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Western Intake Partnership

Final Preliminary Engineering Report

Regional Water Treatment Facility

October 2024 (Revised 10/22/24)

Executive Summary

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To provide a long-term water supply for the communities served by the Western Intake Partnership (WIP), the WIP plans to build and commission a greenfield regional water treatment facility (RWTF) by 2031. Jordan Lake will serve as the raw water source for the RWTF with an intake near the Vista Point recreational area. Facilities will include a raw water pump station and the RWTF on nearby property, a raw water transmission main between the raw water pump station and the RWTF, and a finished water transmission main from the RWTF to Chatham County's and the City of Durham's water distribution systems.

The purpose of this preliminary engineering report (PER) is to establish and document preliminary design criteria and concepts for the RWTF. Separate documents by others address the intake, raw water pump station, and the transmission system. The WIP RWTF will be designed to treat a maximum daily flow of 22 million gallons per day (MGD) and pump to the distribution system a maximum daily flow of 20 MGD as part of initial construction (Phase I). The 10% difference in the 22 mgd treated and 20 mgd pumped to the distribution system is the allowance for backwash wastewater, sedimentation basin sludge and other plant water uses. An extra filter and extra flocculation/sedimentation train will be designed for obtaining alternate bids to allow the WIP to have an additional 5 MGD initially of these treatment components if the alternate pricing is attractive to the WIP due to economies of scale. Plant expansions to 30 MGD (2050), 40 MGD (2070), and buildout (77 MGD) are planned.

The RWTF will be constructed on a 121.6-acre tract located near the intersection of Pea Ridge Road and Seaforth Road in Chatham County. Many of the facilities constructed as part of Phase I will be capable of supporting 30 MGD (Phase II) of finished water production.

For long-term planning (Phases III and IV), a master site layout for future improvements to treatment and finished water pumping capacities has been developed as shown in **Figure ES-1**. Phases are conservative in site space allocations and acknowledge that the WIP may pursue uprating of some facilities, thereby altering the expansion phasing plan in the future. The project includes several structures, tanks and basins including, but not limited to raw water storage tanks, raw water ozone, rapid mix basins, flocculation and sedimentation basins, settled water ozone, filters/filter gallery, post-filter per- and polyfluoroalkyl substances (PFAS) removal contactors (advanced treatment), finished water storage in circular clearwells, finished water pump station (FWPS), administration, maintenance, electrical buildings, and residuals structures. The site layout incorporates details required for obtaining the rezoning achieved for the RWTF site, such as the buffer and landscape requirements and general concepts for appearance of all facilities. Grading will support vehicular access and the treatment processes. The site layout is designed to best suit the process flow progression and to provide gravity flow through the plant where possible. The raw water pump station is located at the southern point closest to the lake. Raw water is pumped to the raw water storage tanks located at the approximate high point on the site along N Pea Ridge Road.

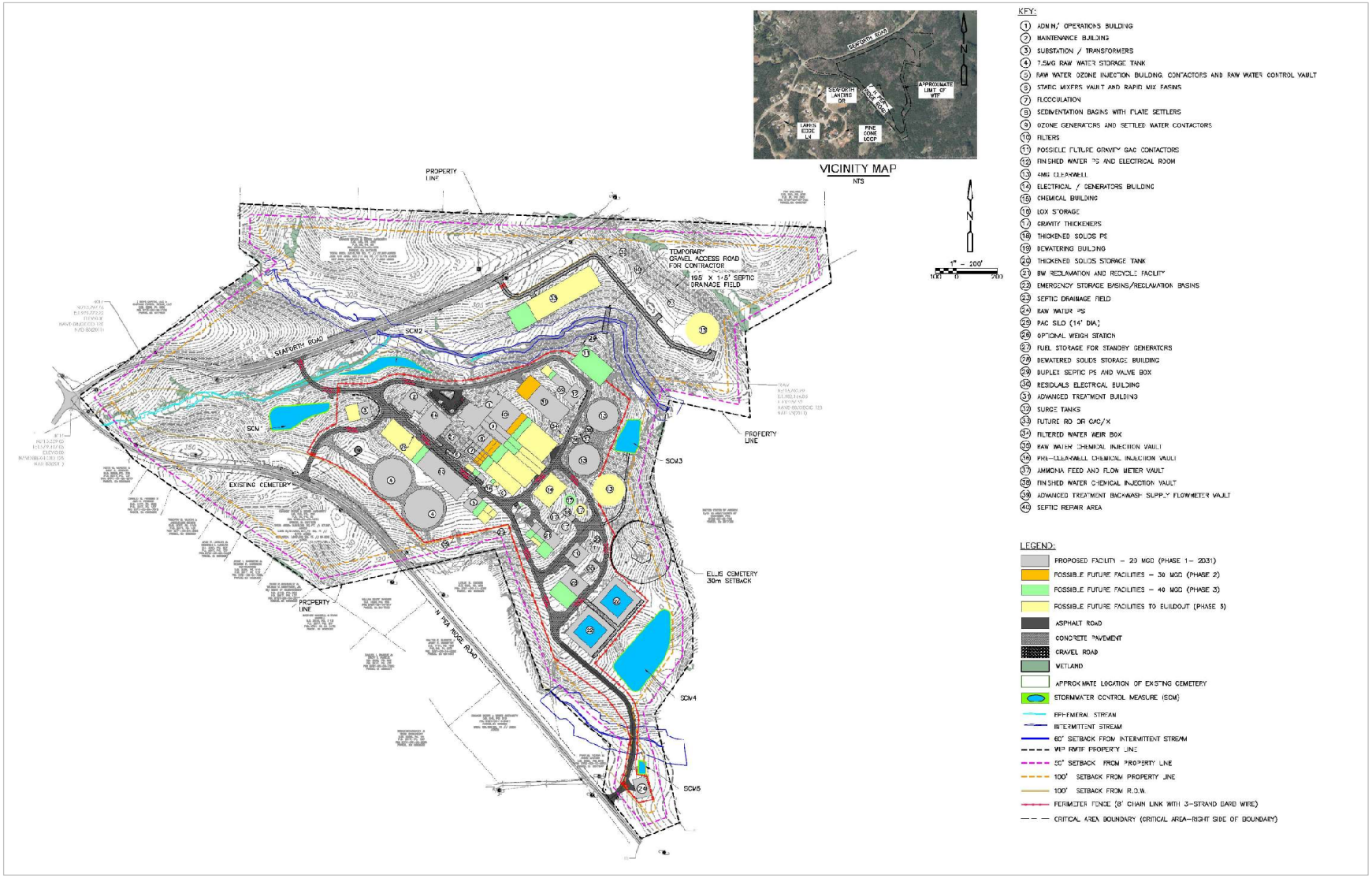

Figure ES-1 | Site Plan

The location of the raw water storage tanks provides gravity flow to the northeast following natural topography downslope through raw water ozone, rapid mix, flocculation, sedimentation, settled water ozone, and filters, then pumping feeds the advanced treatment (post-filter contactors) which will then gravity flow to the clearwells and ultimately to the FWPS for conveyance to the Partners.

Due to concerns over seasonal contaminants and PFAS present in Jordan Lake, the WIP undertook a comprehensive pilot and bench testing effort between February 2023 and January 2024 to identify means to treat Jordan Lake water and compare treatability at the Cary Apex Water Treatment Facility (CAWTF)/Chatham County Utilities Water Treatment Plant (CCUWTP) intake and the proposed Vista Point Intake.

Informed by the bench/pilot report and the PER, the WIP has made the following decisions for the initial construction of the WIP RWTF:

- The WIP **finished water treatment goal** is to meet all current federal and state drinking water quality standards at all times, as well as the recently finalized EPA PFAS standard and possible future 1,4-dioxane maximum contaminant level (MCL).
- The **selected processes** are raw water storage, raw and settled ozone advanced oxidation process (AOP) for oxidation and 1,4-dioxane removal, static mixers followed by vertical turbine rapid mixing, flocculation and settling either with plate settlers or SuperPulsators®, filtration with granular activated carbon (GAC) or anthracite over sand followed by pressure vessel contactors for post-filtration advanced treatment. The pressure contactors will be designed to accommodate either of the three media (GAC, anion exchange resin (AER), or novel sorbent (NS)).
- The WIP will continue to monitor developing regulatory requirements and the evolution of treatment technologies. The WIP will plan to include reverse osmosis (RO) (or some other advanced treatment technology) in the future if needed, likely repurposing the pressure vessel contactors for sidestream treatment of the RO concentrate.
- The proposed **residuals handling system** will be designed to treat residuals from sedimentation and backwashing, and process drains. The goals for treatment are to clarify solids from the residuals streams, to collect, equalize, thicken and dewater solids into a cake for disposal using belt presses, and to either recycle the treated effluent back to the head of the treatment process or discharge the effluent to a permitted National Pollutant Discharge Elimination System (NPDES) outfall. The residuals facilities will be located downhill of the treatment basins as shown on the site plan to allow gravity flow of sedimentation sludge to the thickeners and backwash water to the equalization basin. A covered storage area will be included for storage of dewatered cake, as needed, such as during inclement weather that would delay sludge hauling and disposal. The residuals facilities are to include two 1.8 million gallons (MG) each, emergency storage basins to provide a large volume for draining of a sedimentation basin or other process basin for maintenance or cleaning, storage of water or residuals

that have to be wasted for various reasons, helping with GAC fines if GAC is being changed out concurrently as the backwash treatment system is heavily loaded with filter backwashes.

- The design is to adhere to the **City of Durham's High-Performance Building Policy** which has multiple requirements including designing for LEED Gold for the administration and maintenance buildings as discussed particularly in the HVAC and Architecture sections. The design aesthetic has been set through the rezoning process. The **Envision Sustainability Framework (Envision)** is being applied to the Program as discussed further in Section 15.

Supporting facilities include electrical; instrumentation and controls; civil; structural and architectural; heating, ventilation, and air conditioning (HVAC); and plumbing and fire protection. The supporting facilities are to be designed in accordance with related state and federal codes as described further herein, such and the North Carolina Building Code, and in accordance with the WIP standards. The WIP is using the City of Durham standards for items where the WIP has not standardized separately.

The **architecture** of the RWTF is to promote a context-sensitive design that preserves the rural character of Chatham County. In addition to large buffers of existing woodland, the WIP selected a natural modern aesthetic as illustrated for the Administration/Operations Building in **Figure ES-2**.

Figure ES-2 | Natural Modern Building Aesthetic for Administration/Operations Building

The **electrical** design will include considerations for reliability, maintainability, and safety. To provide for a reliable distribution, the system will be designed with two incoming utility feeds along with standby power generators. To provide that portions of the distribution can be taken out of service for routine maintenance without disrupting the entire electrical system, a double-ended design (Main-Tie-Main configuration) is planned.

Instrumentation and controls will include a redundant protocol such as a proprietary ring or Rapid Spanning Tree Protocol (RSTP) to facilitate on-premise control network redundancy that prevents a single point of failure from causing network downtime. Variable Frequency Drives (VFD) and power monitors will be connected to the supervisory control and data acquisition (SCADA) network using the managed Ethernet switch within the plant area

programmable logic controller (PLC). Equipment with vendor provided PLC-based controls will be connected to the SCADA network utilizing the managed Ethernet switch in the network rack. Data in other networks such as those for business/internet, voice over internet protocol (VoIP) phones, video or security will be transmitted using different pairs within the same fiber optic cable backbone and be terminated in separate fiber patch panels and network interfaces inside the various buildings. The business network rack will be in a separate lockable room from the plant SCADA control network infrastructure for cybersecurity purposes.

Goals for the **civil design** include limiting the amount of clearing necessary to provide a fully functional site while maximizing the area for wildlife habitat and protecting riparian areas. Other goals include material reuse onsite and limiting the hauling off of debris and excess soil.

The plant design will address **security and resiliency**. The RWTF will comply with appropriate standards such as ANSI/ASCE/EWRI 56-10 Guidelines for the Physical Security of Water Utilities. The plant site will be surrounded by an 8-ft high chain link fence with 3-strand barbed wire. Access will be through one of three vehicular gates; each with an automatic gate operator, keypad, and dial-in feature. Individual man gates will also be provided in locations approved by WIP stakeholders. Other security measures include adequate site lighting and security cameras. There will be alarms in certain parts of the plant to prevent intrusion and/or vandalism. Security and resilience elements to be included are to be consistent with prior City of Durham and Chatham County plans for security and resilience.

The site will contain 5 **stormwater** ponds to receive, treat, store and discharge stormwater along the site. The ponds will not be lined, thereby encouraging infiltration. Native vegetation will be provided in the basins to take up nutrients and provide evapotranspiration. Aquatic vegetation will be provided in the wet basin, and herbaceous species that can withstand both hydric and drought conditions will be planted in the infiltration basins to withstand the varied conditions between wet weather events.

There will be a **sanitary waste septic system** on-site. An on-site gravity sewer collection system with precast concrete manholes will service the administration and maintenance building restrooms and various floor drains. This collection system will flow to a lift station on the east end of the property that takes wastewater to a proposed septic system on the northeast corner of the site.

HVAC systems will be provided for the Operations Building, Maintenance Building, Raw Water Ozone Building, Settled Water Ozone Building, Filters Building, Advanced Treatment Building, FWPS, Electrical Building, Chemical Building, Thickened Solids Pump Station, Dewatering Building, and the Generator Building for the WIP RWTF. The HVAC systems will be monitored via equipment sensors, Automatic Temperature Control (ATC) panels, and/or SCADA integration as required by final design to ensure the systems are properly monitored.

Several **regulatory permits and approvals** will be needed to construct and operate the WIP RWTF. Section 13 contains a discussion of the anticipated permit and approval requirements.

A summary of the Opinion of Probable Construction Cost (OPCC) for the WIP's preferred options for each facility is presented in **Table ES-1** in March 2024 dollars. The preferred options are based on the WIP's decisions in the April 3, 2024 workshop (Workshop #19: WIP RWTF Workshop on Options and Costs). The OPCC for a the RWTF is $445 million.

Table ES-1 | OPCC for 20 MGD WIP RWTF

Facility	Selected Option	Cost (Millions) [1]
Raw Water Storage Tanks	(2)-7.5 MG Tanks	$16
Ozone[2]	Raw and Settled Ozone AOP, LOX	$33
Flocculation and Sedimentation	(4) Trains	$22
Filters	(5) Filters with Concrete for 6th	$26
PFAS Pressure Contactors	20 MGD Lead-Lag	$59
Clearwells	(2)-4 MG	$16
Finished Water Pump Station	One Row of Pumps with Two Suction Feed Pipes	$19
Chemical Building[2] and PAC Silo	Indoor Tanks, Metering Pumps; (1)-PAC silo with Dual Feeders	$19
Residuals Facilities	Residuals with Dewatering and Covered Cake Storage	$39
Administration Building	Administration/Operations Building as Presented in Section 8	$19
Maintenance Building	Maintenance Building as Presented in Section 8	$7
Building Heat/Air Conditioning	Electric Heat with Raw Water Heat Exchange	$6
Generators, Electrical, Instrumentation and Controls (I&C)	Electrical, I&C, Diesel Generators, Electrical Building	$94
Site, Yard and Building Piping	Site with Parallel Pipes where Chemical Injection	$50
Rock and Hauling Offsite	Reduced Offsite Hauling	$5
Applicable Buildings	High Performance Building Additions LEED, Envision	$7
Allowances	Small Piping, Equipment, etc.	$8
	Total	**$445**

1. Costs include 30% contingencies and other assumptions listed in Section 16.
2. Structure sized for 30 MGD.

The total O&M costs (in March 2024 dollars) are summarized in **Table ES-2.** The O&M miscellaneous cost item is based on City of Durham WTP budgets and does not include full Renewal and Replacement, which is separately estimated in section 16 as requested.

Table ES-2 | Estimated O&M Cost

Category	Estimated Annual Cost ($ Million)	
	Low End	High End
Labor	$2,300,000	
Power	$2,500,000	
Chemicals	$3,000,000	
Sludge Disposal	$730,000	
Advanced Treatment	$2,100,000	$4,300,000
Miscellaneous	$200,000	
Subtotal	**$10,800,000**	**$13,000,000**
Contingency (10%)	$1,100,000	$1,300,000
Total Annual O&M Cost	**$11,900,000**	**$14,300,000**

A 20-year net present value (NPV) for the WIP RWTF has been prepared using the capital and operation and maintenance (O&M) costs estimated for the facility. An escalation rate of 5% is assumed for years 1-5, and a 4% escalation rate is assumed for the remaining years in the 20-year analysis period. The first year of facility operation is assumed to be 2031 for this analysis. The 20-year NPV for the WIP RWTF is presented in **Table ES-3.** The high end allows use of ion exchange media and potentially more stringent disposal requirements. The low-end would meet the requirements as currently promulgated. The PFAS treatment alternatives represented in this analysis are facilities intended for compliance with current PFAS regulations.

Table ES-3 | Net Present Value for WIP RWTF

	Low End	High End
PFAS Treatment Alternative	Full-Scale Ozone + Pressure Vessels with Novel Sorbents or GAC	Full-Scale Ozone + Pressure Vessels with Ion-Exchange Resin
Spent Media Disposal	Landfill	Incineration
20-Year Net Present Value	**$760,000,000**	**$820,000,000**

A **preliminary schedule** is shown in **Figure ES-3** below for the detailed design, construction and commissioning of the WIP RWTF. The schedule is conservative and completes the project ahead of the 2031 deadline.

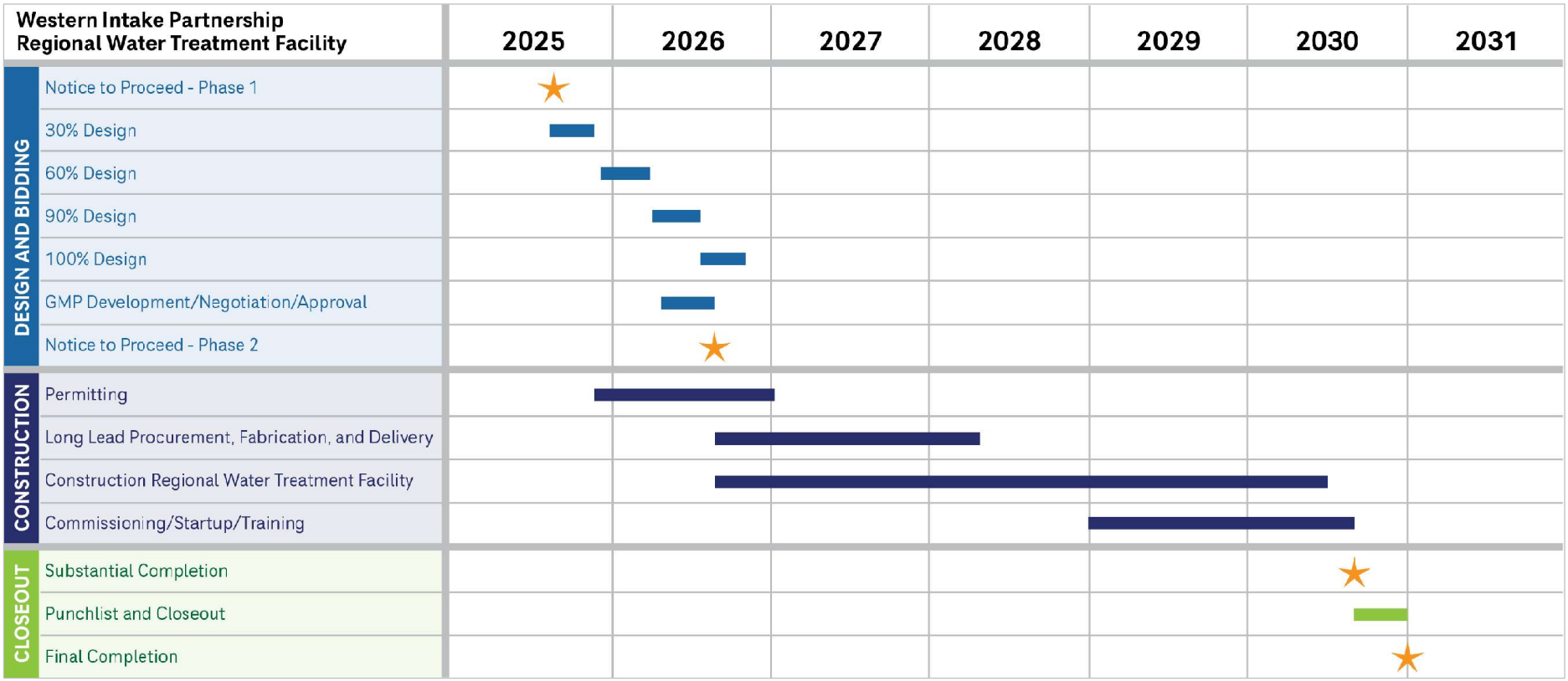

Figure ES-3 | Preliminary Schedule Estimate