operations/Maintenance Buildings	\$ 3,430,000
Site Electrical	\$ 1,644,500
Sitework	\$ 3,040,000
Yard Piping	\$ 3,000,000
Instrumentation	\$ 1,100,000
<b>Subtotal WRF Construction Cost</b>	<b>\$ 73,389,600</b>
Construction Contingency (15% of subtotal)	\$ 11,008,400
Engineering & Construction Services (10% ECC)	\$ 8,439,800
Legal and Finance Services (5% ECC)	\$ 4,641,900
WRF Site Land Cost	\$ 7,585,000
<b>Subtotal WRF Construction Costs (all factors included)</b>	<b>\$ 105,064,700</b>
<b>Effluent Pumping and Conveyance Facilities (24.0 mgd MMF)</b>	
Effluent Pump Station	\$ 8,726,000
Effluent Force Main	\$ 33,054,200
Effluent Discharge Structure	\$ 2,283,600
Additional Land/Easement Cost (Effluent Pump Station/Force Main)	\$ 1,464,900
<b>Effluent Pumping and Conveyance Subtotal</b>	<b>\$ 45,528,700</b>
<b>Overall Estimated Capital Cost (\$2005)</b>	<b>\$ 207,755,900</b>

**TABLE 2  
WESTERN WAKE REGIONAL WASTEWATER MANAGEMENT FACILITIES  
SUMMARY OF TECHNICAL MEMORANDA**

Cost Item No.	TM No.	Facility Description	Cost	TM Cost Estimate Table Reference	Selected Alternative
<b><u>Raw Wastewater Pumping and Conveyance Facilities</u></b>					
	TM 01	West Cary Pump Station Site Selection	-	-	West Cary Pump Station North Site - Apex to Reedy Branch Interceptor
	TM 02	West Cary Pump Station, Force Mains, and Gravity Sewer	-	-	-
1		West Cary Pump Station	\$ 7,086,600	Table 2-7	West Cary Pump Station North Site - Apex to Reedy Branch Interceptor
2		West Cary Force Main	\$ 7,235,300	Table 2-8	Wimberly Road Alignment
		Reedy Branch Gravity Sewer	\$ 13,115,000	Table 2-9	Wimberly Road Alignment
	TM 03	Beaver Creek Pump Station Site Selection	-	-	Richardson Road Site
	TM 04	Beaver Creek Pump Station and Force Mains	-	-	-
3		Beaver Creek Pump Station	\$ 14,996,500	Table 4-7	Richardson Road Site
4		Beaver Creek Force Main	\$ 14,729,100	Table 4-8	Route A-1
<b><u>Western Wake Water Reclamation Facility</u></b>					
	TM 05	Water Reclamation Facility Site Selection	-	-	Site 14 (between US 1 and Old US 1 in Wake County)
	TM 06	Influent Wastewater Characteristics/Effluent Limits	-	-	-
	TM 07	Not Used	-	-	-
	TM 08	Process Design/Mass Balance Pretreatment Evaluation	-	-	-
	TM 09	Hydraulic Design	-	-	No primary clarifiers, diffused air for post aeration of effluent
5	TM 10	Preliminary Treatment Facility	\$ 2,925,800	Table 10-2	Mechanical screens, vortex-type grit collectors
6	TM 11	BNR Process Tanks	\$ 22,200,000	Table 11-4	3 parallel trains
	TM 12	Secondary Clarifiers/RAS Pumping Facilities	-	-	-
7		Secondary Clarifiers	\$ 5,099,000	Table 12-6	3 rotating hydraulic removal-type secondary clarifiers
8		RAS Pumping Facilities	\$ 1,562,000	Table 12-7	Full radius scum collection with rotating scum trough
9	TM 13	Blowers and Blower Building	\$ 3,200,000	Table 13-8	5 multi-stage centrifugal blower units
10	TM 14	Effluent Filters	\$ 6,749,000	Table 14-3	Deep bed tertiary effluent filters with denitrification capability
	TM 15	UV Disinfection Facilities and Post Aeration Facilities	-	-	-
11		UV Disinfection Facilities	\$ 1,980,000	Table 15-5	Low-pressure, high-output UV system
12		Post Aeration Facilities	\$ 400,000	Table 15-6	Diffused aeration
13	TM 16	Waste Activated Sludge Pumping/Thickening Facilities	\$ 3,622,300	Table 16-5	Gravity belt thickeners
14	TM 17	Foreign Solids Receiv./Aerated Holding Tanks/Biosolids Loading	\$ 4,200,000	Table 17-3	On-site storage with jet-mix aeration
15	TM 18	Biosolids Dewatering Facilities	\$ 1,421,200	Table 18-2	Centrifuges for dewatering, off-site composting
16	TM 19	Scum Digestion Facilities	\$ 285,000	Table 19-1	Aerated scum digester tank
17	TM 20	Filtrate/Centrate Treatment Facilities	\$ 582,750	Table 20-4	Equalization storage tank
18	TM 21	Chemical Storage and Feed Facilities	\$ 1,008,000	Table 21-8	Facilities for methanol, ferric chloride, sodium hydroxide, and polymer

**TABLE 2 (cont'd)**  
**WESTERN WAKE REGIONAL WASTEWATER MANAGEMENT FACILITIES**  
**SUMMARY OF TECHNICAL MEMORANDA**

	TM No.	Facility Description	Cost	TM Cost Estimate Table Reference	Selected Alternative
		<b><u>Western Wake Water Reclamation Facility (cont'd)</u></b>			
19	TM 22	Non-potable On-site Reuse	\$ 271,000	Table 22-1	Pumps and tank for reuse of treated effluent
20	TM 23	Standby Power Facilities and Electric Utility Service	\$ 3,747,000	Appendix 23A	Alternative 1 - single standby power generation facility for entire WRF
	TM 24	Odor Control Facilities	-	-	
21		Preliminary Treatment Facility Odor Control	\$ 597,000	Table 24-1	Single-stage packed-tower scrubber
22		Aerated Sludge Storage Odor Control	\$ 975,000	Table 24-2	In-ground biofiltration system and covered tanks
23	TM 25	Operations and Maintenance	\$ 3,430,000	Table 25-1	Will house staff, control room, lab spaces, storage rooms, maint. shops
		<b><u>Effluent Pumping and Conveyance Facilities</u></b>			
24	TM 26	Effluent Pump Station	\$ 8,726,000	Table 26-3	2 sets vertical turbine pumps with VFDs
25	TM 27	Effluent Force Main	\$ 33,054,200	Table 27-6	Route along Old Hwy 1/RR corridor, Christian Chap. Ch. Rd, utility easements
	TM 28	Effluent Discharge Structure Site Selection	-	-	Effluent to be discharged downstream of Buckhorn Dam in Chatham Co.
26	TM 29	Effluent Discharge Structure	\$ 2,283,600	Table 29-4	Multi-port diffuser
27		Additional Land/Easement Cost (Effluent Pump Station/Force Main)	\$ 1,464,900	-	-
		<b><u>General (included in WRF Construction Cost)</u></b>			
28	TM 30	Site Development and Utilities	\$ 3,040,000	Table 30-1	-
	TM 31	Not Used	-	-	-
	TM 32	Cost Estimate Methodology	-	-	-
29	TM 33	Instrumentation and Controls	\$ 1,100,000	Table 33-1	PC-PLC-based monitoring and control system
30		Plant Drain Pump Station	\$ 350,000	-	-
31		Site Electrical	\$ 1,644,500	-	-
32		Yard Piping	\$ 3,000,000	-	-
<b>Subtotal WRF Construction Cost</b>			<b>\$ 73,389,600</b>	Includes Cost Item Nos. 5 through 23 and 28 through 32	
Construction Contingency (15% of subtotal)			\$ 11,008,400		
Engineering & Construction Services (10% ECC)			\$ 8,439,800		
Legal and Finance Services (5% ECC)			\$ 4,641,900		
WRF Site Land Cost			\$ 7,585,000		
<b>Subtotal WRF Construction Costs (all factors included)</b>			<b>\$ 105,064,700</b>		
<b>Subtotal Raw Wastewater Pumping and Conveyance Facilities<sup>1</sup></b>			<b>\$ 57,162,500</b>	Includes Cost Item Nos. 1 through 4	
<b>Subtotal Effluent Pumping and Conveyance Facilities<sup>1</sup></b>			<b>\$ 45,528,700</b>	Includes Cost Item Nos. 24 through 27	
<b>Overall Estimated Capital Cost (\$2005)</b>			<b>\$ 207,755,900</b>		

**Note:** <sup>1</sup> Contingencies are already included in costs for Raw Wastewater Pumping and Conveyance Facilities and Effluent Pumping and Conveyance Facilities

See accompanying notebook for a copy of the Preliminary Engineering Report.