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Western Intake Partnership

WIP Water Intake and Transmission Infrastructure PER Executive Summary

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1. Introduction

The Western Intake Partnership (WIP) consists of four Jordan Lake Water Supply allocation holders: the City of Durham, Orange Water and Sewer Authority (OWASA), Chatham County, and the Town of Pittsboro. The collective group is referred to as the WIP Partners. The goal of the WIP program is to facilitate the WIP Partners' access to their Jordan Lake water supply storage allocations through a new water supply intake on the west side of Jordan Lake, a new water treatment facility, and additional transmission infrastructure to each of the Partners' systems.

Technical Memoranda (TM) were developed by Hazen to address the following:

- Water Capacity Requirements (May 31, 2024)
- In-Lake Raw Water Quality Modeling (May 31, 2024)
- Intake Siting and Basis for Conceptual Alternatives (July 18, 2023)
- Finished Water Transmission Hydraulic Analysis (May 31, 2024)
- Water Treatment Facility Site Evaluation (July 17, 2023)
- Finished Water Transmission Infrastructure (August 14, 2024)
- Raw Water Intake, Pump Station, and Transmission Alternatives Evaluation (August 23, 2024)
- Water Quality Sampling Program (August 23, 2024)

This Executive Summary (ES) summarizes the key findings and recommendations from each of the above TMs. The work associated with the evaluations and development of these preliminary engineering documents spans the period of August 2021 to May 2024. This ES brings together the latest findings for each of these, understanding that scenarios, options, nomenclature and project drivers have changed over the course of this work.

2. Water Capacity Requirements

Capacity planning for WIP facilities will take into account the ability to phase components to defer capital costs and right-size facilities to cost-effectively meet the Partners' capacity requirements as the needs develop. The review and summary of the Partners' demand and capacity requirements suggest capacities of 20 mgd (million gallons per day) for the Initial construction phase, 26.2 mgd for the 2050 planning year and 40.4 mgd for the 2070 planning year are warranted for the WIP facilities. It is acknowledged the water treatment facilities have defined capacity increments due to individual unit process capacities, and actual future capacity increases for these conveyance facilities will warrant coordination with water treatment capacities projected at the time of expansions. The assessment of Maximum Potential Withdrawal reveals an ultimate maximum day capacity of approximately 85.5 mgd based on the remaining available supply from Jordan Lake.

The capacity projections assume the City of Durham's allocation of 16.5 mgd would be withdrawn consistently and would be available to the City immediately following the construction of the facilities. If the City determines it is not necessary to utilize its full allocation as a baseload at the outset of facility operations, this excess capacity could be made available to other Partners on an interim basis and influence the timing of capacity development.

Opportunities for phasing and further refinement of facility capacities will continue to be evaluated throughout preliminary engineering; however, it is generally anticipated the Initial planning year capacity requirements will be used to size the first phase of construction for components that have a relatively short life span (i.e. mechanical equipment) or are easily expandable. The 2070 planning year capacity requirements will be considered for those components that would not be easily phased or expanded (i.e. long transmission mains and pumping facility structures). Sensitivity analyses will be completed during transmission main sizing to define how accounting for potential demand in addition to the WIP 2070 Maximum Day Demand (MDD) may influence the facility planning.

The Partners will consider sizing the tunneled intake components and pump station wetwell structure for the Maximum Potential Withdrawal of 85.5 mgd. Other components of the intake facilities like screens and mechanical equipment that can be constructed in phases will be planned based on the Initial, 2050 and 2070 planning years as appropriate.

The dynamic nature of the rapidly growing region results in some uncertainty in demand projections and highlights the need for planning and phasing to balance the near-term investments with the ability to react to the water supply needs. Therefore, these demand and capacity projections will serve as guidance for facility planning but will warrant revisiting as growth occurs to ensure the facility planning and design are adapted to the realities observed.

3. In-Lake Raw Water Modeling

The In-Lake Modeling task utilized available hydrologic, water quality, and hydrodynamic models available for the Jordan Lake reservoir and watershed to support the establishment of the preferred location for the new intake and to assist in the development of feasible intake configuration alternatives for the new Western Intake. Modeling results serve to supplement other concurrent evaluation activities underway (water quality sampling program, feasible construction methods, identification of stakeholder concerns, etc.) to develop conceptual alternatives for further assessment.

In-lake modeling conclusions ascertained from the completion of the OASIS and EFDC modeling exercises are summarized below.

- Uncertainty surrounds future downstream water needs in the Cape Fear River, which may have impacts on controlled releases from Jordan Lake. Sediment deposition occurs throughout the lake, not just in the existing sediment pool, reducing the available volume between elevations 202 feet and 216 feet (the currently defined lower and upper bounds of the conservation/water supply pool). Intake withdrawal access below the existing conservation/water supply pool within the thalweg of the reservoir would provide the new Western Intake with greater resilience to adverse events or operating policies that could reduce the lake's water surface elevation.

- Modeling efforts confirmed the seasonal lake stratification and the water quality challenges presented at different lake depths observed in historic and ongoing water quality sampling efforts in the reservoir. Multiple intake withdrawal elevations allow the Western Intake to seasonally select withdrawal from water depths in the lake that optimize water quality and mitigate treatment expenses in-situ and/or at the water treatment plant.

Given the knowledge gained from these modeling efforts, the following recommendations are provided:

- Develop intake concepts with three (3) withdrawal elevations; two (2) within the approximate extents of the existing conservation/water supply pool elevations and one (1) near the thalweg elevation.

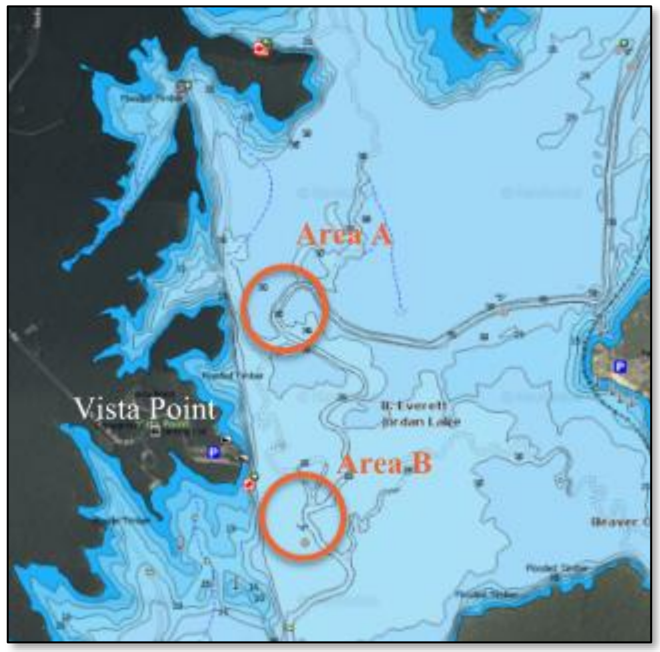
- Develop intake concepts that provide an accessible, maintainable means to readily change withdrawal elevations in response to water quality changes and/or contamination events.

4. Intake and Raw Water Pump Station Siting

4.1 Intake Location Recommendation

Based on the prior studies and recent evaluations related to the location for a new western intake for the Partners, Site 1 (the thalweg just north of Vista Point), identified in the 1991 Water Intake Site Investigation B. Everett Jordan Lake, by CH2M Hill, remains the recommended location to withdraw water from Jordan Lake. This intake site is referred to in the Intake Siting and Basis for Conceptual Alternatives TM by Hazen, and in Figure ES-1Figure ES-1, as Area A.

Figure ES-1: Potential Intake Sites



This site allows access to deep water as near to the shoreline as possible, thereby allowing the use of impact-minimizing trenchless construction methods to connect the intake and raw water pump station and avoids the typically poorer water quality further south and closer to the Narrows. The Narrows is the relatively narrow portion of Jodan Lake between the Haw River and New Hope Creek arms of the lake. No other site provides this combination of benefits. Consequently, the development of alternatives proceeded based on the intake site just north of the Vista Point Recreation area.

4.2 Raw Water Pump Station Location

The 1991 study included concepts for raw water pumping on the peninsula closest to the intake site as well as on a tower in the lake. However, the Partners have established that the raw water pump station should be above the full flood elevation and be accessible during flood conditions. This precludes either of these arrangements. Instead, alternatives include pump station sites on high ground outside of the flood pool. The options include U.S. Army Corps of Engineers (USACE) property managed by NC Parks near the Seaforth property (the property currently owned by OWASA and the intended site for the Regional Water Treatment Facility), or on the Seaforth property itself. The raw water pump station is recommended to be on the Seaforth property.

5. Finished Water Transmission Hydraulic Analysis

5.1 System-Specific Modeling

System-specific modeling revealed the following:

- The City of Durham system-specific modeling identified the corridor along Hwy 751 as a favorable delivery location.

- OWASA system-specific modeling was not completed within the analysis. Given the transmission infrastructure required for the City of Durham to receive water along NC 751, it was determined the most appropriate way for OWASA to receive water from the WIP WTF is to leverage the existing interconnections at NC 54 and I-40.

- Chatham County system-specific modeling initially indicated the corridor along Jack Bennett Rd. is the optimal location to deliver WIP water. Since the system-specific modeling was completed, Chatham County expressed interest in receiving water from the transmission main near the intersection of Seaforth Rd and US 64. The County is currently evaluating options to pump directly from the northern transmission main.

- Town of Pittsboro system-specific modeling identified the favorable delivery strategy is from the east to the center of the future service area where it can be pumped north to the 710 Zone or south to a higher zone.

5.2 Northern Route Transmission System Hydraulic Analysis

5.2.1 Preferred North Route

The Big Woods route is more favorable than the Mt. Gilead route from a hydraulic perspective based on the following:

- The Mt. Gilead route requires a higher HGL, which results in increased pumping energy at the WIP WTF finished water pump station and results in greater operating pressures along the transmission main (greater than 150 psi).
- The higher HGL of the Mt. Gilead route does not allow for gravity supply to the City of Durham. Therefore, the increased HGL does not provide any additional benefit.
- The lower HGL of the Big Woods route allows for more flexibility in locating intermediate storage along the transmission main and results in lower transmission operating pressures.

5.2.2 Transmission Sizing and Capacity Considerations (North Route)

For the north route, a 42-inch transmission main is recommended, which adequately conveys the needed capacity of 27.1 mgd to Chatham County, the City of Durham, and OWASA for the 2070 planning projections. The maximum capacity of a 36-inch transmission main to the City of Durham is approximately 18.0 mgd. If the WIP requires additional flow to be conveyed to Durham initially via a single pipe, a 42-inch transmission main will need to be constructed. If the WIP desires to convey 18.0 mgd in the near term via a 36-inch transmission main but wants to expand the conveyance system in the future, a parallel 30-inch transmission main would provide adequate capacity to meet future capacity requirements (i.e. 23.5 mgd to the City of Durham and OWASA). Initial additional capacity to Chatham County could be provided by including a 42-inch transmission main up to US 64.

The capital investment implications of installing a 42-inch length transmission main compared to a 36-inch now with a parallel 30-inch in the future were evaluated. If a 36-inch pipe is initially installed, the parallel 30-inch pipe required to achieve the 2070 planning basis would need to be deferred beyond 30 years into the future for the net present value of the two options to be similar. Otherwise, installing a 42-inch pipe initially would be more favorable from a net present value perspective.

An evaluation of long term needed capacity was completed to determine the ultimate infrastructure that may be required within this corridor. Using an annual average to maximum day demand peaking factor between 1.3 and 1.5, and accounting for the current Jordan Lake allocations for Durham, OWASA, Hillsborough, and Orange County (24 mgd), as well as the unallocated supply (8.8 mgd), the ultimate required capacity to the north could be between 42.6 mgd and 49.2 mgd. This assumes a total yield from Jordan Lake of 100 mgd. Matching the HGL in the scenarios evaluated herein, a combination of a 42-inch and 36-inch pipe would provide a capacity of 45.0 mgd, and parallel 42-inch pipes would provide 54.1 mgd. It can be concluded from this that initially installing a 36-inch or 42-inch pipe does not preclude achieving a likely ultimate required capacity within the range of potential needs as long as the future parallel pipe is adequately sized.

Regardless of the initial pipe size, it is recommended the Partners purchase sufficient easement to accommodate a future parallel pipe to allow for increased transmission capacity to the north.

5.2.3 Transmission Storage (North Route)

Storage within the transmission system requires the following:

- Redundant Storage is desired by the Partners along the Big Woods route to maintain system functionality when one of the tanks is required to be temporarily removed from service for maintenance.
- At least one storage tank is required at the intermediate point of the system, and one storage tank is required at the end of the transmission system at the City of Durham delivery point.
- Initially only one storage tank is proposed at each of the two storage sites; however, storage sites should be sized to allow for two storage tanks per site if added volume is desired at one or both sites in the future.

- Storage within the transmission system will be elevated storage to maintain acceptable HGL and pressures at higher elevations.

The system was modeled assuming a single 42-inch transmission main would deliver water to Chatham County and to Durham for the 2070 planning projections. The resulting HGL was used to establish tank heights at the intermediate site and the northern site. The two storage tanks will be constructed at different overflow elevations and will not operate balanced during lower flow or static conditions. However, the storage strategy ensures the transmission system maintains adequate pressure during low or no flow conditions and allows for tank outages (intermediate storage or end-of-line storage) while maintaining a consistent HGL, WIP WTF finished water pumping performance, and hydraulic suction conditions at the City of Durham booster pump station. The storage tanks are recommended to be 1 MG each to provide water level management.

5.3 Town of Pittsboro Transmission System Hydraulic Analysis

5.3.1 Preferred Route (Town of Pittsboro)

The hydraulic analysis indicated that both routes produce similar and acceptable hydraulic results. Therefore, the route selection is based on the evaluation summarized in the Finished Water Transmission Route Technical Memorandum, which establishes the US 64 route as the recommendation.

5.3.2 Transmission Sizing and Delivery HGL (Town of Pittsboro)

A 30-inch transmission main is recommended to meet Pittsboro’s future capacity requirement of 13 mgd. When considering the impacts of reducing the main to a 24-inch, the capacity is reduced to 7 mgd under equivalent hydraulic conditions (similar resulting HGL) to that of a 30-inch. A 36-inch provides similar hydraulic conditions to that of a 30-inch for the 2070 demand conditions, and therefore, upsizing to a 36-inch is not recommended.

Delivering WIP water to the Town of Pittsboro at a hydraulic grade of 565 ft allows WIP to supply the Town’s 565 Zone. Delivery at a lower hydraulic grade results in an HGL that is not sufficient to serve the 565 Zone without a booster pump station and is therefore not recommended.

Given the wide range of potential expansion opportunities for the Town of Pittsboro, additional future analysis of system-specific performance is warranted once more refined system planning is completed.

Pittsboro has been actively engaged in securing additional supply from the City of Sanford and recently decided to merge its system with Sanford’s. The intent is that the City of Sanford will meet near-term demands for Pittsboro, and neither Pittsboro nor Sanford will participate in the initial phase of WIP.

Once more refined system planning is completed, future analysis of system-specific performance and storage requirements within the Town’s system is warranted. This planning will inform whether additional 565 Zone storage is beneficial near the WIP delivery location to receive WIP water.

6. Water Treatment Facility Site Evaluation

Based on the review of the sites identified, the site currently owned by OWASA (Site 1 in the Intake Siting and Basis for Conceptual Alternatives TM), also referred to as the Seaforth site or property, is recommended for the construction of the WIP WTF. Each of the five (5) potentially viable sites evaluated had the requisite size and configuration to accommodate the proposed and future water treatment facilities. Differences in environmental impacts were found to be insignificant between the sites. Additionally, all the sites are currently zoned for residential use and have residential zoning and existing residences adjacent to their perimeter.

Therefore, the primary differences between the evaluated sites are their location, the degree to which they cost-effectively accommodate the water transmission, and their ability to accommodate the RWPS (Raw Water Pump Station) on a site with the treatment facilities. Based on these findings, the Seaforth site is the most favorable and recommended for developing the WIP WTF.

7. Finished Water Transmission Infrastructure

7.1 Final Transmission Main Route Recommendations

The recommended north route toward Durham is shown in Figure ES-2. The route is approximately 87,000 feet. An initial pipe size of 36-inch or 42-inch is anticipated, and a parallel main with a diameter ranging from 30-inch to 42-inch will be constructed in the future as demands require.

The north route toward Durham leaves the proposed WTF heading north on Seaforth Road, crosses under US-64, and continues on the east side of Big Woods Road before turning east to cross Jordan Lake. After crossing Jordan Lake, the route continues north on Farrington Point Road, continuing to Old Farmington Road, Farrington Mill Road, and Farrington Road. The route turns east on the City of Durham-owned property and continues cross-country parallel to an existing gas main easement and in a new easement ending at Hwy 751.

The project included evaluation of route alternatives for the finished water transmission from the WTF site to Pittsboro. Though no longer anticipate to be included in the initial phase of WIP facilities, the recommended route to Pittsboro is shown in Figure ES-3. The route is approximately 33,300 feet of 30-inch transmission main. The route leaves the proposed WTF heading west on Seaforth Road, turns north on N. Pea Ridge Road, and then west on Ridge View Road. From Ridge View Road, the route crosses through private easements parallel to US-64, crosses the Haw River south of US-64, then follows the River Access Road and Foxfire Trace to US-64 Business. It ends at Chatham Parkway.

7.2 Transmission Main Materials

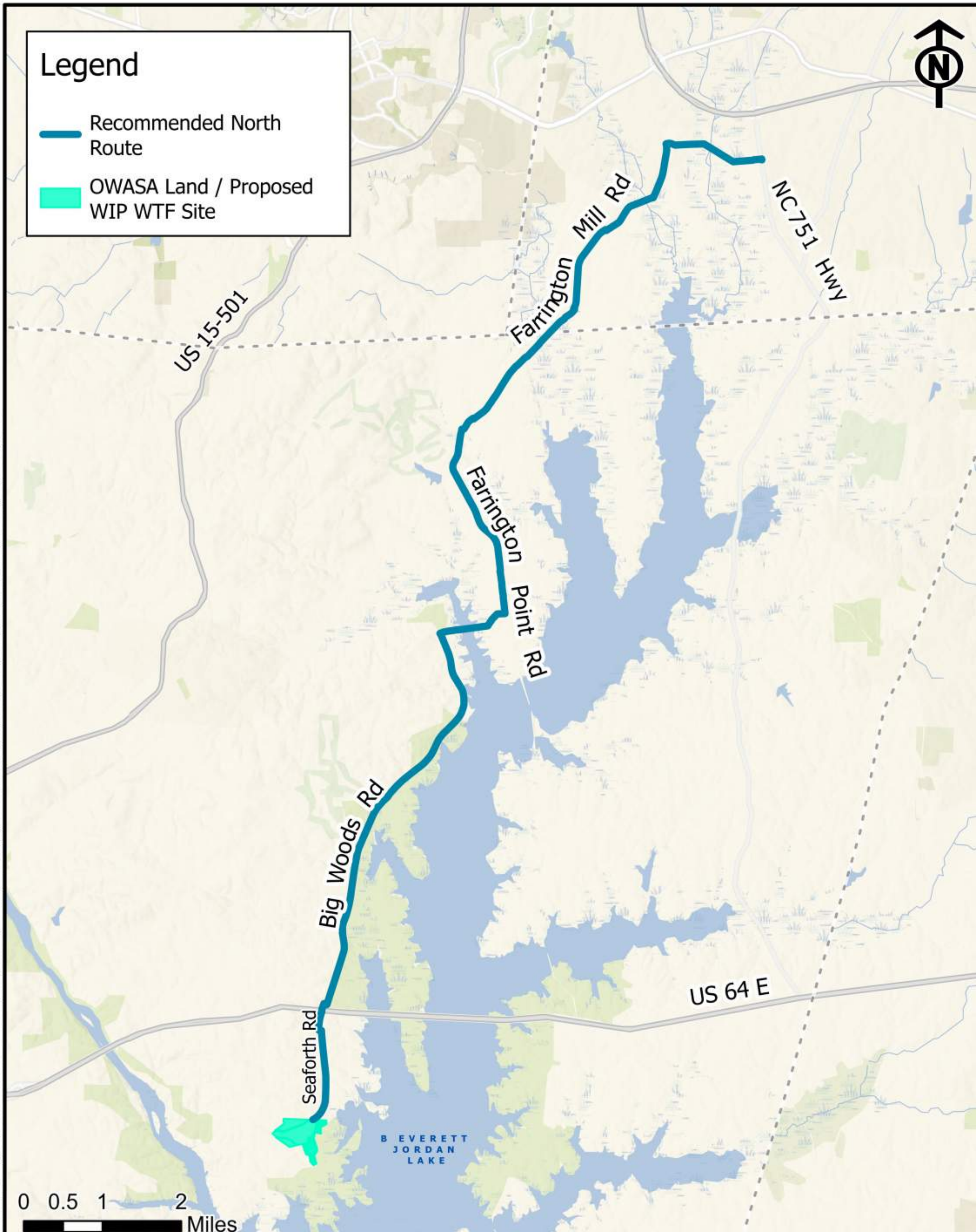
Ductile Iron pipe (DIP) and carbon steel (CS) are the most suitable materials for the project. These materials are readily available and of common use for larger-diameter water mains in the region. Additionally, they are familiar products for contractors that will construct a project like this. While CS is not as common as DIP in the region, handling and repair of CS can be addressed with local resources and expertise.

DIP has been utilized as the basis for preparing the opinion of probable construction cost (OPCC) within this report and is recommended to be utilized as a base bid for the project. CS can be utilized as a direct competitor within the bid or as an alternate bid for pipes sizes 36 inches and greater. It is unlikely that a CS bid would be provided for any 30-inch main utilized as this is deemed too small for man-entry welding.

7.3 Trenchless Crossings Assumptions

The recommended tunneling alternatives included both 30-inch through 42-inch ductile iron carrier pipes. The minimum tunnel diameters required to install these proposed pipes are dependent on the tunneling method. Where a single pipe is initially recommended, the current OPCC reflects a single trenchless crossing and pipe. This assumption will be further evaluated during detailed design. Parallel pipes may be considered at some locations, and potentially, multiple approaches may be included in the bid to allow a competitive cost as a basis for the decision.

The microtunnel boring machine (MTBM) method was used for cost analyses for longer trenchless crossings under portions of the lake. Traditional jack and bore trenchless methods are assumed for the shorter trenchless crossings under roadways. Other tunneling methods may be appropriate along the recommended tunnel alignments and can be evaluated further during design. Geotechnical investigations are warranted to further assess the applicability of each method at each crossing.



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Water Intake and Transmission Infrastructure PER
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Review By:	N. Johnson

Recommended North Route

Figure ES-2

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Service Layer Credits: UNC, Chatham County, NC, State of North Carolina DOT, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, USFWS, Esri, CGIAR, USGS

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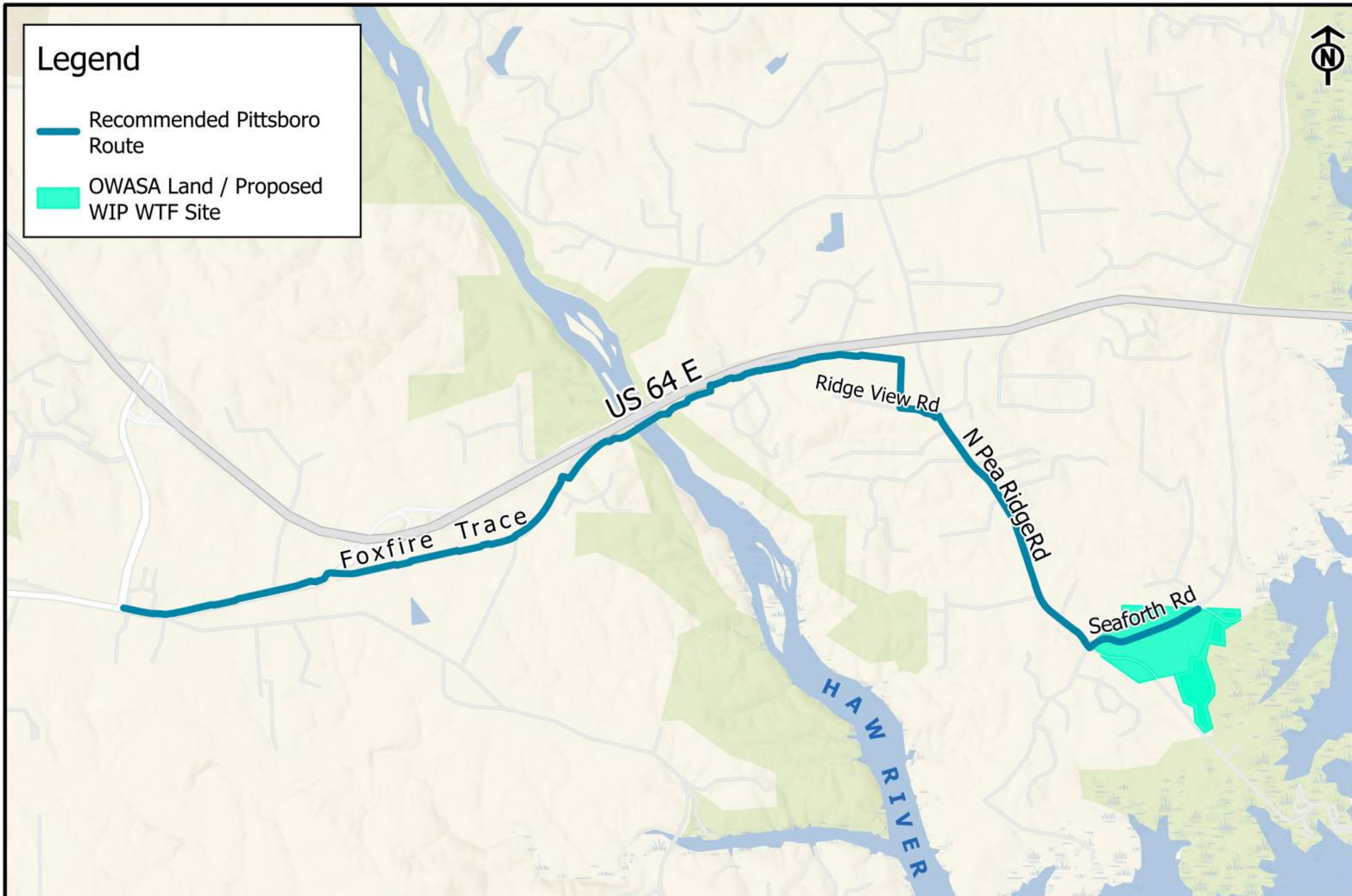

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Water Intake and Transmission Infrastructure PER Executive Summary

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Recommended Route to Pittsboro

Figure ES-3

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8. Raw Water Intake, Pump Station, and Transmission Alternatives Evaluation

8.1 Raw Water Intake

The in-lake tower-style intake is the recommended intake configuration for the Partners' new intake in Jordan Lake. Backfill and spoils volumes and, subsequently, off-site disposal costs are all smaller with the intake tower approach, and the tunnel concepts presented for the intake tower can reduce the construction duration by as much as nine months. The tower-style intake also avoids permanent impacts at the Vista Point recreation area that would be associated with the gate structure and submerged screen concept.

The Vista Point recreation area includes hiking trails, camping, parking, and boat launching. Significant coordination with stakeholders, including USACE, NC Parks, and WRC, is ongoing to ensure that each stakeholder's input is incorporated into the planning and design recommendations and that the temporary and permanent impacts are defined and mitigated.

Barrel screens mounted on the tower are the recommended technology for use in the Partners' new intake in Jordan Lake. This technology has been successfully used by other neighboring utilities in reservoir source waters (Town of Cary, Raleigh Water, etc.). Spacing between the tapered wedge wires can be selected to screen out aquatic life that environmental regulators seek to protect in Jordan Lake while also safeguarding expensive downstream pumping equipment and mitigating cleaning efforts of the intake, piping, and pump station wet well.

Table ES-1 documents the preliminary design elements of the recommended intake and piping configuration. Figure ES-4 represents this selected configuration. Drawings in Appendix B Raw Water Intake, Pump Station, and Transmission Alternatives Evaluation TM provide additional detail regarding the planning recommendations.

The preliminary elevations of the upper two withdrawal elevations were selected to provide the Partners with as much reasonable access to the water supply pool in Jordan Lake. The standard operating procedure would be to utilize the upper withdrawal elevation during the warmer months once the lake has stratified to mitigate treating a more challenging water quality present at the lower two withdrawal elevations. Should lake levels drop to levels requiring the use of the second withdrawal elevation, the thermocline in the lake will have also lowered providing access to less challenging water quality to treat at the plant, especially when compared to the lowest withdrawal elevation.

Screen withdrawal elevations should be revisited in the final design when additional water quality data is available for analysis. The intake tower design shall provide flexibility to allow screen withdrawal elevation modifications in the future should water supply or water quality factors necessitate a change.

Hypolimnetic oxygenation is likely the best mechanical in-situ approach to addressing the specific water quality challenges in Jordan Lake at the intake site (see Water Quality TM for discussion). Installation includes both in-lake and on-shore infrastructure. Stakeholders have already expressed concerns with the disturbances to recreational activities caused by raw water infrastructure located on the Vista Point peninsula requiring regular access for operations and routine maintenance, as well as the potential for flooding. Withdrawal elevation flexibility at the intake and other chemical and physical barriers at the plant are recommended to be leveraged to mitigate water quality challenges in Jordan Lake. Given these challenges and the added capital and recurring O&M costs, hypolimnetic oxygenation is not recommended for the WIP intake.

Table ES-1: Recommended Intake and Piping Configuration

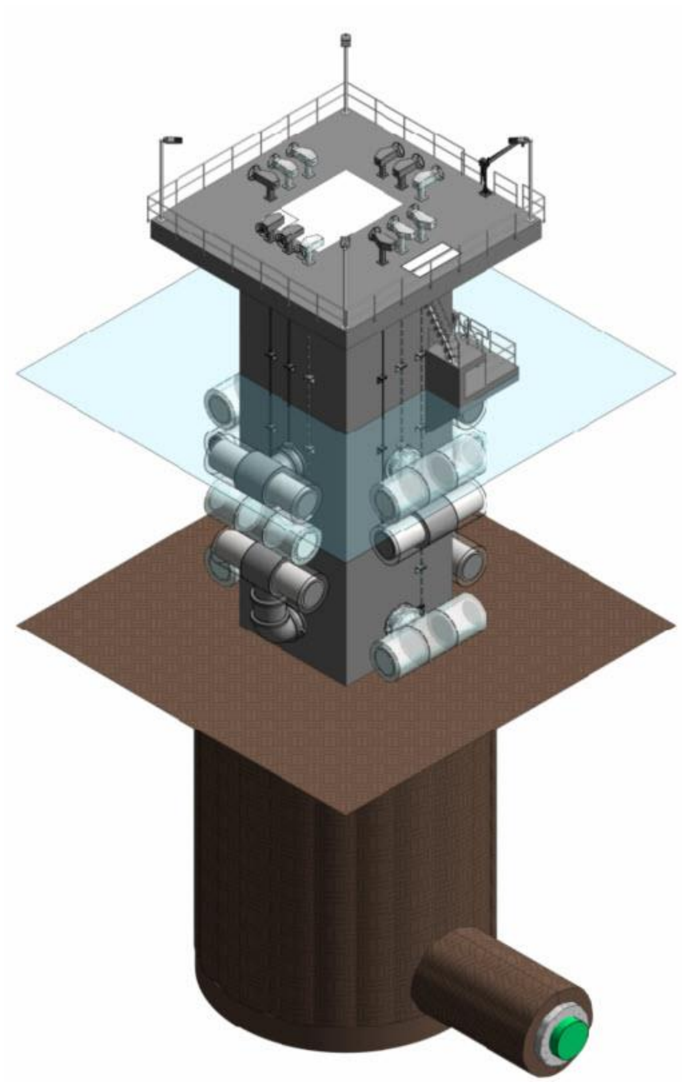
Design Feature	Selection	
Intake Location	Vista Point – Area 1[1]	
Pump Station Location	OWASA-owned Seaforth Property	
Intake Design		
Configuration	Tower	
Screen Technology	Tee-Style Barrel Screens	
Screen Barrel / Outlet Diameter	60 inches / 48 inches	
Slot Size	1/8-inch	
Screen Capacity, each	~23 mgd	
Screen Isolation	48-inch Butterfly Valve	
Withdrawal Elevations	3 – EL 207.00, EL 200.50, EL 182.50	
Screen Quantity per Withdrawal Elevation	2 (Initial Construction), 4 (Build-Out)	
Trenchless Technology	TBM	
Tunnel / Piping Design[2]	**Option 1**	**Option 2**
Tunnel Diameter	8.5 feet	12 feet
Intake Piping Quantity / Diameter	1 / 66 inches	2 / 48 inches

Notes:

(1) Area 1 refers to the northern intake location considered in the Vista Point area of Jordan Lake.

(2) Two (2) tunnel piping configurations may be considered as bidding alternates to determine the most cost-effective option given bid numbers are affected by contractor and TBM installation equipment availability.

Figure ES-4: Raw Water Intake Configuration



8.2 Raw Water Pump Station

Given the intake design and piping outlined above, the pump station substructure will utilize the tunneling shaft as the wet well. Leveraging the initial excavation of the tunnel shaft, a circular concrete wet well was a more efficient, less costly use of this space. In the circular configuration, more pumps can be fit into the wet well thus offering more capacity flexibility between the planning horizons. However, physical modeling is required to ensure proper flow distribution and pump performance.

At the initial station capacity, there will be four (4) vertical turbine pumps installed (3 duty, 1 standby). Two different pump sizes are proposed to provide a range of different deliverable capacities to the plant, accommodating lower, average, and higher flow operating conditions and mitigating the need for variable frequency drives. An additional pump is provided at the 2050 and 2070 planning horizons leveraging similar capacity pumps. For the ultimate build-out capacity, all pumps will be replaced with larger capacity pumps. As anticipated, without upgrades to the raw water transmission capacity for the 2050 and 2070 planning horizons, system pressures requirements will increase, forcing the pumps to slide slightly left on their pump performance curves, subsequently reducing their output capacity. Pump design efforts will consider this phenomenon when selecting pump models, impeller trims, and motor sizes to ensure adequate deliverable capacity to the plant. A summary of the nominal pumping requirements at each planning horizon is provided in Table ES-2.

Table ES-2: Pumping Requirements

Planning Horizon	Station Capacity (mgd)[1]	No. Pumps[2]	Pump Capacity (mgd)[3]	System Pressure (ft)
Initial	24	4	2 – 7 2 – 10	189
2050	34	5	2 – 7 3– 10	191
2070	44	6	2 – 7 4 – 10	199
Build-Out	88	6	2 – 14 4 – 20	208

Notes:
(1) Firm capacity.
(2) Quantity includes 1 standby pump.
(3) Quantity – Capacity.

8.3 Raw Water Transmission Configuration

Water is conveyed through a common header outside the pump station where it splits into parallel transmission lines that convey the raw water to the two 7.5-MG raw water storage reservoirs. The parallel pipes sizes and quantities are selected to provide acceptable velocities at each planning horizon. Parallel 36-inch raw water transmission mains are required through the 2070 demand conditions, and a third 36-inch main is required for flows beyond the 2070 condition up to the ultimate demand condition.

9. Project Cost Summary

A project cost estimate for the proposed preliminary design of the WIP raw water infrastructure (intake through transmission) and the finished water conveyance facilities (transmission main and transmission storage) was prepared in 2024 dollars. Additional cost detail is provided in each of the respective Technical Memoranda for the project components.

The prepared estimate is commensurate with an Association for the Advancement of Cost Engineering (AACE) International Class 4 estimate with an expected level of accuracy of -15 to -30% (low) and +20 to +50% (high).

9.1 Raw Water Intake, Pumping and Transmission

The project costs for the raw water intake, pumping and transmission facilities are the following:

Table ES-3: Project Cost Estimate for In-Lake Tower-Style Intake with Integral Gates

Component	Cost
Cofferdam / Intake	$16,431,000
Pump Station Shaft / TBM	$52,743,000
Raw Water Pump Station and Transmission	$18,227,000
Subtotal	**$87,401,000**
Contingency (35%)	$30,590,000
Construction Total	**$117,991,000**
Engineering (15%)	$17,699,000
Total Project Costs	**$135,690,000**

The cost estimate outlined in Table ES-3 is reflective of 4,800 ft of an 11.5 ft TBM with an intake tower structure. The pump station is assumed to utilize the TBM for the shaft and initially house four (4) vertical turbine pumps. The cost for raw water transmission is based on 4,400 linear ft of two (2) 36-inch DIP lines.

One important note to make is that the costs defined above include disposal costs for the spoil material generated from excavation of the tunnel shafts and subsequent tunneling activities. An economic approach would be to repurpose this material as fill, structural fill, and subbase material to support construction activities on the OWASA property. However, there may not be a need or space on the property to accommodate such a large volume of spoils. The contractor may elect to find other end users willing to accept these materials for their beneficial use and cover the hauling costs. Off-site disposal is the third and most costly alternative available to the contractor. Disposal costs will be influenced by the disposal location (and subsequent mileage) and the quantity of disposal runs per day that can be feasibly accomplished by a 20-ton dump truck. It is likely that some combination of these three disposal options would be leveraged by the contractor. However, for conservative planning purposes, off-site disposal of all spoils material have been captured in the project cost estimate.

9.2 Finished Water Transmission Facilities

Opinions of probable cost were generated based on the final recommended routes. The project cost for the finished transmission main to Pittsboro is below:

Table ES-4: Pittsboro Route OPCC

Item	Opinion of Cost
30" Water Main Construction	$46,215,000
Easements	$1,178,000
Engineering Design and CA/CO	$6,933,000
Total	**$54,400,000**

The project cost for the finished transmission main to the north toward Durham is below:

Table ES-5: North Route OPCC

Item	Single 36" Transmission Main	Single 42" Transmission Main
Construction	$152,107,000	$189,153,000
Easements	$1,245,000	$1,245,000
Engineering	$22,817,000	$22,817,000
Total	$176,200,000	$213,300,000

As documented in Section 3.2 of the Finished Water Transmission Hydraulic Analysis Technical Memorandum, the Partners requested additional analysis on the required pipe diameter. The analysis was performed by segmenting the North route into three parts:

- From the WTP High Service PS to the south side of the US64 and Seaforth Road intersection (WTP to US64)
- From the south side of the US64 and Seaforth Road intersection to the Intermediate Storage Tank (US64 to Intermediate Storage Tank)
- From the Intermediate Storage Tank to the North Storage Tank

Table ES-6 shows the construction and easement costs only for each segment as either a 36" or 42" pipe and the total for each combination of diameters. The intent of the matrix below is to provide a comparison of these costs for the different combinations of pipe diameters.

Table ES-6: Easement and Construction Cost by Diameter

Diameter of each segment	WTP to US64	US64 to Intermediate Storage Tank	Intermediate Storage to North Storage Tank	Total
36"/36"/36"	$11,400,000	$42,600,000	$99,600,000	$153,600,000
42"/36"/36"	$14,700,000	$42,600,000	$99,600,000	$156,900,000
42"/42"/36"	$14,700,000	$54,900,000	$99,600,000	$169,200,000
42"/42"/42"	$14,700,000	$54,900,000	$120,900,000	$190,500,000

9.3 Storage Tank Planning and OPCC

The project costs for the elevated storage required for the transmission system are below:

Table ES-7: Elevated Storage Opinions of Cost

Item	Intermediate Tank	North Tank
Construction	$10,340,000	$10,900,000
Engineering	$1,551,000	$1,635,000
Total	**$11,891,000**	**$12,535,000**