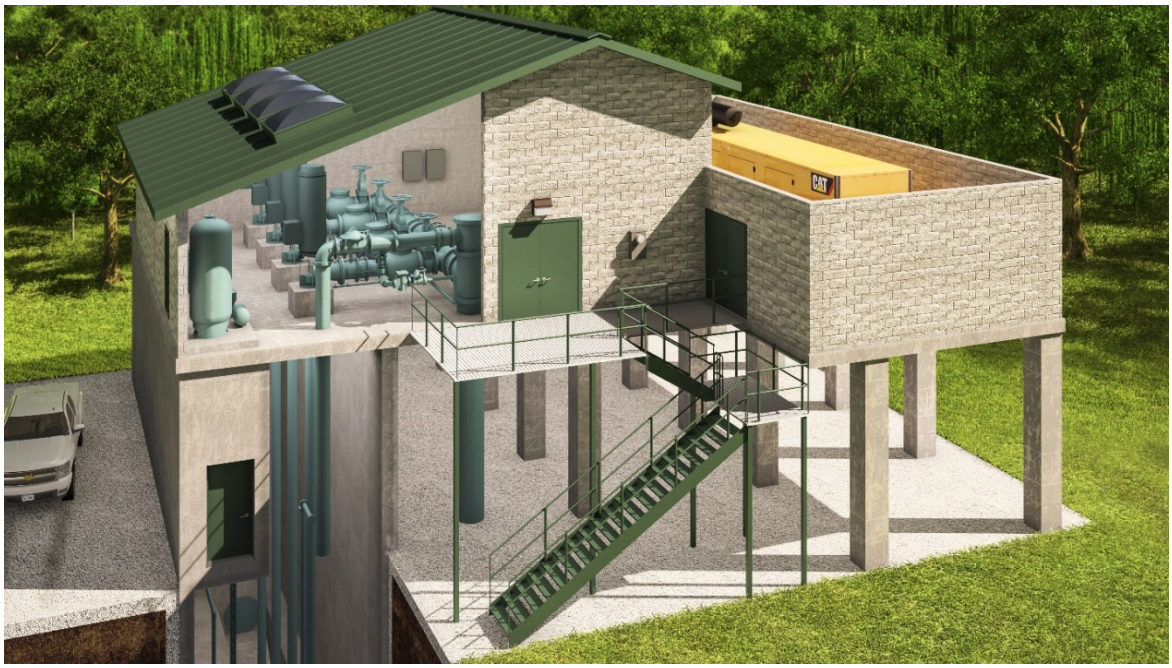

Rendering Photograph: Revit design of raw water intake pump station design.

Rendered Photograph: Pump Station building and concealed intake structure as viewed from the James River.

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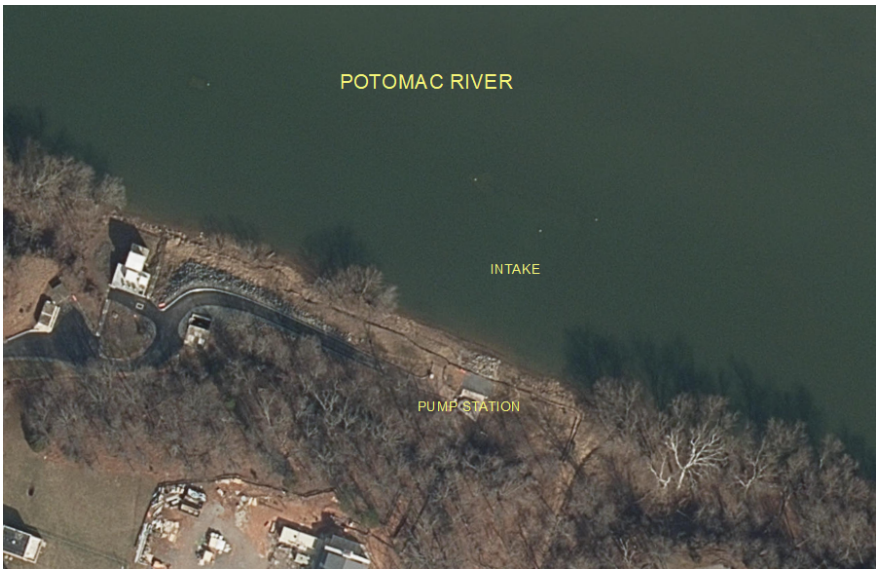
2.4.2 Raw Water Intake

The layout proposes the construction of an intake utilizing semi-circular stainless steel wedge wire intake screens arranged in a manifold and set on the bottom of the James River's bed. These screens will be connected to the pump station wetwell by a gravity pipe. The intake screens will be provided with an air burst cleaning manifold supplied by a compressor. The intake screens will prevent large debris from entering the wetwell and thus protect the pump equipment and improve raw water quality. The intake screen openings will be sized to protect aquatic life. Although not directly applicable to this project, the intakes have been designed to be compliant with cooling water intake standards developed by the U.S. Environmental Protection Agency under Section 316(b) of the Clean Water Act for intake velocities for avoidance of impingement and entrainment of aquatic life. The minimum criterion is a screen size of 1 mm and an intake velocity of 0.5 Feet Per Second (FPS). The Virginia Department of Game and Inland Fisheries (VDGIF) recommends a more conservative intake velocity of not more than 0.25 FPS, which has been incorporated into the design as well. The slow intake velocity of this gravity-fed intake is designed to avoid trapping small fish against the screen, and it follows that it will not present a risk to recreational users of the river.

The intake screen has been sized to accommodate a maximum flow rate of up to 12 MGD. That is marginally greater than the maximum daily withdrawal presently authorized by the Project's VWP permit (up to 8.39 MGD), but provides additional capacity to allow JRWA to meet long-term water demands and seek increased permit withdrawal limits as necessary to meet the future water supply demands of the Counties. Because the intake structure is wholly submerged, it is not expected to be visible to persons recreating on the James River. The photographs below show aerial imagery of the Loudon County Water Treatment Plant on the Potomac River which is very similar in design. After construction and installation, the intake is situated to be minimally visible if not hidden from sight within the water.



Photograph: Esri World Aerial Imagery of Loudon County intake and pump station post construction.

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2.4.3 Wetwell Influent Pipe

A 30” ductile iron pipe flowed by gravity will connect the intake screen manifold to the pump station wetwell. A precast concrete manhole will be provided at the bank of the river to allow a transition in the alignment and to provide an additional access point for maintenance. The manhole top will be installed at grade to be minimally visible (example installation below).

Photograph: Manhole at grade near small creek.

Photograph: Manhole installed at grade near forested area.

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2.4.4 Pump Station Wetwell

The layout proposes the construction of a below-grade reinforced concrete wetwell beneath the pump station structure to permit proper submergence of the pumps during all anticipated river level operating conditions. The top of the wetwell and pump building enclosure will be elevated above the 100-year floodplain and thus will require the construction of a staircase to access the pump and valve equipment. The wetwell will be provided with appropriate access for inspection and maintenance.

The wetwell will be configured with an elongated channel to permit a “self-cleaning” maintenance operation. This will be similar to an ogee ramp style wetwell that is commonly used in wastewater pumping applications.

The wetwell will extend approximately 45 feet below existing grade to facilitate a gravity connection to the intake screens. At this depth, approximately 16-17 feet of rock excavation will be required at the proposed site. The necessity of a wetwell at greater depths is to allow the raw water to flow by gravity in the intake pipe to reach the wetwell. The water enters the intake structure at the river bottom elevation where the screen is situated. As the river bottom elevation is typically lower than the ground elevation at the pump station, an adequate depth is required to gravity flow the water from the riverbed to the submerged pumps which are located at the bottom of the wet well.

It is desirable to locate the wetwell, and subsequently the pump station, near the intake structure to minimize the length of intake piping installation and reduce siltation to avoid sedimentation in the intake structure. This is further detailed in 4.2.1.2.2 Intake and Pump Station Proximity and Depth of Wetwell.

2.4.5 Pump, Piping and Valve Equipment

The Project will include the installation of multi-stage vertical turbine pumps. Each pump will be connected to a common discharge manifold and will be provided with a check valve and gate valve. A surge relief valve will be provided to mitigate the effects of pressure surges that may occur in the raw water main during abnormal conditions such as a pipe break or power outage. An emergency pump connection will be provided to permit the use of a portable pump in the event of an equipment failure. As required by the Project’s VWP permit (Special Condition 12), the flow meter will be located on the raw water pipe adjacent to the wetwell. (“The permittee shall monitor withdrawals from the James River on a daily basis using flow totalizer technology to confirm that the withdrawals are in compliance with this permit.”).

2.4.6 Electrical and Pump Control Equipment

Electrical and pump control equipment will provide for variable speed control of pumps, alternation of lead and lag pumps and duplex, triplex, and quadplex pump operation. 3-Phase power and associated utilities will be provided to the site for operations of this equipment. Dominion Power will obtain a separate CSX Facility Encroachment Agreement for theses

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utilities. Utilities will be installed without above-ground disturbance across the CSX Right of Way and will parallel the authorized raw water main crossing. A stand-by power source using an on-site diesel generator will provide uninterrupted operation during power outages.

2.4.7 Raw Water Main

A 24-inch Class 350 ductile iron raw water main will proceed northwest from the pump station for approximately 800 feet through a field and recently forested field. It then proceeds west for approximately 600 feet paralleling the nearby the CSX rail right-of-way. It takes another northwestern turn, where it crosses under the CSX tracks and follows a Dominion Power electrical easement approximately 1,200 feet to Old Columbia Road (State Route 624). It takes a northeasterly turn to follow the Colonial Gas pipeline easement approximately 1,600 feet, where it crosses the Rivanna River and terminates in an agreed-upon T interconnection point at Route 6. There, the water main will connect to a raw water main constructed by Louisa County for conveyance of water to the existing Ferncliff Water Treatment Plant. The interconnection allows Fluvanna County to construct a water main to the interconnection point to draw water from the JRWA system at such time is becomes necessary to meet its residents' water demands. To the extent practical, the raw water main will be constructed in areas that have been previously disturbed and/or encumbered by other utility easements.

The crossing of the Rivanna River has been permitted by the VMRC to be constructed by open-cut or horizontal directional drill (HDD). However, it has since been determined that the project exceeds the working pressures of the typical and easier to work with HDD materials: fused high-density polyethylene (HDPE) and polyvinyl chloride (PVC). Both of these materials would have allowed for relatively small bending radii. However, welded steel piping must be utilized to withstand the working pressures associated with crossing the Rivanna River by HDD. Utilizing steel piping presents a challenge as its larger bending radius requires a much larger work area. Analysis of an HDD crossing of the Rivanna River using steel pipe indicates the need for a 3,200 square foot bore pit, 20,000 square foot pull back staging area, and a drilling length of approximately 938 feet for the crossing (see Appendix F-2). These spacing requirements exceed what is available in the current project easement areas. Additional landowners' approvals and tree clearing for staging would be required to accommodate work outside the previously coordinated easements, which would not be practicable given past landowner coordination efforts. Furthermore, additional stream impacts would be required. Therefore, the Project plans to complete the crossing using the approved cofferdam open-cut method to avoid the challenges presented with using the HDD method.

Except for the initial exit from the pump station, which is located on property owned by JRWA, the remainder of the raw water main will be constructed in utility easements previously acquired by JRWA.

The water main generally will be installed using a construction right-of-way 20 feet wide. Pipe installation generally entails excavation of a linear trench 5 feet wide and 7-8 feet deep. The pipe is lowered into the trench, which is then backfilled. Preconstruction contours will be restored following construction and the land will return to its preconstruction uses (generally agriculture), except in limited areas that will need to be maintained free of trees. A permanent

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easement 20 feet wide will be minimally maintained as necessary to prevent woody vegetation from growing over top of and damaging the buried water main.

Use of the jack and bore method will be necessary to cross the CSX rail line and Route 6. For these crossings, minimum size bore pits of approximately 20 feet by 50 feet and minimum size receiving pits of approximately 10 feet by 10 feet will be excavated at both sites for the rail or road crossings. Boring equipment will be lowered into the launching (or bore) pit and drill horizontally to the receiving pit. This drilling method does not use high-pressure drilling mud, which eliminates the risk of inadvertent returns (also called “frac-outs”). Following pipe installation, the pits will be back filled, and the surface restored to preconstruction conditions.

2.4.8 Existing Access Road

An existing gravel road (Old Route 624) with a CSX rail crossing will be minimally improved to provide an all-weather access road to the site. Minimal road improvement will require a 12-foot-wide coarse grade aggregate road sufficient for the safe passage of vehicular construction and maintenance needs in all-weather conditions. Considerations for vehicle weight and turning radius (minimum turning radius of 60 feet) will be applied in the design of the road to allow temporary and permanent access to the site. Culverts will be provided beneath the access road to allow wetlands to remain hydrologically connected where required (see Appendix I-1).

The applicant possesses or will possess the requisite property interest to undertake the activity proposed in the sections identified above. Affirmation of this is provided though the signature of the applicant/ duly authorized agent on ENG Form 4345 per 33 CFR §§ 325.1(d)(8) and 325.1(c) (see Appendix A).

2.5 Project Schedule

Construction activities, to include Phase III Cultural Resources work, on the proposed Project is anticipated to commence in Summer 2020 and be completed by Summer 2023. Permit authorization is requested through Summer 2025 to provide sufficient construction time in the event that unforeseen circumstances postpone Project completion.

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3.0 PURPOSE AND NEED

The information in the Purpose and Need section is provided per CFR § 325.1 (d) (1).

3.1 Basic Project Purpose

To provide a source of raw water for public water supplies.

3.2 Overall Project Purpose

The purpose of the proposed Project is to provide a new and reliable raw water supply of sufficient quantity to meet the short and long-term needs of Fluvanna and Louisa Counties for delivery to an agreed-upon T interconnection point planned for use by Fluvanna and Louisa Counties.

3.3 Project Need

Public water supply planning is a core function of cities and counties in Virginia. Communities depend on the availability of a reliable public water supply for public health and sanitation, fire suppression, economic development, and growth. As detailed in Section 2.1, Fluvanna and Louisa County recognized as early as the 1990s that their existing water supplies, which rely largely on small groundwater well systems, are inadequate to meet the projected needs of both communities. Recognizing it would be more efficient and cost-effective to address these needs collaboratively, the Counties agreed in 2003 to develop a shared water system. By 2013, the Counties agreed on the concept for this project. A joint entity, JRWA, would construct a raw water intake in the James River and deliver the water to a mutually convenient connection point that each County could tap for its own uses.

The urgent need for a new water supply has only increased since the 1990s. There is both a near and long-term need for this water in Fluvanna County and Louisa County. Details of the projected future water demands for each County were outlined in their adopted water supply plans (see Appendix G: County Water Plans) and data summarized from these plans is provided in Table 2. The Counties' respective needs for an increased water supply are summarized below.

3.3.1 Fluvanna County Water Needs (see Appendix G-1)

In its 2010 Regional Water Supply Plan, Fluvanna County evaluated its then-current and future water supply needs to ensure that the needs of the people living in the County will be met. Fluvanna County's population was projected to reach a population of approximately 47,010 by 2030 and 91,816 by 2060. As a result of this projected population growth, the water demands were projected to reach 155.5 MGD by 2030 and 161.2 MGD by 2060 (increasing from the 2010 usage of 151.83). It's important to note that Dominion accounts for 148.3 MGD of the projected water demands for years 2010 through 2060. Dominion has since shut down the Bremo Power Station and it is undetermined what, if any future water demands, Dominion

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might have at the power station site. However, the projections for the JRWA application did not included any present or future water demands for Dominion.

This plan identified that the water demands in the more densely developed area of the County can only be met by a community water system. Specifically, the areas of greatest need include the projected demands in the Zion Crossroads Urban Development Areas, the existing demands in Fork Union, and the predicted demands in the Palmyra area of the County.

Many of the County's residents are served by individual wells. Observed declines in groundwater levels in combination with an increasing population led the 2010 report to conclude that a new community water system was needed to ensure a reliable and safe drinking water sources is available that provides both the quality and quantity needed to support all citizens and business needs.

Although the 2010 Regional Water Supply Plan is approaching ten-years old, the water supply limitations identified in the report have not been resolved. No significant new public water supplies have come online in the County since the plan was issue while the population has increased more than 4% since the 2010 census. Fluvanna County has identified three areas that will benefit in the near- or long-term from an increased water supply:

(1) Zion Crossroads

The Zion Crossroads Water and Sewer System is currently being constructed in Fluvanna County to serve a majority of the Zion Crossroads Community Planning Area (CPA) for growth. This system will include nearly four miles of water and sewer lines along the US Route 250 and US Route 15 corridor to help foster commercial and industrial growth. The final completion for the system is slated for November 2020. The current water source for this area once complete is the Mechunk Creek and the allocation through the Department of Corrections allows for 75,000 gallons per day (GPD) of usage.

Zion Crossroads' current 75,000 GPD of water allocation is adequate in the near-term to supply to low-intensity water uses such as logistics, light retail, and existing single-family homes. However, an increased supply for the Zion Crossroads area is necessary to facilitate development of new land uses such as restaurants and hotels to serve the public along the growing I-64 corridor. This development is planned to serve the local labor supply within the Zion Crossroads area and allow the County to capture additional retail, food, and lodging taxes that are vital to the County's long-term growth. A long-term solution is needed to serve the Zion Crossroads area for the next 50 years, that is shared with Louisa County to the north.

(2) Fork Union

The Fork Union Sanitary District (FUSD) provides water through 26 miles of pipe to roughly 425 customers, including residences, small businesses, the Fork Union Military Academy, Carysbrook, and Fluvanna County Middle School. The district's service area includes Bremo Bluff, Fork Union, Thessalonia, Cloverdale, West Bottom, and portions of Carysbrook. In

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2007, the system enhanced its volume and pressure by replacing two ground-level standpipe storage tanks with two elevated storage tanks.

The Fork Union Community Planning Area (CPA) currently has a limited quantity and quality supply of water because it is dependent solely on an overtaxed groundwater system. The system has a current usage of 73,000 gallon per day (GPD). A new supply is needed to provide a sustainable source for the existing single-family homes in the district. Furthermore, Fork Union's potential growth is tied to the attraction of additional industry to include food and beverage, logistics, and manufacturing uses. An increased water supply is needed to support these planned commercial and industrial uses.

(3) Palmyra

Fluvanna County owns several wells at Pleasant Grove, which serve various portions of the park, the Fluvanna County High School, and the municipal buildings located in the vicinity. Fluvanna County also owns a well which serves the Courts building with domestic water and fire control service.

The County's plans contemplate a future public water system in Palmyra that would include existing groundwater sources but would need to be supplemented by other sources.

3.3.1.1 Consultation Regarding the Fluvanna Water and Wastewater Master Plan

On February 25, 2020, Timmons Group consulted with Fluvanna County and Dewberry to discuss the Water and Wastewater Master Plan currently underway by Dewberry on behalf of Fluvanna County. Dewberry provided an overview of the Master Plan and noted they were in the preliminary stages of plan development. As part of the Master Plan, they will be evaluating options for and timing of utilizing water from the JRWA for Zion Crossroads (Fluvanna CWS), Fork Union CWS, Palmyra CWS, Columbia CWS and other potential service areas in Fluvanna County. Since the plan is in the early stages of development, it's expected that the final plan will be released sometime later this year.

3.3.2 Louisa County Water Needs (see Appendix G-2)

The 2011 Louisa County Long Range Regional Water Supply Plan outlines the Regional Water Supply Plan for all of Louisa County through the year 2050. The combined water demand for the municipal community water systems was anticipated to exceed the current permitted public source capacity as soon as 2021 and surpass the known available public water source capacity in 2041 to create an estimated public water supply deficit of approximately 841,000 GPD in 2050. The Louisa County population was projected to grow to 50,739 by 2030 and 65,183 by 2050. Population growth is hampered by the fact that existing and available public water sources are not in the vicinity of the County's designated growth areas (including Zion Crossroads, Ferncliff, Shannon Hill, Gum Spring, Gordonsville, and the Town of Mineral). To preserve the rural character of Louisa and provide adequate water supply to its citizens and businesses, the County identified a need to develop of new water source near or within the designated growth areas.

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As with Fluvanna County, Louisa County's water needs have not lessened since the 2011 water supply plan was developed. The population has grown an estimated 10% since the 2010 census without a significant new water source. Louisa County has identified six areas that will benefit in the near or long-term from an increased water supply:

(1) Zion Crossroads Growth Area

This area is currently served by a public groundwater well system nearing capacity. Less than 50% of the Mixed-Use land area has been developed and much of the remaining area is planned to be more densely developed than the existing development, increasing the demand for a reliable water source. This area cannot achieve the planned level of growth, including the planned mix of commercial and residential development, without an additional water supply.

The County's Long Range Water Supply Plan projects future demand needs. Peak daily water demand for the Zions Crossroads area is forecast at 1.63 million GPD by 2050. On a near term basis, the Zion Crossroads growth area is expected to be the fastest growing residential and commercial development area in Louisa County. In recent years, several high-quality business prospects chose to locate in other localities, citing long-term water source reliability as the primary factor eliminating Louisa County from consideration.

(2) Ferncliff Growth Area

Water infrastructure has been constructed through this growth area in anticipation of the Project's completion and delivery of water to the previously agreed-upon T interconnection point. The existing water supply currently feeds one small industrial park but cannot be expanded until additional water capacity is available. This growth area is planned for industrial/commercial development. Potential businesses expected in this area, which will rely on a reliable water source, will support the families of Louisa County with quality employment opportunities.

The County's Long Range Water Supply Plan projects future demand needs. Peak daily water demand for the Ferncliff area is forecast to be over 410,000 GPD by 2050. The Ferncliff growth area cannot develop as needed or expected without a reliable water source supplied by the completion of this project.

(3) Shannon Hill Growth Area

Near-term extension of water and sewer infrastructure is planned in anticipation of an increased water supply. In 2019, Louisa County purchased approximately 700 acres of land in this growth area to develop a Regional Business/Industrial park. The Virginia Economic Development Partnership (VEDP) has endorsed this site and has committed to support Louisa County in marketing this site to global and domestic businesses. This site represents a significant investment of public capital which is intended to bring quality employment to regional citizens and provide economic stability for Louisa County. This site's utility and appeal

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from an economic development standpoint are essentially on hold without a reliable and sufficient water source.

The County's Long Range Water Supply Plan projected peak day water demand for the Shannon Hill growth area to be over 206,000 GPD by 2050. However, that projection was developed prior to the planned Regional Business/Industrial Park. The planned and responsible development within this growth area cannot proceed without a high-quality public water source.

(4) Gum Springs Growth Area

Future development of water infrastructure in this growth area is anticipated. The area includes the easternmost County interchange on Interstate 64, and the County is closely monitoring development demand as it considers infrastructure deployment options. The growth area includes a large area of Mixed Use development, which would allow level of density and intensity of uses. A mix of commercial and residential development is encouraged to ensure responsible growth. This level of density and intensity requires the support of a reliable, high-quality public water source. The residential development is likely to be a denser collection of dwelling types; apartment, townhouses, and single family homes are expected to be mixed through a well-planned development. The commercial development is likely to be residential supportive businesses, such as restaurants, retail, offices and hotels.

The County's Long Range Water Supply Plan projects peak day water demand for the Gum Springs growth area to be over 313,000 GPD by 2050. However, the planned and responsible development within this growth area cannot proceed without a high-quality public water source.

(5) Towns of Louisa and Mineral

These Towns (which include growth areas) are currently interconnected by a shared water utility system. These are mixed use communities with an industrial park located between the two. A significant amount of the County's community support services are also located in these areas and rely on public water, including:

- Louisa County High School
- Louisa County Middle School
- Louisa County Career and Technical Education Center
- Louisa County Public Library
- Betty J. Queen Community Center
- Louisa County Aquatic Center
- Louisa Fire Department
- Mineral Fire Department
- Louisa Rescue Squad
- Mineral Rescue Squad
- Louisa County Sheriff's Office
- Louisa County District Court

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- Louisa County Juvenile and Domestic Relations Court
- Louisa County Circuit Court

Both the Towns of Louisa and Mineral are expected to continue to develop with a mix of dense residential development and supportive commercial, such as restaurants, offices, retail, and medical services. The area between the Towns includes a large industrial park and industrially zoned land which is expected to continue development in the future. The public water system in this area is supplied by a water reservoir which is sufficient to support these towns' near-term needs but is insufficient to support projected long-term demands.

The County's Long Range Water Supply Plan projects peak day water demand for the Towns' growth area to be over 1.2 MGD by 2050. The planned and responsible development within these growth areas cannot proceed without a high-quality public water source. Currently the Town's are being served by the Northeast Creek Reservoir and treatment plant which has a safe yield capacity of 1.0 MGD.

(6) Lake Anna Growth Area

Lake Anna is the third largest lake in the Commonwealth, and the area represents a significant residential, recreational, tourism, and environmental asset to Louisa County. Commercial development, which is planned and desired for the area, has been severely limited due to the absence of a reliable water source. As a cooling system for a nuclear power generation facility, the lake itself is not an allowable withdrawal point for a potential public water system.

The existing residential development (which supports lake-related tourism and the local economy) is in desperate need of support businesses such as medical services, pharmacies, retail, restaurants, and related establishments. Associated development is severely constrained without a reliable and sufficient water source. The Mixed Use corridor of this growth area represents a significant potential future value to the County as a growing tourism and commercial destination.

The County's Long Range Water Supply Plan projects peak day water demand for the Lake Anna growth area to be over 2.6 million GPD by 2050. Lake Anna is unable to reach its potential as a residential, tourism, and commercial hub in central Virginia without the development of responsible, reliable water source.

3.3.3 DEQ Basis of Need Concurrence

As part of the Section 401/VWP permit authorization process an applicant to demonstrate to DEQ's satisfaction that there is a need and beneficial use for any requested water withdrawal amounts over the period of the 15-year permit term. DEQ conducted their own review of the project needs under their analogous VWP regulations. This analysis was based in part on the projected water demands as outlined in the 2010 Fluvanna County Regional Water Supply Plan and the 2011 Louisa County Long Range Regional Water Supply Plan. DEQ's evaluation was focused on the short- and near-term water demand as the maximum allowable VWP

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water withdraw permits term is 15 years, however, DEQ staff also considered the 30-year planning needs.

A detailed, comprehensive summary of needs was developed based on the Counties' Water Supply Plans and provided to DEQ for review and approval. DEQ staff reviewed this information and concluded that JRWA had a reasonable and adequately justified need to withdraw up to 8.57 MGD (revised slightly to 8.39 MGD in Minor Modification 2) to meet the projected 15-year, near-term demands based on the Counties' Water Supply Plans. A summary of DEQ's reviews and analysis are provided in the VWP Project Fact Sheets (see Appendices D-1-2 and D-1-6).

The Counties' long-term water demands entails a much longer planning horizon than the 15 years covered by the VWP permit. As such, the project infrastructure has been designed to accommodate a future expansion to 12 MGD, which JRWA and its member Counties believe will be sufficient to meet their long-term water needs and is consistent with the DEQ analysis.

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Table 2. Summary of County Approved Water Supply Plans with Projected Demands

Note that the following table was provided to DEQ on 12/17/2014 as part of the initial VWP permit review process. Figures associated with the Fluvanna CWS were later revised down slightly as part of DEQ Minor Modification 2. The revision was necessary as the Fluvanna County Correctional Center for Women submitted a permit request to DEQ in 2016 stating they would be supplying the Fluvanna CWS with a portion of their water needs. Therefore, DEQ modified the JRWA permit in order to avoid a potential duplication of withdraw authorizations. See detailed discussion in the DEQ Minor Modification 2 Factsheet (Appendix D-1-6).

Louisa County WSP (1)			15 Year Permit Period				30 Year Planning Period			
	2020		2030		2040		2045		2050	
	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
Gum Spring	58,391	87,587	118,409	177,614	161,798	242,697	185,455	278,182	209,111	313,667
Ferncliff	76,322	114,483	154,773	232,160	211,910	317,865	242,844	364,266	273,778	410,667
Shannon Hill	37,931	56,897	77,500	116,250	106,517	159,776	122,037	183,055	137,556	206,334
Zion Crossroads	460,460	690,690	712,045	1,068,068	890,562	1,335,843	989,837	1,484,755	1,089,111	1,633,667
Economic Development Prospects (6)	250,000	375,000	400,000	600,000	600,000	900,000	750,000	1,125,000	900,000	1,350,000
Route 250 / I 64 Service Areas	883,104	1,324,656	1,462,727	2,194,091	1,970,787	2,956,181	2,290,172	3,435,257	2,609,556	3,914,334
LCWA	73,859	110,789	73,020	109,530	72,199	108,299	71,798	107,697	71,397	107,096
Town of Louisa	266,090	399,135	392,736	589,104	482,092	723,138	532,043	798,064	581,993	872,990
Town of Mineral	107,343	161,015	148,317	222,476	196,831	295,247	223,338	335,007	249,845	374,768
Lake Anna	496,858	745,287	1,009,242	1,513,863	1,380,674	2,071,011	1,582,930	2,374,394	1,785,185	2,677,778
North East Creek WTP Service Area (3)	944,150	1,416,225	1,623,315	2,434,973	2,131,796	3,197,694	2,410,108	3,615,162	2,688,420	4,032,630
James River Supply (Louisa)	1,827,254	2,740,881	3,086,042	4,629,063	4,102,583	6,153,875	4,700,280	7,050,419	5,297,976	7,946,964
Peak Factor - Louisa		**1.50**		**1.50**		**1.50**		**1.50**		**1.50**

Fluvanna County WSP (2)	2020		2030		2040		2045		2050	
	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
Columbia CWS	4,315	6,473	5,158	7,737	6,473	9,710	7,768	11,651	9,062	13,593
Fork Union CWS	196,116	294,174	226,020	339,030	282,525	423,788	339,030	508,545	395,535	593,303
Palmyra CWS	25,720	38,580	70,730	106,095	102,558	153,837	125,634	188,450	148,709	223,064
Proposed Fluvanna CWS	324,315	486,473	1,070,541	1,605,812	1,403,336	2,105,004	1,724,245	2,586,367	2,045,153	3,067,730
Economic Development Prospects (6)	150,000	225,000	300,000	450,000	450,000	675,000	525,000	787,500	600,000	900,000
James River Supply (Fluvanna)	700,466	1,050,699	1,672,449	2,508,674	2,244,892	3,367,338	2,721,676	4,082,513	3,198,459	4,797,689
Peak Factor - Fluvanna		**1.50**		**1.50**		**1.50**		**1.50**		**1.50**

(Table 2 continues on next page)

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Table 2. (Cont.) Summary of County Approved Water Supply Plans with Projected Demands

			15 Year Permit Period				30 Year Planning Period			
Combined Projected Demands	2020		2030		2040		2045		2050	
	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
James River Water Supply (4)	2,527,720	3,791,580	4,758,491	7,137,737	6,347,475	9,521,213	7,421,955	11,132,933	8,496,435	12,744,653
Adjustment for Treatment Residuals 7.5% (5)	189,579	284,369	356,887	535,330	476,061	714,091	556,647	834,970	637,233	955,849
Total Demand	2,717,299	4,075,949	5,115,378	7,673,067	6,823,536	10,235,303	7,978,602	11,967,902	9,133,668	13,700,501
Combined Peak Month Factor for Entire System Demand		1.50		1.50		1.50		1.50		1.50
Deduct Northeast Creek WTP Supply & Capacity	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Total Demand	1,717,299	3,075,949	4,115,378	6,673,067	5,823,536	9,235,303	6,978,602	10,967,902	8,133,668	12,700,501
Adjusted Peak Month with NEC WTP Capacity			(7)	1.62				1.57		
Max Daily Demand; 6 day per week operation			(8)	7,785,245				12,795,886		
Max Daily Peak Factor			(8)	1.89				1.83		
Current Permit Withdrawal Rate (2021)	*2,850,000*	*5,700,000*	*2,850,000*	*5,700,000*						
Louisa Portion %	48%	57%	51%	54%	53%	56%	53%	55%	53%	55%
Louisa Portion GPD	827,254	1,740,881	2,086,042	3,629,063	3,102,583	5,153,875	3,700,280	6,050,419	4,297,976	6,946,964
Fluvanna Portion %	52%	43%	49%	46%	47%	44%	47%	45%	47%	45%
Fluvanna Portion GPD	890,045	1,335,068	2,029,336	3,044,004	2,720,953	4,081,429	3,278,322	4,917,483	3,835,692	5,753,537
Total Return Flow (Assume 20% consumptive)										
Total Demand less 20% (9)	1,373,839	2,460,759	3,292,302	5,338,453	4,658,829	7,388,243	5,582,881	8,774,322	6,506,934	10,160,401
% of Total Withdrawal Return to York River Watershed	39%	45%	41%	44%	43%	45%	42%	44%	42%	44%
Total GPD to York River Watershed	661,803	1,392,705	1,668,834	2,903,250	2,482,066	4,123,100	2,960,224	4,840,335	3,438,381	5,557,571
% of Total Withdrawal Return to James River Watershed	41%	35%	39%	36%	37%	35%	38%	36%	38%	36%
Total GPD to James River Watershed	712,036	1,068,054	1,623,469	2,435,203	2,176,762	3,265,143	2,622,658	3,933,987	3,068,553	4,602,830

1 Data from Louisa County Long Range Regional Water Supply Plan, dated June 2011
2 Data from Fluvanna County Regional Water Supply Plan, dated April 2010
3 The Northeast Creek Water Treatment Plant is rated at 1.0 MGD per Dewberry PER, dated June 2013.
4 It is proposed that the withdrawal limits of 4.11 MGD average daily and 7.79 MGD peak daily be permitted. These limits reflect existing permitted capacity at the Louisa Northeast Creek WTP.
5 Proposed Demands are increase by 7.5% to account for treatment plant residuals that are not delivered to customers as treated water.
6 Economic Development projections based upon previous prospect requests from RFI's and VEDP provided information
7 Peak Factor for Louisa is increased above 1.62 due to adjustment of demand while recognizing existing withdrawal of 1,000,000 at the Northeast Creek WTP.
8 Max Daily Demand and Max Daily Peak Factor are based on a 6 day per week operation or increase by the ratio of 7 divided by 6; which equates to 1.17.
9 Assumes a consumptive use of 20% therefore 80% of flow is returned to the James and York River basins.

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4.0 ALTERNATIVES ANALYSIS

4.1 Summary of Alternatives

JRWA has prepared this Alternatives Analysis to comply with 33 CFR § 325.1(e), 33 CFR § 230.10(b), and 40 CFR § 1502.14. In total, JRWA has evaluated a dozen primary alternatives and numerous additional sub-alternatives that incorporate minor water main route variations, as follows: (1) five alternative water supply sources; (2) six build alternatives and 12 water line route variations; and (3) the no-action/no-permit alternative. This analysis represents a reasonable range of alternatives that potentially could accomplish the purpose and need of the proposed Project. All documents pertaining to the alternative analysis can be found in Appendix H: Alternative Analysis.

4.1.1 Alternative Water Supply Sources

An alternatives screening process was used to determine the reasonableness of specific alternatives to be considered for detailed analysis. Reasonable alternatives were those that were considered to potentially meet the project purpose and need while still being reasonably practicable when considering overall factors associated with engineering and cost. As a first step, JRWA evaluated five alternative water sources that would not involve a direct surface water withdrawal from the James River including: the Rivanna River, Lake Anna, Cobbs Creek Reservoir, groundwater, and purchased water from neighboring communities. As explained below, however, each of these potential alternative water sources have readily apparent drawbacks that allow them to be screened from further detailed consideration as practicable alternatives. Appendix H-1 includes additional information supporting the review of these potential alternative water sources. Accordingly, these alternatives are discussed in this Section 4.1.1 but are not carried forward for additional detailed consideration and evaluation.

4.1.1.1 Alternative Water Supply 1: Rivanna River

The Rivanna River's watershed is 769 square miles, approximately 13% of the total combined James River and Rivanna River watershed of 5,844 square miles at the confluence of the two rivers at Columbia. As such, the Rivanna River watershed does not provide a sufficient quantity of water to meet the JRWA members' long-term water supply demand.

The Rivanna River watershed is already taxed as it currently serves as the primary water source for the City of Charlottesville and Albemarle County, as well as the Fluvanna Correctional Facility and Lake Monticello subdivision. The Rivanna Water and Sewer Authority (RWSA) currently maintains five reservoirs in the Rivanna watershed which serve as the primary water source for the Charlottesville and Albemarle region. In addition, the Virginia Department of Corrections maintains an off-line reservoir and withdraws from Mechunk Creek to serve the Fluvanna Correctional Facility. Lake Monticello maintains a reservoir that serves as the primary water source for the Lake Monticello community. As indicated by the *Water Study for Fluvanna County* (Anderson & Associates, Inc, 2003), the Rivanna River was severely taxed by the Lake Monticello system during the droughts of 2002, resulting in the

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report conclusion that the James River was the best long-term solution to meet the County's water demands.

Furthermore, the Virginia Department of Health (VDH) limits the acceptable withdrawal of a public water supply without a reservior, to 10% of the generally lowest flow of record at the point of withdrawal. Timmons Group staff spoke with DEQ Office of Water Supply – Water Withdrawal Permitting Department staff (Mr. Josh Rader) to discuss how safe yield and withdrawal limits are determined. A summary of those discussions follows:

> DEQ performs a simulation of the stream of interest on the lowest day of flow of the period of record. This simulation considers several factors including surface water withdrawals and discharges along the stream. This simulation produces a number that is DEQ's interpretation of the lowest flow of record. This number is then used by the Virginia Department of Health (VDH) to determine the 'safe yield', which VDH has defined as 10% of the lowest flow of record.
>
> As an example, the lowest flow of record for the Rivanna River at the confluence to the James is 6 CFS or 3.9 MGD according to USGS stream gage data. For the sake of the example, it is assumed the DEQ simulation also produces a low flow of 3.9 MGD. In this case VDH would say the safe yield is 0.39 MGD. Mr. Rader indicated this process is typical for DEQ permitting surface water withdrawals throughout the state.

The nearest stream gage on the Rivanna River upstream of the confluence with the James River, is located at Palmyra. Below is a graph from the U.S. Geological Survey (USGS) website of daily flows at the gage starting in 1960.

Based upon an ultimate withdrawal capacity for the JRWA, a source with a safe yield of 12 MGD is required for a proposed intake location on the Rivanna River at Columbia, Virginia, to meet the long-term needs of JRWA's member communities. A safe yield of 5.73 MGD would be required to meet JRWA's short-term needs. Based upon the VDH 10% low flow requirement, this would equate to 57.3 MGD (short-term needs) or 120 MGD (long-term needs) as the minimum historical flow required at the intake structure. This equates to a minimum flow rate of 88.7 to 185.7 CFS for an intake structure located on the Rivanna River in the vicinity of Columbia. The area of the drainage shed at Palmyra is 663 SQ MI as compared to 769 SQ MI drainage area of the Rivanna River at the confluence with the James River at Columbia. As such, a conversion factor of 0.862 (see Table 3 below) must be applied to relate the required flows at Palmyra to a potential intake at Columbia.

Table 3. Rivanna Drainage Areas

Rivanna Drainage Area @ Palmyra Stream Gage	663 SQ MI
Rivanna Drainage Area @ Columbia	769 SQ MI
Conversion Factor (663 / 769)	0.862

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Table 4. Minimum Low Flow Rates

JRWA Withdrawal @ Columbia (MGD)	JRWA Withdrawal @ Columbia (CFS)	Req'd Flow Rate @ Columbia for 10% low flow (CFS)	Conversion Factor for Stream Gage @ Palmyra	Req'd Flow Rate @ Palmyra Stream Gage for 10% low flow (CFS)
5.73	8.87	88.7	0.862	76.4
12	18.57	185.7	0.862	160.1

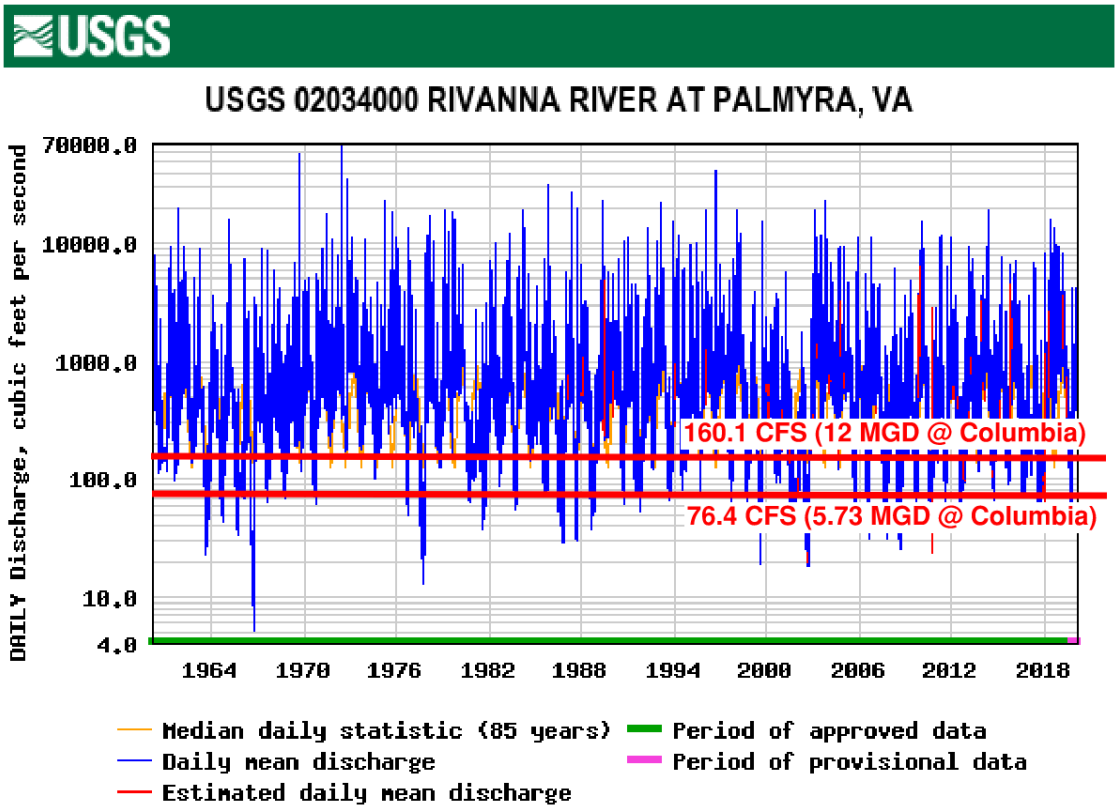

Figure 5. Daily discharge (CFS) from the Rivanna River gauge in Palmyra from 1960 through 2020 (graph obtained from the USGS website on March 17, 2020)

Based on this conversion factor, a minumum low flow of record of 160.1 CFS would be required at Palmyra to consider the safe yield acceptable to support the JRWA 12 MGD ultimate withdrawal capacity, as shown in Table 4. As is evident in the USGS graph (see Figure 5 above), the daily discharge at the Palmyra stream gage is routinely well below the required minimum flows to meet the project's long-term needs. During the October 2002 drought, the discharge at the Palmyra stream gage was as low as 18.1 CFS and 1966, from September 9th through September 11th, the flow was 5.2 CFS; the lowest flow of recod. Therefore the safe yield of the Rivanna River is 0.52 CFS, or 0.34 MGD at the Palmyra gage. Indeed, these flows would be insufficient to meet the much lower short-term needs of the

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project without the construction of a reservoir. Therefore, a direct withdraw intake located anywhere on the Rivanna River will not support the Project needs.

This conclusion is supported by previous studies as outlined in the *Water Resources Study for the Zion Crossroads Area* (1996) jointly commissioned by the Counties and the *Water & Wastewater Preliminary Engineering Report and Facilities Master Plan* (1998) prepared for Fluvanna County. Both documents indicate that, without a storage reservoir, a direct water withdraw from the Rivanna River would not provide sufficient water volumes necessary to meet the regional public water supply needs. Development of an off-line reservoir for raw water storage would be the only way to meet the JRWA water supply demands from the Rivanna River. However, a raw water storage reservoir would add substantial land acquisition, construction, permitting, and maintenance costs. Planning, design, permitting, and construction of a reservoir would take significant time, in some cases 20 years or longer, as was the case for the Cobbs Creek Reservoir. Construction of a reservoir would also result in alternations of natural systems beyond what would be necessary for a direct withdraw and waterline. Therefore, a storage reservoir was considered impracticable for detailed consideration in this analysis.

In addition to the limits of available direct withdraw, excessive siltation and sedimentation in the Rivanna River presents a water quality issue. Withdraws from the Rivanna would require adding a pre-settling basin and clarifiers at the Louisa WTP which would include additional capital costs as well an increase in annual operations and maintenance costs. Detailed information regarding the siltation issues and additional equipment necessary is addressed in Section 4.2.1.2.1 Adequate Water Quality.

In sum, the Rivanna River does not have sufficient quantity of water to meet the JRWA members' short-term or long-term water supply demand, and issues of water quality from the Rivanna would of concern. Therefore, the Rivanna River as a water supply does not fulfill the project purpose and can be excluded from further analysis.

4.1.1.2 Alternative Water Supply 2: Lake Anna

Lake Anna is currently owned by Dominion Energy and is located on the north side of Louisa County and is split between Louisa and Spotsylvania Counties. Lake Anna is used for the North Anna Nuclear Power Stations hydro-power and cooling system, which is a "once-through" system that returns the full amount of the withdrawal to the Lake. The North Anna Power Station uses over 500 times the amount of the entire county of Louisa's average water demand for its cooling system and hydro units. Lake Anna cannot be used as a water supply due to its purpose of supporting the Dominion North Anna Power Station. Louisa County unsuccessfully attempted to establish a water withdrawal intake on Lake Anna in 2012. Dominion denied Louisa County access to Lake Anna for this purpose. A copy of this letter is included in Appendix H-1-1 with the following excerpt provided below:

> *"Using Lake Anna for public water supply conflicts with Dominion's rights and responsibilities for reasons, including:*

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1. *Allowing another entity to control withdrawals from Lake Anna would interfere with Dominion's ability to safely and efficiently operate the Station's existing and proposed units.*
2. *Additional withdrawals would alter lake levels and downstream flows, with Dominion controls at the Lake Anna Dam in compliance with permit conditions designed to ensure protection of other beneficial uses such as recreation.*
3. *The Virginia Water Quality Standards (9VAC25-260) establish public water supply numeric criteria that are more restrictive than the existing criteria in Lake Anna could (a) result in additional restrictions on waste water discharges from the Station requiring material changes to Station operations, (b) impact Dominion's ability to perform pest/invasive species control measures, if needed, and (c) result in restrictions to existing recreational uses on Lake Anna.*
4. *By agreeing to grant access to Louisa County for a water withdrawal, Dominion may be compelled to consider future requests for additional water withdrawals from the County or other entities – which would further undermine Dominion's interest in managing Lake Anna for the reasons stated above.*

For these and other reasons, Dominion will not grant access to Louisa County, or any other entity, for the competing purpose of establishing a water withdrawal intake and infrastructure."

Lake Anna is also a significant distance from a number of key designated service areas in Fluvanna and Louisa County, to include approximately 30 miles of water main routing to Zion Crossroads and approximately 42 miles of water main routing to Fork Union (see Figure 6).

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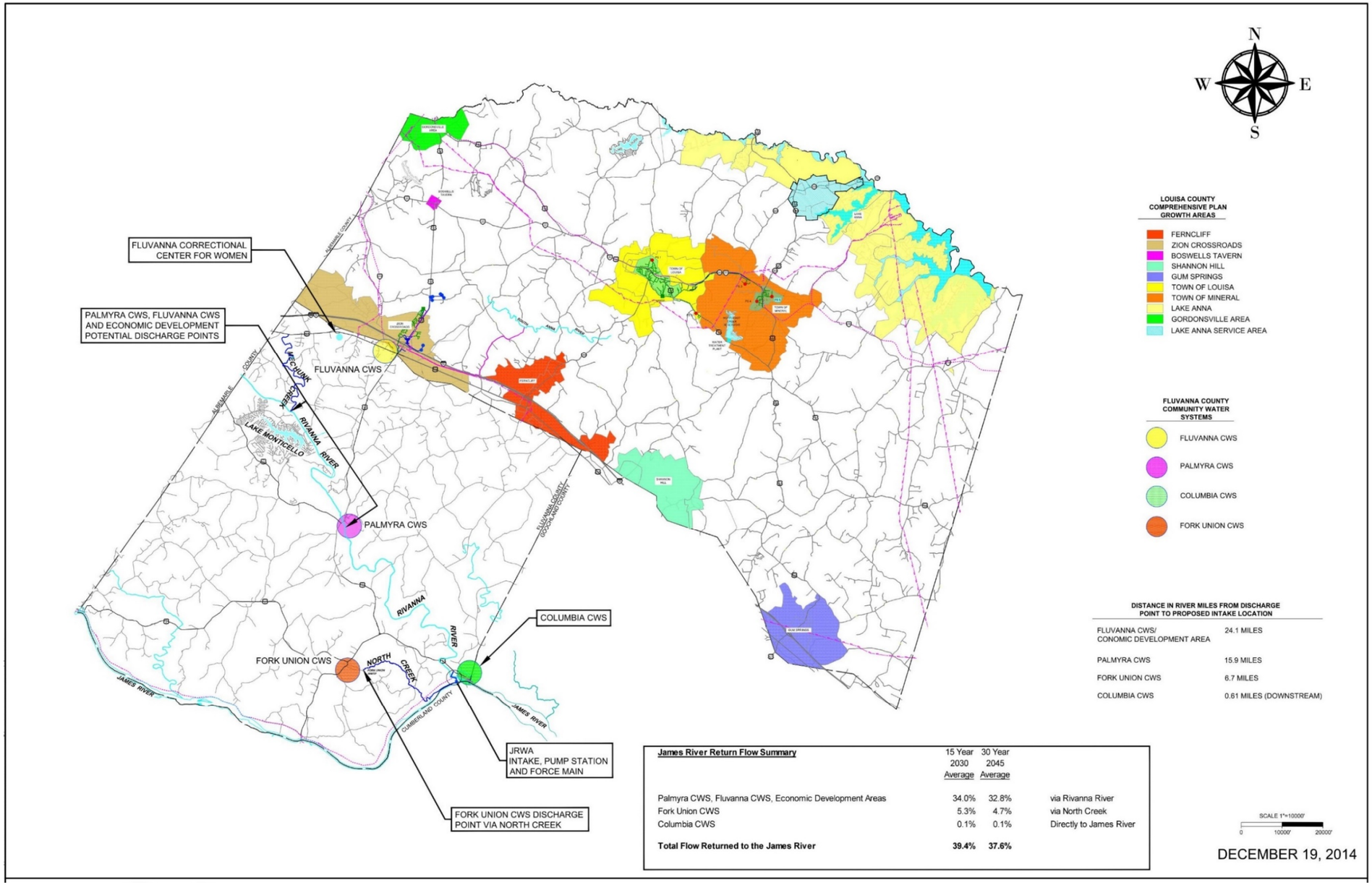

James River Return Flow Summary	15 Year 2030 Average	30 Year 2045 Average	
Palmyra CWS, Fluvanna CWS, Economic Development Areas	34.0%	32.8%	via Rivanna River
Fork Union CWS	5.3%	4.7%	via North Creek
Columbia CWS	0.1%	0.1%	Directly to James River
Total Flow Returned to the James River	**39.4%**	**37.6%**	

Figure 6. Demand Centers of Fluvanna and Louisa Counties

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In sum, given the location of Lake Anna in the north side of Louisa County and Dominion's specific use of the lake for cooling water for the North Anna Power Station and subsequent denial for use as a public water supply, it is not a feasible nor available option for the James River Water Authority and Louisa and Fluvanna's long-term water supply demand and has been excluded from further analysis.

4.1.1.3 Alternative Water Supply 3: Cobbs Creek Reservoir

Cobbs Creek Reservoir (CCR) is a Henrico County project that will serve as a side stream reservoir and pumping facility that pumps and stores water from the James River during high flow conditions and releases this water back to the river during low-flow and drought conditions. Cobbs Creek Reservoir cannot be used as a water supply due to its purpose to provide extra water to the flow of the James River during drought or near drought conditions. Specifically, this extra water is intended to supply drinking water to Henrico County via the James River during droughts or near droughts.

Cobbs Creek Reservoir is a $280 million construction project according to the Henrico County website, last updated January 30, 2020, and has a safe yield of 47 million gallons per day (MGD). This represents approximately $6 per gallon ($280 million / 47 MGD = $5.96 per gallon) for capital costs to construct the reservoir. Should the JRWA need to buy capacity from Henrico County, it is anticipated it would cost a minimum of $6 per gallon to purchase the capacity in Cobbs Creek Reservoir. That would be in addition to the costs that would be incurred to extend a water main across the James River and construct an intake and pump station on the reservoir. Below are estimated capital costs for various capacities should they be purchased by JRWA:

Potential Capital Costs for Desired Capacities:

- 8 MGD x $6 / gal = $48 million
- 12 MGD x $6 / gal = $72 million

In addition, the JRWA would need to construct a raw water intake and pump station on the Cobbs Creek Reservoir and install a water main along Columbia Road and cross the James River in close proximity to Columbia and then tie-in to the agreed-upon T interconnection point. Given the prohibitive capital costs for purchasing reservoir capacity, no further costs were evaluated for the intake, pump station, water main, and James River crossing.

In summary, Cobbs Creek Reservoir is not considered a practicable alternative and is not a viable option for the James River Water Authority.

4.1.1.4 Alternative Water Supply 4: Groundwater

Groundwater cannot be used as a water supply because existing groundwater sources in the Fluvanna and Louisa County are insufficient to meet the project need.

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As the 2010 Fluvanna Regional Water Supply Plan states, groundwater resources have largely been already maximized for community scale uses. This is evidenced by the multi-year significant decrease of groundwater resources in 2002 due to lack of precipitation and droughts. This modern episode indicates unpredictable and insufficient groundwater supplies within the County and demonstrates that water demands in the more densely developed areas of the County can only be met by a surface water driven community water system.

The 2011 Louisa County Long Range Regional Water Supply Plan states much of the County, like Fluvanna, has an overreliance on groundwater wells. Given the County's goal of preserving its rural character, it is imperative to preserve groundwater resources for rural residents in the future while providing a community water system for densely developing areas. For example, the Louisa County Water Authority (LCWA) utilizes water from wells in the Zion Crossroads area to serve commercial and industrial development that are adjacent to the Green Springs National Historic District. However, the large scale use of groundwater in this area has taxed reserves and the right to withdraw water from wells has faced numerous legal challenges throughout the years and has been the subject of numerous lawsuits including Historic Green Springs, Inc., Louisa County, LCWA, the USEPA and a number of private citizens in various capacities. Reducing dependency on and use of groundwater in this general area has been a major driver behind the James River Water Project. This, in addition to a growing water demands of the Louisa County in general, support the need for a public water source supplied by surface waters to service high growth areas while preserving the rural nature of much of the County.

Beyond preserving groundwater supplies for current and rural uses, the groundwater yields within the Counties appear to be insufficient to meet the needs of the JRWA. The 1998 *County of Louisa Water Quality Management Plan and Groundwater Study* (Appendix H-1-2-1) indicates the average yield of public water supply wells in the County were about 42 gallons per minute (GPM), three times greater than the average yield of 14.5 GPM for all wells in the County. However, in order to achieve these maximum yields, significantly greater well depths (>300 feet) are required than typically well depths (<300 feet). Similarly, the *Fluvanna County Geology and Water Well Productivity* study produced by the Virginia Department of Mines Mineral and Energy (Appendix H-1-2-2) indicates that the most productive wells in Fluvanna County can be found to occur in wells > 300 feet in depth within specific rock families (slate and quartzite) and have, on average, a yield of 89 GPM. This is further validated when you look at each County's demand centers relative to their location in the respective watersheds. Per the attached Hydrologic Unit Code map (see Page 13, Figure 2), the growth areas of Zion Crossroads (both Fluvanna and Louisa), Ferncliff, Shannon Hill and Gum Springs all are located at the "head of a watershed" and adjacent to Interstate 64, which appears to be a "ridge road" as constructed.

Using the most productive figures with wells of 89 GPM as a baseline estimates (from the *Fluvanna County Geology and Water Well Productivity* study), an average deep well (> 300 feet) within an area of high productivity could produce on average of 128,160 gallons per day (GPD). Under this scenario, nearly 100 highly productive deep wells would be required.to meet the 12 million gallons per day (MGD) ultimate needs of JRWA. The development of 100 highly productive deep wells across the Counties would require multiple site-specific

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groundwater studies, multiple test wells and the development of well fields, individual water treatment units at the wells and/or associated infrastructure to connect these fields to a central water treatment plant and related distribution networks. The planning, logistics, testing, permitting, and costs associated with such an endeavor make groundwater withdraws impractical to meet the long-term needs of the JRWA.

In sum, groundwater is not considered to be a practicable alternative and is not a viable option for the James River Water Authority.

4.1.1.5: Alternative Water Supply 5: Purchased Water from Neighboring Communities

Fluvanna and Louisa development corridors are adjacent to Albemarle County to the west and Goochland and Hanover Counties to the east. Rivanna Water & Sewer Authority (RWSA) provides water to the City of Charlottesville and Albemarle County Service Authority and currently has a limited water supply. When the RWSA was considering water supply options in the early 2000's, it evaluated constructing a water line along Route 20 to get direct access to the James River at Scottsville and also partnering with Fluvanna and Louisa Counties to expand the water withdrawal from the James River to include additional demands for the RWSA as the RWSA expressed that it did not have an adequate water supply to serve its residents' needs and the needs of Fluvanna and Louisa Counties. Ultimately RWSA concluded they could meet their long-term water demands utilizing the existing Rivanna watershed by improving their existing reservoirs and abandoned the idea of utilizing the James River as a long-term water source.

JRWA has been informed that RWSA has currently developed their water supply system to exclusively meet the long-term needs of the City of Charlottesville and Albemarle County Service Authority and are not in a position to sell water to Louisa or Fluvanna Counties. Please see attached letter from RWSA dated March 11, 2020 (see Appendix H-1-3).

The next closest municipal water system to Fluvanna and Louisa service areas is Goochland County. Goochland County currently purchases water from Henrico County to serve the Tuckahoe Creek Service District, which is generally located along the east end of Goochland County serving multiple properties along Route 288 and I-64 up to the Manakin-Sabot/Rockville area located just off of exit 173 on I-64. The Tuckahoe Creek Service District would be the closest connection point for Louisa and Fluvanna Counties to purchase water from Goochland/Henrico and is approximately 35 miles east from Zion Crossroads and approximately 38 miles southeast from the Town of Louisa, thereby making it unfeasible to construct a line to this area and purchase water from Henrico or Goochland.

Based upon the items noted above, purchasing water from neighboring communities is not practicable alternative and therefore not a viable option.

For the reasons stated above, JRWA was not able to identify any alternative sources of water that presented a potentially feasible alternative to the James River. As such, these alternatives were not carried forward for a more detailed analysis.

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4.1.2 Build Alternatives

Six alternative raw water intake locations (i.e., the Build Alternatives) were evaluated for the Project. For each Build Alternative, one or more water main route variations were evaluated as sub-alternatives. An overall map of each alternative (Figure 8) and summaries of each Build Alternative follows.

The Build Alternatives included in this analysis were developed to represent a wide-range of options for locating an intake and pump station along the James River within a reasonable radius of the agreed-upon T interconnection point. The upstream and downstream extents of the analysis were guided by a reasonable consideration of constraints. The upstream extent was established at a location near Bremo Bluff, which was the location of the original JRWA withdraw permit. This extent represents the furthest alternative to be evaluated from the agree-upon interconnection point. The downstream extent was determined to be a site in Goochland County approximately one mile downstream from the Columbia Bridge and just upstream of Elk Island. This extent was established based on multiple factors, including distance, water quality (see Section 4.2.1.2.1), and the high occurrence of known cultural resources near Elk Island. Alternative intake locations within the overall extents were also developed based on reasonable considerations including ease of access via existing CSX rail crossings and distances from wastewater treatment plant (WWTP) discharges into the James River. Locations of existing Dominion and Fork Union WWTP discharge points on the James River are shown in Figure 7. Section 4.2.1.2.1 Adequate Water Quality further details raw water withdrawals with regard to the 5-mile discharge in accordance with the Virginia Waterworks Regulations. Routing alternatives were developed to avoid sensitive resources and to be co-located with existing VDOT roads, utility corridors, or CSX right-of-way to the maximum extent feasible and / or practicable. The Build Alternatives selected for detailed analysis are summarized in the Sections below.

The evaluation of Build Alternatives has been prepared using the best available information and field investigations where practicable. This analysis is believed to be comparatively reasonable for each of the alternatives evaluated. Should additional information be acquired or due diligence be completed, it could slightly alter the results of the analysis, however, we don't believe it will alter the final conclusions of the analysis.

The proposed action, Alternative 6, has been extensively studied over a period of years, and the analysis of that alternative is based on known conditions of the currently designed intake and pump station site. For Build Alternatives 1 through 5, 6-1 and 6-2, the best available information was gathered from mapping data, online data, other reliable sources, and visual inspections where accessible. For elements that would not be materially different between alternatives—such as pump station construction costs—the information developed for Alternative 6 was used to inform the related elements of the other alternatives. The available information for the alternatives that have comparatively less information available than the proposed action is sufficient to determine whether there are any known factors that make construction *impracticable*. That is, if an alternative is demonstrated to be impracticable based on one or more factors, no further analysis is warranted. However, it must be recognized that additional information and further analysis could result in the identification of additional factors that may make a given alternative impracticable. Information on the considerations listed below was not fully developed for the Build Alternatives (other than the proposed alternative), and

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therefore this analysis *assumes* that these considerations would not make an alternative impracticable but additional information could change that conclusion:

- Topography. The elevation of pump station sites must be suitable in relation to the elevation of the river bottom.
- Bathymetry. The depth and shape of the river bottom must be suitable for a submerged water intake.
- Geology. Presently unknown information about the type and depth of soils and rock could lead to constructability challenges.
- Availability of Land for Pump Station Construction, Temporary Construction Easements, Access and Water Line Easements. Fluvanna and Goochland County GIS data has been used to assess the availability of land for alternative sites, access to the sites and associated easements. However, no boundary survey, title investigations, or appraisals have been performed.

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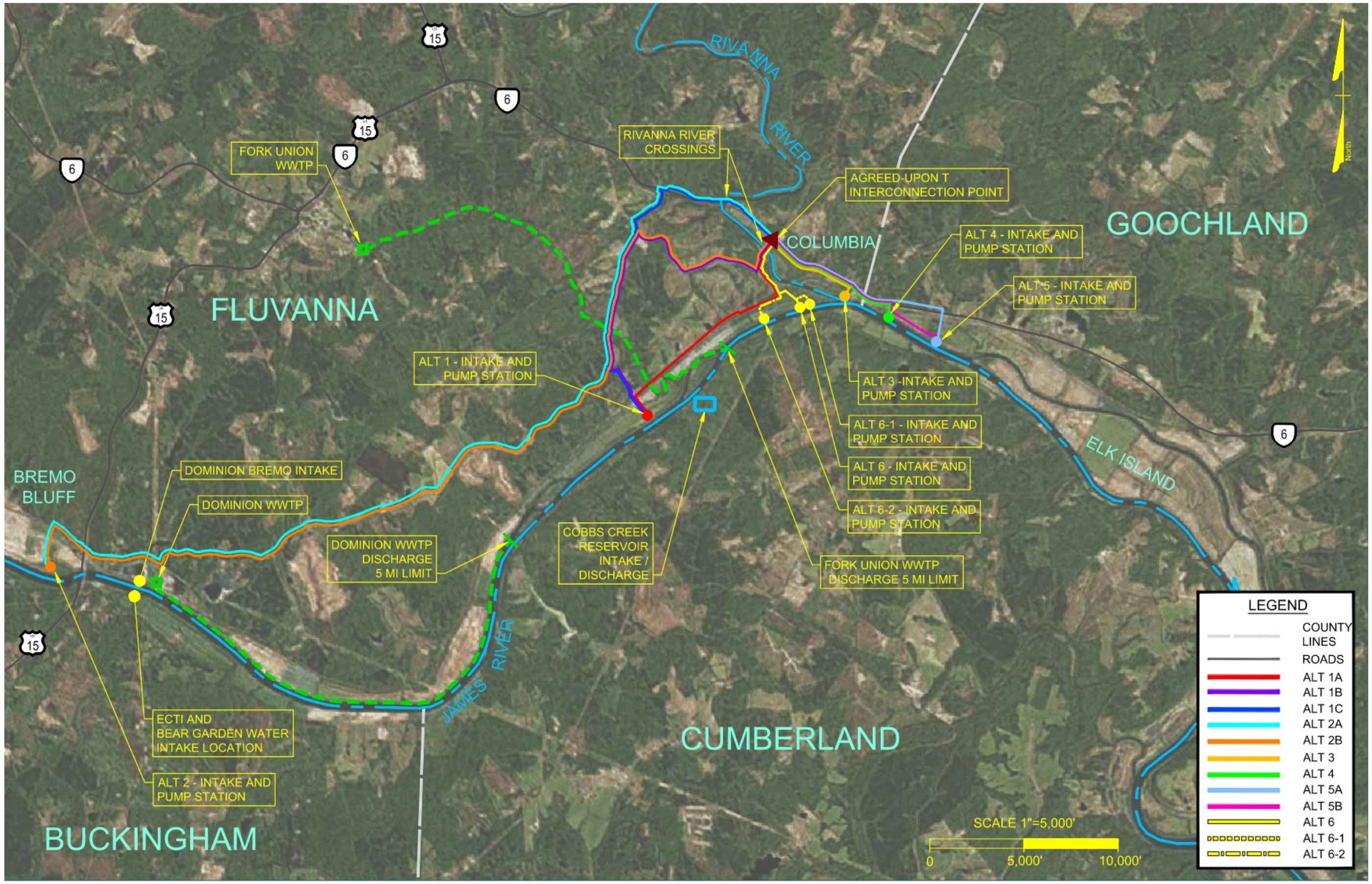

Figure 7. Overview of Build Alternatives and Routing

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4.1.2.1 Build Alternative 1: Forsyth

- **Build Alternative 1** is approximately 2.3 miles upstream of the confluence of the James River and Rivanna River on property owned by Forsyth (TM 61 1 6). The evaluation considers three water main routes to this site as follows:
    - **Sub-alternative 1A**; crossing the Rivanna River and following the Colonial Pipeline and Dominion Power utility corridor as currently designed, then following the CSX rail to the alternative site.
    - **Sub-alternative 1B**; crossing the Rivanna River and following the Colonial Pipeline utility corridor as currently designed to Point of Fork Road (Route 624); then following Point of Fork Road and Bremo Road (Route 656) to the Forsyth property; then extending into the Forsyth property, crossing the CSX rail to the alternative site.
    - **Sub-alternative 1C**; following Route 6 and crossing the Rivanna River at Route 6 and continuing to Bremo Road (Route 656) to the Forsyth property; then extending into the Forsyth property, crossing the CSX rail to the alternative site.

    See Figure 9. Build Alternative 1 Evaluated Routing Options for details

4.1.2.2 Build Alternative 2: Bremo

- **Build Alternative 2** is in the vicinity of Bremo Bluff west of the US 15 Bremo Bridge. It is approximately 0.35 miles upstream of the Route 15 Bridge on property owned by Orf (TM 58 A 9). The site is situated such that the intake location avoids rapids and sand bars in the vicinity. This evaluation considers two water main routes to the site as follows:
    - **Sub-alternative 2A**; following Route 6 and crossing the Rivanna River at Route 6 and continuing to Bremo Road (Route 656) to the west of the Route 15 bridge at Bremo Bluff onto CSX Road, then crossing the CSX rail and extending into the alternative site.
    - **Sub-alternative 2B**; crossing the Rivanna River and following the Colonial Pipeline utility corridor as currently designed to Point of Fork Road (Route 624) and continuing to Bremo Road (Route 656) to the wet of the Route 15 bridge at Bremo Bluff onto CSX Road, then crossing the CSX rail and extending into the alternative site.

    See Figure 10. Build Alternative 2 Evaluated Routing Options for details

4.1.2.3 Build Alternative 3: Columbia

- **Build Alternative 3** is in the vicinity of Columbia, downstream of the confluence of the James and Rivanna Rivers; approximately 0.4 miles downstream of the current site on the properties owned by Harry (TM 54A 1 96, TM 54A 1 79, TM 54A 1 80, and TM 54A 1 97) and Kidd (TM 54A 1 80A). The water main route is as follows:
    - Following Route 6 east to Columbia and extending into the alternative site in Columbia.

  See Figure 11. Build Alternative 3 Evaluated Routing Options for details

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4.1.2.4 Build Alternative 4: Goochland 1

- **Build Alternative 4** is in Goochland County, downstream of the confluence of the James and Rivanna Rivers; approximately 1/2 miles downstream of the existing Columbia Bridge on property owned by Valentine (TM 24 1 1). The water main route is as follows:
    - Following Route 6 east to Columbia and into Goochland; then crossing the CSX rail and extending into the alternative site.

  See Figure 12. Build Alternative 4 Evaluated Routing Options for details

4.1.2.5 Build Alternative 5: Goochland 2

- **Build Alternative 5** is in Goochland County, downstream of the confluence of the James and Rivanna Rivers; approximately 1 mile downstream of the existing Columbia Bridge on properties owned by Welch (TM 24 2 7A). The evaluation considers two water main routes to this site as follows:
    - **Sub-alternative 5A**; following Route 6 east to Columbia and into Goochland, then crossing the CSX rail and entering the Welch property into the alternative site.
    - **Sub-alternative 5B**; following Route east to Columbia and into Goochland, then crossing the CSX rail and entering the Valentine property; extending east towards the Welch property into the alternative site.

  See Figure 13. Build Alternative 5 Evaluated Routing Options for details

4.1.2.6 Build Alternative 6: Hammond 1 (Proposed Action)

- **Build Alternative 6** is the Preferred Alternative. This alternative is described more fully above in Section 2, which is incorporated here by reference.

  For the purposes of this Alternatives Analysis, JRWA evaluated two variations on the proposed Project that were not sufficiently different to warrant evaluation as independent alternatives. Additional actions to avoid and minimize impacts associated with the Build Alternative 6 are discussed in Section 6 below.

4.1.2.7 Build Alternative 6-1: POF Farm

- **Build Alternative 6-1** is the original property considered in the Joint Permit Application with the intake structure approximately 0.4 miles upstream of the confluence of the James River and Rivanna River with the water transmission line following an old roadbed until it intersects with the existing Dominion Power easement. This intake and water main location are located on Point of Fork Farm LP (parcel 53-A-62C) and was included in the original Joint Permit Application. It was anticipated at the time of the application that the JRWA would be able to acquire the pump station site from Point of Fork Farm LP, however, JRWA was not able to acquire the site. Subsequently the JRWA was able to

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negotiate the acquisition of a pump station parcel from the adjacent landowner, William Hammond (parcel 61-A-4), just upstream of this pump station location. Once the JRWA acquired this parcel, they requested a minor modification from DEQ to move the proposed pump station and intake structure upstream approximately 250 liner feet.

This alternative would realize the purpose and need of the project in the required configuration. However, this alternative site presented issues due to breakdowns in property owner negotiations regarding the placement of the intake structure and water main. Shifting the station upstream to the location of the Preferred Alternative minimizes property acquisition from reluctant parties and better utilizes existing easements without increasing any environmental impacts.

4.1.2.8 Build Alternative 6-2: Hammond 2

- **Build Alternative 6-2** is the intake structure approximately 0.8 miles upstream of the confluence of the James and Rivanna River with the intake and pump station located adjacent to the Colonial Gas Pipeline easement.

  This alternative would realize the purpose and need of the project in the required configuration but presents issues due to safety concerns. The proximity of the pump station to the existing Colonial Gas pipeline was determined to be unsafe for blasting necessary for construction. Additionally, there is also no existing rail crossing to easily access this site, which would increase the overall cost and time needed for the project.

See Figure 14. Build Alternative 6, 6-1, and 6-2 Evaluated Routing Options for details.

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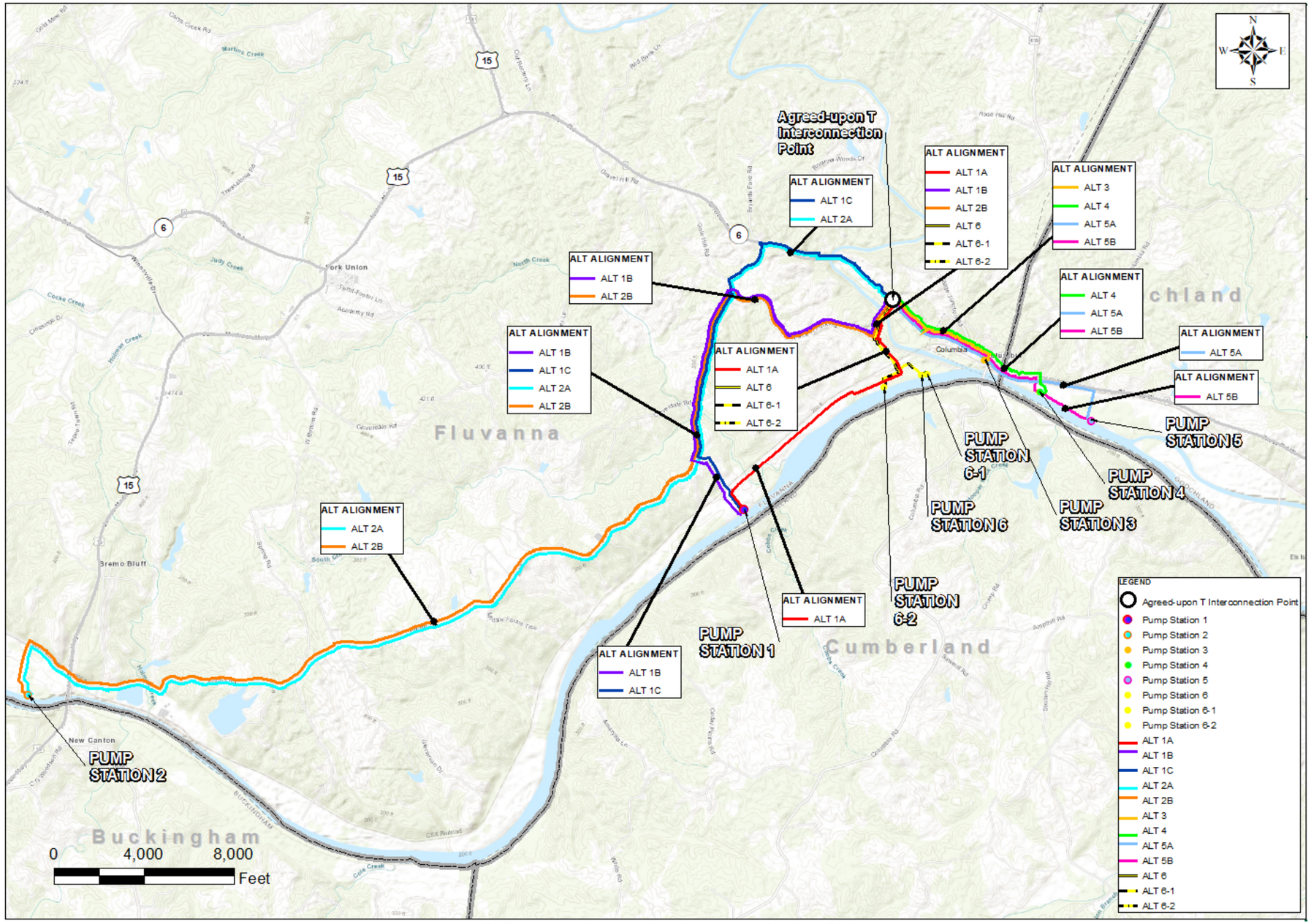

Figure 8. Overview of Evaluated Alternative Routing Options

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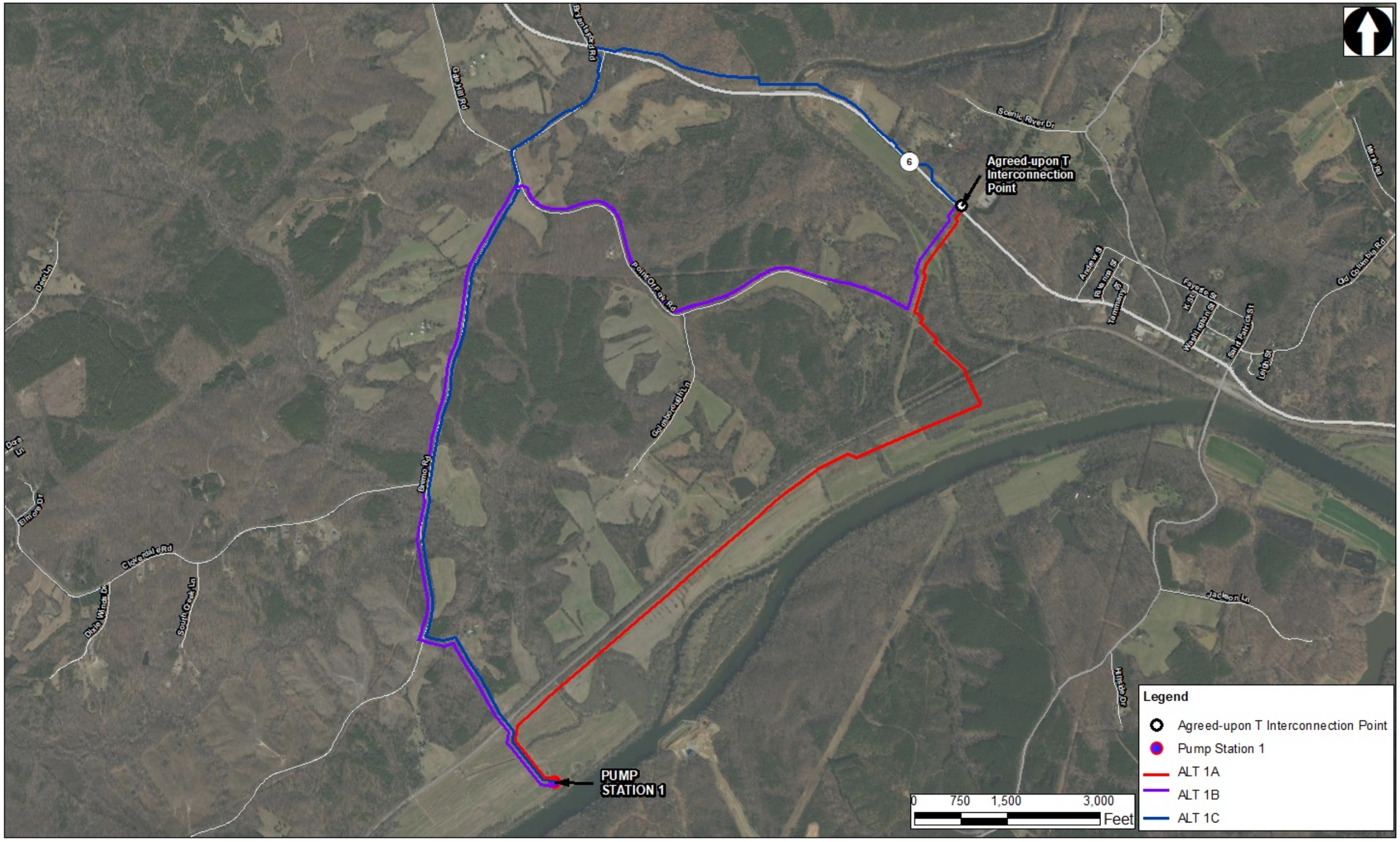

Figure 9. Build Alternative 1 Evaluated Routing Options

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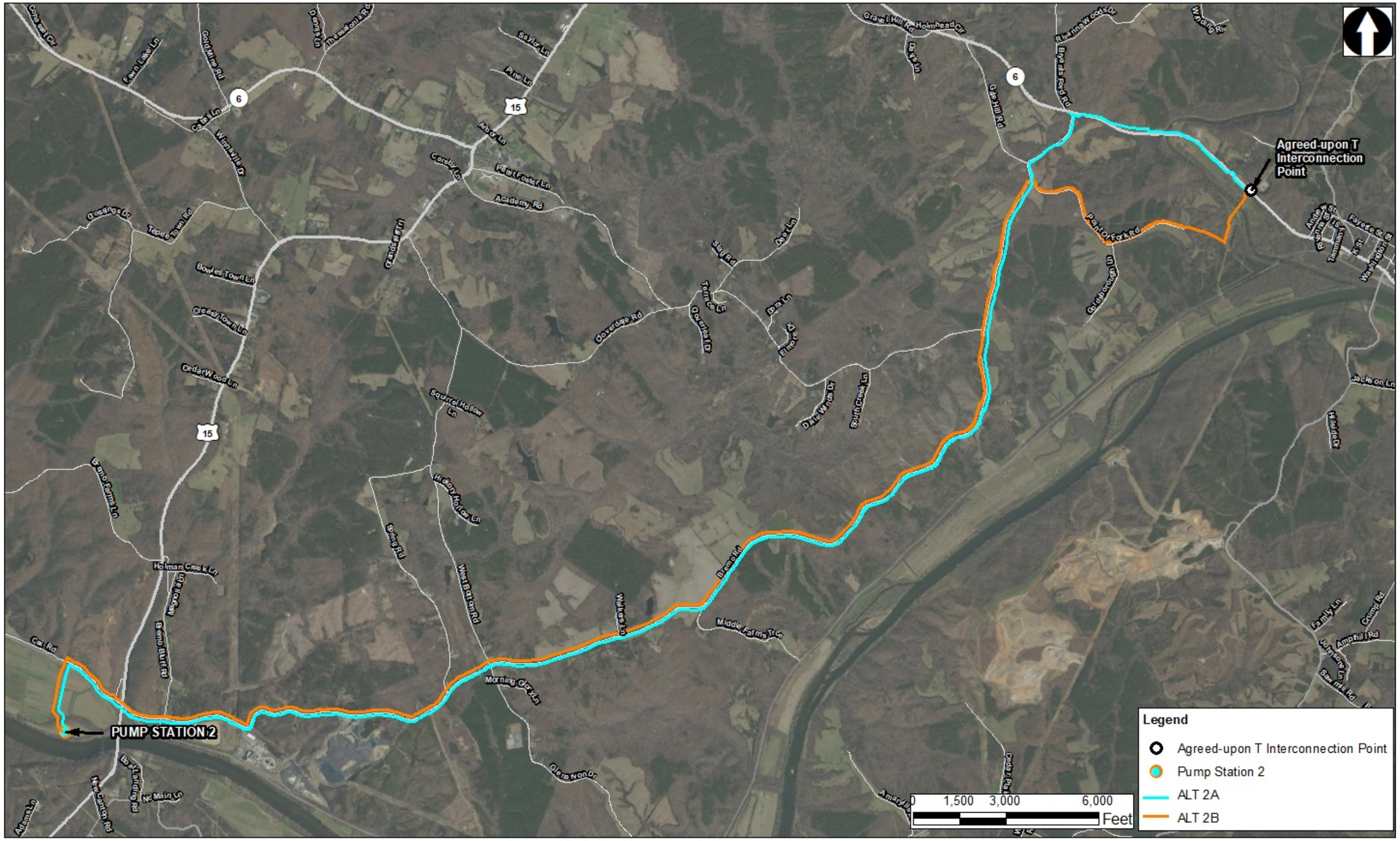

Figure 10. Build Alternative 2 Evaluated Routing Options

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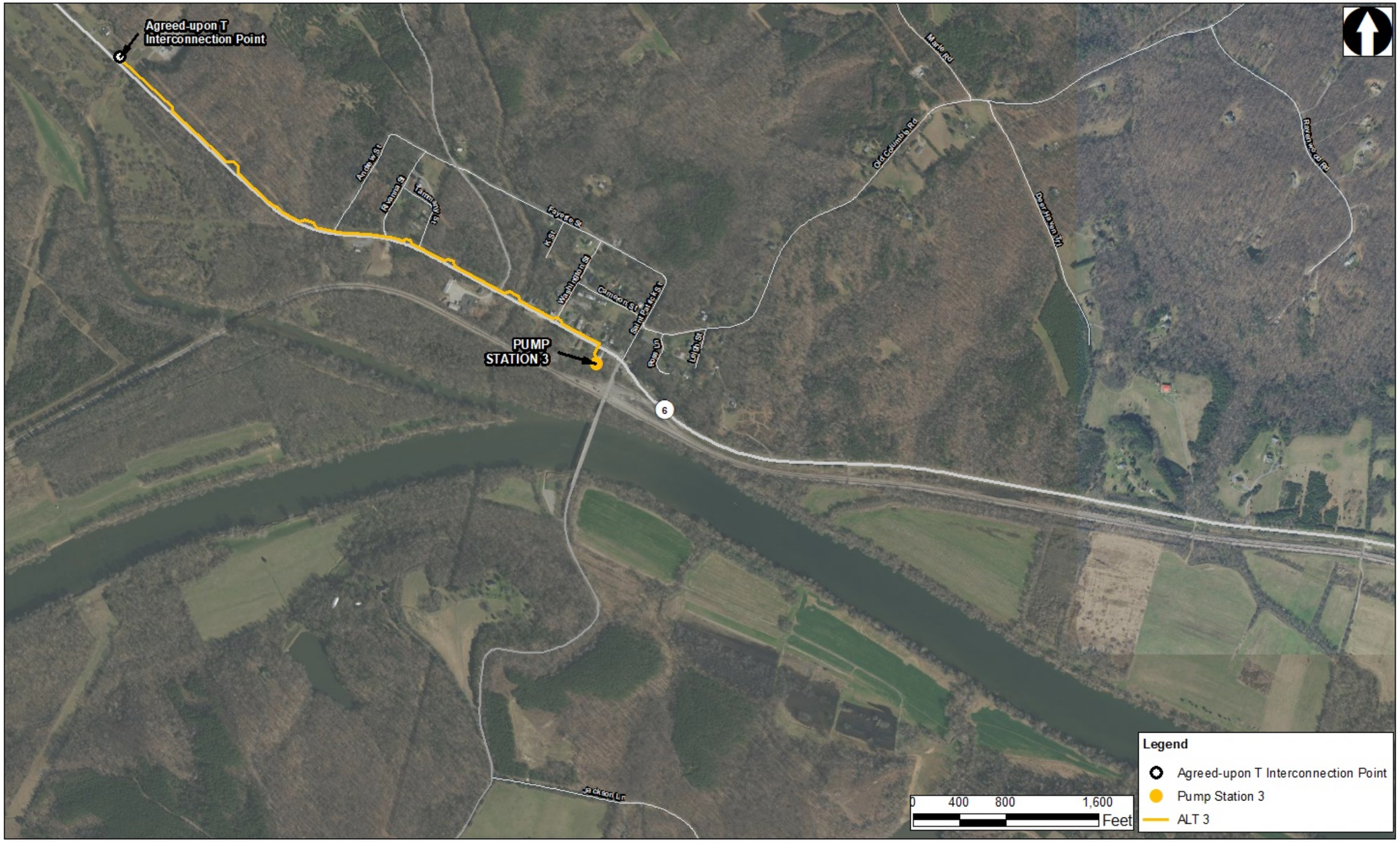

Figure 11. Build Alternative 3 Evaluated Routing Options

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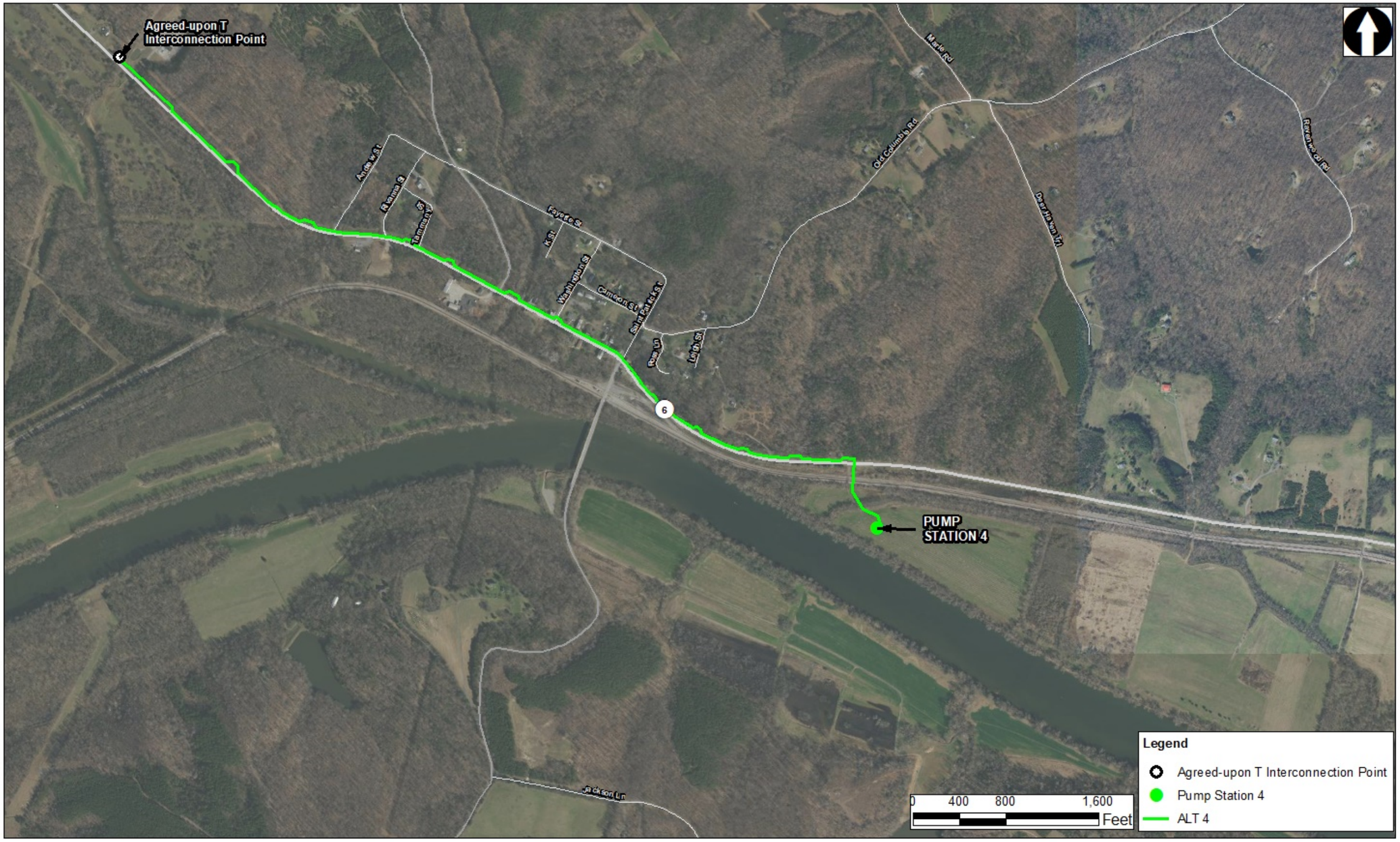

Figure 12. Build Alternative 4 Evaluated Routing Options

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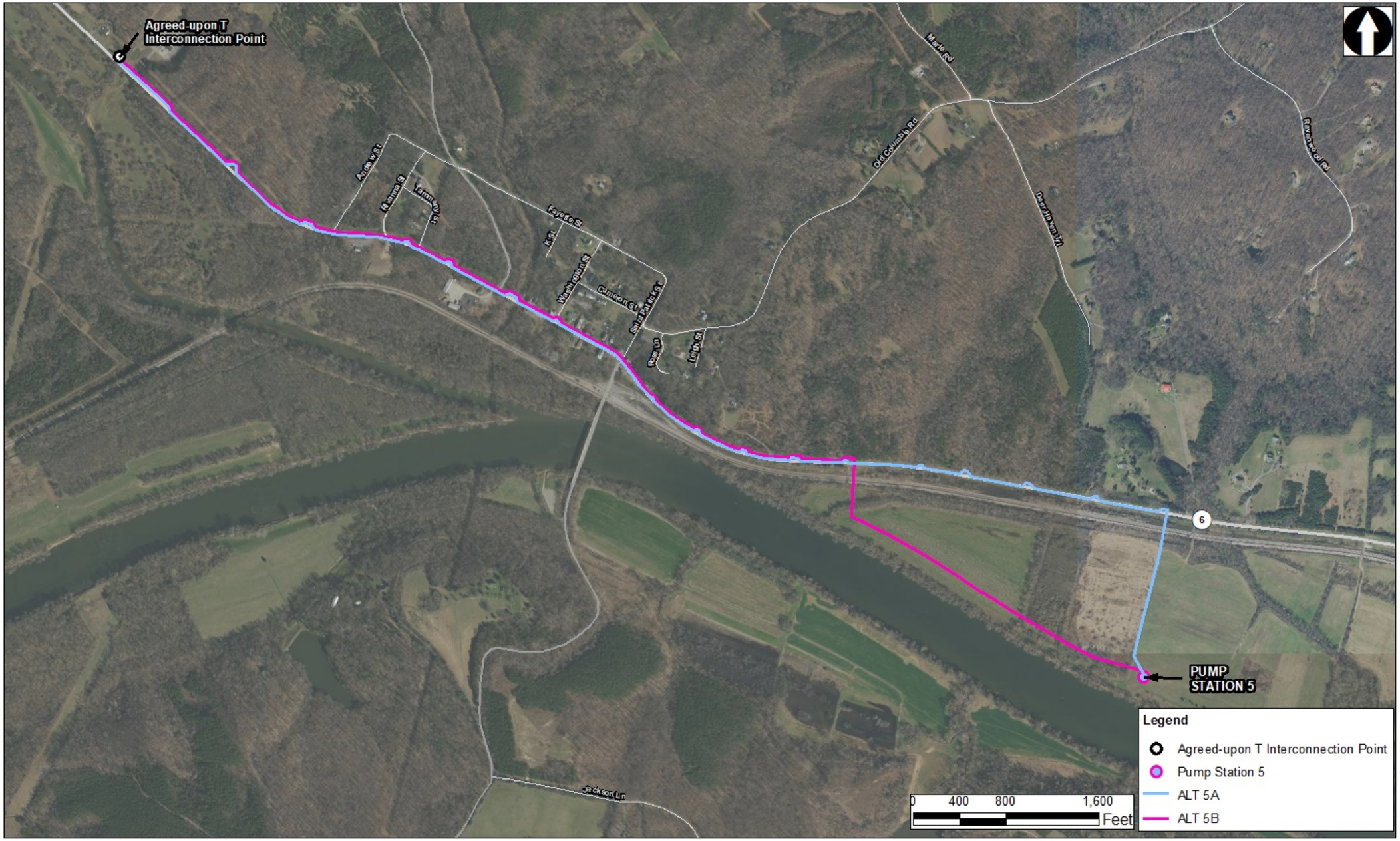

Figure 13. Build Alternative 5 Evaluated Routing Options

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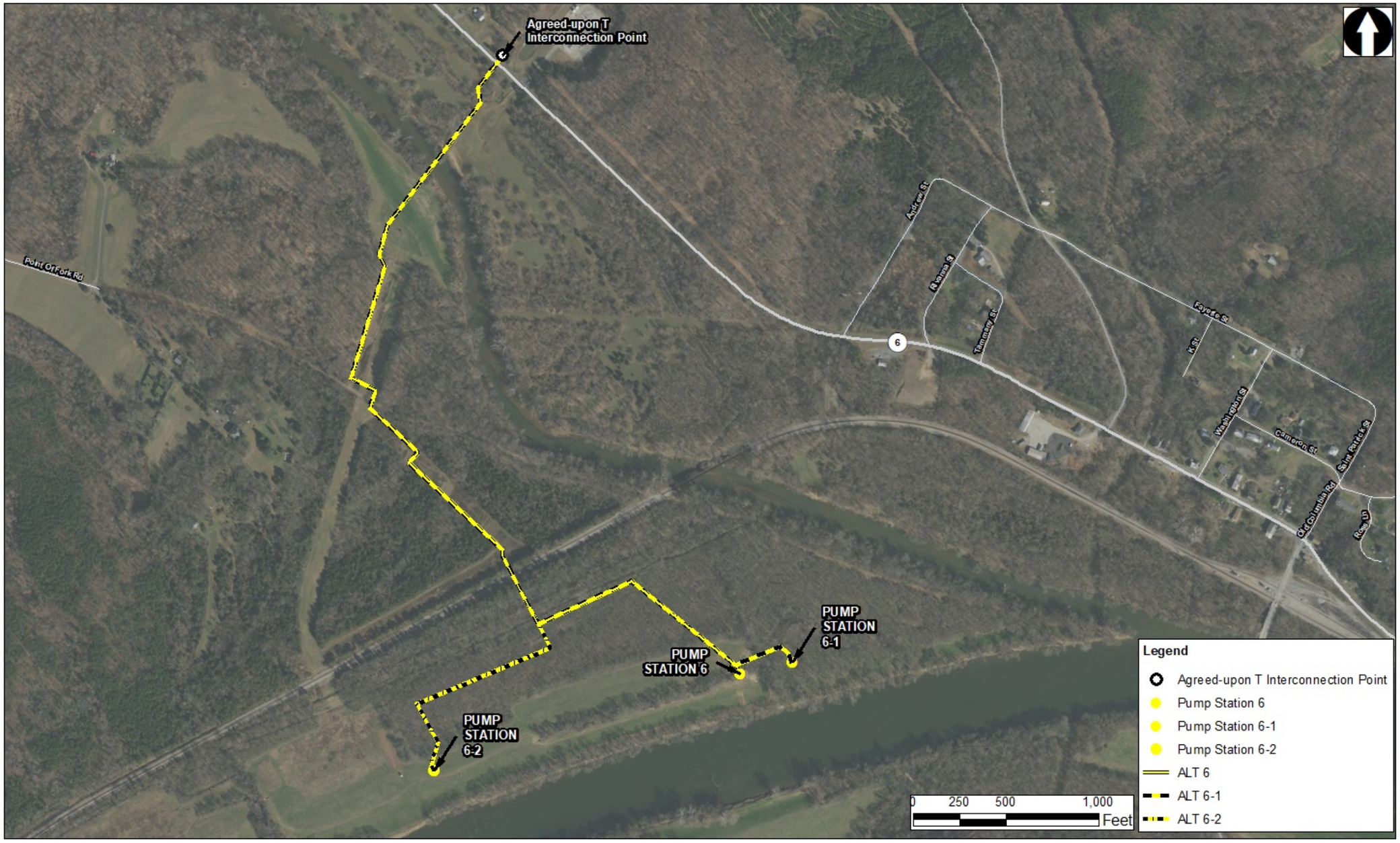

Figure 14. Build Alternative 6, 6-1, and 6-2 Evaluated Routing Options

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4.1.3 No-Permit and No-Action Alternative

There is no feasible way to get an adequate quantity of water from the James River, or any other potential source of surface water, to the interconnection point without impacting jurisdictional waters. Boring under all jurisdictional waters would not represent a No-Permit Alternative because there is no technologically feasible way to construct the raw water intake in a surface water in a manner that would avoid the need for a permit. Although drilling a groundwater supply well immediately adjacent to the connection point could theoretically avoid jurisdictional impacts, groundwater does not provide a sufficient supply of water to meet the Project purpose. Thus, that option cannot be considered a true alternative. Accordingly, the No-Permit Alternative and No-Action Alternative are the same. The No-Action/No-Permit Alternative entails not constructing the water supply Project in any form.

4.2 Alternatives Evaluation Criteria

4.2.1 Practicability Considerations

An alternative is “practicable” if it is “available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.” 40 C.F.R. § 230.10(a)(2). This analysis applies each of the evaluation criteria noted below to each Build Alternative.

The first set of criteria evaluated were construction logistics. These criteria pertain to whether it is practicable to construct all elements of the project at the particular location. These criteria include:

- Size and Configuration of Site Suitable for Construction of a Pump Station
- Heavy Equipment Access to Pump Station Site from Public Right-of-Way
- Presence of Rock
- Constructability of Water Main
- Suitable Railroad Track Crossing Location
- Acquisition of Land and Easements

The second set of criteria evaluated were site suitability logistics. These criteria include factors that bear on whether a site is suitable for the operation and maintenance of public water supply infrastructure. These criteria include:

- Adequate Water Quality
- Intake and Pump Station Proximity and Depth of Wetwell
- River Bottom Depth at Intake Location
- Access to Suitable Power Supply
- Proximity to Residential Dwellings

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The third criterion evaluated is cost. That evaluation tallies the capital construction and financing costs to determine total probable project costs.

From an engineering standpoint, the technology exists to construct a pump station and water main at any of the six build alternatives. Because technology is not a relevant basis upon which to differentiate among the alternatives it is not considered in this analysis.

4.2.1.1 Construction Logistics Considerations

4.2.1.1.1 Size and Configuration of Site Suitable for Construction of a Pump Station

The overall size and configuration of the site available for purchase must be sufficiently large to contain the pump station and offer enough additional laydown area adjacent to the structure to allow for the operation and movement of construction equipment. The site must offer favorable conditions to permit the construction of the project at a reasonable cost and in a safe manner that minimizes the impacts to traffic safety, the environment, and clearing and rock excavation. Below is a site diagram and description of each Build Alternative. An alternative would be deemed impracticable on this criterion if would not allow for the safe construction of the project. For further detail see Appendix H-2 for intake structure to wetwell cross section exhibits.

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Build Alternative 1 offers enough area to construct and maintain the proposed facilities. Figure 15 below shows the access road path and configuration of the site.

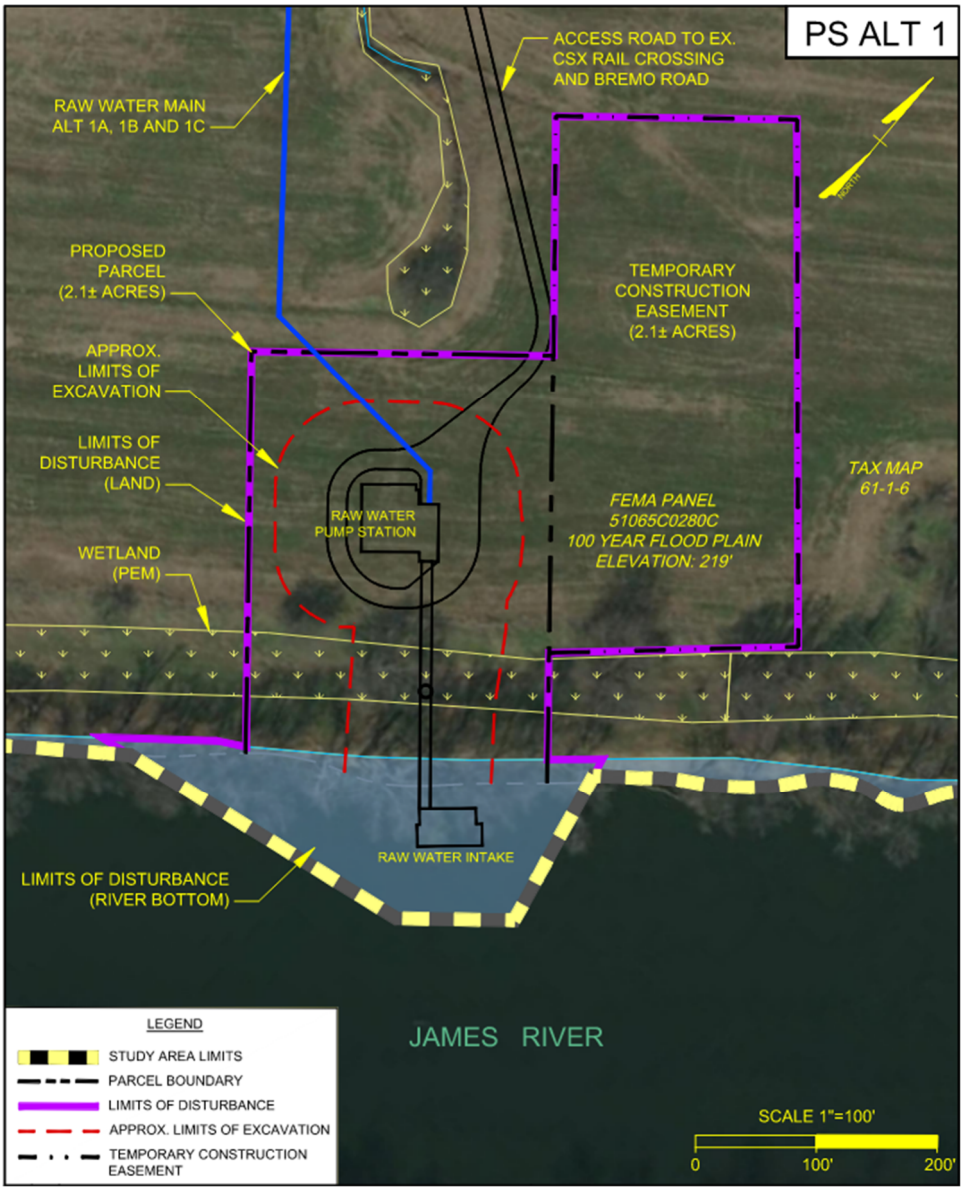

Figure 15. Build Alternative 1 Pump Station Plan View

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Build Alternative 2 offers enough area to construct and maintain the proposed facilities. Figure 16 below shows the access road path and configuration of the site. A culvert will be installed near the site beneath the access road to provide safe access to the pump station site.

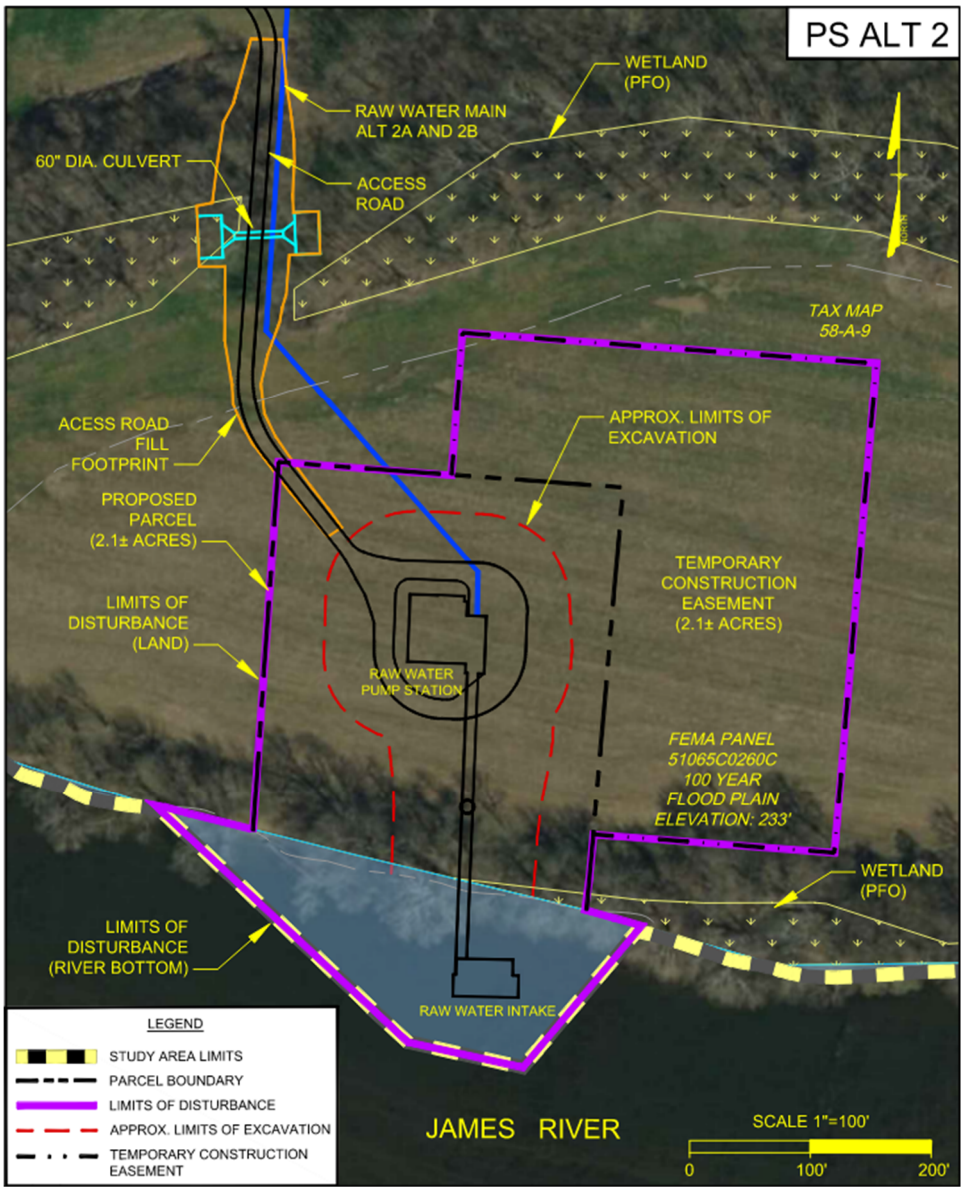

Figure 16. Build Alternative 2 Pump Station Plan View

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Build Alternative 3 offers limited area to construct and maintain the proposed pump station. Figure 17 shows the access road path and the configuration of the site. The site is immediately adjacent to residential structures and the CSX rail line. Construction at this site is not practicable due to the lack of space and proximity to existing structures and rail. The construction and maintenance of the intake is not practicable due to lack of accessibility to the river. Accessing the river from Columbia Bridge was considered as an option, but that is deemed infeasible due to maintenance of traffic difficulties.

This alternative is unique compared to others in that it would require construction immediately adjacent to the CSX rail and existing residential structures. These factors would result in significant additional cost and project risks as follows:

a. Due to the lack of area to layback excavations, the construction of the wetwell will require that the excavation be sheeted and braced to the elevation of bedrock (approximately 28.4 feet deep). This sheeted excavation will require extensive lateral bracing that will impede the progress of excavation, and construction of the structure. Implementing the project using a sheeted excavation will result in significant cost and schedule increases and greater safety risks during construction.

b. Due to there being active rail lines between the wetwell and intake, it will be required that the gravity intake pipe be installed by jack and bored through rock with a casing pipe approximately 500 feet in length. A boring through rock of this length, while working in a sheeted excavation, will result in significant cost and schedule increases and greater safety risks during construction.

c. Similarly, due to there being active rail lines between the wetwell and intake, it will be required that an additional casing be install approximately 500 feet in length to carry the air-burst piping used for cleaning the intake screens. A boring of this length, while working in a sheeted excavation, will result in significant cost and schedule increases and greater safety risks during construction.

d. There is no practical way to construct an access road between the pump station and intake, thus a crane must be utilized to deliver equipment and materials to the intake locations. Considering there is not practical location other than the existing bridge at Columbia, the crane would be positioned on the bridge for the duration of the intake construction, thus requiring a lane closure and temporary traffic lights to manage traffic on a 24/7 basis during construction. Positioning a crane on the bridge, will result in significant cost and schedule increases and greater safety risks to construction workers and the public. In addition, the crane will need to be positioned such that if it were to fall, it would not land on the rail line and impede rail operations.

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e. A concrete pump truck would be required to deliver concrete to the intake site. This truck would also need to be staged on the bridge. Positioning a concrete pump struck on the bridge, will result in significant cost and schedule increases and greater safety risks to construction workers and the public.

f. The site is very confined, thus reducing turn around space for vehicles. This will result in additional traffic control on Route 6 to allow long body vehicles to back in or out of the site. This condition will result in cost and schedule increases and greater safety risks to construction workers and the public.

g. One or more residential structures will require demolition, this will also require residents to be relocated following federal guidelines. In addition to the human and environmental impacts, this would add additional costs, timing, and logistical obstacles to construction at this site.

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