BWRR
BALTIMORE-WASHINGTON RAPID RAIL

BALTIMORE-WASHINGTON SCMAGLEV PROJECT

Maryland High-Quality Waters (Tier II)

Social and Economic Justification Report

REVISION: 2

DATE: March 1, 2022

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1. INTRODUCTION

1.1. PROJECT SUMMARY

Baltimore-Washington Rapid Rail (BWRR) proposes to build a new intercity high-speed passenger train with the first segment connecting Washington, D.C. and Baltimore, MD, with an intermediary stop at Baltimore-Washington International Airport (BWI Airport). The overall vision is to connect Washington, DC to NYC with stops in Wilmington DE, Philadelphia PA, Newark, NJ in addition to Baltimore. The project will provide new infrastructure, passenger stations, and ancillary facilities required to implement Central Japan Railway's Superconducting Maglev (SCMaglev) system and technology.

The Final Environmental Impact Statement (FEIS) is expected to be published in 2022 with the Record of Decision (ROD) to follow thereafter. The FEIS and ROD are expected to be completed before the Joint Permit would be issued by the US Army Corps of Engineers (USACE) and Maryland Department of Environment (MDE) for the alteration of any floodplain, waterway, tidal or nontidal wetland. These federal and state permits must be finalized and granted before construction could begin.

The project has location specific restrictions that prevent complete avoidance of Tier II watersheds (See the Alternatives Analysis – No-Discharge Alternative document for more details):

1. The study area for the project was mandated by the enactment of Maglev Deployment Program (MDP) by U. S. and includes Tier II Catchment watersheds.
2. The SCMAGLEV technology requirements must comply with Federal safety requirements.
3. There is no reasonable alternative alignment outside of the Tier II Catchment watersheds. 14 alignment alternatives were evaluated throughout the study area before the current alignments were brought forward through the NEPA process by FRA.

Additionally, the guideway alignment is subject to the technology provider's specific geometry requirements, which ensure the safety of the system at time-saving high speeds. Support facilities outside the mainline alignment include substations, signaling equipment, Maintenance of Way (MOW) facilities, and a Train Maintenance Facility (TMF) where trainsets are inspected and maintained. The MOW houses equipment for nightly inspections of the guideway and must be within 25km of the terminus station in Washington, DC to ensure inspections are completed and the guideway is cleared within the nightly maintenance window.

Baltimore Washington Rapid Rail's (BWRR) proposal includes a(n):

- Washington, D.C. station in Mount Vernon East.
- Alignment between Washington, DC and Baltimore, MD (SCMAGLEV DEIS alignment J).
- Train maintenance facility (TMF) located on United States Department of Agriculture Beltsville Agricultural Research Center (USDA BARC) land west of the Baltimore Washington Parkway.
- Baltimore City Station in the Cherry Hill neighborhood.

1.2. IMPACTS

The limits of disturbance (LOD) presented are worst case scenario and include both permanent and temporary impacts. Additional effort will be made through final design to reduce these. The single largest impact is from the Train Maintenance Facility (TMF), which needs to be located as near to the DC terminus

station as possible and cannot be disaggregated. Selection of the BARC West TMF minimized and avoided environmental impacts to the greatest extent possible. The minimization and avoidance efforts are detailed in the Tier II Alternatives Analysis Minimization Report. The SCMAGLEV project permanent impacts to forest cover and waterways, within Tier II Watersheds and prior to mitigation, are summarized in the following table:

Table 1: Summary of Impacts to Tier II Watersheds

Total Impact Type	Tier II Catchment Watersheds		Total
	Beaverdam Creek 2	Patuxent River 1	
Forest (Acres)	257	56	313
New Impervious Surfaces (Acres)	204	18	222
Stream Buffer (LF)	2,808	1,526	4,334

1.2.1 MINIMIZATION & AVOIDANCE

The following measures were incorporated during conceptual design to avoid and reduce impacts to forest cover, streams, and their buffers. A more comprehensive list is available in the Tier II Alternatives Analysis Minimization Report.

1) Approximately 70% of the alignment project-wide was designed in deep tunnel, meeting SCMAGLEV operational requirements while avoiding adverse impacts to communities and the environment. This includes approximately 1-mile of tunnel under the Beaverdam Creek Tier II Watershed.
2) Earlier plans for the TMF located in Tier II waters called for a 235-acre facility footprint. BWRR, in consultation with Central Japan Railway, redesigned the TMF to require only 180 acres. This is a 55-acre (23%) reduction in impacts to Tier II waters.
    a. Further reductions in footprints were analyzed but these measures would have resulted in significant operational constraints that jeopardized the technology license, introduced system reliability risk, increased durations for train staging, compromised service levels, and added safety concerns.
    b. 15 potential TMF locations along the alignment were evaluated.
    c. The irreparable harm caused by residential displacements was considered a fatal flaw for siting the TMF. Since 11 of the 15 TMF sites that met the design criteria would result in residential displacements, they were removed from consideration.
    d. Two sites located on the Beltsville Agricultural Research Center (BARC) property were found to have the least environmental impacts while still meeting the design criteria.

    NOTE: Additional detail is available in the TMF report included as Appendix – 7.
3) Selecting the BARC West TMF with the J alignment alternative results in approximately 4 acres of permanent wetland impact avoidance and minimization as compared with pairing the J alignment to the BARC East-Airstrip alternative.
4) The above ground guideway is viaduct resulting in small periodic impacts from pier foundations, rather than continuous impacts from embankment used in traditional rail projects.
5) The viaduct will be a minimum of 32’ above ground and reach heights over 100’, minimizing effects of shading and impervious structures.
6) A Maintenance-of-Way (MOW) facility is co-located with the TMF, avoiding additional impacts by sharing TMF ramps rather than creating additional ramps between the MOW and mainline.
7) The stormwater management design in the vicinity of the south portal was redesigned to minimize wetland and stream impacts and will be replanted once construction is complete.

Further impact reduction will be sought as the design progresses. However, significant changes to the guideway alignment or siting of the TMF/MOW facilities would result in delays and increased costs, ranging from 6 months to more than a year with signifigant cost increases.

1.2.2 MITIGATION MEASURES

1.2.2.1 *REFORESTATION*

To evaluate options available for mitigating impacts, BWRR performed a GIS analysis that identified properties conducive to reforestation and mailed letters to the owners of these properties. The letters described BWRR's reforestation goals and invited interested property owners to contact BWRR. The complete methodology is described in the site search appendix of the Minimization and Mitigation Alternatives Analysis.

BWRR found willing property owners of 62 acres of land for reforestation in the Patuxent River I Watershed and found willing property owners of 4 acres of land for reforestation in the Beaverdam Creek 2 Watershed. BWRR is evaluating each site's potential and will proceed to negotiations after complete assessments of the properties and approval of the project.

BWRR also coordinated with key government stakeholders in the area. The USDA's real property group (responsible for BARC) was contacted by mail and email in September of 2021. BWRR inquired about reforestation opportunities and offered to discuss other initiatives (like environmental remediation for toxic substances) that might help maintain the health of the watershed. No response was received.

1.2.2.2 *CONSERVATION*

Recognizing the opportunity to further mitigate impacts in Beaverdam Creek, BWRR conducted an additional analysis for conservation in the watershed. BWRR found willing property owners of 20.6 acres of land for conservation in the Beaverdam Creek 2 Watershed. Throughout the process, BWRR consulted the Region 11 General Services Administration, the Maryland Department of Natural Resources, and the Maryland National Capital Park and Planning Commission (M-NCPPC) to explore reforestation and conservation opportunities in the area. Though the search for mitigation was thorough and exhaustive, BWRR will continue exploring additional mitigation opportunities that become available as the project progresses. Table 2 below summarizes the results of BWRR's off-site search for mitigation opportunities by watershed. Table 3 below includes all mitigation opportunities organized into the Maryland Department of the Environment (MDE) mitigation preference hierarchy.

Table 2: BWRR's Off-site Mitigation Search Results

Build Alternative	Mitigation Type	Tier II Mitigation Summary		
		Beaverdam Creek 2	Patuxent River 1	Total (Acres)
J-03	Reforestation	4	62	66
	Conservation	20.6	N/A	20.6
			Total	86.6*

***One acre of conservation counts for a 0.5-acre offset**

Table 3: Summary of On-Site and Off-Site Tier II Mitigation Opportunities

Patuxent 1 Watershed			
Proposed Tier II Mitigation Type		Acreage of Mitigation	Mitigation Location
In-kind, on-site	Reforestation	16	Patuxent River I watershed
In-kind, off-site	Reforestation	62	Patuxent River I watershed
	Watershed Total	78	
Beaverdam Creek 2 Watershed			
Proposed Tier II Mitigation Type		Acreage of Mitigation	Mitigation Location
In-kind, on-site	Reforestation	41	Beaverdam Creek 2 watershed
In-kind, off-site	Reforestation (1:1)	4	Beaverdam Creek 2 watershed
In-kind, off-site	Conservation (2:1)	20.6 Acres Conservation 10.3 Acres Credit	Beaverdam Creek 2 watershed
	Watershed Total	55.3	
	Project Total	133.3	

1.2.2.3 *STORMWATER RETROFITS*

BWRR offered stormwater management system retrofits to community establishments subject to the Prince George's County Clean Water Act (CWA) fee. BWRR identified sites with at least 4 acres of impervious surfaces (CWA Fee of about $1500 annually) or sites that might not have dedicated funding for stormwater management improvements. These facilities included religious organizations, apartments, and condominiums. The benefit to the organizations in the watershed comes in the form of potential long-term CWA fee reductions and compliance with the current regulations. The retrofits provide long-term environmental improvements which would otherwise struggle to come to fruition. In addition, SWM improvements at community locations can increase awareness for the importance of water quality and the value of Beaverdam Creek.

BWRR identified and contacted four religious organizations with viable retrofit sites within the watershed; they were not interested at the time. The owners of two apartment complexes and one townhouse association were also sent letters in February 2022. BWRR received no responses.

BWRR contacted Maryland-National Park and Planning Commission *(*M-NCPPC) to assess whether any stormwater retrofits could be incorporated into properties they own in the watershed. M-NCPPC coordinated with the Prince George's County Department of Parks and Recreation. They concluded BWRR's proposal would not provide substantial benefit to the park system. Note M-NCPPC's response:

> *"The Beaverdam Creek 2 watershed is not a priority area for the M-NCPPC due to it having high-quality waters with assimilate capacity. Using parkland to construct stormwater retrofits to improve water quality within this watershed would have an unsubstantial impact. Resources are better spent in areas with significant untreated impervious surface and in watersheds with lower water-quality ratings."*

1.2.2.4 *NEW IMPERVIOUS SURFACE MITIGATION*

BWRR will treat new impervious surfaces with Stormwater Management Environmental Site Design (SWM ESD) to the Maximum Extent Practicable (MEP), or with equivalent practices to meet Maryland stormwater management requirements. MDE's Plan Review Division will review all SWM plans ensuring they meet the requirements. As such, all new impervious surface impacts are fully mitigated.

1.2.3 NET IMPACT SUMMARY

Table 4: Summary of On-Site and Off-Site Tier II Mitigation Opportunities

	Tier II Catchment Watersheds		
	Beaverdam Creek 2	Patuxent River 1	Total
Forest Cover Impacts (Acres)	257	56	313
Total Mitigation (Acres)	55.3	78	133.3
Net Impacts	201.7	-22	179.7

1.3. ANTIDEGRADATION POLICY

Federal regulations (40CFR131.12) require states to develop and adopt an antidegradation policy. The Maryland antidegradation implementation procedures are found in the Code of Maryland Regulations (COMAR) 26.08.02.04-1, and the regulation states that high-quality waters shall be maintained. Fish and Benthic Index of Biotic Integrity (IBI) scores from the Maryland Biological Stream Survey (MBSS) were used to designate Tier II waters. Tier II review is focused on impacts to these scores.

Impacts are assessed through changes in assimilative capacity (AC), which is the difference between the measured IBI score when designated as Tier II (Scores above 4) and the Tier I water quality criterion (Score of 3). MDE evaluates impacts to forest cover, given that forests are key to healthy watersheds, to infer on the use of assimilative capacity. MDE has determined that the Beaverdam Creek 2 and Patuxent River 1 Tier II Watersheds both have assimilative capacity.

Regulations specify that Tier II water quality is considered diminished if the AC is reduced by more than 25%. This identifies the Tier II stream's assimilative capacity threshold and the lowest possible Tier II benthic and fish IBI scores. When data is above the assimilative capacity threshold, MDE determines that there is some capacity remaining. Conversely, if there is a decline in scores to a level at or below the AC threshold, the stream is determined to have no remaining assimilative capacity.

Antidegradation policy directs applicants to minimize the use of assimilative capacity. If impacts remain after all reasonable efforts have been made to minimize the use of assimilative capacity, applicants are required to submit a social and economic justification (SEJ).

Section L of 26.08.02.04-1 outlines the components of an SEJ. Section M defines the department's responsibilities when reviewing an SEJ, and Section K describes when the requirement for social and economic justification is met. BWRR has worked with MDE to ensure that this project's submission provides adequate information on the socioeconomic contributions of the project.

1.4. DOCUMENT PURPOSE

The purpose of this document is to provide the social and economic justification for proposed impacts to Tier II waters. This is necessary because there are limited cost-effective alternatives to the discharge in the Beaverdam Creek and Patuxent River Tier II watersheds. It is important to point out that in the Beaverdam Creek watershed is relatively small at 14.1 sq miles and most of the land is federally owned, providing few mitigation options. Although SCMAGLEV project impacts have been avoided, minimized, and mitigated to the greatest extent practicable, some impacts, particularly in the Beaverdam Creek 2 Tier II watershed, are unavoidable. Throughout this document, BWRR will demonstrate that the socioeconomic contributions of the SCMAGLEV project are extraordinary and provide benefits that outweigh the ecological services and water quality benefits that the impacted segments of the Tier II watersheds provide.

2. SOCIOECONOMIC CONTRIBUTIONS OF THE PROJECT

The purpose of the SCMAGLEV Project is to provide new, reliable, safe, high-speed passenger transportation and significantly reduce travel time to meet the capacity and ridership needs of the Baltimore-Washington region. The project will provide an additional travel option to a corridor that is near capacity in all existing travel modes while reducing mobile source emission in the region. It will add connections to existing modes of transportation, provide complimentary alternative rail expansion opportunities to adjacent corridors, and support local/regional economic growth. Within the first few years of operation, this project will divert 11-12 million car trips from the Baltimore-Washington DC corridor, relaxing congestion and improving air quality on a regional scale.

SCMAGLEV is needed to address regional congestion, increased development, and the following:

1. **Increasing population and employment:** The Baltimore-Washington region makes up one of the largest and densest population centers in the United States. Between 2015 and 2040, the population in this region is projected to increase 23 percent between 2015 and 2045, along with a 33 percent increase in employment workforce.
2. **Growing demands on the existing transportation network:** Travel demand will continue to increase along major roadways and railways, including Interstate 95 (I-95), the Baltimore-Washington Parkway (BWP), MD 295, I-295, US 29, US 1, and the Northeast Corridor (NEC).
3. **Inadequate capacity of the existing transportation network:** All the major roadway corridors between Baltimore and Washington, D.C. have segments that operate at level of service (LOS) ratings E/F (heavy congestion) or LOS F (severe congestion) during AM and PM peak hours. Heavy congestion during peak AM and PM hours is likely to spill over to non-peak hours as travelers shift their departure times to avoid peak congestion. With the increased demand on the roadway network, the number of severe congestion segments is projected to increase.

   Likewise, the NEC FUTURE Tier 1 FEIS document shows increasing demand for improved rail service between Baltimore and Washington, DC. It also demonstrated that multiple portions of the NEC, including those in the SCMAGLEV study area, are experiencing congestion and delays due to capacity constraints and other maintenance needs while the average ticket prices increase between Washington DC and Baltimore, MD.
4. **Increasing travel times:** According to the 2015 Maryland State Highway Mobility Report, fourteen of the 30 most unreliable roadway segments in Maryland are between Baltimore and Washington, DC. These segments can experience travel delays of more than 50 minutes per trip.

   Rail transit between Baltimore and Washington, DC is more consistent than auto travel based on scheduling and the dedicated transit right-of-way. However, emergency repairs, deferred maintenance, and heavy use of the NEC have significantly affected performance. Bus service in the corridor, specifically Metrobus B30 from Greenbelt Metrorail Station to BWI Marshall Airport, has less consistent travel times related to congestion issues along the BWP.

   For transit and airport users, trips to and from transit stations, park and ride lots, or airports also have delays. As congestion on the roadway network increases, the total travel time for all modes is anticipated to increase.
5. **Decreasing mobility:** Increased demand on the transportation network results in travel time delays and degraded level of service. There is a direct impact on the reliability of transportation

options and the mobility of travelers within the Baltimore-Washington region. Maryland commuters lose more than 100 hours/year in traffic[1].

6. **Maintaining economic viability:** The Baltimore-Washington area is an important economic engine in the Mid-Atlantic region. Improvements to the transportation network are needed to help support the predicted population and employment growth and sustain the economic health of the region.
7. **Air Quality:** Much of Maryland and the entire SCMAGLEV study area, are in non-attainment areas for 8-Hour Ozone (2015)[2], which is contributed to by motor vehicle exhaust[3]. This system is forecasted to reduce 284,918,509 vehicle miles traveled (VMT) in the first year alone (DEIS Appendix D.2, Table D.2-3), highlighting its ability to help decrease harmful pollutants from intercity trips.

2.1. ECONOMIC IMPORTANCE & BENEFITS

The SCMAGLEV project will bring economic, environmental, and quality of life benefits to the communities within Tier II watersheds. This project will provide local jobs, reduce time lost commuting, and reduce local greenhouse gas emissions. Within the Beaverdam Creek 2 Watershed (BC2), 300+ permanent operations and maintenance jobs are anticipated at the TMF. In addition, key benefits include significant reductions in vehicle miles travelled (VMT) from "through traffic" within Tier II watersheds.

The Maryland COMAR 26.08.02.04-1(M)(2) states, *"Evaluation of the SEJ shall consider the relative magnitude of costs and benefits of development, recognizing the difficulty in quantifying benefits."* The SCMAGLEV system is expected to begin operations in 2030. Considerable variation in job forecasts is expected (given technology improvements, wage changes, etc.). However, BWRR has provided estimates in broader categories of temporary and permanent jobs with additional refinements to County and Tier II Watershed levels.

The Beaverdam Creek watershed, which encompasses the proposed TMF location, is relatively small at 14.1 square miles and is wholly within Prince George's County. The Patuxent watershed is approximately 168 square miles and straddles Prince George's and Anne Arundel Counties as well as three other counties not impacted by the SCMAGLEV project. Economic data has been refined to the greatest extent practicable, which in this analysis is at the county level. More refined data is rarely available with a reasonable degree of accuracy.

2.1.1 TEMPORARY JOBS:

Employment Presented in this Report

The employment numbers in this report were produced based on an evaluation of various existing railroad staffing requirements and will be refined as project operating details are refined.

[1] Schrank, D., Albert, L., Eisele, B., & Lomax, T. (2021). (rep.). *2021 Urban Mobility Report* (pp. 1–78). College Station, Texas: The Texas A&M Transportation Institute. https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2021.pdf
[2] https://www3.epa.gov/airquality/greenbook/mddcvade8_2015.html
[3] https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics

RIMS Method

The SCMAGLEV DEIS[4] Chapter 4.6 methodology relies on the Bureau of Economic Analysis Regional Input-Output Modeling System Series 2018 Multiplier (RIMS II). It estimates the SCMAGLEV project will generate 161,000 job-years of temporary labor to build (i.e., one job-year equals one year of work for one person) composed of 123,000 temporary construction job-years and 38,000 professional services job-years. This is approximately 23,000 jobs for the expected seven-year construction period, Construction of the SCMAGLEV would add temporary jobs to the local economy via hiring construction workers, renting or purchasing equipment, and procurement of materials. Professional services include architectural engineering, project management, and planning services. According to the DEIS (4.6-17), this construction effort will produce $8.8 billion direct labor earnings.

Table 5 refines temporary job estimates to locations where Tier II impacts occur - Prince George's (Beaverdam Creek II) and Anne Arundel (Patuxent River I) Counties. The average annual wage for someone building the SCMAGLEV in Prince George's County is estimated to be $62,559 and in Anne Arundel County $70,689. The current average incomes for the two impacted Tier II Counties, by industry, are presented in Table 6.

Based on the DEIS RIMS analysis and the BWRR-Commissioned IMPLAN analysis, the SCMAGLEV average wages will be on par with the existing market wages. BWRR's expected average wage in Anne Arundel County, $70,689 (Table 5) is within 1% of the current market rate average in Anne Arundel County, $71,462 (Table 6). Current wages in Prince George's County are $60,819 (Table 6) while BWRR estimates wages approximately 2.86% higher at $62,559 (Table 5).

IMPLAN Method

BWRR commissioned an independent economic analysis in March 2021 to look at temporary job estimates at a State and County-level. This analysis used an industry-accepted input-output model, IMPLAN[5], which is widely used and was originally developed by the U.S. Forest Service.

The analysis suggests that across the Washington-Baltimore-Arlington CSA, more than 243,840 job-years of employment, or 34,830 jobs over a 7-year construction period, will be generated by the SCMAGLEV

[4] https://www.bwmaglev.info/project-documents/deis

[5] IMPLAN uses data from public sources, including from the U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U.S. Bureau of Census, and the U.S. Department of Agriculture. The system uses advanced modeling techniques to develop customized analyses based on geography, industry detail, and time. The study includes:

1 Direct Impacts: wages construction/professional services workers

2 Indirect Impacts: supporting industries who supply goods and services to enable the direct spending on SCMAGLEV—including industries supplying construction materials; equipment; and the steel, concrete, wood, and plastic materials that are needed for building guideways, and station facilities)

3 Induced Impacts: industries that are supported by the re-spending of SCMAGLEV direct and indirect worker income and salaries on consumer goods and services – including food, shelter, recreation, education and personal services

construction. Most of these jobs are expected to be within the study area, which consists of Washington DC, Baltimore City, Baltimore County, Anne Arundel County and Prince George's County, Maryland.

Table 5: Prince George's and Anne Arundel Counties and Maryland State Expected Temporary Economic Impact

Study Area	Employment (job-years) (a)	Labor Income ($millions) (b)	Average Annual Wages/ person (b/a)	GDP ($millions)	Economic Output or Sales ($millions)	State Tax Revenue ($millions)
Prince George's County	54,365	3,401	$62,559	2,939	5,980	250
Anne Arundel County	91,966	6,501	$70,689	5,914	11,138	543
State of Maryland	193,329	13,166	$68,102	12,845	24,168	1,111

Table 6: Employment and Wages by Industry (Source: Quarterly Census of employment and Wages - Annual Averages 2019)

Annual Wages by Industry	Anne Arundel County ($2019)	Prince George's County ($2019)
Utilities	118,256	102,304
Construction	67,801	73,171
Manufacturing	110,379	62,079
Wholesale Trade	80,537	64,908
Retail Trade	33,063	33,881
Transportation and Warehousing	61,611	49,770
Finance and Insurance	91,699	71,002
Real Estate and rental/leasing	54,064	50,208
Professional and Technical Services	111,013	97,298
Administrative and Waste Services	49,598	43,491
Health Care and Social Assistance	55,010	55,075
Accommodation and Food Services	24,516	26,641
Unweighted County Average	**$71,462**	**$60,819**

2.1.2 BEAVERDAM CREEK 2 - PERMANENT OPERATIONS AND MAINTENANCE JOBS

As noted in the DEIS Appendix G15: *Operations and Maintenance Memorandum*, permanent direct employment for SCMAGLEV operations is anticipated to be approximately 690-750 jobs across the entire system (See Table 7). This estimate is based on a thorough evaluation of various other railroad manpower requirements and will be refined as project planning advances and operating details are finalized.

Table 7: Permanent Operations and Maintenance Job (Source DEIS Appendix G15)

Type of Job	Approximate Number of Employees
General Management and Administration	40-50
Security	60-70

Railway/Stations Operations	290-310
Train Maintenance Facility/Maintenance of Way	300-320
TOTAL	**690-750**

The permanent jobs located specially in impacted Tier II Watersheds will be the 300-320 TMF and MOW jobs, which is significant considering that Beaverdam Creek 2 only has an estimated total population of 8,510[6]. Using the IMPLAN model, BWRR has extrapolated estimated wages and economic impacts of TMF jobs in the Tier II watersheds from the project's overall direct operations and maintenance (See Table 9).

Table 8: Beaverdam Creek 2 Watershed Economic Impact Projections. (Methodology: IMPLAN Modeling)

Study Area	Employment (O&M/year in $2020) (a)	Labor Income ($millions) (b)	Average Annual Wage/person (a/b)	State/County Tax Revenue ($millions) (a*6%) – (b*6%)
Beaverdam Creek 2	300-320	$20.12-$21.46	$67, 070	$1.21 - $1.29

SCMAGLEV's projections are reasonable and comparable to other large-scale passenger rail operating numbers. Worth noting is that California High Speed Rail's 2020 Business Plan *Operations and Maintenance Cost Model Documentation* Technical supporting document includes anticipated staffing levels at their rolling stock depot and track inspection teams. The expectations outlined in that document are similar to staffing for the SCMAGLEV TMF and MOWs[7].

2.1.3 BEAVERDAM CREEK 2 – DIVERSITY, EQUITY AND INCLUSION PLAN

Environmental Justice (EJ)communities adjacent to the project will benefit from SCMAGLEV construction spending. On March 1st, 2021, BWRR announced a Diversity, Equity, and Inclusion Plan that laid out the following goals:

a. At least 40% of the construction workforce will be from diverse populations in which the route travels through;

b. At least 25% of construction spending will be on Minority-Business Enterprises (MBEs) and Women Business Enterprises (WBEs);

c. At least 25% permanent workforce from minority and women populations.

BWRR will work with places of learning, such as Capitol Technology University (Located in BC2), to establish training and apprenticeship programs for their students to benefit from the unique engineering and construction opportunities presented by the SCMAGLEV project.

BWRR's *Diversity, Equity, and Inclusion* vision aligns with local efforts to enhance opportunities for all. For example, Prince George's *Plan2035* has several policies that connect with BWRR's *Diversity, Equity, and Inclusion Plan*. Economic Prosperity Policy 6.3 calls *to "Connect potential employees and innovation activities […] with local minority business enterprise development. Enhance opportunities for qualified job seekers and attract employers to local talent…" (*P. 132) while Economic Prosperity Policy 9.2 seeks to *"establish workforce-based partnerships, including internships, apprenticeships, and work study programs to connect students to future employers, particularly in industry clusters."* Additional information on compatibility of the project with county master plans is in Appendix 2 of this report.

[6] Based on a BWRR Analysis of 2020 Census blocks with centroids in the watershed.

[7] 2020 Business Plan Operations and Maintenance Cost Model Documentation (ca.gov)

2.1.4 REDUCTIONS IN VEHICLE MILES TRAVELLED (PROJECT-WIDE)

Based on the SCMAGLEV ridership forecast, during the first year of operation, 2030, between 11.38 and 12.61 million annual passengers are expected to divert from cars to SCMAGLEV (DEIS 4.2-7).

Economic benefits are reaped from such diversions from auto trips, which decreases congestion, accidents, noise, and pavement maintenance costs. However, BWRR chose not to estimate the economic benefits in this report as reliably estimating the empirical values can be difficult, especially with the vast number of auto trips expected to continue even after forecasted SCMAGLEV diversions.

Regardless, significant diversions from cars will be needed to meet Maryland environmental and transportation goals (see Appendix 6). SCMAGLEV service can provide a vital jumpstart to this process. Table 9 outlines forecasted reductions in VMT as a result of SCMAGLEV.

Table 9: Summary of Reduction in VMT (Source: DEIS Appendix D.2 Table D.2-3)

Year	Station	Changes in VMT
2030	Cherry Hill	284,918,509
	Camden Yards	316,108,014
2045	Cherry Hill	393,149,002
	Camden Yards	436,566,324

2.1.5 METHOD OF FINANCING AND CATEGORIZED PROJECT COSTS

Project costs for SCMAGLEV in Tier II watersheds will include construction of the Train Maintenance Facility (TMF), ramps to the TMF, ramps to the Maintenance of Way (MOW) facility, and a segment of the mainline viaduct guideway.

The funding for construction has not been finalized but will likely be covered by a combination of federal, Japanese government, and private sources.

The civil construction costs within Tier II watersheds for BWRR's preferred alternative, J-03, are estimated (using DEIS Appendix G9 Capital and Construction Costs Memorandum) at $1,070,555,955 and are split between the two watersheds:

- Beaverdam Creek 2 at $834,843,545
- Patuxent River 1 at $235,712,410

Table 10: Categorized costs based on the SCMAGLEV DEIS Economic Impact Analysis

Categorized Project Costs			
Category	**Beaverdam Creek 2**	**Patuxent River I**	**Both**
Civil Construction*	$834,843,545	$235,712,410	$1,070,555,955*
Professional Services (30% of Civil Construction)*	$250,453,063	$70,713,723	$321,166,786
Civil Construction Contingency (20%)**	$166,968,709	$47,142,482	$214,111,191
Professional Services Contingency (20%)**	$50,090,613	$14,142,745	$64,233,357
Total	**$1,302,355,930**	**$367,711,360**	**$1,670,067,289**

* Does not include core system cost

** Rates based on DEIS estimate (Appendix D.4, page D-20)

Furthermore, BWRR anticipates operating costs for the system will be covered by farebox revenues. The SCMAGLEV service does not anticipate subsidies by the Maryland Transportation Trust Fund (TTF), as is MDOT MARC service. The most likely allocation of funding is summarized below:

Table 11: SCMAGLEV Source and Use Matrix

Source	Use
Maglev Deployment Program	Development and Construction
Japanese Government	Development and Construction
US Government Grants	Construction
US Government Loans	Construction
Private Sector Investment	Construction
SCMAGLEV Riders	Operation and Maintenance

2.1.5.1 *FAREBOX REVENUE*

While BWRR's economic forecasts are proprietary, they show sufficient demand with ticket prices ranging from less than $1 per mile to around $2 mile depending on time of day and demand. For comparison, Acela tickets also use dynamic pricing and average $1.30 per mile (DEIS 4.6-13).

Though it is too early to predict exact ticket pricing (route selection, detailed engineering, permitting, and mitigation methods all need to be finalized), ticket prices will vary based on several factors including destination, expected capacity, day of the week and time of day, and final funding plan. For instance, a last-minute ticket purchased for a weekday rush-hour business traveler will likely be higher than a ticket bought two weeks in advance.

The range of ticket prices and variety of trip options make it financially feasible for communities within the affected watersheds and counties to use the SCMAGLEV system.

2.1.6 ANNUALIZED COST OF MINIMIZATION IMPLEMENTATION:

The estimated cost for mitigation is $50,042,824 (see section 3). Based on a conservative 50-year project life, the annualized cost of mitigation is $1,000,856 (Calculation: $50,042,824/50). This cost of minimization is attainable given the project's current budget estimates. These mitigation expenses are not included in Table 11's project cost estimates but will be included in the final budget once approved.

2.2. SOCIAL IMPORTANCE AND BENEFIT

The social importance and benefits of the SCMAGLEV project are widespread and include both economic and environmental gains for many of the communities in and near the impacted Tier II Watersheds. Benefits apply to both riders and non-riders.

The SCMAGLEV project brings three key improvements to the Tier II watersheds and their encompassing communities:

1 Diverted auto trips that help provide shorter and more reliable commutes.

2 Better air quality through reduction of vehicle traffic on roadways.

3 Job creation (both with short-term construction and long-term operations).

Residents who don't ride the train benefit from diverted auto trips, which results in reduced congestion on local and intercity roads, travel time savings, and reduced local emissions. Additionally, the TMF in the Beaverdam Creek watershed requires 300+ full-time jobs ranging from skilled trades to management.

Furthermore, the SCMAGLEV project will meet its purpose and need while avoiding widespread displacements in residential communities. This cannot be overstated. Along a nearly 40-mile alignment with strict operational requirements, project designers have ensured that no homes are taken. Other significantly smaller linear projects, such as the B & P tunnel, are proposing several residential displacements.

2.2.1 TRANSPORTATION IMPROVEMENTS (PROJECT-WIDE)

2.2.1.1 *ROADWAY NETWORK*

The State of Maryland tops the charts for the longest commute times (32.5 minutes each way) in the nation, according to the 2016 U.S. Census American Community Survey. Washington, D.C., which includes many Maryland commuters, is fourth in the nation with commuting times on average of 29.9 minutes each way. Travel times can range from 45 minutes to well over an hour during peak hours for the 30-mile trip from Washington to BWI Marshall Airport. Due to unexpected incidents (i.e.: an accident) travel times by automobile can range from 90 minutes to two hours (DEIS pg. 2-13). Given the volume and congestion along the major corridors such as I-95, the Baltimore-Washington Parkway, MD 295, US 29 and US 1, an accident can severely inhibit travel. This often results in unreliable and unpredictable estimated travel times and complicates transportation mode decisions.

National Capital Region Long Range Transportation Plan: "the Baltimore Washington-Parkway has the worst traffic of the National Capital Region parkways (P.100)".

The Fort Meade Alliance recently noted[8] that the BW-Parkway was designed for 50,000 cars per day and now sees traffic frequently exceeding 120,000 users per day. The National Park Service *National Capital Region Long Range Transportation Plan (2018)* highlights safety as a first-priority issue (pg. 153), and it identifies the need for partners to help address the parkway's underlying challenges.

The Northeast Corridor Commission's Connect NEC 2035 notes (pg. 4) that I-95 crowding issues are set to become so severe in the region that 24% of it will operate at speeds lower than 27 mph at peak hours by 2030.

The *2040 Maryland State Transportation Plan* notes that the State's VMT has risen 6.6% in recent years. Moreover, according to the State's plan, vehicle hours travelled are expected to increase 73% in the DC region and 48% in the Baltimore region from 2015 to 2040 (P.11). Travel Time Index predictions show that Central MD roadways will have 50% worse traffic in 2040 compared to now, especially I-95 and BWP (P.14).

The SCMAGLEV provides a highly desirable alternative to automobile travel. Per BWRR's ridership analysis and the SCMAGLEV DEIS, the SCMAGLEV is expected to divert between 11.38 million to 12.61 million cars off the road by its opening year and up to 16.48 million cars per year by 2045 (Table 4.2-3). This will be up to approximately 57,000 diverted daily trips (4.2-20). This translates to a reduction of overall regional vehicle miles traveled (VMT) in a range of 9% to 12% during 2027 and 2045 (4.16-10), which will help alleviate the increasing congestion and environmental impacts in the corridor.

[8] https://www.ftmeadealliance.org/initiatives/transportation/

2.2.1.2 *ROADWAY NETWORK-TIER II*

Reducing the number of cars traveling between D.C. and Baltimore is also important for the Tier II watersheds. In a 2015 study from the Volpe Center[9], it was noted that an average of 6 fatalities and 547 crashes per year have occurred on the Baltimore Washington Parkway since 2006 (pg. 1). The Baltimore-Washington Parkway has an interchange at Powder Mill Rd (BC2) and MD-197 (PR1). Also of note is its 495 Interchange, which is just outside of BC2. Maryland Statewide Crash Data[10] from 2015 through June 2021 shows clusters of crashes at these intersections. Through a safer travel option and reduced vehicle congestion on the Baltimore Washington Parkway, the project can help increase travel safety and help reduce commute times for those who move to and from destinations in the watersheds [11].

2.2.1.3 *RAIL NETWORK*

Improvements in capacity and speed on existing rail systems are welcome. However, there are limited opportunities for improvement without a new right-of-way. The MARC train service between Baltimore and Washington, DC shares tracks with Amtrak and CSX trains, which creates added capacity limitations. MDOT forecasts that 70% of MARC stations will be at capacity by 2025[12]. According to the 2010 NEC Infrastructure Master Plan, passenger rail between Baltimore and Washington, D.C. could realize capacity utilization higher than 100 percent by 2030[13] while the 2014 NEC Commission added that multiple segments of the NEC are already experiencing critical infrastructure challenges due to capacity constraints[14].

Also noted is that scheduling more trains to meet increasing ridership demands of 2-3% per year is increasingly difficult as the high volume of Amtrak trains prevent a higher number of MARC trips on the NEC[15]. These capacity constraints suggest that the number of MARC trips will remain stagnant even as demand for MARC service grows. A February 2021 Johns Hopkins 21st Century Cities Initiative report further highlights the challenges in adding trains and funding improvements[16].

Capacity constraints combined with forecasted population increases enable conditions that often contribute to low levels of service. By adding complementary capacity, SCMaglev will also provide needed relief on existing modes to do maintenance, repairs, and safety upgrades. Since SCMAGLEV will operate within an exclusive right-of-way, trains will not be dependent on the capacity restraints seen by other modes of travel, and SCMAGLEV service will provide the fastest, most reliable connection between D.C. and Baltimore.

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[9] https://rosap.ntl.bts.gov/view/dot/12208

[10] https://opendata.maryland.gov/Public-Safety/Maryland-Statewide-Vehicle-Crashes/65du-s3qu

[11] Based on the National Highway Traffic Safety Administration (NHTSA) 2016 Traffic Safety Facts, there were 1.18 traffic fatalities and 99 traffic injuries per million VMT.

[12] The NEC Master Plan Working Group consisted of FRA, Amtrak, 12 northeast states, and the District of Columbia. Northeast Corridor Infrastructure Master Plan.

[13] The NEC Master Plan Working Group consisted of FRA, Amtrak, 12 northeast states, and the District of Columbia. Northeast Corridor Infrastructure Master Plan.

[14] Northeast Corridor Infrastructure and Operations Advisory Commission. (February 2014). State of the Northeast Corridor Region Transportation System

[15] MDOT_MTA MARC Cornerstone Plan P.58

[16] Investing in High-Speed Rail to Washington D.C. to Boost Baltimore's Economy (Ronald J. Hartman and Mac McComas, Johns Hopkins 21st Century Cities Initiative, February 2021(P.5)

An additional high-quality travel mode will help relieve some of the capacity burdens plaguing other passenger rail services. It will also finally provide transportation options that have been standard in other metropolitan areas around the world.

2.2.1.4 *RAIL NETWORK-TIER II*

Communities in Tier II watersheds will benefit from improvements to the region's rail network. By satisfying demand for high-speed intercity travel service, SCMAGLEV directs pressure away from MARC to make service changes for express routes. The Johns Hopkins report referenced above highlights the two ways in which MARC Service must change to provide faster service between D.C. and Baltimore: (1) added trains or (2) local trains converted to express trains. The MARC Camden Line provides local service to Laurel, Muirkirk, and Greenbelt - all stops located just outside the impacted Tier II Watersheds. Riders from the nearby communities within Tier II watersheds like Laurel (Patuxent Watershed), Montpelier (BC2), and Greenbelt (BC2) would benefit from preserved local MARC service, especially as MARC explores expansions to midday and weekend service. This reflects the direct benefit of having multiple, redundant modes of travel throughout the region.

2.2.2 PRESERVING COMMUNITIES (PROJECT-WIDE AND IN BC2)

The DEIS notes that *"the above-ground viaduct would not bisect communities"* (4.4-4). Historically, few large, linear transportation projects could make this claim (of note are the 94,000 displaced Marylanders of select highway projects of the past century[17]). In fact, a previous Maglev proposal in the region (i.e., 2003 TransRapid) was planned entirely at-grade. At significant cost to BWRR, approximately 70% of the SCMAGLEV project is designed in deep tunnel to avoid impacts to communities.

To better evaluate the impact on the project, BWRR analyzed the financial burden that tunneling creates (See Appendix 3). Given that most of the alignment extends under EJ communities, BWRR focused its review on the tunneling costs specifically below EJ communities. Tunneling under rather than building above-ground viaducts through EJ communities, adds approximately $1.5 billion in construction costs.

In addition to preserving communities by tunneling, the 30% above-ground portion (viaduct), is designed entirely next to the Baltimore Washington Parkway. Thus, SCMAGLEV's viaduct segment avoids homes while concentrating visual and noise impacts near an established transportation route that already carries more than 120,000 cars per day.

The viaduct's southernmost point avoids significant impacts and any displacements to approximately 125 homes located in the BC2 Watershed. These homes are primarily located in the Glen Oaks Apartments (approximately 25 residences) and Greenbriar Condominiums (approximately 99 homes). These impacts can be seen in DEIS Appendix G.01 Part A Pages 23 and 24 of 85. The would-be impacted Parcel IDs are 24226 through 24385 (properties east of the parking lot and north of State Highway 193) and 25055 through 25540 (northeast of Mandan Road and east of the Baltimore Washington Parkway).

2.3. ENVIRONMENTAL & QUALITY OF LIFE BENEFITS

2.3.1 IMPROVED AIR QUALITY

Impacts to air quality could begin in the first year of SCMAGLEV operation by reducing car VMT by 9%-12% in the region (DEIS page 4.16-10). Reductions in emissions are urgent as the EPA notes that most of

[17] Not in My Neighborhood: How Bigotry Shaped a Great American City (2010). Antero Pietila. Page 219.

the SCMAGLEV project area is already in non-attainment status air quality, from Washington, DC to Baltimore MD including Prince George's County and Anne Arundel County[18].

The American Lung Association gave the County a grade of "F" for its number of high ozone days[19]. Ozone is a byproduct of reactions between vehicle emissions, other pollutants, and sunlight. Furthermore, Prince George's County *Plan2035* notes that 41% of the County's CO2 comes from single-occupancy vehicles (P.140). Reduction of over 12 million cars and their vehicle emissions would help ensure progress towards the county's goal for cleaner air.

By taking DC-Baltimore traffic off the major roadways, communities in between, specifically those within and around the impacted Tier II watersheds, will benefit as there will be fewer passing cars leaving behind emissions, noise, and congestion.

As mentioned in 2.1.4, there will be a significant amount of reduced VMT derived from the SCMAGLEV project, steadily rising from approximately 284,918,509 VMT in 2030.

Table 12: Emission Reduction Economics from VMT Reductions

Type of Pollutant	Emission Reduction (in metric tons over 30-years)*	Damage Cost ($2030/metric ton)	Present Value (2020 $'s) of Emission Reduction Benefit
CO2e	2,199,369	$62	$78,640,000
VOC	30	$2,161	$30,000
NOx	118	$8,849	$530,000
SO2	15	$51,549	$440,000
PM2.5	89	$398,501	$16,380,000
Total			**$95,940,000**

*To split the difference between the 284 to 393 million expected VMT reductions per year between 2030 and 2045, this table assumes 328 million VMT per year with a 3% discount rate from 2020$s.

Although primarily a quality-of-life and environmental benefit, reductions in emissions also translate into economic benefits. Regionally, $96 million in economic benefits are derived from the environmental gains of reduced tailpipe emissions (See Table 12). According to the EPA[20], the economic benefits of cleaner air are derived through fewer premature deaths and illnesses, lower medical expenses, and better work productivity among others. A county level analysis is not available. However, many of these gains can be realized by the impacted the Tier II Watersheds since they are located between the Baltimore Washington Parkway and Route I-95, the two busiest through-roadways between Baltimore City and Washington DC.

2.3.2 REDUCTION IN POLLUTANTS FROM OBSOLETE BARC BUILDINGS

In January 2020, the USDA announced their intention to demolish twenty-two (22) obsolete BARC buildings to reduce long-term operating costs[21]. The USDA notes that these twenty-two buildings are no longer mission critical, and their removal would have no adverse impact on BARC operations. Moreover, USDA notes that the buildings are dangerous, containing a mix of asbestos, mercury, lead, and refrigerant among others, and must be demolished for BARC's overall safety (Sections 2.3.1; 3.6.2.2).

[18] Non-attainment Areas for Criteria Pollutants (Green Book) | US EPA

[19] https://www.lung.org/research/sota/city-rankings/states/maryland/prince-george-s

[20] The Clean Air Act and the Economy | US EPA

[21] *Demolition of 22 Buildings at the Henry A. Wallace Beltsville Agricultural Research Center (January 2020). USDA-ARS*

Fourteen of these buildings fall within the footprint of BWRR's preferred BARC West TMF (located in the Tier II Catchment watershed) and would be demolished as part of the SCMAGLEV project. BWRR shares the concerns with USDA regarding toxic asbestos, mercury, lead, and refrigerant leaking into the surrounding community – especially Tier II Catchment watersheds. BWRR would remove these obsolete and dangerous buildings so that aging and leaking buildings do not spill toxins into the fragile ecosystem. Furthermore, this offer frees up funds for mission critical research at BARC.

NOTE: Portions of BARC are Environmental Superfund sites. DEIS Pages 4.15-4 and 4.15-5 highlight USDA CERCLA activities at BARC. See map in Appendix 5 for more details related to mixed property uses at the BARC.

2.3.3 PROPERTY VALUE (BC2)

Most SCMAGLEV property impacts are concentrated around stations. There are no residences near the proposed BARC East TMF, and there are several residences within a 0.5-mile buffer of the proposed BARC West TMF. As noted on page 4.6-6 of the DEIS, property premium and tax revenue impacts are expected to be small.

At the BARC TMF's, impacts on property value aren't expected to translate to negative tax impacts for the region because the proposed facilities are located on government lands exempt from property taxes. The annual tax revenue impact around BARC West is approximately -$7,000 while there is no estimated annual tax revenue impact at the BARC East Airstrip TMF (Appendix D.4, pgs. D-61-62).

3. SOCIOECONOMIC BENEFITS OF HIGH-QUALITY WATERS

3.1. BENEFIT OF MAINTAINING HIGH-QUALITY WATERS

Healthy watersheds provide social and economic benefits to the surrounding community. The EPA outlines such socioeconomic benefits[22]:

- Reduced drinking water treatment costs
- Reduced flood mitigation costs
- Increased revenues from recreation and ecotourism
- Increased property values
- Enhanced capacity for climate change mitigation and adaptation

Referencing the value added through the above metrics, BWRR reconciled the specific benefits of healthy waters to the communities in BC2 as follows.

3.1.1 IMPACTS TO PROPERTY VALUES

Property values are discussed in Section 2.2.3.

3.1.2 RECREATION VALUE

Recreational opportunities for Beaverdam Creek are limited. Most of the creek is confined to USDA property (as gathered from SDAT parcel info and aerial imagery), and there are few points of public access. Beaverdam Road appears to offer scenic views to bike commuters[23]. However, available data on the creek does not suggest that the creek is a significant revenue producer.

3.1.3 OTHER QUALITY OF LIFE BENEFITS

Beaverdam Creek is designated as a Use Class I water body, which does not serve as a public water supply. The Anacostia, to which the Beaverdam Creek eventually flows, is designated as a Use Class II Water Body and also does not serve as a public water supply. Thus, the drinking water treatment costs do not apply for impacts to Beaverdam Creek specifically.

FEMA's readily available Nation Flood Hazard Layer (NFHL) and the Flood Insurance Rate Map (FIRM) for (See Appendix 4) indicates that the BARC West TMF footprint is outside of the special flood hazard areas (SFHAs). Parts of the viaduct would cross SFHA's. DEIS page 4.10-23 notes that the BARC West TMF would have limited impact to floodplains. Although the forest cover in BC2 could help mitigate flooding, the map indicates that the TMF footprint is not located in an area vulnerable to flooding.

[22] https://www.epa.gov/hwp/benefits-healthy-watersheds#economic

[23] https://www.chesapeakebay.net/news/blog/tributary_tuesday_beaverdam_creek_laurel_md

3.2. GENERAL EVALUATION OF ECONOMIC IMPACTS OF RESTORING DEGRADED STREAM RESOURCES

Below is the summary Table 13 for reference. The estimates below are presented assuming the mix of mitigation BWRR has been able to identify in the Beaverdam Creek Watershed with confirmed interest from landowners in the watershed.

NOTE: BWRR has confirmed interest with landowners in the Patuxent watershed in excess of the project's impact in the Patuxent watershed and is excluded from the estimates below.

Table 13: Summary of On-Site and Off-Site Tier II Mitigation Opportunities in Beaverdam Creek 2

Mitigation Type	Beaverdam Creek 2
Reforestation (Acres)	55.3
Conservation (Acres)	20.6
Stream Mitigation (LF)	2,808

3.2.1 IMPACTS TO RESOURCES NECESSARY TO MAINTAIN HIGH QUALITY WATERS

These impacts are covered in section 1.2 of this document.

3.2.2 COSTS OF 1:1 IN-KIND MITIGATION FOR ALL NET FOREST COVER LOSS

The unit cost of mitigation for forest cover loss is approximately $38,500/ acre plus real estate costs. The estimated cost to mitigate loss of permanent forest cover within the Beaverdam Creek 2 watershed, based on approximate reforestation of 55.3 acres is $2,129,050 plus the cost of real estate. Table 14 provides a breakdown for this cost. Real estate costs were not included due to the high variance in price history and the potential variable of property easement vs acquisition for long term protection. Unit rates for the work involved in reforestation were derived from the RT-95 Belvedere project SEJ Analysis.

3.2.3 COSTS OF 2:1 CONSERVATION MITIGATION FOR NET FOREST COVER LOSS

BWRR's search for conservations site only brought about 20.6 acres or 10.3 acres of mitigation credit. Conservation property owners will likely remain the owners of these acres and reap a tax benefit for putting them in conservation. As such, BWRR used the Maryland State COMAR[24] regulation fee-in-lieu cost of $0.366 per square foot to estimate the total cost of mitigating the balance of the forest impact, 201.7 acres (17,572,174.29 square feet) for a total of $6,431,416.

3.2.4 ESTIMATED COST OF STREAM RESTORATION, PER LINEAR FOOT

The unit cost for stream restoration based on the I-95 Belvedere project is approximately $660/linear foot excluding real estate. The estimated cost of stream restoration in Beaverdam Creek 2, based on permanent impacts to 2,808 linear feet (lf) of streams within these watersheds, is $1,855,353.

[24] COMAR 08.19.04.09.D.(2) http://www.dsd.state.md.us/comar/comarhtml/08/08.19.04.09.htm

Table 14: Estimated Costs of Tier II Mitigation

Mitigation Type	Cost Estimate Category	Amount
Tier II Reforestation*	Real Estate	TBD
	Site Prep/Invasive Control	$387,100
	Plantings	$1,161,300
	Maintenance/Warranty	$387,100
	Site Design	$193,550
	Total	**$2,129,050**
Conservation	Fee-In-Lieu **Total**	**$6,431,416**
Stream Restoration*	Real Estate	TBD
	Design and Permitting	$704,275
	Construction	$1,650,767
	Post-Construction Monitoring	$398,283
	Post-Construction Remediation	$110,315
	Total	**$2,863,640**
	Grand Total	**$11,424,106**

*Cost based on estimates presented in RT-95 Belvedere project Tier II SEJ Analysis.

4. CONCLUSION

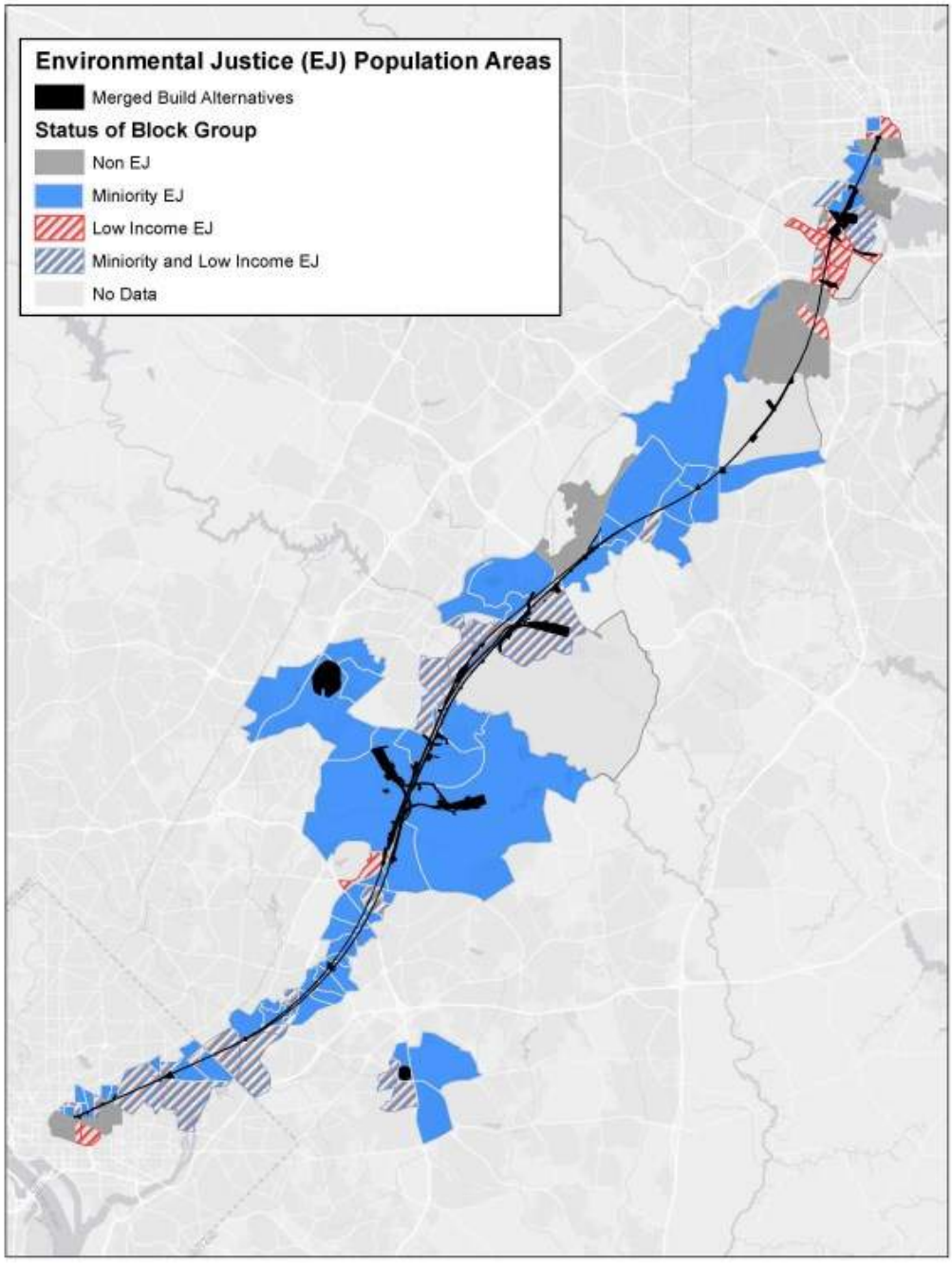
As this document has demonstrated, although SCMAGLEV will impact Tier II watersheds, these impacts will result in significant social and economic benefits that will outweigh the current benefit of affected Tier II waters.

The public benefits to those in BC2 and PR1 include:

- Reduced emissions, which fosters better air quality for the health and safety of Tier II residents.
- Major sources of temporary and permanent jobs. This includes opportunities for EJ communities and partnerships with local educational providers.
- Key transportation improvements without the displacement of residential communities.

Appendix -1-Environmental Justice Areas - DEIS App. D.3

Figure D.3-7: Environmental Justice Population Areas



Draft Environmental Impact Statement and Section 4(f) Evaluation E-116

Appendix -2- Compatibility of County Master Plans

COMAR 26.08.02.04-1(K)(D) notes that one component for justifying SEJ impacts to Tier II Waters is if *"development is consistent with the applicable county master plan."* The SCMAGLEV project is compatible with many aspects of both Prince George's and Anne Arundel Counties' current masterplans.

Within Prince George's and Anne Arundel Counties, the SCMAGLEV project will bring high-quality jobs, promote hiring locally, and reduce congestion. These are key facts that make the SCMAGLEV project compatible with the respective counties' planning goals.

The SCMAGLEV is compatible with the following planning goals:

- Prince George's County Plan2035: Policy Transportation Mobility 7 - Promote the use of low-carbon transportation methods countywide to improve air quality and limit traffic congestion (P.159)
- Anne Arundel Plan2040: Goals Built Environment 10 and 15 – Both seek to reduce growing congestion through more multimodal and environmentally-friendly transportation options (P.41)
- Anne Arundel Plan2040: Goals Built Environment 15.1 - Seeks to reduce preventable deaths from accidents. SCMAGLEV will provide millions in external safety benefits.

ECONOMIC BENEFITS TO PRINCE GEORGE'S COUNTY PLAN2035:

Plan2035 notes the declining jobs-to-population ratio and the declining employment base in Prince George's County's share of the Washington Metropolitan area. (P.64). Moreover, wages in Prince George's County increased by 29% between 2002-2012 while statewide they increased by 37.3% (P.67).

Plan2035 seeks to boost investment and jobs in a County "Innovation Corridor" stretching from College Park UMD to Greenbelt (P.254) near the BARC TMF (P.123). The plan specifically calls for "targeted infrastructure improvements to retain existing and attract new employers" (P.257). BWRR's TMF would be in the area of the Innovation Corridor and bring 300-320 permanent jobs.

IMPLAN Method

In March 2021 BWRR examined temporary job estimates at a State and County-level, using an industry-accepted input-output model, IMPLAN, which is widely used and was originally developed by the U.S. Forest Service.

The results suggests that across the Washington-Baltimore-Arlington CSA, more than 243,840 job-years of employment, or 34,830 jobs over a 7-year construction period, will be generated by the SCMAGLEV construction. Most of these jobs are expected to be within the study area, which consists of Washington DC, Baltimore City, Baltimore County, Anne Arundel County and Prince George's County, Maryland.

IMPLAN Method

BWRR commissioned an independent economic analysis in March 2021 to look at temporary job estimates at a State and County-level. This analysis used an industry-accepted input-output model, IMPLAN, which is widely used and was originally developed by the U.S. Forest Service.

The analysis suggests that across the Washington-Baltimore-Arlington CSA, more than 243,840 job-years of employment, or 34,830 jobs over a 7-year construction period, will be generated by the SCMAGLEV

construction. Most of these jobs are expected to be within the study area, which consists of Washington DC, Baltimore City, Baltimore County, Anne Arundel County and Prince George's County, Maryland.

Table 5 estimates the SCMAGLEV will produce approximately 54,365 job-years generating $3.4 billion in labor earnings, or $62,559 per worker, over a seven-year construction period. This is the type of upward economic opportunity that Plan2035 seeks.

> *"… This area is well positioned to capitalize on the synergies that derive from businesses, research institutions, and incubators locating in close proximity to one another and on existing and planned transportation investment"* (P.23)

ANNE ARUNDEL COUNTY PLAN2040:

Plan2040 makes clear that the county is at a critical juncture with its land consumption and transportation strategies, with an expected population increase of 50,000 by 2040, along with 68,000 new jobs, and 86,950 new daily trips (P.24). At its core, *Plan2040* revolves around six key themes:

- build environmentally sustainable and resilient communities with zero net gas emissions via conservation and renewable power;
- build new infrastructure including roads and mass transit,
- develop transit-oriented development;
- boost the county's innovation and tech abilities;
- protect and conserve the natural environment; and
- encourage inclusive government full of engagement.

Related to Key Elements #2, #3, & #4's goal: SCMAGLEV will fuel the economic engine of BWI airport with new mass transit infrastructure, open up transit-oriented development opportunities, and bring skilled innovation-oriented jobs to the area.

Plan2040's Goals Built Environment (BE)10 and (BE)15 seek to have more multimodal travel that is safe, environmentally friendly, and can reduce growing congestion (page 43). BWRR will help achieve this goal, by diverting more than 11.3 million cars off regional roadways (DEIS 4.2), many of which cut right through Anne Arundel County's Patuxent River Tier II watershed.

Table 5 estimates the SCMAGLEV project will produce approximately 91,166 job-years generating $6.5 billion in labor earnings, or $70,689 per worker, over a seven-year construction period.

Table 5: Prince George's and Anne Arundel Counties and Maryland State Expected Temporary Economic Impact

Study Area	Employment (in job-years)	Labor Income ($millions)	Average Annual Wages/ person	GDP ($millions)	Economic Output or Sales ($millions)	State and County Tax Revenue ($millions)

Prince George's County	54,365	3,401	$62,559	2,939	5,980	250
Anne Arundel County	91,966	6,501	$70,689	5,914	11,138	543
State of Maryland	193,329	13,166	$68,102	12,845	24,168	1,111

Appendix -3- Economic Analysis of Tunnels vs Viaducts in EJ Communities

EJ COMMUNITIES

BWRR identified EJ communities using the University of Maryland's School of Public Health's Community, Engagement, Environmental Justice, and Health (CEEJH) *Maryland EJ Screen Mapper* (screenshot below). The approximate cost to tunnel underneath EJ communities throughout the project in comparison to above-ground viaducts increased costs by approximately $1,487,700,000.

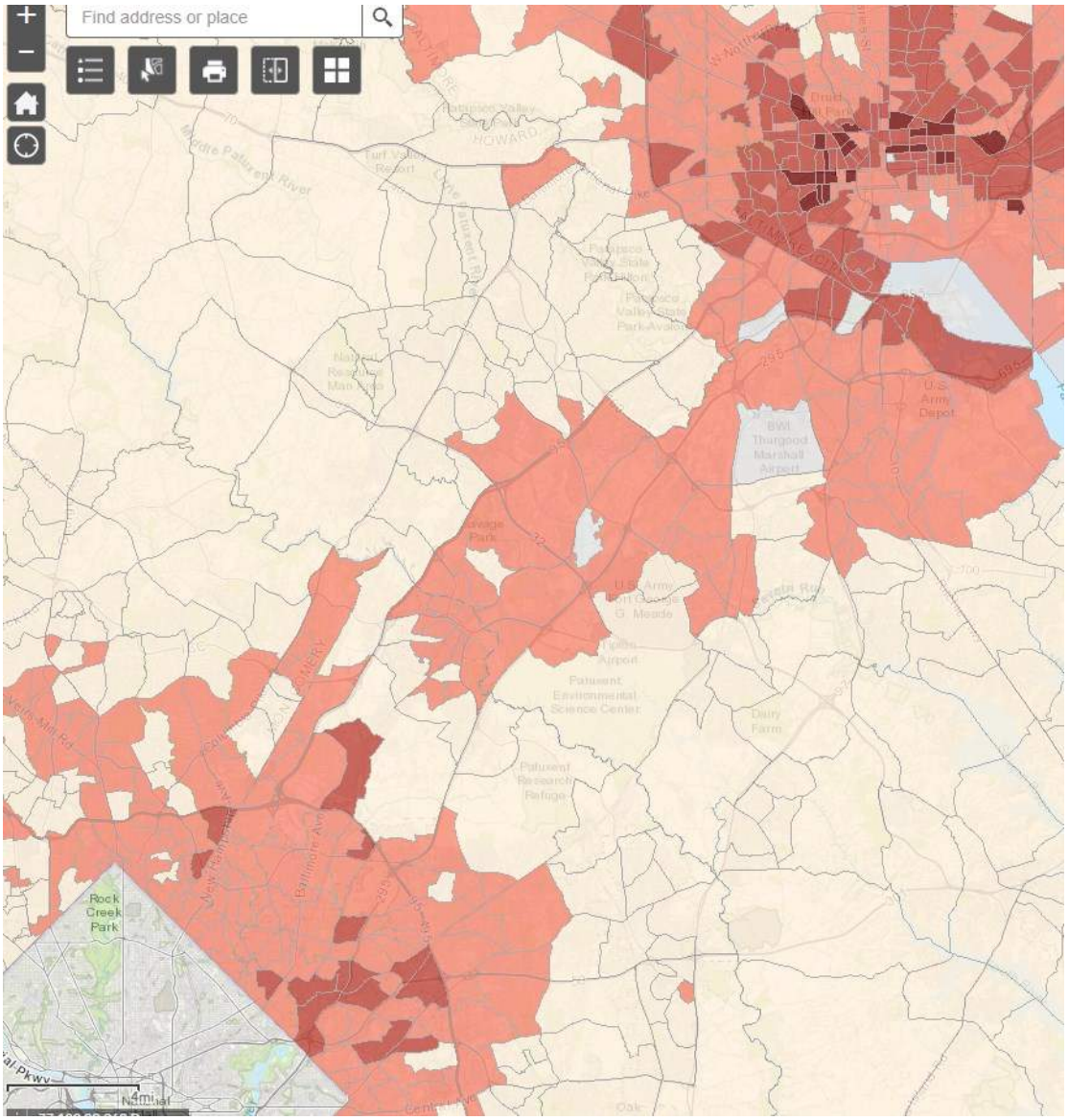
Table 15: Increased Cost of Tunneling Under EJ Communities vs Viaduct

County	***Added Cost* of Tunneling***
Prince George's	*$738,000,000*
Anne Arundel	*$595,800,000*
Baltimore County	*$126,000,000*
Baltimore City	*$27,900,000*
Total	***$1,487,700,000***

*Costs are based on the DEIS Appendix G9 Capital and Construction Costs Memorandum and do not include soft costs or contingency.

BWRR's preferred alternative with J Alignment and a Cherry Hill Station will have ~10.24 linear miles of above-ground guideway and ~24.85 miles of underground tunnel. Per the memorandum, the unit cost per linear mile of above-ground viaduct is $75,000,000 while underground tunnel is $165,000,000. Thus, one mile of tunnel is 220% or $90,000,000, more expensive than a viaduct.

Map # 1: University of Maryland's School of Public Health's Community, Engagement, Environmental Justice, and Health (CEEJH) Maryland EJ Screen Mapper



Appendix - 4- FEMA Flood Insurance Rate Map (FIRM)

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0 North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for the jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 18. The **horizontal datum** was NAD 83, GRS 80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information about the **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at www.ngs.noaa.gov.

Base map files were obtained in digital spatial data format from Prince George's County. Road centerlines were provided by the Prince George's County Office of Information Technology and Communications. Road centerlines were produced at a scale of 1"=200' using geodetic control and aerial photography. Political boundaries and streamlines were provided by the Prince George's County Department of Environmental Resources. Streamlines were rectified to march 2007 digital aerial photography for Prince George's County.

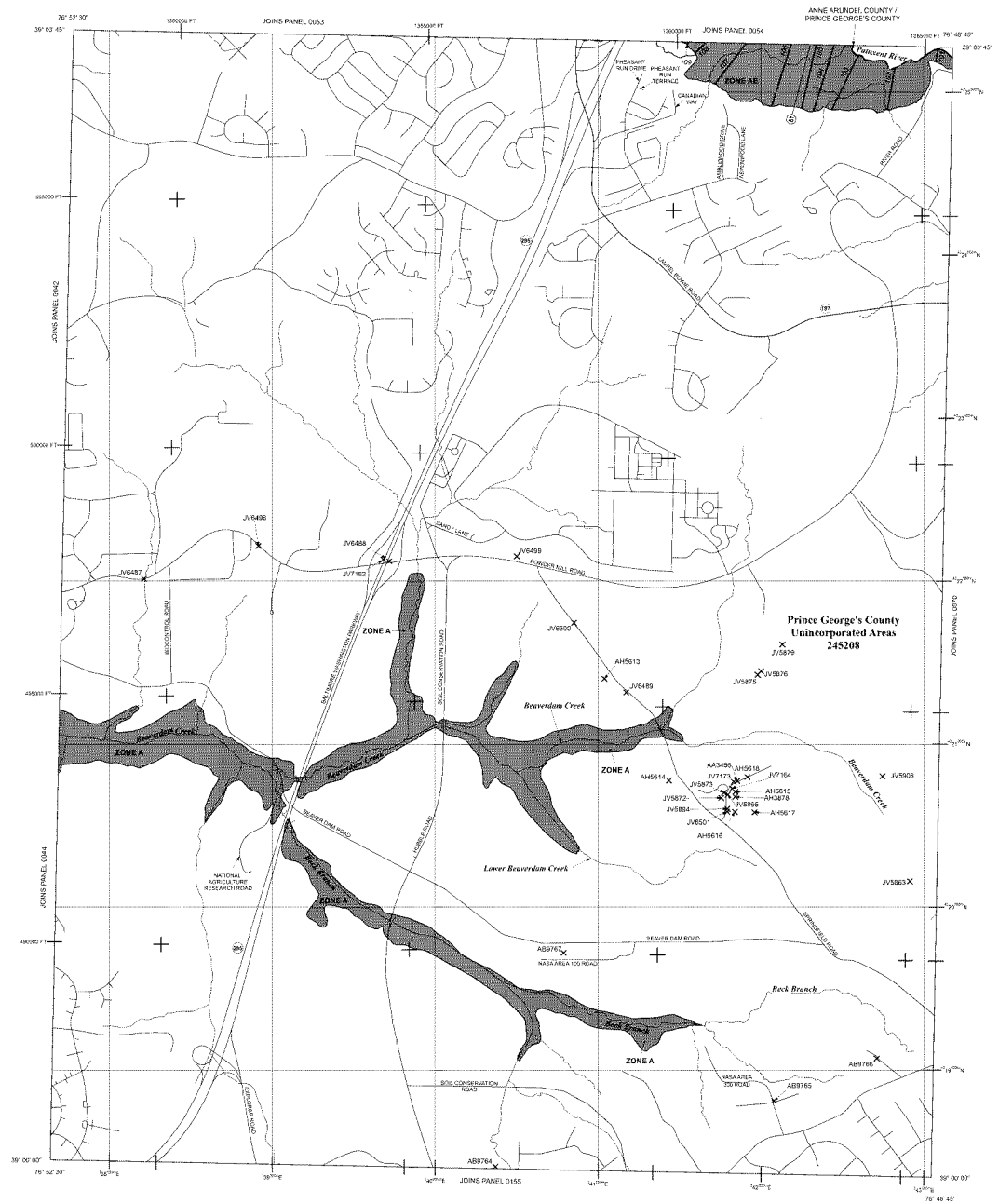
This map reflects more detailed and up-to-date **stream channel configurations and redelineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/national-flood-insurance-program.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths and flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- Bridge
- Floodbridge
- Culvert
- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4278000 M — 1000-meter Universal Transverse Mercator grid values, zone 18
- 600000 FT — 5000-foot grid ticks: Maryland State Plane coordinate system (FIPSZONE 1900), Lambert Conformal Conic projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 16, 2016

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0065E

FIRM
FLOOD INSURANCE RATE MAP
PRINCE GEORGE'S COUNTY, MARYLAND AND INCORPORATED AREAS

PANEL 65 OF 466

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

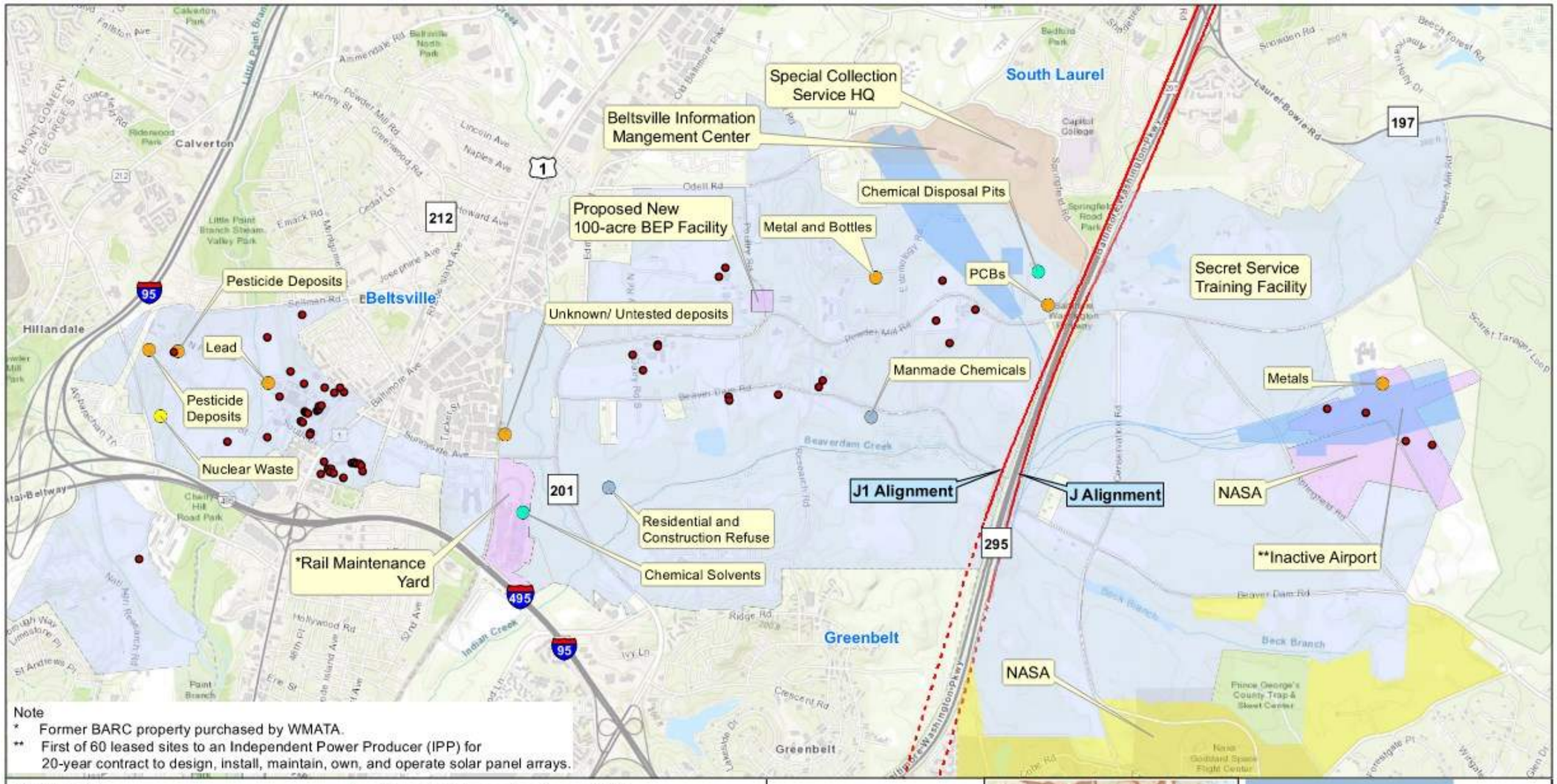
COMMUNITY	NUMBER	PANEL	SUFFIX
PRINCE GEORGE'S COUNTY	245208	0065	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
24033C0065E
EFFECTIVE DATE
SEPTEMBER 16, 2016

Federal Emergency Management Agency

Appendix – 5 – Beltsville Agricultural Research Center Mixed Property Uses


Special Collection Service HQ
Beltsville Information Mangement Center
South Laurel
Chemical Disposal Pits
Proposed New 100-acre BEP Facility
Metal and Bottles
PCBs
Secret Service Training Facility
Pesticide Deposits
Beltsville
Unknown/ Untested deposits
Lead
Manmade Chemicals
Metals
Pesticide Deposits
Nuclear Waste
J1 Alignment
J Alignment
NASA
Residential and Construction Refuse
*Rail Maintenance Yard
Chemical Solvents
**Inactive Airport
Greenbelt
NASA
Calverton
Hillandale
Note
* Former BARC property purchased by WMATA.
** First of 60 leased sites to an Independent Power Producer (IPP) for 20-year contract to design, install, maintain, own, and operate solar panel arrays.
Color Key
Further Investigation Planned
Removal Action Planned
Remedial Investigation/Feasibility Study
Remedial Action Planned
Proposed Solar Array Locations on BARC
BARC Property
Other Non-BARC Use
Dept. of State Parcel (Formerly BARC Property)
NASA Parcels (Formerly BARC Property)
Proposed BARC TMFs
Source: https://cercla.ba.ars.usda.gov/mapsearch
Sources: Imagery (ESRI)
Coordinate System: Maryland State Plane NAD 1983
December 4, 2019
Baltimore
Columbia
Washington
Beltsville Agricultural Research Center
Mixed Property Uses
BWRR
wsp
0
0.5
1
Miles

Appendix – 6 – BWRR Compatibility with Maryland's Climate and Transportation Goals

Maryland has committed to bold and necessary plans to address challenges related to climate change and the transportation network. Several of these plans highlight objectives that are very much in line with the SCMAGLEV project. Compatibility with the SCMAGLEV project's purpose and need include the following highlights:

Maryland 2030 Greenhouse Gas Reductions Act (GGRA) Plan

Maryland is aiming for a 50% reduction in greenhouse gas emissions (from 2006 levels) by 2030 and a net-zero economywide impact by 2045. The strategy to reduce transportation emissions is to:

> *"…provide Marylanders with reliable, clean transportation alternatives to driving single occupancy vehicles, while accelerating deployments of electric and other zero emissions vehicles (ZEVs) that are powered by increasingly clean Maryland electricity" (pg. 45).*

Maryland Commission on Climate Change (MCCC) 2020 and 2021 Annual Reports

The MCCC annual reports show Maryland's efforts to lead in the interstate Transportation Climate Initiative (TCI). While not initially joining the TCI Program (TCI-P), a statement in late 2020 identified Maryland's responsibility to:

> *"…continue to collaborate on the other state and regional strategies, including equitable reduction policies to advance our shared climate and transportation goals."*

Maryland Transportation Plan (MTP) 2040:

Goal: Facilitate Economic Opportunity and Reduce Congestion in Maryland through Strategic System Expansion.

Strategy: Invest in and pursue opportunities to promote system improvements that support economic development, reduce congestion, and improve the movement of people and goods.

Objective: Pursue capital improvements to the transportation system that will improve access to jobs and tourism and leverage economic growth opportunities.

Objective: Strategically invest in expansion and operational improvements to reduce congestion along the multimodal transportation system.

Goal: Maintain a High Standard and Modernize Maryland's Multimodal Transportation System.

Strategy: Preserve, maintain, and modernize the State's existing transportation infrastructure and assets.

Objective: Strategically modernize infrastructure through new and innovative technology, enhanced partnerships, design standards, and practices to facilitate the movement of people and goods.

State Goals and SCMAGLEV

The Transportation sector is Maryland's largest single source of Green House Gas (GHG) emissions at 40% of the total. Most of the transportation emissions come from light duty cars and trucks. Intercity automobile trips between Baltimore, BWI, and Washington DC are a key contributor to transportation greenhouse gas emissions.

Auto trips exceed 110 million annually (pg. 66, BWRR Ridership Report), which is more than 90% of all trips in the entire intercity market across all modes of transportation. Meanwhile, less than 10% of trips are captured by existing transit. In 2019 Baltimore-DC ridership for Amtrak was estimated at only 354,800 trips (DEIS page 4.2-12), and ridership for MARC Penn and Camden Lines was approximately 7,761,000 in 2018 (DEIS page. 4.2-10). This highlights that *commuter* service cannot fulfill the significant demand for *intercity* service.

Maryland climate goals require adoption of travel options disruptive enough to initiate wholesale changes in travel behavior. Between 2006 and 2017 on-road transportation emissions only saw a 4% reduction (pg. 232, 2030 GGRA Plan). To reduce emissions from passenger cars and trucks, significant diversions from auto travel are needed in addition to widespread adoption of electric vehicles. Electric vehicles alone will not address traffic congestion issues, corresponding economic drag, or address the socioeconomic equality issues for those who don't own (or are unable to purchase) a vehicle.

SCMAGLEV is poised to address several of these issues in direct support of the statewide goals. Ridership forecasts suggest substantial automobile diversions that will in turn reduce GHG emissions, congestion, and overreliance on electric vehicles. Further, the project will provide significant economic benefits through construction and operations. This innovative technology modernizes Maryland's transportation system, and it enables Maryland to lead the region in solving climate challenges.

SCMAGLEV would have a significant impact on automobile trip diversions and GHG emissions in its first year of operation. Based on the SCMAGLEV ridership forecast, during the first year of operation, 2030, between 11.38 and 12.61 million annual passengers are expected to divert from cars to SCMAGLEV (DEIS 4.2-7). See Section 2.1.4 of the SEJ for details on VMT reductions. See Section 2.3.1 of the SEJ for details on air quality improvements.

Environmental goals laid out in the GGRA depend heavily on the adoption of electric vehicles. SCMAGLEV would ease excessive reliance on the adoption of electric vehicles, and reduce Maryland's vulnerability to risk, such as material shortages or supply chain issues, associated with the auto and manufacturing industries.

SCMAGLEV also creates diversions from existing transit systems, which are expected to be beyond capacity in the next 10 years. The reduced burden on MARC service would help enable MARC to keep or improve service levels amidst increasing population and demand.

The SCMAGLEV Project will provide temporary and permanent jobs throughout the corridor. In addition to jobs, the state and local tax base will see new revenues (SEJ Section 2.1). Further, BWRR's Diversity, Equity, and Inclusion Plan has committed investing into minority and local businesses (SEJ Section 2.1.3).

Introducing the SCMAGLEV System enables Maryland to quickly become the regional leader in transportation innovation and related climate improvements. As Maryland continues work in the Transportation Climate Initiative (TCI), SCMAGLEV will serve as the high-speed spine of an advanced multi-modal transportation system - helping to address the region's climate goals by providing a safe, reliable, fast, and frequent travel option.

BWRR is working to establish SCMAGLEV, which is not currently offered anywhere else outside of Japan, in the state of Maryland. It stands capable of expanding throughout the corridor as a tool to address the region's climate goals, and it helps Maryland lead the region in its efforts to do so.

Appendix – 7 – Trainset Maintenance Facility (TMF) Alternatives Assessment Comparison

BALTIMORE-WASHINGTON SCMAGLEV PROJECT

TRAINSET MAINTENANCE FACILITY (TMF) ALTERNATIVES ASSESSMENT COMPARISON

REVISION: 4

DATE: October 9, 2020

BWRR

BALTIMORE-WASHINGTON RAPID RAIL

TABLE OF CONTENTS

TABLES

FIGURES

NOTES/REVISIONS FOR VERSION CONTROL

Revision 0: 2020-02-07

Revision 1: 2020-03-27

Revision 2: 2020-04-14

Revision 3: 2020-08-18

Revision 3: 2020-10-09

File Name: BWRR 4.3 TMF Alternatives R4-20.10.09.docx

1. EXECUTIVE SUMMARY

This report presents the site and configuration options for the Superconducting Maglev (SCMAGLEV) Trainset Maintenance Facility (TMF), formerly called the Rolling Stock Depot (RSD), and explores the various considerations for the Washington, D.C. to Baltimore, MD project corridor. The evaluation in this report is based on the project sponsor's best assessments including environmental impacts. Final determination of environmental impacts will be made through the NEPA process.

The TMF is the home for the trainsets. All inspection, maintenance, repairs, and periodic or programmatic work is performed at the TMF. Light trainset servicing and cleaning is done at terminal stations during the operating day. Several hundred people will report to work at the TMF daily.

The Alternatives Report[1] evaluated two TMF locations along the Baltimore-Washington Parkway corridor using a 235-acre facility footprint. As recommended in the Alternatives Report, a subsequent TMF study was undertaken. BWRR considered the possible use of a reduced and disaggregated footprint (approximately 120 acres, later found not viable) to minimize impacts and allow additional sites to be considered. Eleven sites were studied, and the newly identified Patapsco Avenue site was selected along with a new layout within the existing MD-198 site as the two TMF sites to be studied in detail in the Draft Environmental Impact Statement (DEIS). However, a subsequent operational review conducted in the summer of 2019 concluded that the reduced and disaggregated footprints would not meet the operational and maintenance requirements of the fleet. Additional equipment, logistics, and time required for trainset maneuvers in the inefficient TMF layout would preclude completing required inspections and maintenance during the required six-hour nighttime maintenance window and introduce unacceptable operating risks.

A new site evaluation was conducted in the fall on 2019, based on a 180-acre TMF footprint as designed and currently under construction in Chubu, Japan. This site is 55 acres smaller than the 235-acre footprint considered in the Alternatives Report. In this assessment report fourteen sites are considered against key factors and operational considerations of overall size and shape, the ability to provide connecting ramps to the mainline, proximity to Washington DC, avoidance of residential impacts, and elimination or minimization of impacts that would be difficult or impossible to mitigate. These factors are consistent with the Purpose and Need for the project, specifically to achieve SCMAGLEV operational and safety metrics and to avoid, minimize and mitigate impacts to the human and natural environment.

Two locations, #4 Beltsville Agricultural Research Center (BARC) East and #5 BARC West are identified by BWRR as the alternatives for a TMF that best meet the BWRR project criteria, including no residential displacements. The proposed TMF sites on BARC land were developed avoiding the TMF site BARC objected to in the ARDS and incorporating other comments from the Alternatives Report. The BARC proposed sites are consistent with other non-agricultural uses on BARC property including buildings, a rail maintenance facility for WMATA, a new Bureau of Engraving and Printing facility, and many other uses. Additional non-agricultural uses of BARC are outlined in this report.

The MD-198 site (#10A) is the only other site that does not require residential displacements. However, there are increased costs, aviation safety, permitting, conservation easements and infrastructure challenges that are significant for the site. The BARC West, BARC East, and MD-198 alternatives are recommended by BWRR for further assessment in the DEIS, with the caveats noted above concerning MD-198 (#10A).

[1] Baltimore-Washington Superconducting Maglev Project, Final Alternatives Report, November 2018. http://baltimorewashingtonscmaglevproject.com/images/document_library/reports/alternatives_report/SCMAGLEV_Alts_Report_Body-Append-A-B-C_Nov2018.pdf

2. PURPOSE

This report reviews options for the Trainset Maintenance Facility (TMF): its function and requirements, alternatives for siting a facility in the Baltimore-Washington corridor, and conclusions and Sponsor's recommendations for alternatives for inclusion in the Draft Environmental Impact Statement (DEIS).

3. BACKGROUND

The project is a high-speed public transportation system between Washington DC and Baltimore MD via a Superconducting Maglev (SCMAGLEV) train. The project requires new infrastructure, stations, and facilities to implement technology developed by Central Japan Railway Company (JRC).

The U.S. Federal Railroad Administration (FRA), in collaboration with Maryland Department of Transportation (MDOT) and Maryland Economic Development Corporation (MEDCO), is preparing an Environmental Impact Statement (EIS) to evaluate alternatives for the project pursuant to the National Environmental Policy Act (NEPA). The project sponsor is Baltimore Washington Rapid Rail (BWRR).

The November 2018 Alternatives Report (Alternatives Report) selected two alignment alternatives for further study in the Draft Environmental Impact Statement (DEIS):

- Alternative J – Baltimore-Washington Parkway East
- Alternative J1 – Baltimore-Washington Parkway West

The alignments are 53 to 56 kilometers (33 to 35 miles) long, depending on terminal station options, with approximately 75 to 83 percent of the alignment in underground tunnel, and the balance elevated on viaduct.

Alternatives J and J1 utilize the same TMF options, with variations to ramps connecting the TMF to the mainline. When the TMF is on the opposite side of the Baltimore-Washington Parkway from an alignment alternative, the connecting ramps cross over the Parkway on a bridge structure.

4. TMF DESCRIPTION

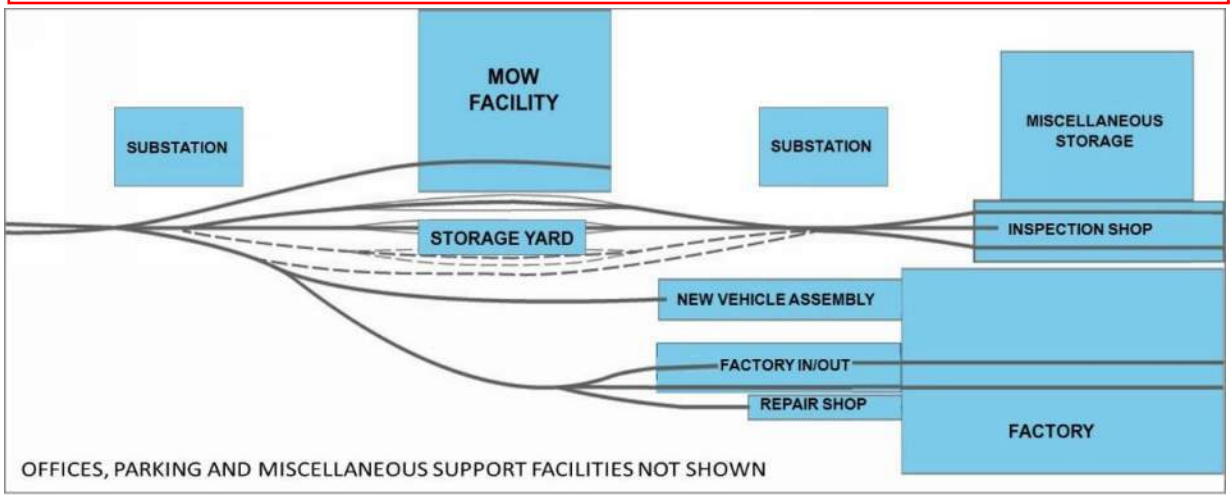
4.1 TMF COMPONENTS

The TMF serves as the home to the system's trainsets where they are stored, maintained, cleaned, inspected, repaired, and overhauled. Nearly 300 workers are employed at the TMF. See Figure 1 for a conceptual layout of TMF elements.

The TMF would house the following facilities:

- Storage yard, with guideways for staged trainsets during nighttime and off-peak periods
- Factory building where scheduled heavy maintenance work would be performed
- Inspection shop for performing daily inspections, daily service, and maintenance, etc.
- Repair facility for unscheduled repairs
- Factory "In/Out" shop for disassembling and assembling trainsets into individual coaches for major overhaul
- New vehicle assembly shop for assembling new component parts into complete trainsets and conducting major maintenance.
- Miscellaneous storage facility for materials used for inspection, maintenance, and repair of trainsets
- Two substations for train control and power supply within the TMF, each approximately five acres
- Miscellaneous support facilities (e.g., tire shop, battery shop, etc.)
- Parking for employees, material suppliers and guests
- Office space
- Maintenance of Way (MOW) facility, depending on TMF location

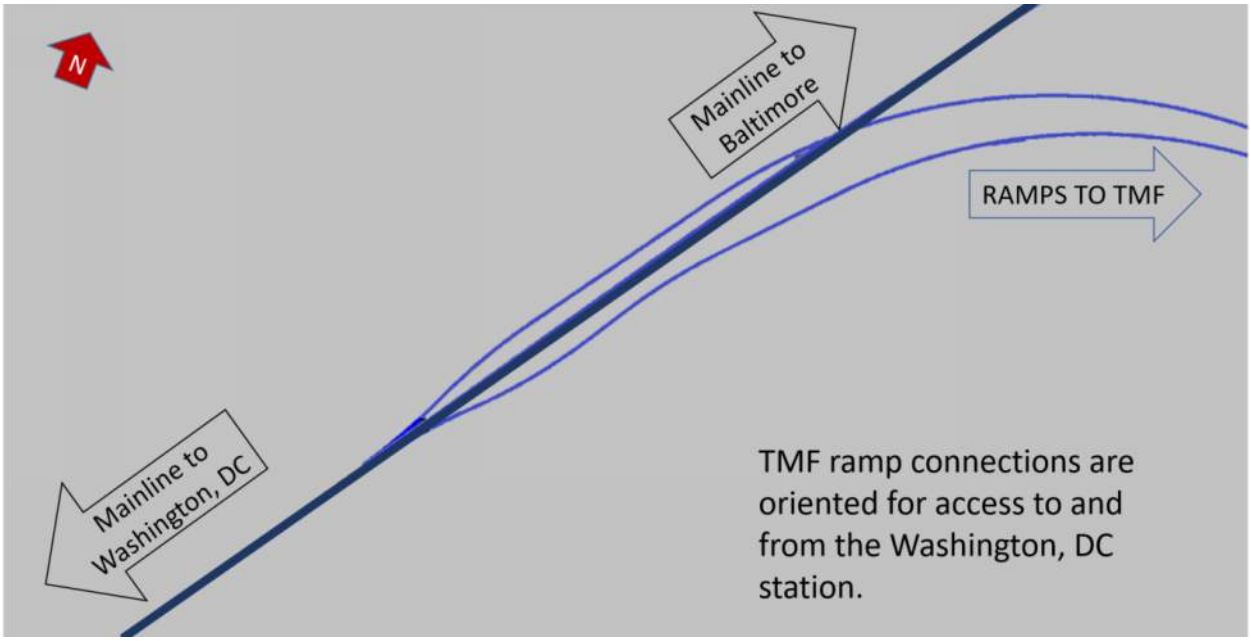
Figure 1. Conceptual Layout of TMF Elements



4.2 TMF RAMPS

Trains on the mainline access the TMF with ramps that connect to the Northbound and Southbound guideways. The turnouts on the mainline are oriented for trains traveling to and from the Washington, DC terminus station (Figure 2). Trains from the TMF that are going towards the Baltimore station would have to enter the mainline headed towards Washington and reverse direction to proceed Northward. Trains entering or exiting the mainline would operate at slow speed to maneuver the TMF turnouts.

Figure 2. TMF Ramp Configuration



The single guideway ramp structures are approximately 8.2 meters (27 feet) wide, supported on piers spaced at approximately 38 to 50 meters (125 to 164 feet).

The mainline guideway at the location of the TMF turnouts needs to be straight and have a profile grade of 0.3 percent or less, with no vertical curvature. The Northbound and Southbound ramps connecting the TMF to the mainline would have a minimum horizontal radius of 800 meters (2600 feet) and a maximum grade of 4 percent, however a reduced grade is preferred for one of the two ramps to facilitate towing of a disabled trainset.

Ramps within the TMF complex have a minimum horizontal radius of 800 meters and 0.0 percent vertical grade.

4.3 MOW FACILITY

Two MOW facilities are required between Baltimore and Washington, one in the Northern portion of the alignment and one in the Southern area. The MOW facility would have a total area of approximately 13 acres, with a maintenance garage for MOW equipment, a material storage facility, a crew building and a parking area. MOW equipment would be staged, inspected, and repaired in the garage.

Workers reporting to the crew building would be dispatched to perform nightly inspection and maintenance operations along the guideway. Ramps connecting the MOW facility to the mainline would allow maintenance vehicles access onto the guideways. A MOW facility co-located with the TMF would

use the TMF ramps for mainline guideway access. Inspection and maintenance of the guideway would occur nightly between 11pm and 5 am, when no trains are allowed on the mainline guideways.

4.4 POTENTIAL TMF IMPACTS

The TMF has both day and night operations. Impacts associated with a TMF are described below.

Traffic. TMF personnel will work in various shifts and schedules with concentrated levels of traffic at normal shift change times. Truck traffic will consist of deliveries made to the material management facility generally during the day shift.

Light. Most of the trainset inspection, servicing and repair work would be performed within buildings at the TMF. Therefore, light and noise from the TMF would be kept to a minimum. Movement of trainsets between mainline, TMF work areas, and the storage yard would generally occur on evening and overnight shifts. Aside from the area lighting around the facilities, the most noticeable visual impact from operations may be from headlights of the trainsets and directional lighting throughout the facility, including the parking lot.

Coach lighting for trainsets while in the storage yard would be kept to a minimum. Yard lighting would be consistent with appropriate safety and security measures and combined with perimeter security. Directional lighting will be used to minimize offsite light impacts.

Noise. Noise impacts from the TMF would be minimal for equipment such as HVAC units, audible warning devices, etc. Trainsets would travel between the storage tracks and the inspection shop or factory on rubber tires, there is no steel on steel or catenary noise like a conventional trainset.

Safety and Security. Safety and security are key elements both to the entire rail operation, and to the TMF. The TMF facility would be designed and operated to protect both employee safety and to ensure the safe handling and storage of materials on site. As an element of the public transport network, the TMF would be made secure from encroachment or sabotage. The facilities would be designed with appropriate safety devices and procedures, directional lighting, and perimeter fencing. Security would be part of all plans, both during construction and during operation.

Onsite Storage. There would be a range of materials stored at the TMF, including trainset parts. Appropriate safety and material handling plans would be developed for all such materials. There would be regular truck traffic to support the material management function, including material deliveries, and outbound material for refurbishment or disposal.

Stormwater. Best management practices will be implemented during construction and continued through operations of the TMF site.

5. CONCEPTUAL ENGINEERING ALTERNATIVES (TMF)

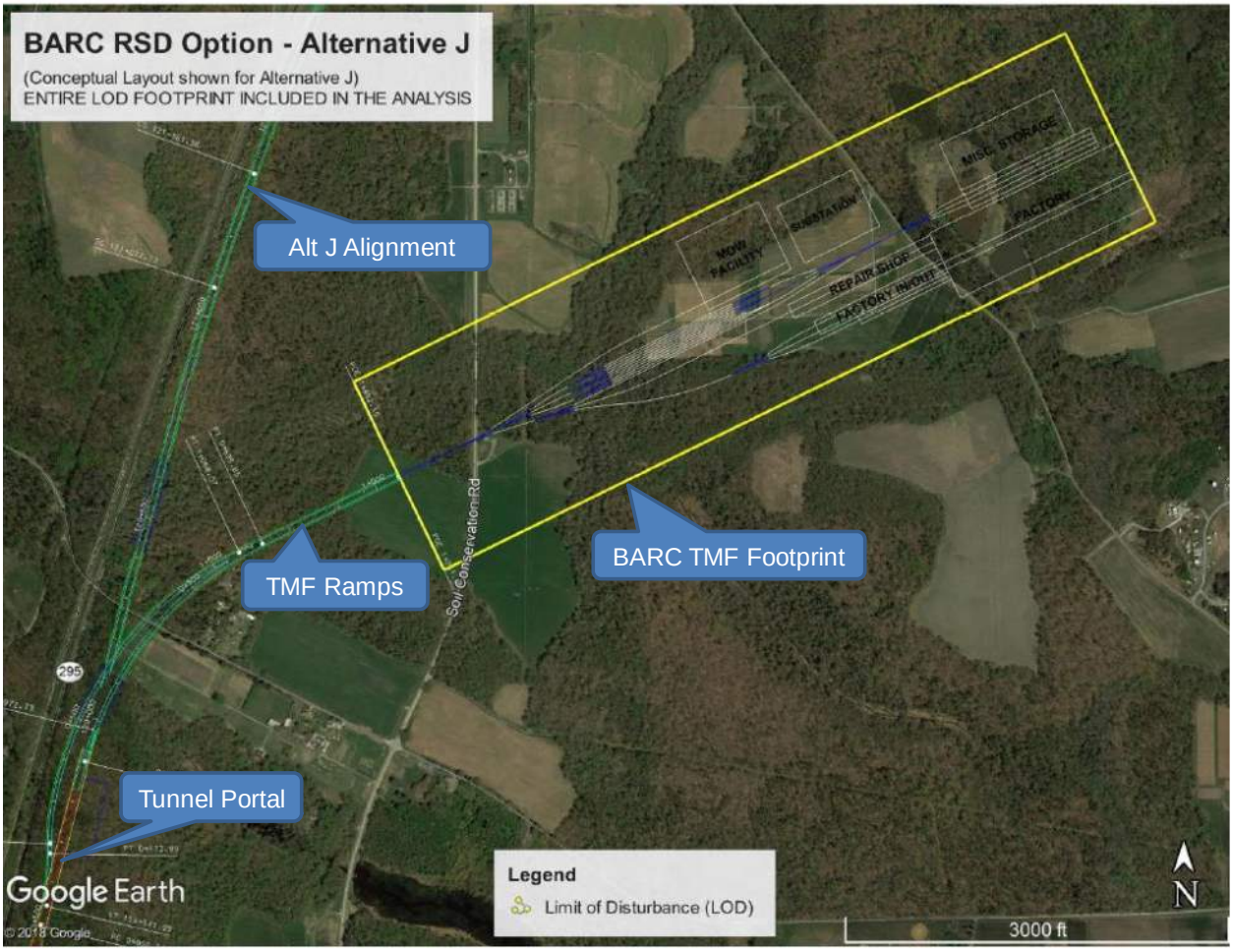
5.1 ALTERNATIVES REPORT

Studies conducted during conceptual engineering in support of the Alternatives Report used a 235-acre TMF footprint. The TMF footprint was applied to multiple locations along the two alignment Alternatives J and J1. TMF plans were developed and studied in the Alternatives Report for the following locations.

- Beltsville Agricultural Research Center (BARC) facility on the East side of the Baltimore-Washington Parkway, Prince George's County, MD. See Figure 3.
- North of MD-198 on the East side of the Baltimore-Washington Parkway, Anne Arundel County, MD. See Figure 4. (The footprint was slightly modified to avoid the Little Patuxent River).

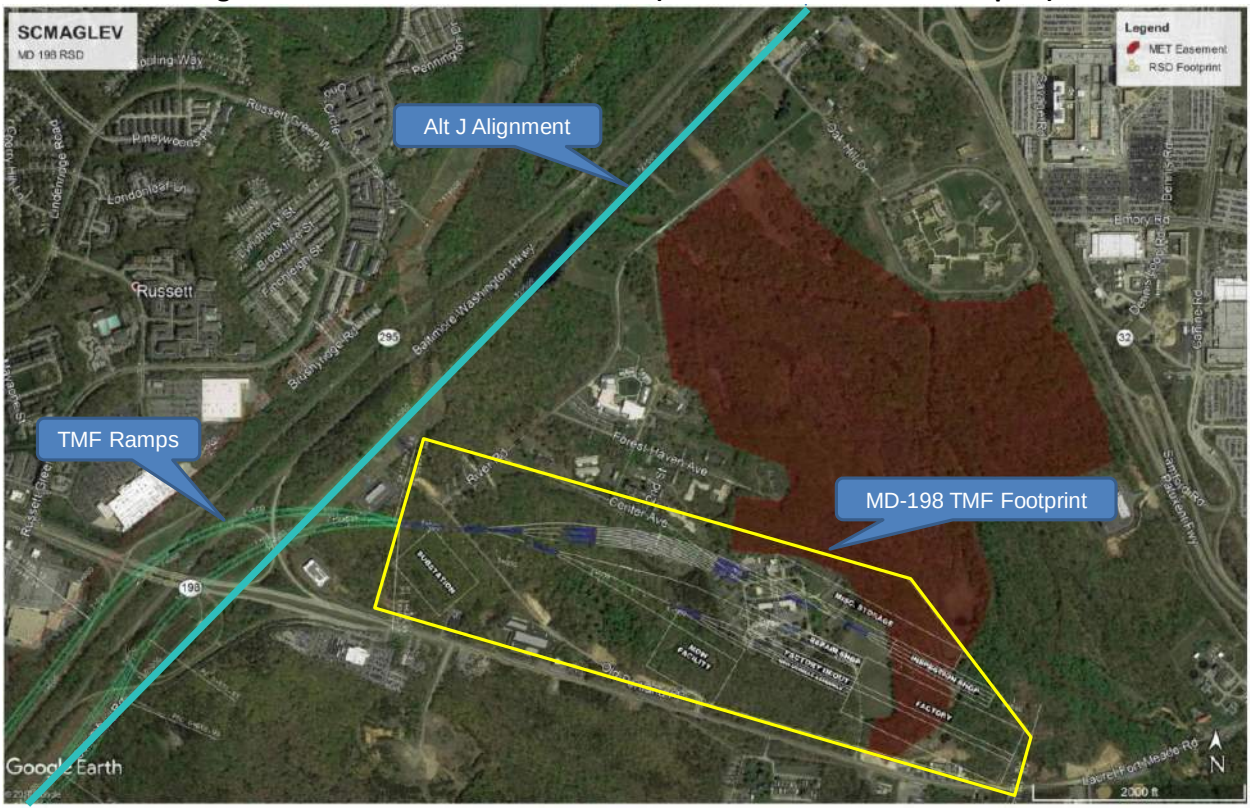
The Alternatives Report eliminated the original 235-acre BARC TMF location due to agency comments and concerns. The report retained the MD-198 alternative and outlined that further sites would be studied.

Figure 3. Original TMF Alternative at BARC (Eliminated in Alternatives Report)



Source: Alternatives Report (Nov 2018)

Figure 4. TMF Alternative at MD-198 (Retained in Alternatives Report)



Source: Alternatives Report (Nov 2018)

5.2 MODIFIED TMF LAYOUT

After the Alternatives Report was issued, BWRR explored options to reduce the site size of the TMF, including disaggregating the major operational elements onto separate parcels. If confined to approximately 120 acres, the reduced footprint and dispersed layout allowed additional sites to be considered. A total of eleven sites were explored along the Baltimore-Washington Parkway corridor for potential suitability. A location for the modified TMF layout with compatible land use was identified along Patapsco Avenue in the Cherry Hill area. That alternative is shown in Figure 5.

A smaller footprint was also explored at the MD-198 TMF site (Figure 6). The factory, inspection shop, repair shop and storage facility were combined into one building to reduce the overall footprint.

5.3 OPERATIONAL REVIEW

BWRR looked at other configurations for a TMF facility considering unique spatial limitations in certain locations. For example, could the various functions of a TMF be "disaggregated" to allow for a smaller footprint than Chubu's streamlined layout. Specifically, BWRR considered disaggregated TMF layouts for the Patapsco Avenue and MD-198 TMF sites. Rather than arranging the storage yard and inspection shop in series, BWRR looked at whether trains could enter the storage yard and then switch back to enter the inspection shop, which was located further from the storage tracks than would be the case using the Chubu configuration.

An operational review was conducted with Japan Central Railroad (JRC) of the 120-acre reduced/disaggregated TMF. BWRR concluded the risk to efficient and reliable operations was simply too great to make a disaggregated TMF feasible. The trains would have to travel a longer distance from

the storage tracks to the inspection shop adding a minimum of five minutes to each train movement between the storage yard and the inspection shop. This would add a total of two hours of travel time, thereby reducing revenue service hours since the required 6-hour maintenance window cannot be reduced. The addition of multiple switches and train movements also increased the risk that a technical malfunction would prevent timely inspections and maintenance.

The disaggregated layout also created inefficient material storage and handling since the inspection shop and factory share materials and equipment. At the Patapsco site, these were separated by approximately 1.7 kilometers (1.1 miles) and required bridging across a four-lane highway. The additional distance between maintenance operations required duplication of the shared resources and/or added travel time to retrieve resources that cannot be feasibly duplicated.

With extensive coordination with JRC BWRR determined that the layout of the Chubu TMF in Japan, which has been fully designed and is under construction, could be utilized for the Baltimore-Washington Project. It is approximately 180 acres and would result in a 24% reduction in size from the original proposal. The original layout at the MD-198 was dropped from consideration since the Chubu TMF layout was the most efficient and compact to have been designed. It requires 55 fewer acres than the original 235-acre MD-198 site in the ARDS report.

The Chubu TMF was designed based upon JRC's extensive experience with train operations and maintenance and is the smallest practicable size. JRC designed the Chubu TMF to allow trains to enter the facility directly from the mainline, and proceed immediately to the storage yard, from which individual trains can be moved into and out of the inspection shop. Similarly, trains can move to and from the assembly shop or factory directly from the mainline. This configuration minimizes the distance and time required for train movements, which is particularly important for ensuring that all necessary inspection and maintenance can be completed as expeditiously as possible, within the six hour window while maximizing the time available for revenue service operations.

It should be noted that JRC high speed trains operate at a very high standard for reliability and safety. JRC moves 150 million people a year on its system and the average passenger delay for a year is 20 seconds. In addition, there have been no fatalities since high speed rail operations began in 1964. In the United States, on-time performance between Washington DC and New York is defined as arriving within 30 minutes of scheduled time. According to the Department of Transportation there are 5,800 train car crashes each year in the United States, most of which occur at railroad crossings. These accidents cause 60 deaths and injure about 2,300, compared with zero on Japanese high-speed rail. Much of this is attributed to design, construction choices (viaducts and tunnels, no curves outside train geometry), and daily inspection and maintenance.

The operational inefficiencies produced by the disaggregated layout are similar for both the Patapsco and MD-198 TMF sites. Therefore, BWRR concluded that the only acceptable approach was to replicate the streamlined and thoroughly considered layout of the Chubu TMF.

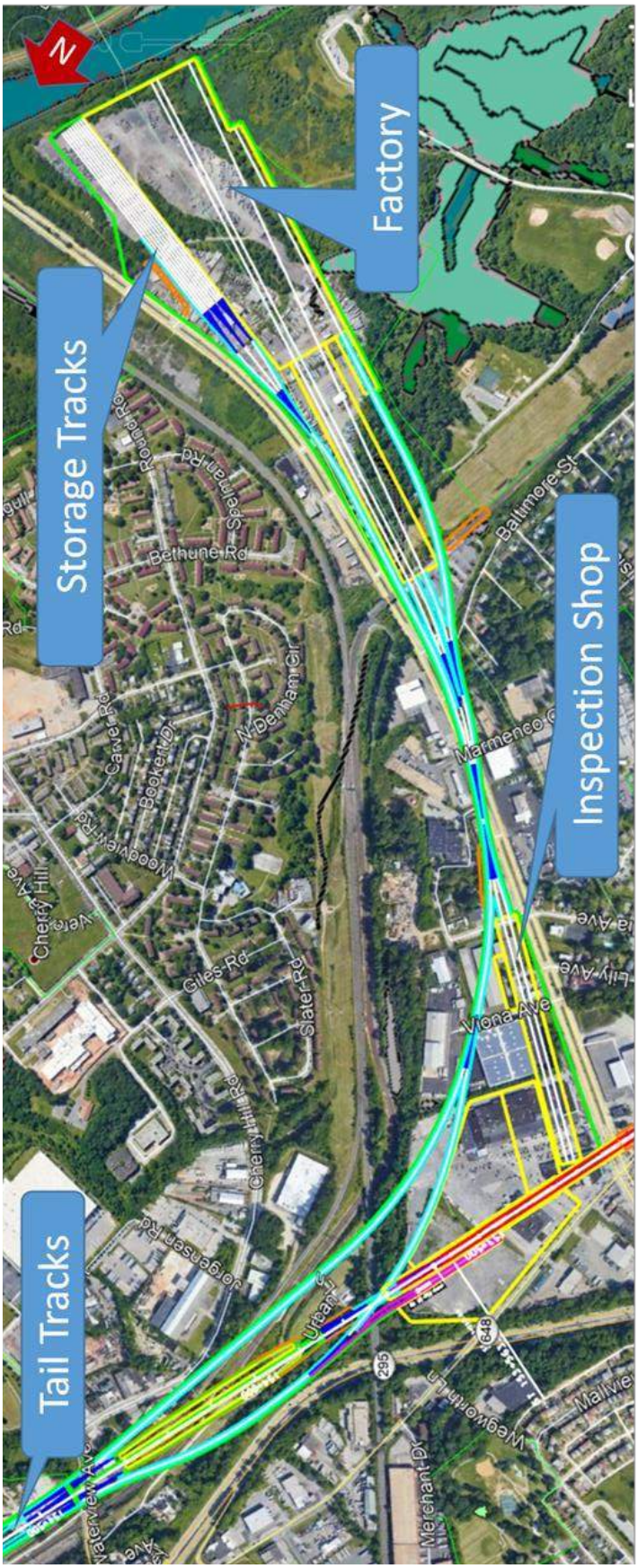


Figure 5. Disaggregated TMF Site at Patapsco Avenue

Figure 6. Reduced TMF Site at MD-198

6. REDESIGNED TMF

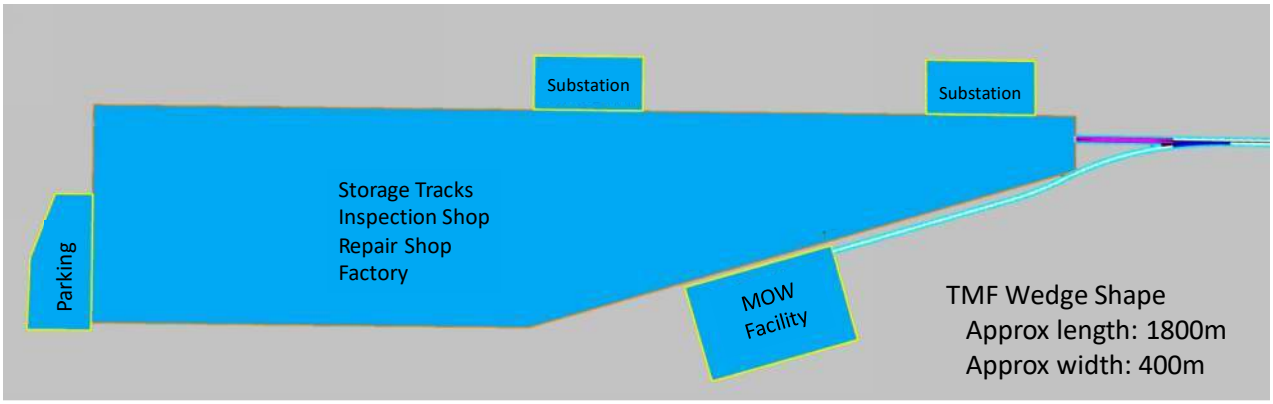
6.1 OPTIMAL TMF FOOTPRINT

Through additional coordination with JRC, and further evaluation of the facility layout and footprint, a 180-acre wedge shape was finalized with a length of 1800 meters (5,800 feet) and a width of 400 meters (1300 feet). This layout optimizes the operations for maintenance of the fleet. The footprint standardizes the TMF that is fully designed and is under construction in Chubu, Japan. The final TMF footprint is provided in Figure 7.

The 180-acre footprint is approximately 55 acres (24%) smaller than the original 235-acre site used in the Alternatives Report. The breakdown of the footprint is as follows:

- TMF wedge shape area of approximately 142 acres.
- Each substation of approximately 5 acres and enables the movement of different trainsets in the TMF.
- MOW facility of approximately 12 acres.
- Parking of approximately 6 acres.
- Ramps to the mainline of approximately 10 acres.

Figure 7. Final TMF Layout



The two substations would be optimally sited on the long side of the TMF, with one located near the entrance and the second substation approximately halfway along the length. For an optimal design, the parking area would be located with easy access to the roadway network, and the MOW facility would be positioned as close to the mainline as possible.

6.2 LOCATION CONSIDERATIONS

BWRR assessed fourteen (14) sites against the following key factors[2]:

- Sufficient size and shape for the 180-acre footprint
- Proximity to the Washington, D.C. terminus station, between D.C. and Baltimore
- Proximity to the mainline alignment with suitable geometry and orientation for TMF ramp connections
- Worker and material delivery access
- Avoidance of residential impacts

In response to agency input, an underground TMF alternative on BWI Airport property and a partially depressed TMF at MD-198 were explored. An underground TMF would require top down construction including the ramp connections to the mainline turnouts, resulting in temporary surface impacts over the full dimensions of the site. Additional permanent surface impacts would be imposed by a comprehensive system of ventilation and emergency egress facilities. According to engineering estimates, BWRR estimated the additional cost for construction would be over $1 billion compared to a conventional TMF on the surface. This additional cost results from several factors including, for example, the extensive excavation and movement of spoils, the need to construct walls and to cover the TMF, etc. Therefore, an underground TMF is not a reasonable or cost effective and economically infeasible.

Supported by this analysis, the TMF must be built above ground along a portion of the mainline alignment that is also above ground (viaduct). Both alignment alternatives have an elevated viaduct along the Baltimore-Washington Parkway, between Greenbelt and Fort Meade for Alternative J, and between Greenbelt and Maryland City for Alternative J1. Both alignment alternatives also have a short viaduct section around the Cherry Hill station alternative.

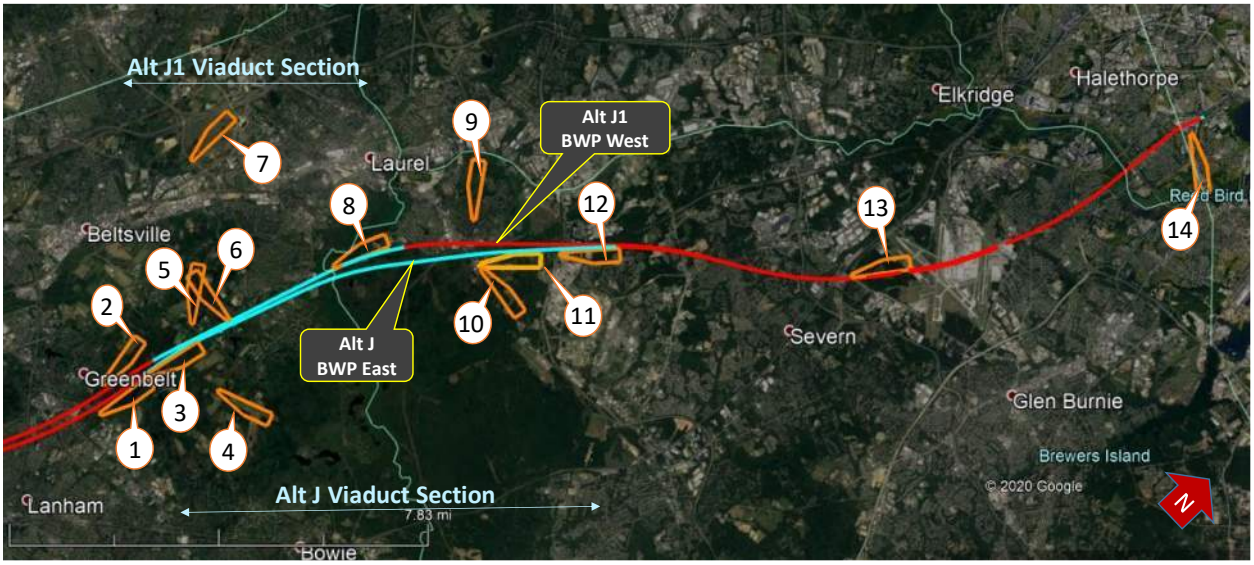
[2] Key factors were developed based on the subsequent operational analysis to ensure the TMF was located in an area along the alignment that meets the operational and maintenance requirements of the system.

7. TMF ALTERNATIVES

7.1 DESCRIPTION OF ALTERNATIVES

Using the 180-acre final footprint shown in Figure 7, a study was undertaken that included eleven sites that were previously evaluated plus three new locations that were subsequently identified, resulting in a total of fourteen sites shown in Figure 8 and assessed in Table 1.

Figure 8. TMF Site Alternatives



Each site is further described in Table 1.

All of the TMF sites are above ground and adjacent to a viaduct section of the mainline alignment, with the exception of Site #13, BWI Airport, and site #7. The MD-198 site was assessed two ways, #10A and #10B, with #10B excavated and depressed ~20m (66 feet) to avoid encroaching on Tipton Airport airspace.

TMF options on the West side of the Baltimore-Washington Parkway require TMF ramps to bridge over the Parkway to connect Alignment Alternative J. Similarly, TMF options on the East side of the Parkway require TMF ramps to cross over the Parkway to connect to Alignment Alternative J1.

7.2 EVALUATION CRITERIA

Table 1 provides information on each site, including ownership, surface characteristics, land use, feasibility of providing connecting ramps to the mainline, and impacts for each TMF alternative.

The first five columns in Table 1 provide site characteristics as described below.

- **Number (No.)** – Corresponds to numbers on Figure 8
- **Stationing** – Location along the Alternative J or J1 alignment
- **Location Descriptor** – Brief word identification
- **Property Owner** – Public or private owner
- **Characteristics / Land Use** – Surface characteristics such as woods, cropland, wetlands, rivers, and land use: residential, commercial, institutional parkland, etc. The elevation differential across the TMF footprint is provided.

The remaining columns provide additional details about each site that can be considered in an evaluation of alternatives. The following discussion describes the characteristics and how they are evaluated for consistency with the design criteria of the project.

- **TMF Ramps to Mainline** – Ramps that connect the TMF site to the Northbound and Southbound guideways on the mainline alignment.
    - Ramps that do not connect above ground were inconsistent with the design criteria adding additional cost on the order of $500 million, adversely impacting financial viability. Additionally, surface impacts associated with the construction of underground switchboxes, tunnel transition portals and ventilation facilities would pose substantial impacts.
    - Ramps in tunnel are therefore deemed **UNACCEPTABLE.**
- **Residential Impacts** – Direct impacts to residential properties by either the TMF or the TMF ramps.
    - Impacts to residences were considered **UNACCEPTABLE** and serious impediments based on the objective to avoid, minimize and mitigate impacts.
    - Impacts to residentially zoned properties that are not developed were considered **ACCEPTABLE**.
- **Wetland Impacts** – Wetland impacts quantified based on GIS data, supplemented by AECOM field studies, where available. The impacts noted are gross impacts and do not reflect mitigation, construction methods or post-construction impacts.
- **Parkland Impacts** – Impacts identified for areas that are designated as parkland.
- **Other Impacts** – Impacts to institutional facilities, major utilities, churches, cemeteries, transportation infrastructure, etc.
    - Completion of the TMF is a critical component of the project schedule as it is required to take delivery of the trainsets and commence assembly and testing.
    - Impacts were considered **UNACCEPTABLE** if the mitigation efforts required would add two or more years to the project schedule. The cost of overall construction would increase with a delay.

- **Cost Increment** – The additional cost of an alternative compared to all other alternatives due to site specific conditions, such as a requirement for underground construction.
    - Substantial cost increases were deemed **UNACCEPTABLE** due to a substantial adverse impact on the economic viability of the project.
- **Distance to Washington, DC Station** – The deadhead travel distance between the TMF and the Washington, DC terminal station. The operating assumption is that all revenue trains end their service at the DC station. The distance is important because a longer distance reduces time available for maintaining trainsets and guideway infrastructure during the 6-hour maintenance window.

Table 1. Evaluation of Fourteen Potential TMF Sites (180-acre footprint)

No.	Stationing	Location Description	Property Owner	Characteristics / Land Use	TMF Ramps to Mainline	Residential Impacts	Wetland Impacts (acres)	Parkland Impacts	Other Impacts / Cost Differential	Distance to DC Station km (miles)
1	118+500	Greenbelt, MD East of BWP	BARC, NASA, Prince George's County	Woods, cropland Institutional - USDA facilities 18m (60 ft) elevation differential	Ramps would connect to mainline in tunnel Unacceptable	None	1	Yes	Relocate Explorer Rd	18.5 (11)
2	119+500	Greenbelt, MD West of BWP	BARC, Greenbelt	Greenbelt Forest Preserve Woods, cropland Institutional - USDA facilities 29m (95 ft) elevation differential	Ramps would connect to mainline in tunnel Unacceptable	44 acres zoned residential, not developed	4	Yes	Relocate access road to Northway Fields ballpark	19.5 (12)
3	121+000	BARC East Parallel to BWP	BARC	Woods, rivers, wetlands, cropland Institutional - USDA facilities 12m (40 ft) elevation differential	Ramps would connect to mainline in tunnel Unacceptable	None	34	No	Relocate Beaver Dam Rd	21 (13)
4[3]	121+000	BARC East	BARC, NASA	Airstrip, wooded, wetlands Institutional - USDA facilities 15m (50 ft) elevation differential	Ramps connect above ground to viaduct. No issue.	None	4	No	Relocate Springfield Rd Adjacent to NASA GGAO Ramps would be adjacent to BARC research fields may influence evapotransporation research, impacts to be assessed and mitigations to be developed in consultation w/BARC.	21 (13)
5[4]	121+500	BARC West	BARC, private	Woods, wetlands Institutional - USDA facilities: Several deteriorating buildings, 14 of which are slated for demolition per the recent EA (United States Department of Agriculture, 2020) 15m (50 ft) elevation differential	Ramps connect above ground to viaduct. No issue.	0.5 acre zoned residential, not developed	4	No	Relocate Entomology Rd Adjacent to DoS Beltsville Information Management Center Ramps in vicinity of BARC research fields may influence evapotransporation research, impacts to be assessed and mitigations to be developed in consultation w/BARC.	21 (13)
6	122+500	BARC West Perpendicular	BARC, GSA	Woods, wetlands Institutional - USDA facilities	East-West orientation of TMF requires ramps across US Secret Service Alt J1 ramps cross BW Parkway two times	None	11	No	Adjacent to DoS Beltsville Information Management Center Relocate US Secret Service training facility due to TMF ramp traversing through the middle of the campus. Unacceptable	22.5 (14)

[3] Alternative recommended for further study in the DEIS

[4] Alternative recommended for further study in the DEIS

No.	Stationing	Location Description	Property Owner	Characteristics / Land Use	TMF Ramps to Mainline	Residential Impacts	Wetland Impacts (acres)	Parkland Impacts	Other Impacts / Cost Differential	Distance to DC Station km (miles)
7	124+000	Konterra, Beltsville, MD	PEPCO, Konterra Associates LLC	Open, disturbed 30m (100 ft) elevation differential	3 miles of ramps through residential and commercial areas	Ramps cross through several residential neighborhoods. Unacceptable	2	No	Site development is planned	24 (15)
8	127+500	Suburban Airport, Maryland City, MD	Commercial, Anne Arundel County	Woods, parkland Residential Former Suburban Airport site 14m (45 ft) elevation differential	Ramps connect above ground to viaduct. No issues	Over 50 homes Unacceptable	44	Yes	Relocate Brock Bridge Road Relocate Maryland City Wastewater Treatment Facility Relocate Maryland City Park ball fields	27.5 (17)
9	130+500	Russett, MD	Anne Arundel County, Private Owners	Woods, Wetlands 37m (120 ft) elevation differential	1 mile of ramps through residential and commercial areas	5 to 10 homes for TMF and ramps Unacceptable	23	No	Relocate Resurrection Roman Catholic Church Relocate Brock Bridge Rd	30.5 (19)
10A[5]	130+500	MD-198 East-West Laurel, MD	Federal Gov't (DC use) BGE Private	Woods, Wetlands, Commercial, Rivers Institutional Conservation easement 30m (100 ft) elevation differential	Ramps connect above ground to viaduct. No issues	None	32	Yes	Encroaches 10m (30 ft) into Tipton Airport airspace Oak Hill Conservation Easement 61m (200 ft) high shop next to residential area Relocate BGE critical infrastructure, relocate Job Corps Relocate Old Portland Rd	30.5 (19)
10B	130+500	MD-198 East-West Laurel, MD Same as Alternative 10A, except TMF depressed 20m (66 ft) to avoid Tipton airspace	Federal Gov't (DC use) BGE Private	Woods, Wetlands, Commercial, Rivers Institutional Conservation easement 30m (100 ft) elevation differential	Ramps are depressed in tunnel, with tunnel portals and switchbox in Patuxent Research Refuge Unacceptable	None	32	Yes	Avoids Tipton Airport airspace impact Oak Hill Conservation Easement 52m (170 ft) high shops next to residential area Relocate BGE critical infrastructure, relocate Job Corps Relocate Old Portland Rd Portal and switchbox in Patuxent Refuge Unacceptable Added cost of approximately $500 million for depressed TMF and ramps Unacceptable	30.5 (19)

[5] Alternative recommended for further study in the DEIS

No.	Stationing	Location Description	Property Owner	Characteristics / Land Use	TMF Ramps to Mainline	Residential Impacts	Wetland Impacts (acres)	Parkland Impacts	Other Impacts / Cost Differential	Distance to DC Station km (miles)
11	130+500	MD-198 North-South Laurel, MD	Federal Gov't (DC use)	Woods, Institutional River valley Cemetery Conservation easement 24m (80 ft) elevation differential	Ramps connect above ground to viaduct. No issues	None	17	Yes	Historic Forest Haven Cemetery Oak Hill Conservation Easement Relocate critical BGE infrastructure Relocate Maya Angelou Academy / Youth Rehabilitation Services Department (DC) 61m (200 ft) high shops Relocate River Rd, Center Ave, Forest Haven Ave, Old Portland Rd Unacceptable	30.5 (19)
12	133+500	Fort Meade	Fort Meade (NSA Exclusive Use)	Institutional, Woods 29m (95 ft) elevation differential	OK for Alt J. Alt J1 is in tunnel, requires 3 mile long ramps to North portal	30 homes Unacceptable	0	No	Relocate multiple NSA facilities Relocate Connector Rd Unacceptable	33.5 (21)
13	142+500	BWI Airport	State of Maryland	Airport, Woods 21m (70 ft) elevation differential	Ramps would connect to mainline in tunnel Unacceptable	Switchboxes for ramps would impact dozens of homes. Unacceptable	0	No	Relocate active BWI freight facilities Relocate planned new runway at BWI Relocate Mathison Way Unacceptable Requires underground facility, and underground ramps, with additional cost of approximately $1 billion Unacceptable	42.5 (26)
14	153+500	Patapsco/ Cherry Hill	Private commercial/ industrial CSX, MTA Residential Baltimore County	Developed area Parkland Utilities 18m (60 ft) elevation differential	Ramps would connect to mainline in tunnel Unacceptable	Hundreds of residences in 20 acres of Cherry Hill apartment buildings Unacceptable	0	Yes	Relocate CSX Relocate MTA Light Rail Relocate W. Patapsco Ave Southwest Area Park	53.5 (33)

7.3 EVALUATION OF ALTERNATIVES

Based on the evaluation provided in Table 1, all but three alternatives were found to have conditions that did not meet the design criteria for the project. The two BARC alternatives were found to have the least amount of impacts, and given both alternatives were located on BARC property it was determined to retain a third non-BARC alternative for purposes of study and comparison to the two BARC alternatives.

- Six alternatives did not allow connecting ramps to the viaduct section of the mainline: #1, #2, #3, #10B, #13 and #14
- Six alternatives impact existing residences: #7, #8, #9, #12, #13 and #14
- Six alternatives had other impacts of a severity that mitigation would be difficult or impossible: #6, #10A, #10B, #11, #12 and #13
- Two alternatives, #10B and #13, had an unreasonable cost penalty for all underground construction

Impacts to parks and wetlands were also assessed:

- Four sites have over 20 acres of wetland impacts: #3, #8, #9, #10A and #10B
- Seven sites impact parkland: #1, #2, #8, #10A, #10B, #11 and #14

The original MD-198 (#10A) location that was recommended for further study in the Alternatives Report was found to have multiple design, construction and property complications in the opinion of BWRR. The following impacts were identified (see Figure 9):

- Substantial elevation changes across the site resulting in a 60m high (200 feet or 20 stories) maintenance shop within a river valley and adjacent to a new residential development.
- Encroachment into the Tipton Airport airspace (Note: an EA is under review by the FAA to extend the airport's runway and expand the clear zones at both ends of the runway).
- Encroachment on the Oak Hill Conservation Easement that was created as part of a consent agreement with USEPA.
- Impacts to critical BGE infrastructure, including aerial and underground power lines feeding NSA and underground gas lines. BGE has stated it is unacceptable to impact power supply to NASA.

With the exception of mitigating airspace encroachment, the excavated and depressed version of the MD-198 site (#10B) does not eliminate these impacts. A depressed facility would add substantial cost (near $500 million).

Aside from the sites located on BARC property, the MD-198 site (#10A) is the only other site that does not require residential displacements. It is the only non-BARC alternative and so is retained for further discussion and comparison with the two BARC alternatives.

The Patapsco / Cherry Hill TMF location that was identified following the Alternatives Report is no longer considered viable with the final TMF footprint. The following impacts were identified:

- Substantial residential impacts.
- TMF ramps would not be able to connect to the mainline in a viaduct section, see Figure 10.

Figure 9. Alternative #10 MD-198 TMF

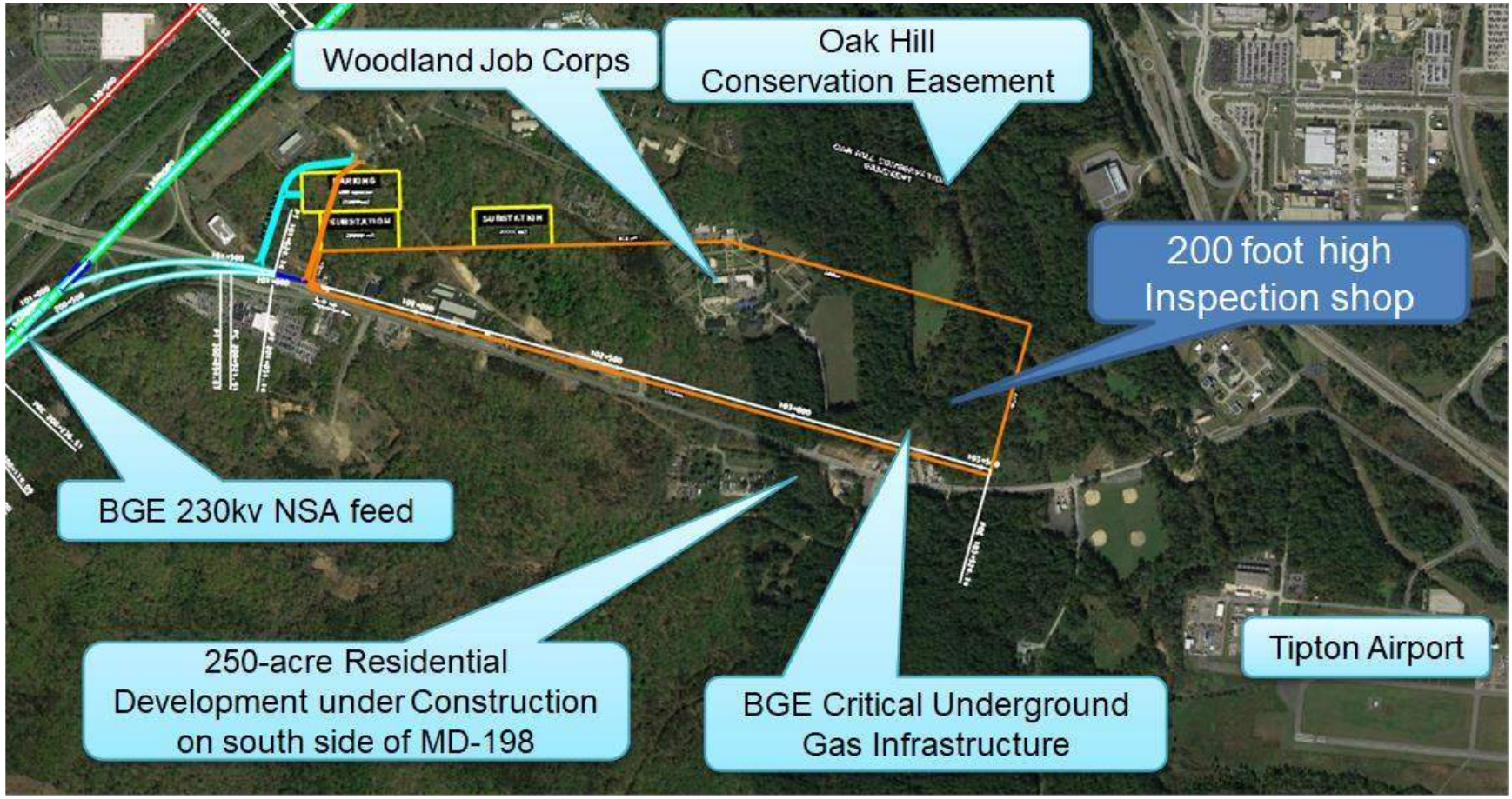
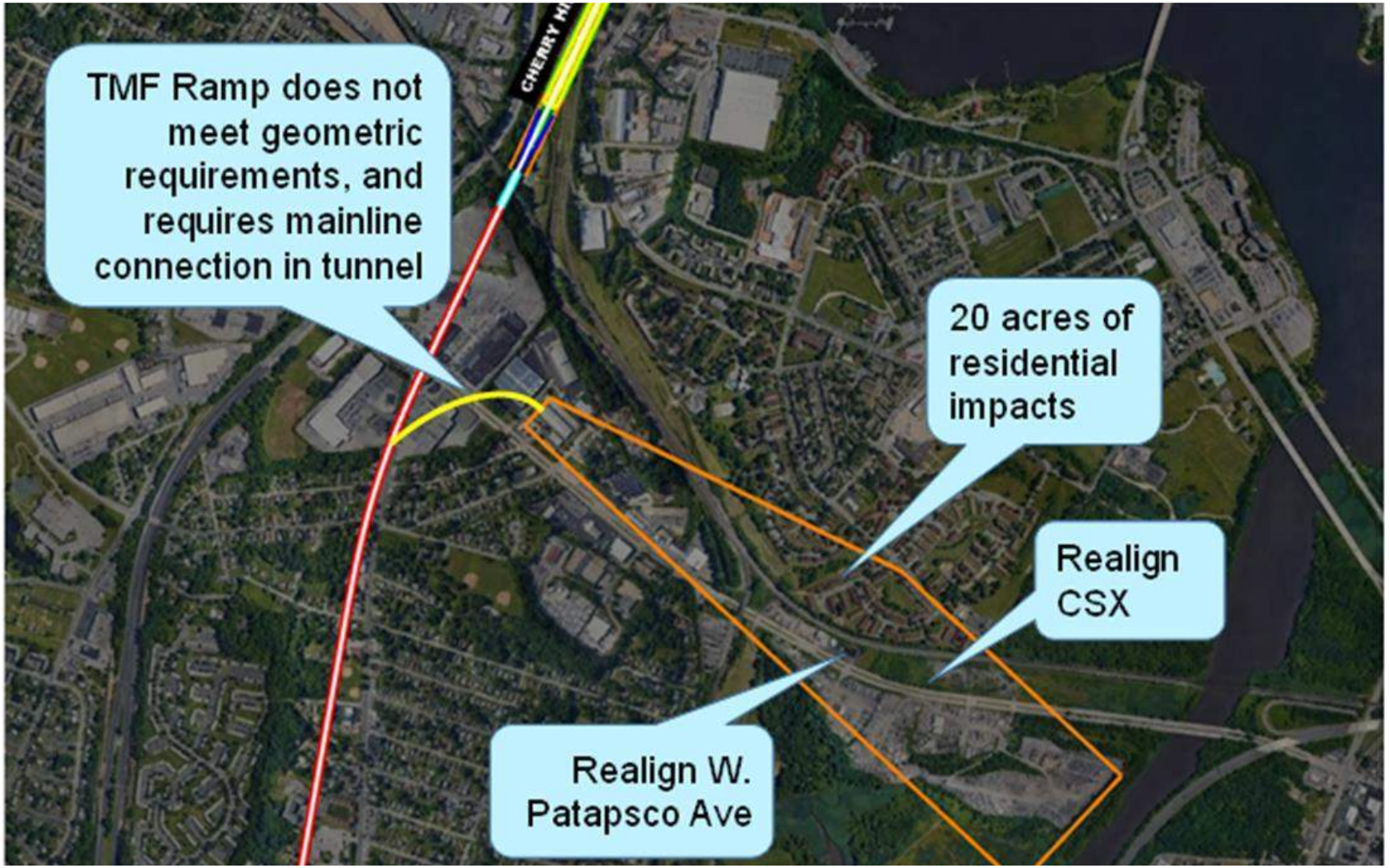


Figure 10. Alternative #14 Patapsco Avenue TMF



8. CONCLUSIONS AND RECOMMENDATIONS

Avoiding impacts to residential properties through this densely populated corridor presents the single biggest challenge to siting a TMF. Of the alternatives studied, two were found by BWRR to best meet the design criteria and a third, while containing multiple property, design and construction complications is retained for further review and comment in comparison with BARC alternatives in the DEIS:

- **#4 BARC East** – Located on the USDA BARC Eastern campus on land formerly used as an airstrip. Adjacent to NASA Goddard Geophysical and Astronomical Observatory (GGAO). NASA raised issues related to frequency interference, EMF, vibrations, and light impacts; BWRR believes these concerns can be mitigated. For example, the primary frequencies used by SCMAGLEV are outside the frequency range identified by NASA as a concern. BWRR believes additional concerns can be mitigated upon detailed review and discussion.
- **#5 BARC West** – Located on the USDA BARC Central Farm on forested land; adjacent to the Department of State (DoS) Beltsville Information Management Center and a residential area. In a discussion between BWRR and DoS on November 22, 2019, the DoS representative indicated there would be no concerns about potential interference from the TMF.
- **#10A MD-198 –** Located on the North side of MD-198 encroaching 10m (30 ft) into Tipton Airport airspace, requiring an FAA Safety Waiver, into the Oak Hill Conservation Easement, requiring a release or replacement of the conservation easement, with a 61m (200 ft) high shop next to residential area, which BWRR deemed a significant impact, requiring relocation of BGE critical infrastructure, which BGE has noted is not subject to relocation due to national security concerns, and relocation of Job Corps facilities, which are possible but difficult.

The BARC property sites are reasonable choices for full NEPA evaluation given BARC's ability to house a 180-acre facility without residential impacts and its proximity to the Washington, DC terminus station. It is similar to public uses currently occupying BARC (or former BARC) property and new proposed uses. Of note, BARC recently was issued a Finding of No Significant Impact for the demolition of 22 derelict buildings, 14 of which are within the TMF footprint. This highlights the fact that BARC West is not a pristine untouched habitat.

To help mitigate concerns expressed by BARC in the Alternatives Report, BWRR proposes to explore hardscaping mitigations such as engineered drainage management and "green roof" systems as well as solar panel installations on the approximately 100-acres of TMF roofs.

These mitigations would be beneficial to BARC for the following reasons:

- The project mainline will be constructed on an elevated viaduct, which may offer other opportunities for the study of vegetation control measures for grasses, low shrubs, and other flora located adjacent to cropland and transportation infrastructure.
- Possible use of TMF Site facilities to preserve 100+ acres of green rooftop for the study of:
    - Cropping efficiency, productivity, and quality using roofs and other hard infrastructure as a sustainable crop production system (See National Programs # 216 "Sustainable Agricultural Systems Research;" # 305 "Crop Production").
    - Soil biodiversity and nutrient retention on green-rooftop and other hard-infrastructure systems (See National Program # 212 "Soil and Air").

- Innovative green-rooftop technologies for stormwater storage and retention and improved watershed management (See National Program # 211 “Water Availability and Watershed Management”).

- Utilization of the TMF to construct a modern greenhouse over a portion of the site.
  - USDA would benefit from a large-scale facility for greenhouse research projects.

Figure #11 shows Alternative #4, BARC East, including a MOW facility, substations, parking facility, and connecting ramps to the Alternative J alignment. Figure #12 shows the same TMF connecting to the Alternative J1 alignment, with TMF ramps crossing over the Baltimore-Washington Parkway.

Figure #13 shows Alternative #5, BARC West, with the supplemental facilities and connecting ramps to the Alternative J alignment across the Baltimore-Washington Parkway. Figure #14 shows the TMF with ramps connecting to the Alternative J1 alignment.

Figure #15 shows Alternative #10A, MD-198, developed with the supplemental facilities and connecting ramps to the Alternative J alignment. Figure #16 shows the TMF with ramps connecting across the Baltimore-Washington Parkway to the Alternative J1 alignment.

Figure 11. Alternative #4 BARC East TMF with Alternative J Alignment

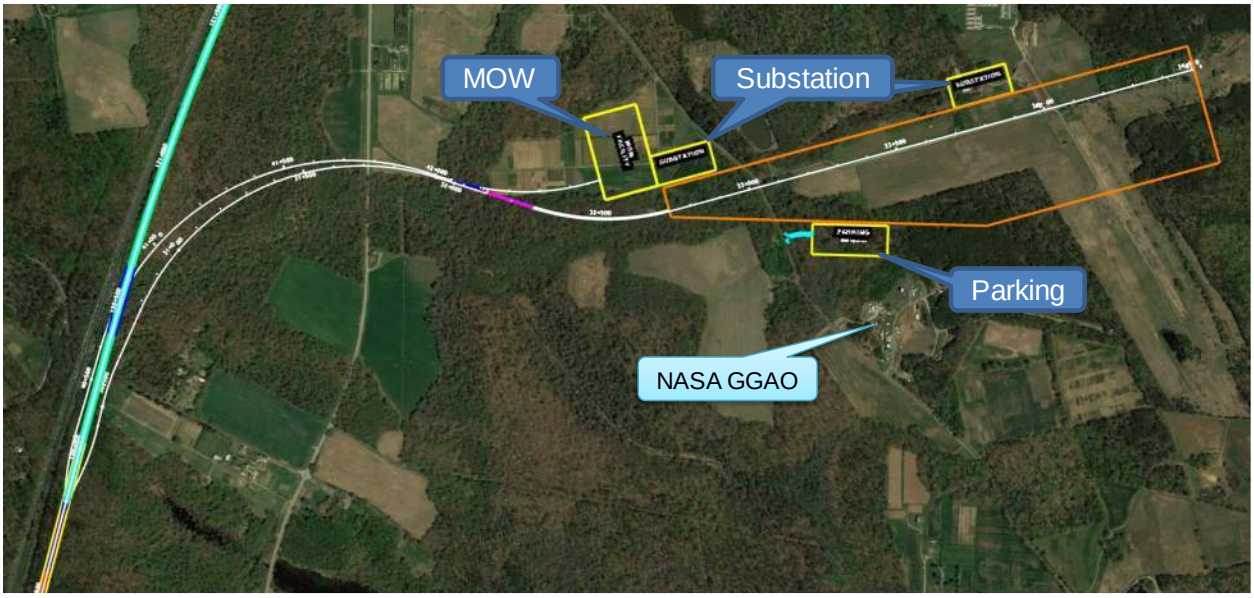


Figure 12. Alternative #4 BARC East TMF with Alternative J1 Alignment

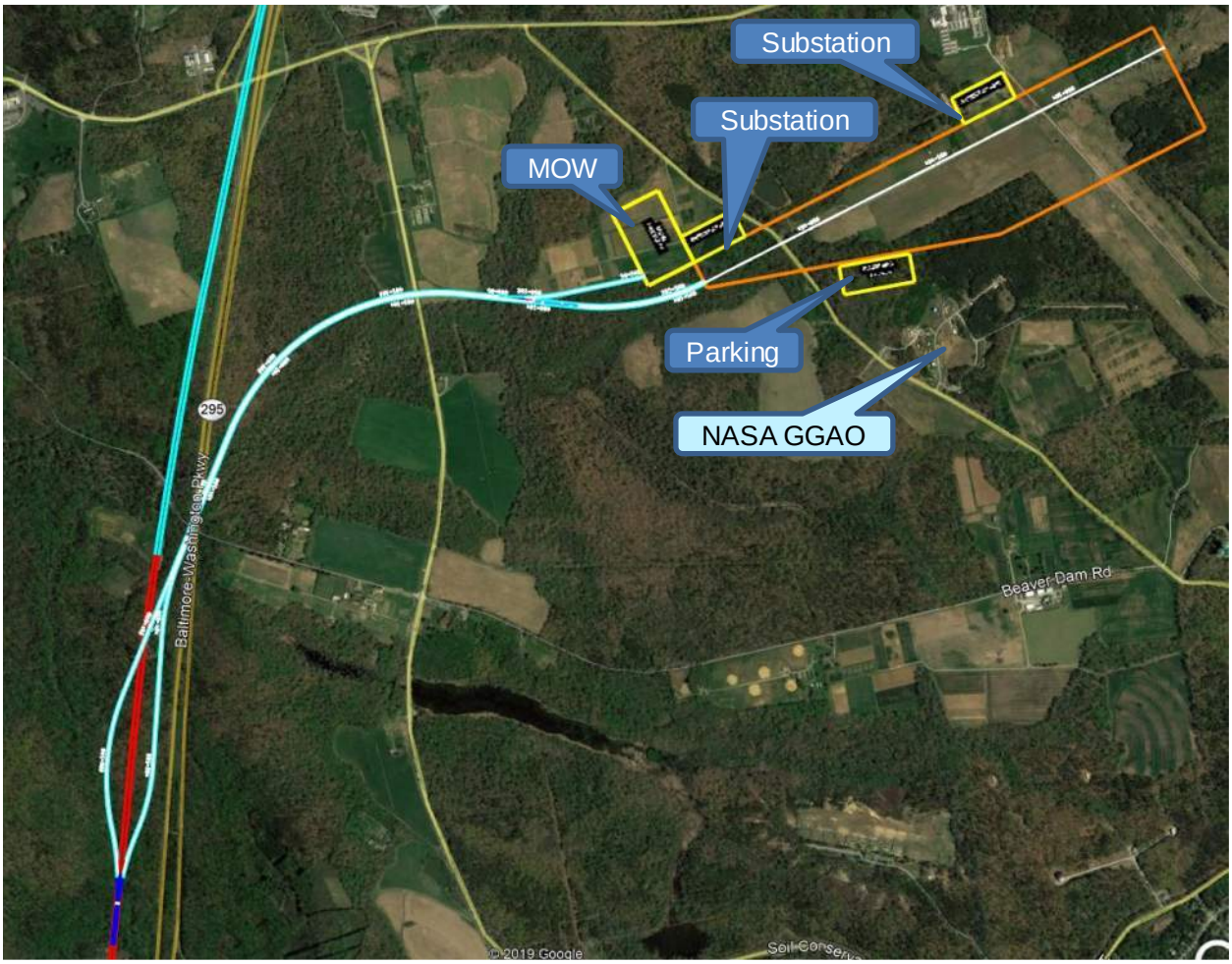


Figure 13. Alternative #5 BARC West TMF with Alternative J Alignment

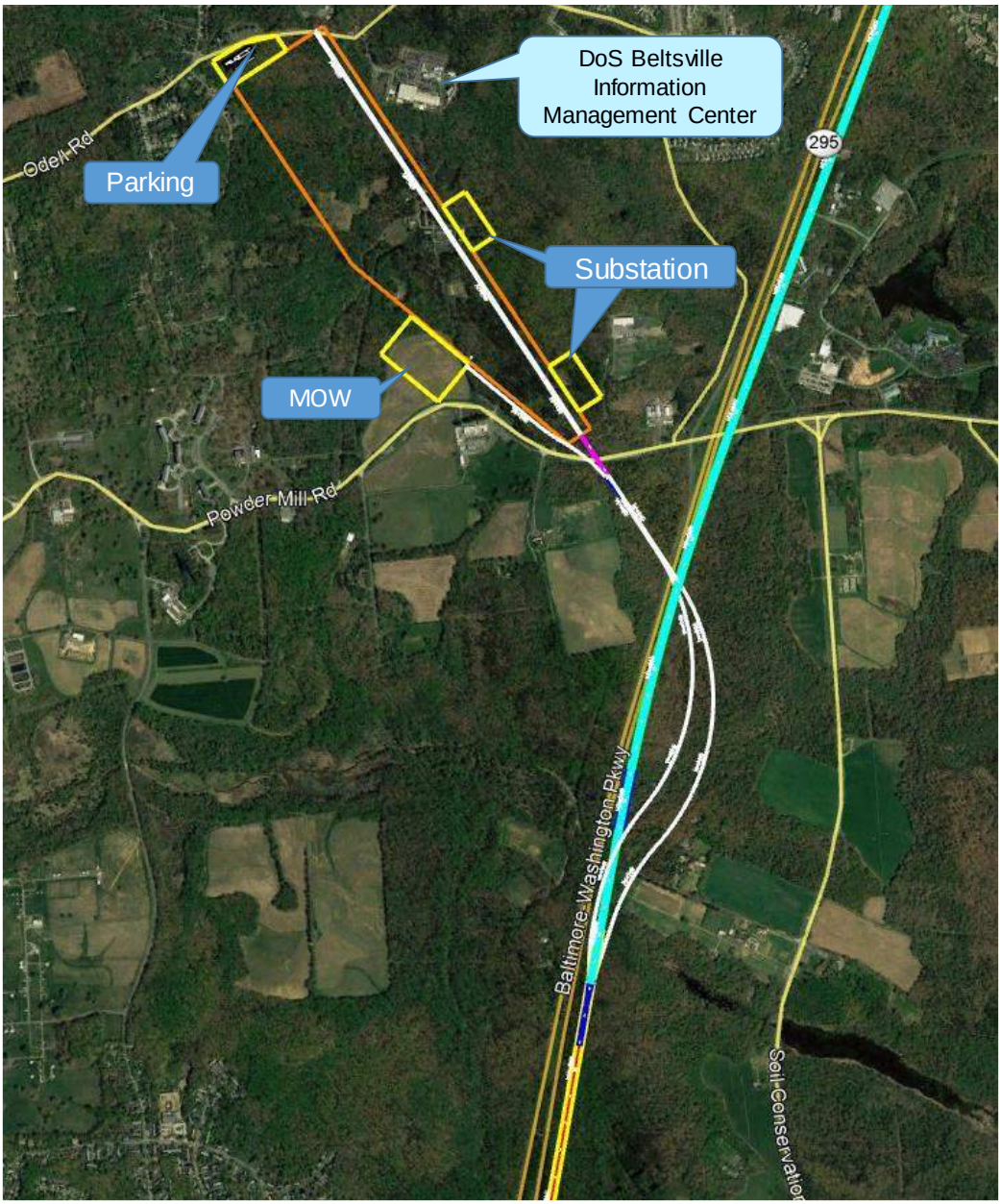


Figure 14. Alternative #5 BARC West TMF with Alternative J1 Alignment

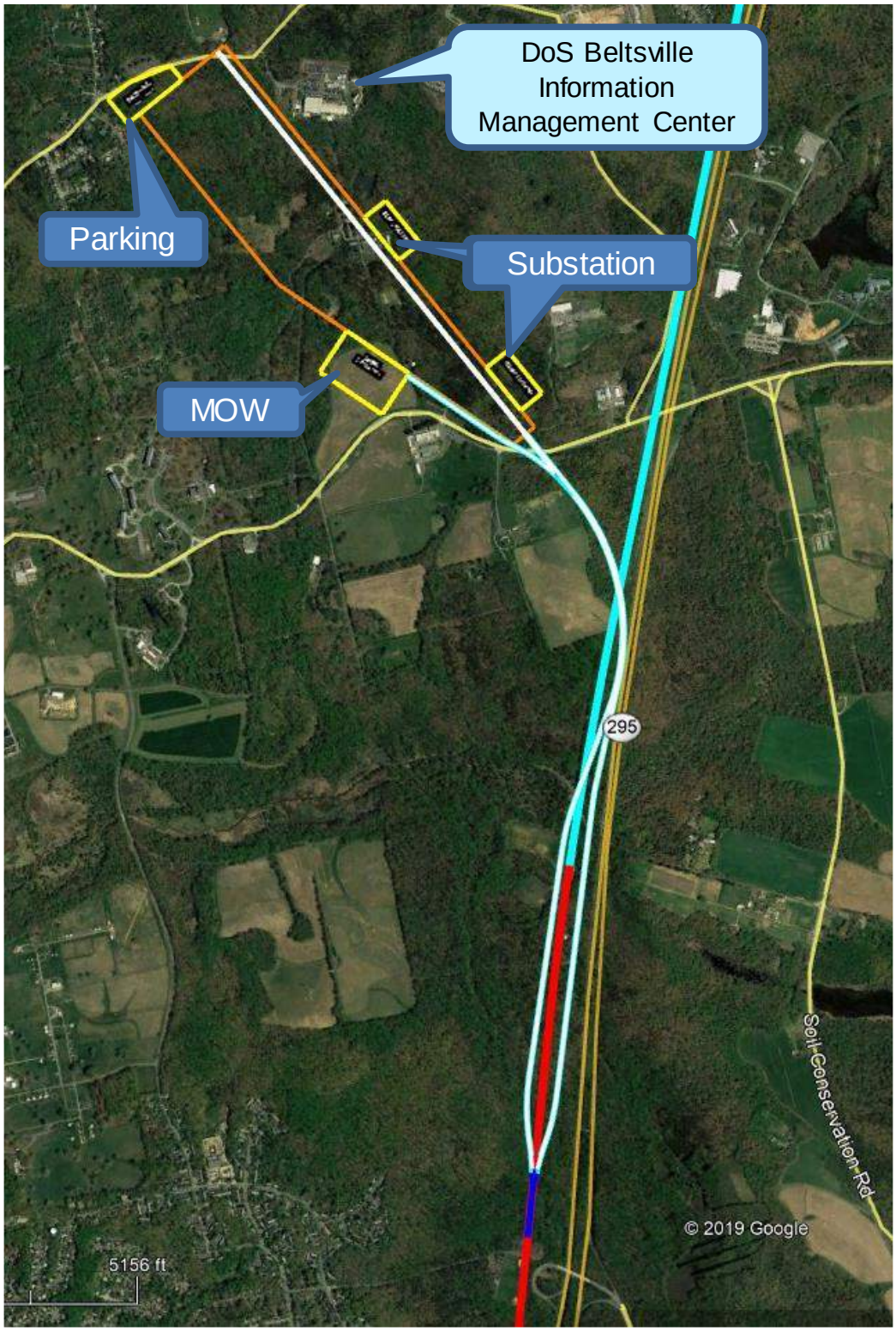


Figure 15. Alternative #10A MD-198 TMF with Alternative J1 Alignment

Figure 16. Alternative #10A MD-198 TMF with Alternative J1 Alignment