

4.2 HYDROLOGY

4.2.1 Methods and Impact Definitions

Impacts to hydrology within the study area were evaluated qualitatively and quantitatively using GIS, aerial photography, literature reviews, and best professional judgment. Factors that are addressed include impacts to surface water and groundwater flows, infiltration and stormwater runoff, and floodplains.

The City of North Charleston Stormwater Program Permitting Standards and Procedures Manual (City of North Charleston 2008b) requires that all hydrologic computations be completed using volume-based hydrograph methods. For estimating peak flows, the manual further requires the use of SCS Method TR-55 for land disturbances greater than one acre. Stage storage and discharge analysis is required. Computer models approved for use by the County include ICPR, Drain: Edge, PondPack/Civil Storm, HEC-HMS, and HYDRAFLOW.

Impact thresholds are defined and managed under the regulatory framework of municipal and state codes. Table 4.2-1 outlines the potential range of impacts and defines their severity for use in comparison of the alternatives.

Table 4.2-1
Impact Definitions, Hydrology

Negligible	Minor	Major
No change in surface water or groundwater flows or circulation. No change in impervious surface from pre- to post-construction. Percentage of impervious surface for the site remains below zoning limit and does not increase stormwater runoff. No base floodplain affected or changes in floodway areas or volume of fill in the floodplain.	Temporary or long-term change to surface water flows or circulation, but the changes do not alter the creek or river channel paths. Percentage of impervious surface for the site remains below zoning limit but increases stormwater runoff; base floodplain affected, but placement of fill in the floodplain does not result in flooding to adjacent areas.	Long-term change to surface water flow or circulation that results in alterations to creek and/or river configurations; reductions in groundwater that may impact their use for municipal water supplies. Percentage of impervious surface for the site exceeds zoning limit and increases stormwater runoff; base floodplain affected and placement of fill in the floodplain would result in flooding to adjacent areas.

4.2.2 No-Action Alternative

Under the No-Action Alternative, the study area would remain as a mixed industrial land use, where mixed use (residential and commercial) and industrial land uses occur. In light of Palmetto Railway's ownership of the properties, there would be the potential for redevelopment of these areas to include rail-served warehousing and distribution. These land uses could result in alterations to land cover, and, if adjacent to or within waterways, could have the potential to alter surface water flows and

circulation; however, adherence to local ordinances, including the conduct of requisite modeling, and the use of BMPs to control runoff, would likely result in a negligible impact to hydrology.

Under the existing zoning, a maximum impervious level of 82 percent would be allowable. If future development within the study area increased the percentage from the existing impervious surface of the Project site from 40 to 82 percent, the area would experience a permanent increase, but still below the zoning limit of 82 percent, resulting in a permanent, minor adverse impact. Increases in impervious surface can result in less water infiltration from precipitation, thus reducing groundwater recharge and increasing stormwater runoff. Higher frequency runoff volumes may cause increased flooding, scour, erosion, and the deposition of sediments within waterways. Compliance with current stormwater management requirements, potentially including the use of stormwater detention ponds, with future development would minimize the impact of any increase in stormwater runoff to adjacent water bodies, such as Noisette Creek and Shipyard Creek, and instead could provide a minor beneficial impact where no existing stormwater treatment measures exist. The River Center project site would essentially remain at its present 85 percent impervious surface, representing a negligible impact.

Increased impervious surfaces and soil compaction may result from the redevelopment of these areas to include rail-served warehousing and distribution. Soil compaction increases the bulk density of soil reducing its porosity. With fewer natural voids, the rate of infiltration is reduced and the movement of the water below is restricted. Localized groundwater recharge is expected to decrease in light of future development's increases in impervious surface; however, any impact to the aquifer's ability to recharge would be negligible based on the aerial extent of the aquifer and location.

The majority of the ICTF and River Center project sites lie within the 100-year floodplain (See Section 3.2.7). Future residential, commercial, and/or industrial development activities would likely result in the placement of fill and could potentially increase elevations within the study area; however, in light of the existing floodplain zone designations, the fact that the BFE would not change because it is based on coastal surge, and because development activities would conform to applicable state and/or local floodplain protection standards, the development would not increase the flood hazard to other properties. Impacts to floodplains would be negligible.

4.2.3 Alternative 1: Proposed Project (South via Milford / North via Hospital District)

Alternative 1 (Proposed Project) would involve activities that can affect hydrology, such as the construction of impervious surfaces associated with the Navy Base ICTF, and roadway and rail improvements adjacent to and/or within Noisette Creek and Shipyard Creek. Construction of the facility would also require grading of the facility site; however, this fill would be sourced both on-site and off-site. Permanent placement of additional bridge pilings within Shipyard Creek would introduce permanent obstructions into the waterways. Alternative 1 (Proposed Project) would

involve rehabilitating the existing railroad bridge across Noisette Creek by elevating the superstructure a foot to improve hydrology and sheathing existing piles to accommodate the arrival/departure tracks which would result in a negligible impact to surface water flows and circulation patterns. It is not expected that areas within these waterways would be subjected to a measurable change in tidal velocities or alteration in creek configuration as a result of the Alternative 1 (Proposed Project) elements.

Embankment construction through the tidal salt marsh for the arrival/departure tracks near the southwestern limits of the Project would result in the fragmentation of habitat and potential loss of a hydrologic connection to Shipyard Creek; however, the placement of culverts as proposed by the Applicant as a mitigation measure, which would be sized to minimize upchannel surcharge of runoff, would maintain tidal flushing to tidal salt marsh areas to the east of the arrival/departure tracks, and would ensure that any change in hydrology or potential for flooding upstream would be negligible.

Increases to impervious surfaces would be expected to be similar to a full build-out under the No-Action Alternative, resulting in a permanent, minor adverse impact, with the existing impervious surface of the Project site increasing from 40 to 82 percent; however, stormwater management improvements by Palmetto Railways, including placement of pipe of varying sizes, underdrains, construction of five dry detention ponds, and vegetated swales, as well as other BMPs associated with roadway and rail improvements, would collect and slowly release stormwater runoff. As a result, these mitigation measures would minimize the potential for adverse impacts to Noisette Creek, Shipyard Creek, and the Cooper River. Overall, stormwater runoff would be better captured and detained, and its discharge managed, to prevent downstream scour under Alternative 1 (Proposed Project) versus existing conditions, resulting in a minor beneficial impact because no such stormwater facilities currently exist.

Increased impervious surfaces and soil compaction may result from the construction of the proposed embankments and structures. Localized groundwater recharge is expected to decrease in light of the increase in impervious surface within the Project site; however, any impact to the aquifer's ability to recharge would be negligible based on the aerial extent of the aquifer and the Project site's location.

Most of the Project site lies within the Special Flood Hazard Area (SFHA), or 100-year floodplain. Approximately 58.5 percent of the site is within zone AE, 3.4 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (24.6 percent) and zone X (13.5 percent) (Figure 4.2-1). Zone A and Zone AE represent those areas subject to inundation by the 1-percent-annual-chance flood event or the 100-year floodplain, with Zone AE including Base Flood Elevations (BFEs) and Zone A not including BFEs. Zone VE are coastal high-hazard areas where wave action and/or high-velocity water can cause structural damage during the 100-year flood. The 0.2 percent annual chance flood hazard is also known as the 500-year flood. Zone X is outside the 500-year floodplain.

The ICTF design was based on the preliminary Flood Insurance Rate Map (FIRM) data at the time of the EIS, and the design requires the placement of fill within the Project site. Accordingly, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the ICTF would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRMs (but not the BFEs), then Palmetto Railways would need to coordinate with the local National Flood Insurance Program (NFIP) to obtain any necessary permits.

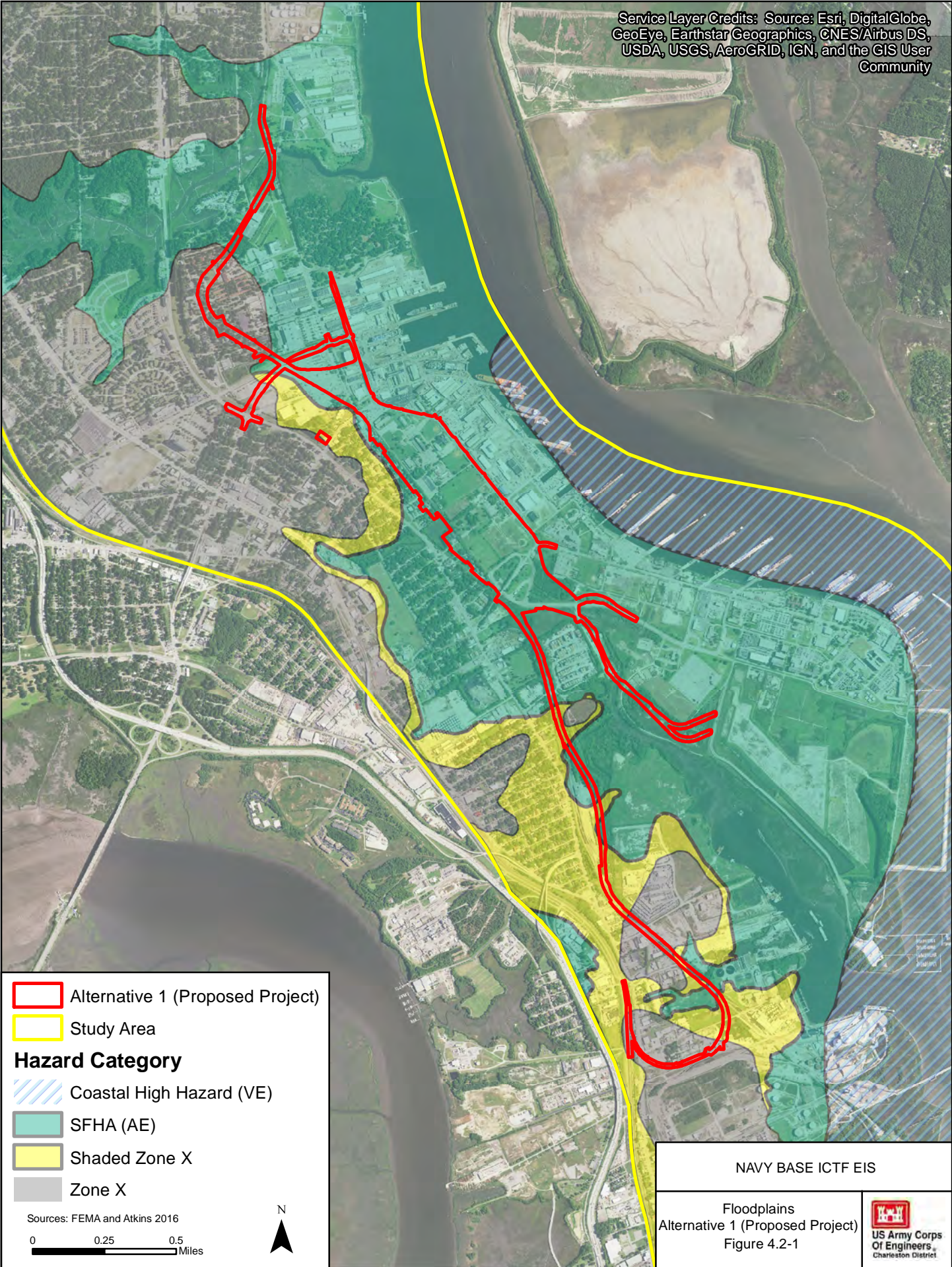
4.2.4 Alternative 2: Proposed Project Site (South via Milford / North via S-line)

Under Alternative 2, impacts to hydrology and impervious surfaces would be similar to those discussed under Alternative 1 (Proposed Project). Most of the Project site lies within the SFHA with 58.7 percent in zone AE, 3.3 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (25.7 percent) and zone X (12.3 percent) (Figure 4.2-2). Due to construction activities associated with Alternative 2, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

4.2.5 Alternative 3: Proposed Project Site (South via Kingsworth / North via Hospital District)

Under Alternative 3, impacts to hydrology and impervious surfaces would be similar to those discussed under Alternative 1 (Proposed Project). The majority of the Project site lies within the SFHA with 63.8 percent in zone AE, 3.7 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (21.5 percent) and zone X (11.0 percent) (Figure 4.2-3). Due to construction activities associated with Alternative 3, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Alternative 1 (Proposed Project)

Study Area

Hazard Category

Coastal High Hazard (VE)

SFHA (AE)

Shaded Zone X

Zone X

Sources: FEMA and Atkins 2016

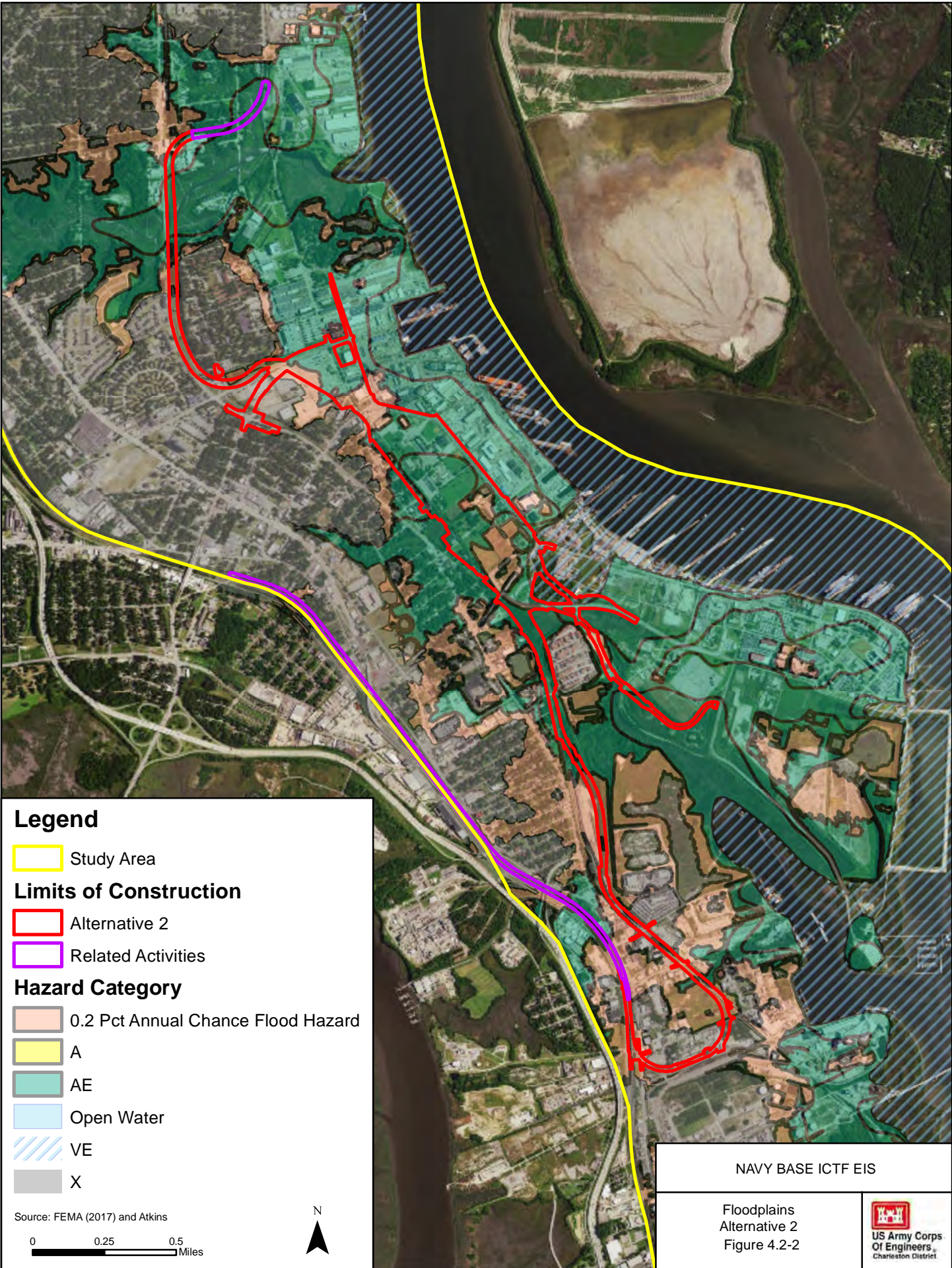
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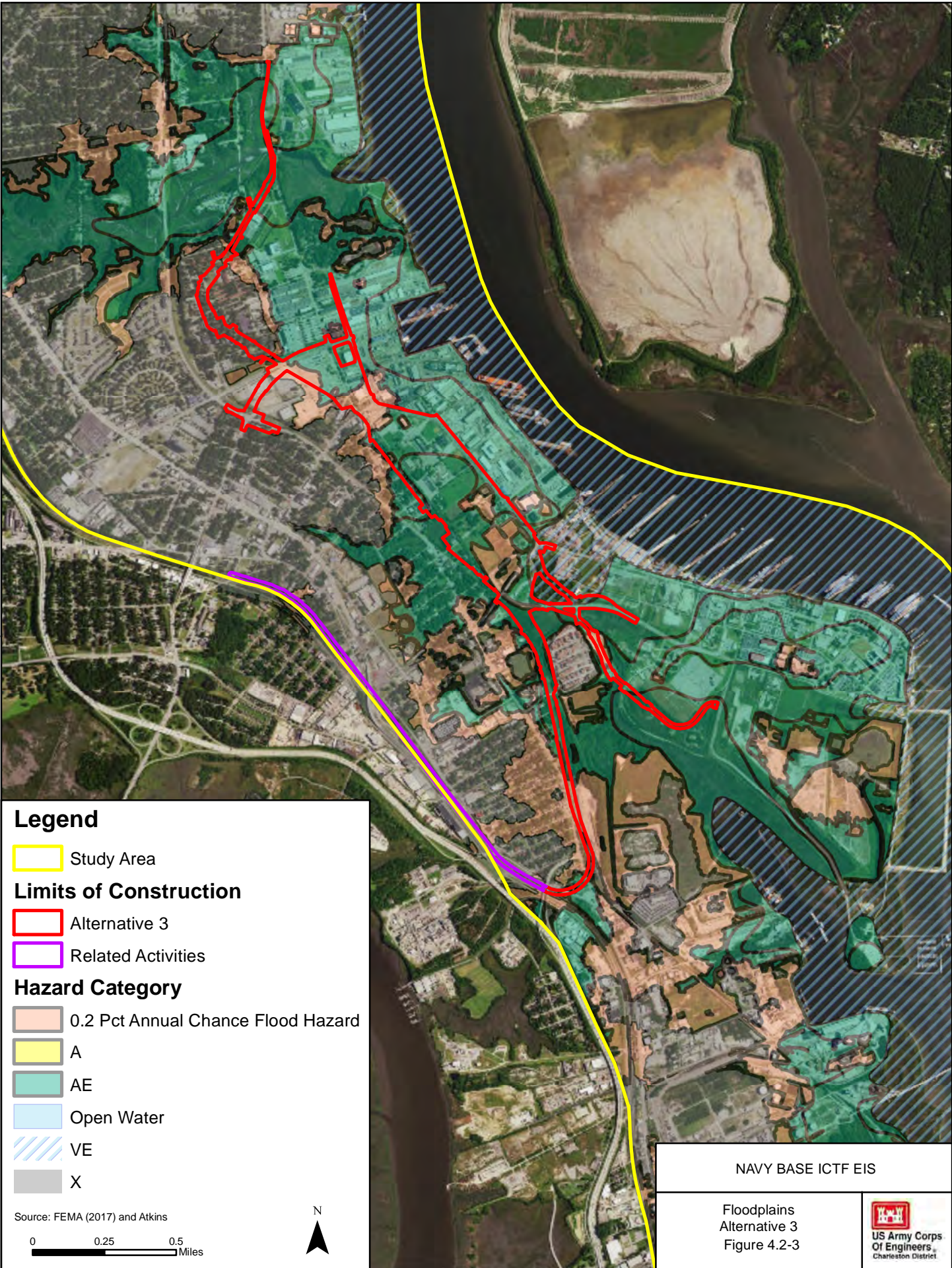


NAVY BASE ICTF EIS

Floodplains
Alternative 1 (Proposed Project)
Figure 4.2-1







4.2.6 Alternative 4: Proposed Project Site (South via Milford)

Under Alternative 4, impacts to hydrology and impervious surfaces would be similar to those discussed under Alternative 1 (Proposed Project); however, the superstructure of Noisette Creek bridge would not be elevated by a foot to improve hydrology. Most of the Project site lies within the SFHA with 57.0 percent in zone AE, 3.4 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (25.1 percent) and zone X (14.6 percent) (Figure 4.2-4). Due to construction activities associated with Alternative 4, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

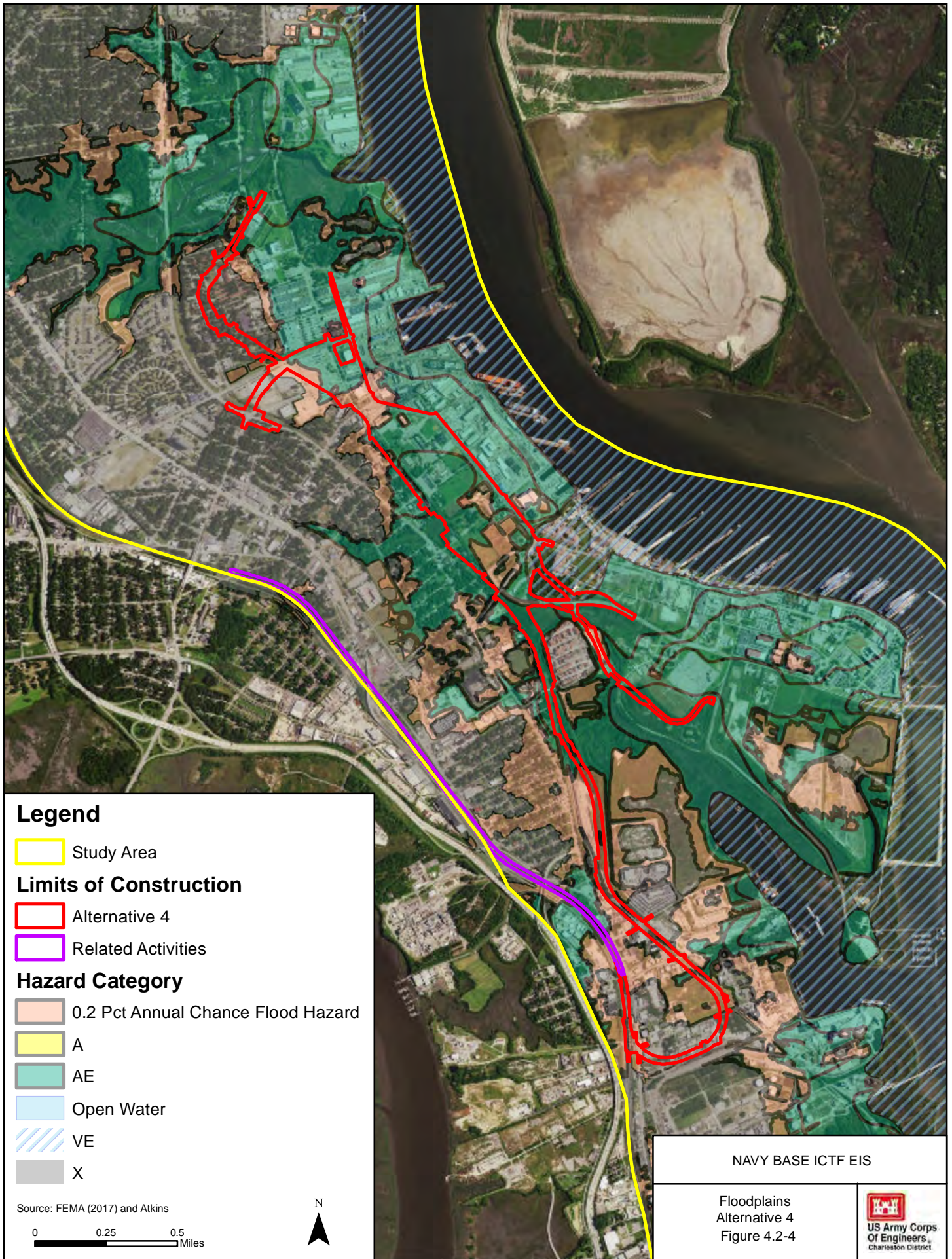
4.2.7 Alternative 5: River Center Project Site (South via Milford /North via Hospital District)

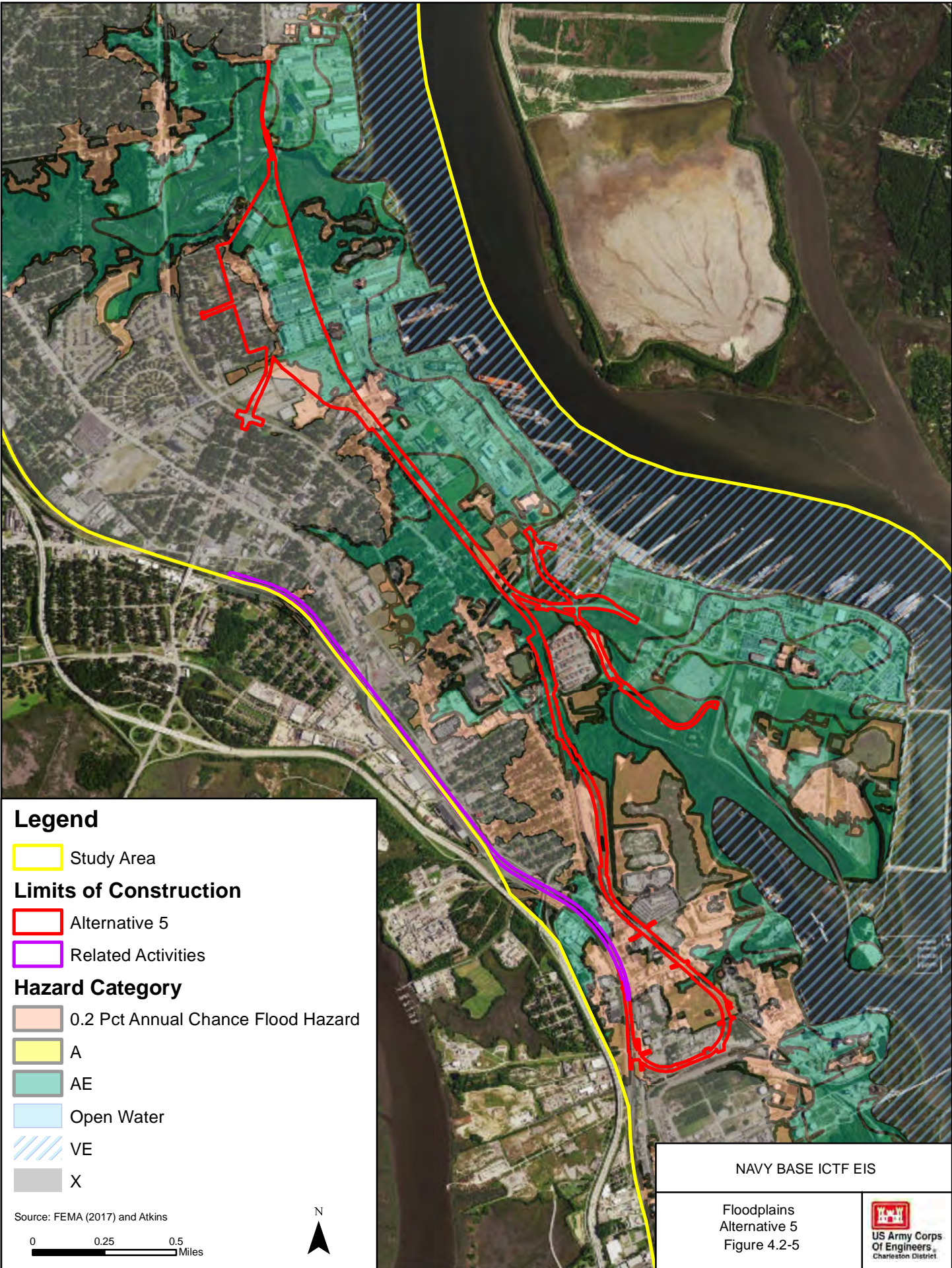
Under Alternative 5, impacts to hydrology would be similar to those discussed under Alternative 1 (Proposed Project). There would not be a notable increase in impervious surfaces under Alternative 5 because a majority of the River Center project site is already paved and contains an impervious surface (currently 85 percent). As a result, there would be a negligible impact to infiltration rates and groundwater recharge. The use of dry detention ponds associated with the River Center ICTF would instead result in a minor beneficial impact by improving the capture and treatment of stormwater runoff, where no such stormwater facilities currently exist.

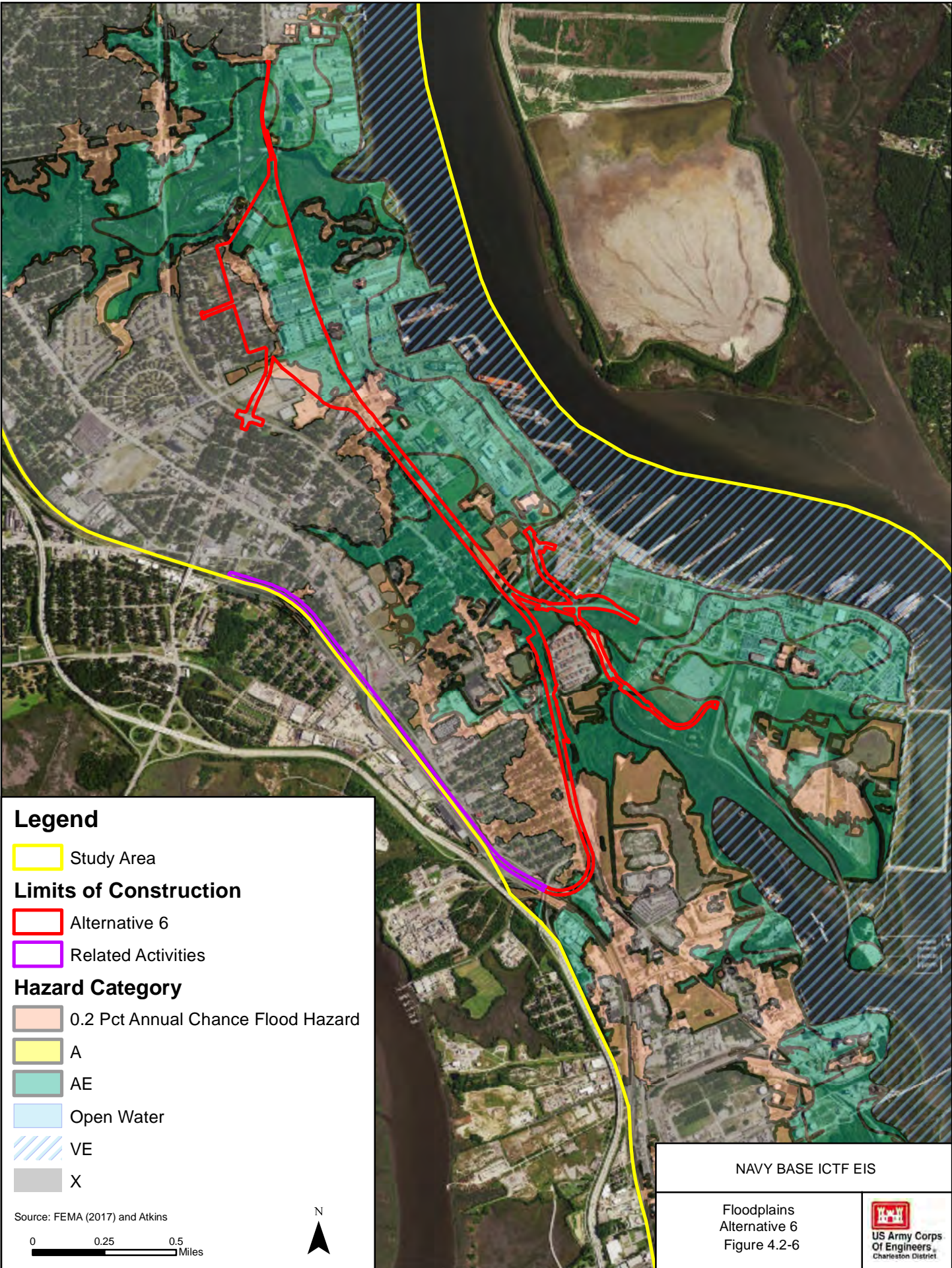
A large portion of the River Center project site lies within the SFHA with 57.3 percent in zone AE, 3.0 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (23.4 percent) and zone X (16.3 percent) (Figure 4.2-5). Due to construction activities associated with Alternative 5, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

4.2.8 Alternative 6: River Center Project Site (South via Kingsworth /North via Hospital District)

Under Alternative 6, impacts to hydrology and impervious surface area would be similar to those discussed under Alternative 5. Most of the Project site lies within the SFHA with 63.8 percent in zone AE, 3.4 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (19.3







percent) and zone X (13.4 percent) (Figure 4.2-6). Due to construction activities associated with Alternative 6, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

4.2.9 Alternative 7: River Center Project Site (South via Milford)

Under Alternative 7, impacts to hydrology and impervious surface area would be similar to those discussed under Alternative 5; however, the superstructure of Noisette Creek bridge would not be elevated by a foot to improve hydrology. The majority of the Project site lies within the SFHA with 55.8 percent in zone AE, 3.0 percent in zone VE, with the remainder in 0.2 percent annual chance flood hazard (23.8 percent) and zone X (17.4 percent) (Figure 4.2-7). Due to construction activities associated with Alternative 7, surface elevations may increase in the Project site; however, similar to the No-Action Alternative, the BFEs would not change. Therefore, the development would not increase the flood hazard to other properties, and impacts to floodplains would be negligible. If the floodplain zone(s) changes for the Project site as a result of upcoming updates to the FIRM data (but not the BFEs), then Palmetto Railways would need to coordinate with the local NFIP to obtain any necessary permits.

4.2.10 Related Activities

Each alternative's Related Activities fall mostly within zone X (outside the 500-year floodplain), with 80.1 percent for Alternatives 1 and 5, 63.6 percent for Alternative 2, 97.9 percent for Alternatives 3 and 6, and 80.4 percent for Alternatives 4 and 7. Zone AE makes up 3.7 percent of Alternative 1 (Proposed Project) and Alternatives 4, 5 and 7 Related Activities Project area. Alternative 2 Related Activities Project area consists of the highest proportion of Zone AE area with 23.5 percent. Alternatives 3 and 6 Related Activities Project area does not include the Zone AE areas. For each alternative's Related Activities, the 0.2 percent annual chance flood hazard comprised 16.3 percent of Alternative 1 (Proposed Project) and Alternative 5, 13.0 percent of Alternative 2, 2.1 percent of Alternative 3 and 6, 15.9 percent of Alternative 4, and 15.9 percent of Alternative 7.

4.2.11 Summary of Impacts Table

Table 4.2-2 summarizes the environmental consequences to hydrology from Alternative 1 (Proposed Project) and all the alternatives.

Table 4.2-2
Impacts Summary, Hydrology

Alternative	Surface water and groundwater flows and circulation	Impervious Surface/ Infiltration and Stormwater Runoff	Floodplains
No-Action	Negligible impact to surface water flows and circulation resulting from construction activities within and/or adjacent to waterways (e.g., bridges); negligible impact to groundwater	Permanent, minor adverse impact from potential increase in impervious surface; negligible or possibly minor beneficial impact from improved stormwater management	Negligible impact to base floodplain resulting from the placement of fill; negligible impact to flood hazard for adjacent areas
1: Proposed Project: South via Milford / North via Hospital District	Negligible impact to surface water flows and circulation resulting from roadway and rail improvements (e.g., arrival/departure tracks, bridges) across Noisette Creek and Shipyard Creek; negligible impact to groundwater	Permanent, minor adverse impact from increase in impervious surface; minor beneficial impact from improved stormwater management. Negligible effect on groundwater recharge.	Negligible impact to base floodplains resulting from the placement of fill; negligible impact to flood hazard for other adjacent areas
2: South via Milford / North via S-line	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)
3: South via Kingsworth / North via Hospital	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)
4: South via Milford	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)	Similar to Alternative 1 (Proposed Project)
5: River Center Project Site: South via Milford / North via Hospital District	Negligible impact to surface water flows and circulation resulting from roadway and rail improvements (e.g., arrival/departure tracks, bridges) across Noisette Creek and Shipyard Creek; negligible impact to groundwater	Minor beneficial impact from improved stormwater management. Negligible effect on groundwater recharge.	Negligible impact to base floodplain resulting from the placement of fill; negligible impact to flood hazard for other adjacent areas
6: River Center Project Site: South via Kingsworth / North via Hospital	Similar to Alternative 5	Similar to Alternative 5	Similar to Alternative 5

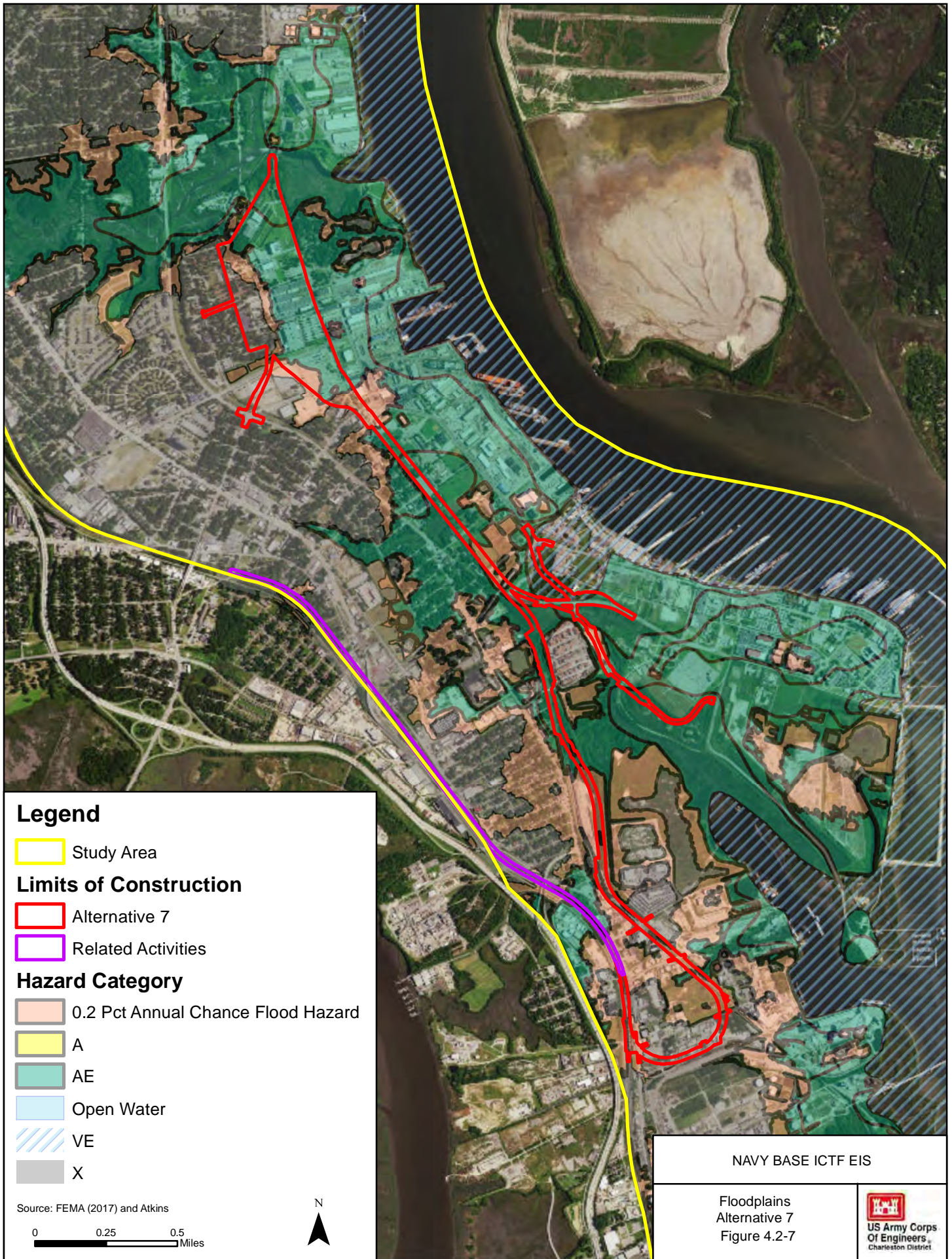
Alternative	Surface water and groundwater flows and circulation	Impervious Surface/ Infiltration and Stormwater Runoff	Floodplains
7: River Center Project Site: South via Milford	Similar to Alternative 5	Similar to Alternative 5	Similar to Alternative 5

Hydrology Impact Definitions

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Minor = Temporary or long-term change to surface water flows or circulation, but the changes do not alter the creek or river channel paths. Percentage of impervious surface for the site remains below zoning limit but increases stormwater runoff; base floodplain affected, but placement of fill in the floodplain does not result in flooding to adjacent areas.

Major = Long-term change to surface water flow or circulation that results in alterations to creek and/or river configurations; reductions in groundwater that may impact their use for municipal water supplies. Percentage of impervious surface for the site exceeds zoning limit and increases stormwater runoff; base floodplain affected and placement of fill in the floodplain would result in flooding to adjacent areas.



4.2.12 Mitigation

4.2.12.1 Applicant's Proposed Avoidance and Minimization Measures

The Applicant has committed to several measures that avoid and/or minimize potential impacts of Alternative 1 (Proposed Project). These measures are taken from Palmetto Railways Mitigation Plan provided in Appendix N. Some of these measures are required under federal, state, and local permits; others are measures that Palmetto Railways has incorporated into the design and operations of Alternative 1 (Proposed Project). Each mitigation measure is also designated as one that either helps to avoid an impact or one that minimizes an impact.

- Design culverts and/or bridges to maintain existing surface drainage patterns and to prevent erosion. (Minimization)
- Where possible, limit the placement of pilings for bridges within waterways. (Avoidance)
- Use existing bridge over Noisette Creek to reduce impacts (Avoidance)
- Design culverts (e.g., under the arrival/departure tracks) and bridges to maintain existing flow and hydrology for wetland areas and to prevent flooding upstream. (Minimization)
- Provide stormwater capacity improvements by constructing new stormwater infrastructure where existing systems are failing from lack of maintenance. (Minimization)

These avoidance and minimization measures, except the items noted with an asterisk (*), have been considered in the preceding impact analysis. The complete list of Applicant-proposed avoidance and minimization measures is also provided in Chapter 6, Table 6-1.

4.2.12.2 Additional Potential Mitigation Measures

The Corps proposes as an additional mitigation measure for Hydrology that the pre-construction course, condition, capacity, and location of open waters must be maintained. Additional avoidance, minimization, and mitigation may be considered by the Corps in its decision-making process. Final mitigation measures may be adopted as conditions of the DA permit and documented in the Record of Decision (ROD).

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