ALTERNATIVES ANALYSIS

Purpose and Need for the Proposed Project

Purpose

The purpose of the proposed action is to implement a Facilities Master Plan for Electric Boat that provides the necessary infrastructure at the Groton facility to allow for both continued safe and efficient design, construction, and lifecycle support of submarines for the U.S. Navy underway currently at that facility, and provides the water-dependent facilities needed to efficiently and safely manage future workload. Continued and future implementation of the U.S. Navy submarine construction and delivery schedule is vital to national security and supports the U.S. Department of Defense critical mission of strategic deterrence.

Need

On-going manufacturing operations in the North Yard of the Electric Boat Groton at the Land Level Submarine Construction Facility preclude the concurrent alteration of that facility for the construction of future submarines, specifically the COLUMBIA class submarines (CCS), which are larger than the current class of submarines in production, the VIRGINIA class submarine (VCS). Specifically, the existing pontoon and graving dock in the North Yard are not of sufficient length to accommodate the CCS. Consequently, to allow for the development of the necessary infrastructure and manufacturing facilities on the Groton site to support the new, larger CCS submarines, construction of new facilities is needed and must occur while the current VIRGINIA class of submarines is still in production. There is also a need to provide the capability to meet the annual production requirements of the U.S. Navy submarine program which specifies two (2) or more VIRGINA class submarines and one (1) COLUMBIA class submarine, starting in Fiscal Year 2021. This project is considered vital to national security. Additionally, EB contractual provisions with the U.S. Navy, assembly of submarines must occur at the Electric Boat facility. As such, the proposed FMP is required to meet Navy submarine production needs. Lastly, there is a need to construct the necessary facilities and infrastructure in a way that will not impact the existing manufacturing process in the North Yard in terms of either safety or efficiency.

Alternatives Assessment

In assessing practicable alternatives, this analysis assesses if the alternatives are available and capable of being done after taking into consideration multiple factors including existing technology and logistics in light of overall purpose of the proposed action. For this proposed action, technical and logistical factors are unique to the requirements of the submarine building process and the related access, transportation needs, and construction techniques. As a result, the suite of practicable alternatives is constrained. In addition to the No Action alternative, alternative locations for new development/redevelopment to

support the purpose and need and alternative designs on the practicable alternative location are considered.

a. No Action

Under the No Action alternative, Electric Boat would not undertake a Facilities Master Plan and would not carry out any major new facilities construction. Consequently, No Action would not result in impact to coastal resources or discharges of dredged or fill material into waters of the United States beyond Electric Boat's maintenance activities. The existing submarine construction facilities in the North Yard at the Groton site would continue to be the only facilities for submarine assembly. Given the on-going construction activities for the VIRGINIA class submarines in the North Yard, and the size requirements for the CCS boats, those facilities used for submarine construction would not be available to support the U.S. Navy's construction schedule for the CCS submarines without potential impact to the on-going VIRGINIA class submarine construction. This would not only have impacts to Electric Boat's business operations, future growth, and local and regional economic benefit, but would also impact the U.S. Navy submarine construction and delivery schedule and result in subsequent impacts to the United States strategic deterrence strategy. Therefore, this alternative does not meet the identified purpose and need.

b. Alternate Locations

Only locations under Electric Boat ownership and/or control are considered feasible and practicable for consideration as alternative locations because of both the nature of the Proposed Action (i.e., construction of new facilities/infrastructure) and the safety and security requirements inherent in the construction of sea vessels for military use. Electric Boat's submarine design, construction, and maintenance workforce is spread across three primary locations: New London, Connecticut, Quonset Point, Rhode Island, and Groton, Connecticut, each of which is considered as alternative locations for activities to support the purpose and need.

i. **New London**

This location, while located along the Thames River, is an office complex. Work at this location focuses on engineering and design and the site lacks the space or infrastructure to support construction activities and does not provide feasible opportunities for expansion of such capabilities, which would require major construction and subsequent impact to coastal resources and waters of the United States. Therefore, based on those constraints alone, the site is not a practicable alternative.

ii. **Quonset Point**

The 125+ acre Quonset Point, Rhode Island facility is currently home to manufacturing, outfitting, and modular-construction capabilities. At this location, major submarine components are manufactured. Completed submarine hull cylinders are outfitted with tanks, propulsion and auxiliary machinery, piping, wiring and lighting, special hull coatings and are then transported by barge to Groton or Huntington Ingalls-Newport News Shipbuilding in Newport News, Virginia, for completion. This location is critical to the overall submarine construction capability of Electric Boat and work at this location will support the overall project purpose and need.

However, Quonset Point poses several challenges for final assembly, test, and launching of submarines. The south end of the yard is very exposed to weather and is at a low elevation. To build a construction facility would require building up the waterfront elevation. Additionally, the water depth is shallow, on the order of 12 feet. An adjacent shipyard was recently denied a permit to dredge to a depth much shallower than would be required to float a submarine. The distance from the Quonset Point waterfront to the channel is approximately 0.5 miles. That channel would need to be dredged approximately 5 feet deeper for approximately 2 miles to allow a COLUMBIA class submarine to transit.

In terms of personnel specialization, Quonset Point is very experienced in fabrication of submarine modules. However, Electric Boat's personnel experienced in testing and commissioning submarines are based in Groton. It is not feasible to duplicate that experience to support VIRGINA construction in Groton and COLUMBIA construction in Quonset Point.

Consequently, the specific and specialized operations that take place there in terms of both types of infrastructure and workforce specialization do not make the Quonset Point location feasible or practicable alternative for expansion of ship production facilities of the kind identified in the purpose and need to support the future workload associated with the construction of COLUMBIA class submarines.

iii. **Groton**

The Groton facility is focused on ship production, material procurement, and fleet support. Because of its current use for production activities including pre-

launch assembly, launch, and testing and delivery, the Groton location is uniquely suited to support the expansion of production facilities. In particular, the current South Yard at Groton provides sufficient space on the existing facility to accommodate the purpose and need for the project without disruption or impact to exiting construction and lifecycle maintenance operations.

In addition, the Groton location supports continued synergy with the Naval Submarine Base New London (SUBASE), which is actually located in the communities of Groton and Ledyard. Almost every submariner in the U.S. Navy is stationed there for training and pre-commissioning crews train on new submarines under construction at Electric Boat in Groton.

Based on an assessment of reasonably available alternative locations, the Groton location is the only feasible and practicable location for the type and amount of construction required to meet the purpose and need for the Proposed Action. Consequently, the remainder of the analysis in this attachment focuses on alternative designs within the Groton facility. While this document focuses on alternatives for the placement and design of the FMP, an associated dredge material disposal alternatives analysis is presented in *Attachment M2*.

c. On-Site Alternatives

EB has evaluated many on-site alternatives for implementation of the Facilities Master Plan. The following sections summarize the major alternatives considered.

i. North Yard Alternatives

The North Yard at the Electric Boat Groton facility is the site of current shipbuilding operations (see *Figure M3.1*). Modification to the North Yard to accommodate construction of the new, larger class of submarines was considered as an alternative. Construction of new facilities or expansion of existing facilities landward was not feasible due to the existing critical infrastructure in the North Yard and the property limits where Eastern Point Road becomes Thames Street. The North Yard Alternative shown in *Figure M3.1*, would meet the production requirements for VCS/VPM and CCS submarines, but would require demolition of some existing buildings, dredging, bulkhead construction, nearshore and offshore pile installation, pier construction, and overwater construction of building and deck.

Work associated with the North Yard Alternative would take place in three phases over approximately four years. Phase I would require demolition of 8 structures adjacent to

the existing Building 260, installation of a coffer dam and dewatering of Seagull Point, and dredging to a depth of -12 feet mean low water (MLW) (-14 ft NAVD88) to accommodate construction access and construction of a new bulkhead. Total permanent fill impacts in the phase would be approximately 64,000 SF. The second phase of construction of the North Yard Alternative would involve dredging to a depth of -24 ft MLW (-26 NAVD88). This would allow nearshore pile excavation, which would result in approximately 8,000 SF of permanent fill. In addition, rock removal of potentially 15,900 SF in area and ~3,533 cubic yards (CY) in volume at an existing graving dock would be required to accommodate the COLUMBIA class submarines. Building construction and placement of piers extending from a modified Building 260 are also included in this phase. In Phase III, the final phase of the North Yard Alternative, off shore pile installation requiring dredging and 3,200 SF of permanent fill would occur. New deck construction would extend the deck area construction occurring in Phase II to match the length of existing piers. *Figure M3.1* shows the conceptual design of the North Yard Alternative at completion of Phase III.

In total the three phases of the North Yard Alternative would result in approximately 64,000 SF of permanent fill and an approximately 87,000 SF dredge footprint. Shadowing associated with the building/pier construction would be approximately 122,000 SF. No impacts to other coastal resources or inland wetlands are anticipated under this alternative.

This alternative is capable of allowing production of the number and type of submarines identified in the project purpose and need, and by being a centralized approach to assembly, eliminates the need for redundancy in some of the Groton facility infrastructure. However, the potential risk to the ongoing VIRGINA Class shipbuilding from construction activities, especially excavation of the rock floor of the existing graving dock, co-located with existing production is determined to be too great, making the North Yard alternative impracticable. The necessary excavation would risk damage to the structural walls and support for the structural deck, as well as creating potential delays in ongoing construction. Use of a floating dry dock, instead of increasing the depth of the existing graving dock, was considered but found to be infeasible in the North Yard because a floating dry dock of the necessary size would impact the navigation channel and interfere with the delivery of submarine modules by barge. A vertical lift, the only other option for launching a ship the size of a COLUMBIA class submarine is not accepted for use by the U.S. Navy for this application.

In order to maintain the required security for the VCS production, delivery of sensitive components would require a series of construction mobilizations and demobilizations. The construction blackout periods, which Electric Boat estimated to be over 900, would range from a few hours to up to 2-4 days. There would also be a need for on-going boat assembly to be visually protected from construction activities for security reasons.

In addition to security requirements that would impact construction, rock removal activities for increased depth, which would be needed for expansion of the graving dock, posed a threat to existing production. Specifically, rock removal associated with the North Yard alternative creates concerns relative potential impacts to the stability and structural integrity of the existing structural deck and maintaining cleanliness requirements for submarine assembly in the existing buildings.

ii. South Yard Alternatives

The South Yard of the Electric Boat facility in Groton is located south of the South Ways Building (Building 356/132) (see *Attachment I*) and includes approximately 1,300 linear feet of shoreline. The EB property narrows southward. The South Yard is not currently used for shipbuilding activities, but does contain a sewer pump station, fueling station for vehicles, hazardous materials storage, and other structures and areas dedicated to storage. Railroad tracks run the length of the South Yard, ranging from approximately 80 to 425 feet from the shoreline.

When considering alternatives in the South Yard, it is important to note that there are several site constraints that limit the feasibility of placing structural elements of the FMP further inland and require options that place certain structures over nearshore waters. These are illustrated in *Figure M3.6* and include:

- Work within relative narrowness of the EB property at this location
- Avoid additional bedrock removal at rock face that defines the edge of the property where it meets Eastern Point Road
- Maintain the existing site access to the South Yard from Eastern Point Road and for ocean-going transport from the Thames River navigational channel into the security zone.
- Maintain the railroad tracks for delivery of submarine components to the Groton facility
- Achieve specific elevations for the ocean transport barge and Sea Shuttle docking location
- Maintain slopes across site for overland transport of modules delivered by rail

- Satisfy code compliance for building elevations in a Federal Emergency Management Agency flood zone, and
- Avoid or minimize activities in the navigational channel in the Thames River
- Avoid impact to South Ways buildings (Buildings 132 and 256) which houses activities that directly support ongoing submarine construction activities.
- Avoid impeding berthing submarines on the South Wing Wall of the existing Graving Dock 1.

In addition, it is important to note that all elements of the submarine production process are functionally dependent upon water. This includes the delivery of the components that are delivered by barge, the testing of systems in the submarines, and the launch of submarines. Four primary sub-alternatives for the layout of the South Yard Alternative were considered in an effort to achieve the project purpose and need of both meeting existing and future production schedules and minimizing impact to the on-going VIRGINA class submarine shipbuilding. The sub-alternatives share several key required features:

- Enclosed structure for submarine assembly
- Floating dry dock
- Submersion basin – for submarine launch via the floating dry dock
- Ocean transport barge docking location – necessary for component delivery
- Sea Shuttle docking location – necessary for component delivery
- Pier(s)

When considering the South Yard alternatives, it is important to note that the key features of the alternatives are dictated by operational requirements for submarine assembly, testing, and launch. These include use of a floating dry dock instead of a graving dock such as the one in the North Yard, configuration of the submersion basin given the necessary basin depth and riverbed material present, and size of the pier and assembly building, each of which are discussed below.

Floating Dry Dock – A floating dry dock is one of four types of dry docks that can be used to launch ships, the other three being graving docks, marine railways, and vertical lifts. There is established precedent for launching U.S. Navy ships, including submarines, on floating dry docks. Floating dry docks are floating assets, rather than civil structures, making them adaptable to future changes in operations. Graving docks are large civil structures, with less flexibility as operations evolve. Although Electric Boat currently uses a graving dock to launch submarines and other shipyards use them for ship construction, they are not as efficient as a floating dry dock to support multiple construction bays, as intended for this project. Marine railways are also civil structures and consist of a platform that is hauled on an inclined rail in or out of the water to

launch or drydock a ship. A marine railway is not feasible for a ship the size of a COLUMBA class submarine. A vertical lift is a platform supported by wire rope that raises and lowers to launch or drydock a ship. The U.S. Navy does not permit submarines to be launched or drydocked on vertical lifts. Consequently, of the two feasible methods for launching the COLUMBIA class submarine, the floating dry dock was identified as the preferred method since it provides better flexibility for ship building operations and reduces the building of more structure in the river compared to the graving dock. The floating dry dock shown in the proposed plans is as small as can be designed to lift the weight of a COLUMBIA class submarine and transfer from the elevation of the building floor.

Submersion Basin – The submersion basin is necessary for launch of the COLUMBIA class submarines. Construction of the submersion basin close to shore and the subsequent dredging needed were required because there is no approved means of transitioning the submarine to deeper water (.e.g., with a tow, etc) to launch that is consistent with Safety Certification Program for Drydocking Facilities and Shipbuilding Ways for U.S. Navy Ships (MIL-STD-1625D, 2009). The submergence basin must be dredged to a depth equal to the maximum submergence of the dry dock with enough clearance (12") under the ship when afloat to exit the dock and at least 12" of clearance between the hull of the dock and the bottom of the submergence basin. These requirements are defined by the U.S. Navy. Geotechnical analysis of the river bottom sediments indicate that in order to maintain stability of the fine grained organic material a side slope of 3.5:1 will be necessary for the submergence basin. The required slope dictates the footprint and volume of dredging needed to meet the required depth of the submersion basin for launching. Therefore, the proposed controlling dredge depth of -89 ft NAVD88 with a 2 foot overdredge is the shallowest possible depth feasible for the launch of the COLUMBIA class submarine.

Pier and Assembly Building – The sizes of the pier and assembly building have been minimized to the extent feasible to allow the safe and efficient construction of the COLUMBIA class submarine. The pier proposed for the east side of the dry dock must be large enough to allow personnel, vehicular, and equipment access to the floating dry dock. The pier must also be sized to take the mooring loads imparted to it by the floating dry dock during severe weather. The pier size shown in the alternatives is the minimum size able to address these needs.

Similarly, the assembly building design is the smallest building that will enable construction of COLUMBIA class submarines in an efficient manner. For example, the building is being designed with multiple access points for the purpose of reducing

building size while allowing modules to be brought into the assembly building. The dimensions of the COLUMBIA class submarine must be accommodated by the proposed building design. As noted in the figure below, the COLUMBIA class is longer and of greater diameter than the VIRGINA class, resulting in a ship nearly three times the volume of the VIRGINIA class.

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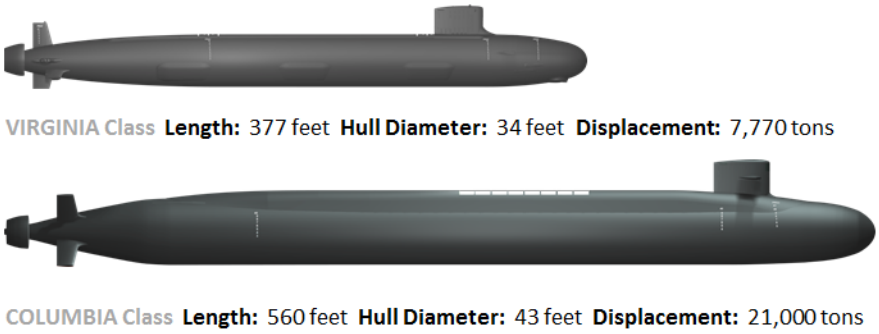

Comparison of VIRGINA class and COLUMBIA class Dimensions

The sizes, placement and orientation of these elements are the differences between the conceptual designs of each sub-alternative.

- South Yard Alternative #2 – Assembly Building Facing West (*Figure M3.2*)
- South Yard Alternative #3 – Assembly Building Facing North (*Figure M3.3*)
- South Yard Alternative #4 – Assembly Building Facing South - Shifted North (*Figure M3.4*)
- South Yard Alternative #5 – Assembly Building Facing South - Offshore (*Figure M3.5*)
- South Yard Preferred Alternative – Assembly Building Facing South - Inshore (*Figure M3.6*)

Each sub-alternative would require dredging, placement of permanent fill and over-water shadowing. *Table M3.1* presents a summary of potential resource impacts for each South Yard sub-alternative. Design, logistic and operational constraints with each of the South Yard alternatives is discussed below and summarized in *Table M3.2*.

South Yard Alternative #2 (*Figure M3.2*) – Placement of the assembly building facing west, perpendicular to the shoreline, would require result in 183,000 SF of shadowing due to a large portion of the building area being over-water and require the floating dry dock to be located within the navigational channel for up to two weeks. This

orientation creates challenges for the submarine launch sequence and may also impact the boat building sequence. The impact to the navigational channel this alternative configuration would create was identified as a fatal flaw in this alternative and additional calculations of impacts to resources (i.e., calculation of dredge footprint) were not performed. Because of the potential for significant impacts to the navigational channel and substantial requirement for permanent fill placement this alternative was not identified as the least environmentally damaging practicable alternative (LEDPA). Note that the total dredge footprint for this alternative in not included in *Table M3.1* because calculation was not performed once infeasibility of the alternative due to navigation channel impact was identified.

South Yard Alternative #3 (*Figure M3.3*) – Placement of the assembly building facing north would also require approximately 85% of the building area to be over-water, resulting in approximately 239,000 SF of shadowing from the building/pier and floating dry dock. Approximately, 44,000 SF of permanent fill would be required for this alternative due to bulk head and drilled shaft installation, and this is the one alternative of those considered in the South Yard that would impact Rocky Shoreline, approximately 650 feet. Bedrock removal of approximately 5000 SF would be required and the overall dredge footprint would be 716,000 SF. In this alternative site configuration, the southeast corner of the building is in close proximity to the railroad and the security fence. This creates issues with site grading to prevent impact to the rail line and also creates security concerns because of proximity to the security fence. In addition, the north-facing orientation for the assembly building creates challenges for floating dry dock operations because of constraints on the dock movements., which would be required if the building were oriented as shown in *Figure M3.3*. Due to the impact to floating dry dock with this building operation, the security and site grading concerns, impact to Rocky Shorefront, and relatively large area of permanent fill this alternative was not identified as the LEDPA.

South Yard Alternative #4 (*Figure M3.4*) – This alternative also has a south-facing assembly building, but with the building translated approximately 200 feet north. This location would require approximately 70% of the building area to be over-water, resulting in approximately 210,000 SF of shadowing from the building/pier and floating dry dock. Approximately 6,400 SF of permanent fill would be required for this alternative due to bulkhead and drilled shaft installation. Bedrock removal of approximately 5,000 SF would be required and the overall dredge footprint would be approximately 1,000,000 SF. This alternative site configuration requires the demolition of two buildings (132 and 256), which currently support manufacturing processes for the VIRGINIA Class. These buildings would need to be replaced with new

construction elsewhere in the South Yard to support the current work and planned work for COLUMBIA construction. However, due to spatial constraints, a location for such a building has not been identified. Buildings 132 and 256 were originally constructed as inclined ways for sliding smaller submarines into the water for launch. Because the COLUMBIA is much heavier than the submarines for which the buildings were designed, the floor slabs and foundations, which extend out to deep water and currently below the mud line, need to be removed and replaced with higher capacity structures under this alternative. Demolishing these structures and their associated foundations would generate construction debris that would need to be disposed of properly. This alternative location presents two additional challenges for vessel traffic. First, berthing submarines on the South Wing Wall of the existing Graving Dock 1 with tug boat assistance would become more difficult due to the building structure proximity. Second, the floating security barrier, which is required by contract with the Navy, would need modification. Although most alternatives require modification, an effective modification for this alternative has not been identified that would provide the coverage needed and permit barge deliveries to the north end of the building without creating a new obstruction in the form of an anchor point that would further obstruct berthing submarines on the South Wing Wall. Due to the need to demolish and replace existing buildings, removal of structures buried in the riverbed, negative impacts on vessel movement, as well as dredge area, shadowing, and permanent fill as described in *Table M3.1* this alternative was not identified as the LEDPA.

South Yard Alternative #5 (*Figure M3.5*) – In this alternative, the assembly building would be facing south with the floating dry dock and ocean transport barge docking location on the south side of the building. While this alternative meets all of the objectives of the project purpose and need and the site constraints identified above, this alternative would result in approximately 90% of the assembly building located over water, resulting in approximately 250,000 SF of shadowing from the building/pier, the greatest of all South Yard alternatives considered. In addition, approximately 43,000 SF of permanent fill would occur and 5,500 SF of rock removal would be required. Due to the large area of overshadowing, permanent fill, and bedrock removal, this alternative was not identified as the LEDPA.

South Yard Preferred Alternative (#6) (*Figure M3.6*) – This alternative also has a south-facing assembly building, but with the building translated approximately 60 feet inland, which is the greatest extent it can feasibly be moved inland given site constraints. In addition to meeting the project purpose and need, and addressing the site constraints described above, this alternative configuration reduces the percentage of the building over water to approximately 60%, resulting in approximately 139,750 SF of shadowing

from building/pier construction, the least of all south-facing South Yard alternatives considered. Most notable about this alternative is over 80% reduction in the area of permanent fill. The reduction of permanent fill to approximately 9,965 SF from 43,000 SF in South Yard Alternative #5 is due in large part to a change in reductions in the need to install bulkhead. Rather than having shafts of 3 foot diameter spaced 10 feet on center, this alternative uses 4-foot shafts spaced 25 feet on center. While a similar change to the shafts in Alternatives 3 and 4 would also reduce the permanent fill, the reduction would not be as great as that seen in Alternative 5 because of the reduced amount of building over water in Alternative 5 compared to other south-facing alternatives. In addition, placement of the dry dock at rest along the shoreline minimizes impacts by allowing for more shallow dredging depths in this area. Based on consideration of the factors in *Table M3.1* and *Table M3.2*, this alternative was identified as the Preferred Alterative and the LEDPA.

In summary, a south-facing assembly building in the South Yard was determined to be the alternative that best met the purpose and need for the project and was practicable given site and operational constraints. By modifying the south-facing alternative, moving it inland and reducing the number of drilled shafts necessary, the Preferred Alternative design for the development of the FMP depicted in *Figure M3.5* is the ***practicable alternative*** resulting in the ***least adverse impact*** on the aquatic ecosystem and is the LEDPA for the proposed project. The dredge disposal management plan in *Attachment M2* discusses the alternatives for disposal of the dredged material including beneficial use, confined placement, upland placement and open water disposal. The results of the alternatives analysis described in that document, determined that the anticipated LEDPA and Preferred Alternative for management of the dredged material is open water disposal due to the material characteristics overall consideration for impacts to the surrounding community and environment, availability and cost factors. The selection of a final alternative for disposal will be contingent upon a suitability determination by the U.S. Army Corps of Engineers.

Table M3.1. Summary of Potential Resource Impacts for Alternatives

	Permanent Fill (SF)	Shadowing[2] (SF)	Dredge Footprint (SF)	Bedrock Removal (SF)	Developed / Rocky Shoreline (LF)	Comments	Limitations/Constraints
No-Build Alternative	0	0	0	0	0		Violates contractual agreements with United States Navy
Alternative #1 - North Yard	64,000	122,000	87,000	0	500 / 0	Permanent fill includes bulkheads and drilled shafts 3' diameter @ 10' O.C.. Dredge footprint includes berthing areas to -24' NAVD88. Shadowing includes building/pier and no floating dry dock.	Interferes with ongoing production of VIRGINIA class
Alternative #2 - South Yard (Assembly Building Facing West)	20,000	183,000	0[1]	0	400 / 0	Permanent fill includes bulkhead and drilled shafts 3' diameter @ 10' O.C.. Dredge footprint not calculated. Shadowing includes total building/pier and floating dry dock (resting position) footprint.	Significant obstruction with navigation channel for vessel berthing and launching
Alternative #3 - South Yard (Assembly Building Facing North)	44,000	239,000	716,000	5,000	800 / 650	Permanent fill includes bulkheads and drilled shafts 3' diameter @ 10' O.C.. Dredge footprint includes basin to -82' NAVD88, berthing to -30' NAVD88, and vessel egress to -42' NAVD88. Shadowing includes total building/pier footprint.	Site access, assembly limitations, module movements
Alternative #4 – South Yard (Assembly Building facing South – Shifted North)	12,750	181,700	902,000	6,615	700 / 0	Permanent fill includes bulkheads, drilled shafts 4' diameter @ 25' O.C., and dolphins for floating dry dock berth. Dredge volume includes basin to -87' NAVD88, berthing to 22' NAVD88, and vessel egress to -42' NAVD88. Overshadowing includes non-dredged areas under building/pier.	Requires demolition of two existing buildings (132, 256), which currently support shipyard work. These buildings would need to be replaced. These buildings were formerly launch ways, requiring the removal of structure extending into deep water. Impact to navigation docking submarines at the South Wing Wall berth.

Table M3.1. Summary of Potential Resource Impacts for Alternatives

	Permanent Fill (SF)	Shadowing[2] (SF)	Dredge Footprint (SF)	Bedrock Removal (SF)	Developed / Rocky Shoreline (LF)	Comments	Limitations/Constraints
Alternative #5 - South Yard (Assembly Building Facing South - Offshore)	43,000	250,000	888,000	5,500	1,300 /0	Permanent fill includes bulkheads, drilled shafts 3' diameter @ 10' O.C., and dolphins for floating dry dock berthing. Dredge footprint includes basin to -82' NAVD88, berthing to -30' NAVD88, and vessel egress to -42' NAVD88. Shadowing includes total building/pier footprint.	Site grading plan and geotechnical indicate building can shift inshore/limit impacts
Preferred Alternative - South Yard (Assembly Building Facing South - Inshore)	9,965	139,75000	923,250	22,000	1,250 / 0	Permanent fill includes bulkheads, drilled shafts 4' diameter @ 25' O.C., and dolphins/anchor points for floating dry dock and sea shuttle berthing. Dredge footprint includes basin to -87' NAVD88, berthing to -22' NAVD88, and vessel egress to -42' NAVD88. Shadowing includes non-dredged areas under building/pier. Estimated dredge volume of 983,500 cu. yd.	

Notes:

1. Grading under building/pier is included in Alternative 5 only
2. Shadowing associated with dry dock in resting position is not included as this area is included in dredge footprint in Alternative 3 through 5.

Table M3.2. Summary of Design/Logistics Considerations for South Yard Sub-Alternatives

South Yard Alternative	Impact to Floating Dry Dock Operations?	Impact to Navigational Channel?	Impact to South Yard Access?	Impact to Railroad?
Alternative #2 (*Figure M3.2*)	No	Yes	No	No
Alternative #3 (*Figure M3.3*)	Yes	No	Yes	Yes
Alternative #4 (*Figure M3.4*)	No	No	Yes	No
Alternative #5 (*Figure M3.5*)	No	No	No	No
Preferred Alternative (*Figure M3.6*)	**No**	**No**	**No**	**No**