Appendix H: Construction Impacts

H-5 Dredged Materials Management Alternatives

A. INTRODUCTION

The Tappan Zee Hudson River Crossing Project proposes to replace the existing Tappan Zee Bridge with two new bridge structures to the north of its existing location. The replacement alternative includes two options for the approach spans (short span and long span options) which differ in terms of the type of structure as well as the number of and distance between bridge piers.

In either option, the proposed bridge alignment would span extensive shallows in the Hudson River. Therefore, to facilitate construction and to prevent significant suspension of sediments during construction, a channel must be dredged to provide access for tugboats and barges to the construction zone during construction of the approach spans. A total of approximately 1.68 and 1.74 million cubic yards of sediment would be dredged for the short and long span options, respectively, over the entire construction period. This estimate is based on a bathymetric survey previously conducted for the project; an updated survey is being conducted which will confirm these estimates.

Transport by ocean scow and placement of the dredged material at the Historic Area Remediation Site (HARS) in the New York Bight would be most beneficial to the project for a number of reasons, including cost, schedule, and the avoidance of impacts to surrounding residential communities. In accordance with federal regulations, the U.S. Environmental Protection Agency (USEPA) must concur that there are no practicable alternative locations and methods of disposal or recycling available before a permit can be issued by U.S. Army Corps of Engineers (USACE) for placement of dredged materials at the HARS. This document evaluates the alternatives available for placement of the dredged materials from the Tappan Zee Hudson River Crossing project.

B. REGULATORY PROCESS AND COMPLIANCE

The Tappan Zee Hudson River Crossing Project proposes placement of dredged materials from the Hudson River at the HARS in the New York Bight. Placement of dredged materials at the HARS is subject to the Marine Protection, Research, and Sanctuaries Act of 1972, also known as the Ocean Dumping Act. Section 103 of the Ocean Dumping Act states that USEPA must ensure that the disposal will not "unreasonably degrade or endanger human health, welfare, or the marine environment." In accordance with implementing regulations (40 CFR § 227), the USEPA must evaluate alternative disposal options before the USACE can issue permits for placement of dredge spoils in the HARS. The USEPA must concur that there are no practicable alternative locations and methods of disposal or recycling available. 40 CFR § 227.16 (b) outlines the test for practicability of alternatives by stating that "…alternative methods of disposal are practicable when they are available at reasonable incremental cost and energy expenditures, which need not be competitive with the costs of ocean dumping, taking into account the environmental benefits derived from such activity, including the relative adverse environmental impacts associated with the use of alternatives to ocean dumping…."

While ocean disposal of dredged materials is the proposed disposal method for the Tappan Zee Hudson River Crossing Project, this analysis also evaluates upland disposal options. Dredged materials destined for upland disposal are considered a solid waste by the New York State Department of Environmental Conservation (NYSDEC) and are subject to regulation under 6 NYCRR Part 360 Solid Waste Management Facility Regulations. Wastes regulated under Part 360 must be disposed of at an authorized solid waste management facility. In addition to the extensive application requirements (i.e., engineering reports, facility plans, and equipment specifications) prescribed under Part 360, waste management facility permits are subject to the New York State Environmental Quality Review Act (SEQRA) and the Uniform Procedures Act, Article 70 of the New York State Environmental Conservation Law, which provides timeframes for application review and procedures for public noticing and hearings.

Certain waste materials, normally classified as solid waste under the Part 360 Solid Waste Management Facility regulations, may be determined by NYSDEC to be appropriate for beneficial reuse. While a Beneficial Use Determination (BUD) is not subject to SEQRA or 6 NYCRR Part 621 Uniform Procedures, the determination process may become complex and time consuming. NYSDEC BUD regulations identify 16 pre-approved BUDs in 6 NYCRR Part 360-1.15. For other situations where the proposed reuse is not specifically identified in the Part 360 regulations, a case-specific BUD petition must be submitted to NYSDEC in accordance with 6 NYCRR Part 360-1.15(d). The petition must include a variety of information about the material and proposed beneficial use such as, but not limited to, the chemical and physical characteristics of the solid waste, a demonstration of a known or probable market for the waste, and a solid waste control plan. Dredged spoils that are determined to be uncontaminated can be used as fill material in accordance with a pre-approved BUD. Dredge spoils that are found to be moderately contaminated require a case-specific BUD.

C. TAPPAN ZEE HUDSON RIVER CROSSING PROJECT DREDGING PROGRAM

Dredging for the construction of the Tappan Zee Hudson River Crossing Project would be conducted in three stages over a four-year period, with a duration of approximately three months each year. Each of these three-month spans would occur during the limited window for such dredging, from August 1st to November 1st. This is the period when dredging activities would have the minimum effect on anadromous species and other aquatic resources.

Table 1 presents the estimated daily and total volumes of materials to be removed for each dredging stage for the two replacement bridge alternatives. As shown in the table, during the busiest dredging stage, Stage 1, up to 15,000 cubic yards of materials would be dredged each day. A total of approximately 1.68 and 1.74 million cubic yards of sediment would be dredged for the short and long span options, respectively, over the entire construction period.

Table 1
Materials Removal by During Dredging

Construction Stage	Short Span		Long Span	
	Average Daily Volume (cubic yards)	Total Volume (cubic yards)	Average Daily Volume (cubic yards)	Total Volume (cubic yards)
Stage 1	14,600	1.08 million	15,000	1.12 million
Stage 2	5,700	0.42 million	5,800	0.43 million
Stage 3	2,400	0.18 million	2,600	0.19 million
Total		1.68 million		1.74 million

The dredged material removed from the river bottom would consist of sand and silt. Although some materials—in particular materials removed from the top layer—may contain some contaminants, it is anticipated that most of the dredged material would be suitable for beneficial re-use at another location rather than disposal in a landfill. The project is proceeding with a sediment sampling plan to confirm the nature and composition of the sediment where dredging is proposed.

Dredged materials would be collected from the bottom of the river by barge-mounted cranes placed into hopper scows, which are boats with a capacity of approximately 2,500 cubic yards. To ensure that the scows do not exceed the maximum allowable draft of the river work zone, they would be limited to 80 percent of their maximum load, or 2,000 cubic yards per load.

After placement in the hopper scows, the next step in the dredge materials handling would depend on the dredge placement option selected, as discussed below.

D. DREDGED MATERIAL MANAGEMENT ISSUES

To address a lack of management options for dredge spoils from various projects in the Port of New York and New Jersey, and the high cost of the limited number of management options that are available, the USACE New York District has prepared a Dredged Material Management Plan (DMMP), last updated in August 2008. The DMMP identified a wide array of both primary and contingency management options needed to meet the dredging requirements of the Port in the long term, through the year 2065. Special emphasis was given in the plan to beneficial uses of dredged material, specifically for land remediation and habitat creation, enhancement, and restoration. The DMMP also considered the possibility of establishing a public dredge spoils processing/storing facility, as an additional option to existing privately funded facilities, to be used primarily by public agencies. The interest in developing such a facility arose not only because of the high cost of processing at private facilities, but also in an attempt to better correlate the availability of dredge spoils to the availability of processing capacity or land at a potential beneficial re-use site. The DMMP noted that once individual dredging projects are complete or when a large real estate development project has exhausted its capacity for dredged material (e.g., as fill material), private processing facilities become no longer economically viable. To protect against the risk associated with the variability in the volumes of incoming dredged materials, private processors maintain low throughputs, restricting capacity. Timing the availability of a beneficial re-use site is similarly challenging since such sites often require additional studies, funding, or permits. According to the DMMP, providing a space to process and store spoils until they are needed would stabilize costs of private processing and would encourage greater beneficial re-use placement of spoils. The DMMP commits to studying various siting, ownership, and management options of such a facility as a way to address the harbor's long term dredge disposal needs.

While the public processing/storage facility and other options described in the DMMP are being evaluated by the USACE for long-term resolution, the Tappan Zee Bridge Hudson River Crossing Project is investigating many of the same dredge placement options, with the same near-term limitations and difficulties identified in the DMMP.

E. DREDGE PLACEMENT ALTERNATIVES

The range of options potentially available for placement/disposal of material removed during dredging of the access channel for the Tappan Zee Bridge Hudson River Crossing Project are as follows:

- Placement in the Historic Area Remediation Site (HARS) in the New York Bight.
- Transfer to an existing dredge material processing facility;
- Beneficial reuse for land remediation;
- Beneficial reuse for habitat creation, enhancement, and restoration;
- Disposal to a permitted landfill facility; and
- Disposal to a to-be-permitted landfill facility.

All of the placement options discussed in this analysis assume that the resulting dredge spoils are transported by barge, directly to a placement/disposal site.

The option to remove the dredge spoils by truck is not practicable, given the large number of truck trips required and the environmental implications. To implement this option, dredged materials would have to be transported to a shoreline site, where they would be dewatered and stockpiled. The site selected for these operations would have to be large enough to accommodate a large volume of material, and located on roadways that can accommodate the daily volumes of trucks, estimated at 755 trucks per day inbound and 755 trucks outbound, that would be required to transport dredge material in Stage 1 of the dredging program, and the approximately 87,000 outbound and 87,000 inbound total truck trips over all stages of the dredging program. Due to the large number of estimated truck trips that would be required, and the potential for adverse traffic, air quality and noise impacts on the local community, the bridge contractor would not be allowed to transport the dredged material by truck from the waterfront staging areas.

All of the disposal alternatives presented below therefore involve the transfer of dredge spoils directly by barge to a processing or placement/disposal site. Dredged materials could also be transported by larger vessel to a waterfront site at a greater distance from the construction zone; however, it is expected that the cost for transporting dredged materials by barge to a more distant site would likely exceed even the alternatives presented below and therefore would not meet the practicability test outlined in 40 CFR §227.16 (b).

PLACEMENT IN THE HARS

In this option, the dredged materials would be transported to the HARS, a site in the Atlantic Ocean approximately 3.5 miles east of Sandy Hook, NJ. The HARS is overseen by the USACE and the USEPA. This site was historically used for ocean disposal of dredged material. Today, the site is being remediated through a program to cap those historic sediments with cleaner sediments dredged from New York Harbor that meet certain criteria established by the Ocean Dumping Act. To receive the Section 103 permit for placement in the HARS, the materials must be suitable for remediation, in that they meet certain criteria related to contaminants based on sediment toxicity and bioaccumulation tests.

Dredged materials from the Tappan Zee Hudson River Crossing Project placed at the HARS would be transferred from the hopper scows to larger capacity (up to 4,500 cubic yards) ocean scows. These vessels have large drafts, typically up to 18 feet, that would be too large to be accommodated in the dredged construction channel. Therefore, materials would be transferred from the hopper scows to the ocean scows in deeper water. The ocean scows would then travel to the HARS, where materials would be placed at the site in accordance with the permit conditions for that placement.

The cost for placement of material at the HARS would consist of the cost for operation of the hopper scows and ocean scows and is estimated at approximately $10 to $20 per cubic yard, plus additional costs to mobilize and demobilize equipment during each dredging stage (up to $1 million per dredging stage). After the Section 103 permitting process is complete, HARS would

be available for disposal at any time. The availability of the site could only be affected by weather which would prohibit ocean scows from traveling to the site.

TRANSFER TO A DREDGED MATERIAL PROCESSING FACILITY

In a 2007 study[1], the USACE identified five private facilities, in and around the Port of New York and New Jersey, that could process and temporarily store dredge material. Four of the facilities were contacted as part of this analysis; one of the facilities identified in the DMMP is not actively operating:

- Clean Earth Dredging Technologies, Inc
- Donjon Marine Company, Inc.
- Jay Cashman, Inc
- Great Lakes Dredge and Dock, Inc.

These private companies could transport, dewater and amend the dredged material, identify suitable disposal locations for the materials, and arrange to have materials placed there. The facilities operate at rates ranging from 4,000 and 8,000 cubic yards/day. Therefore, no single processing facility would be able to accept all of the dredge spoils generated by the Tappan Zee Hudson River Crossing Project. The bridge contractor, or the sub-contractor responsible for the dredging program would need to coordinate disposal among several facilities; each processing facility may need to coordinate among one or more disposal sites. The large volume of material that will result from the Tappan Zee Hudson River Crossing Project would tie up dredge processing capacity throughout New York Harbor.

Based on the information provided by the three facilities that responded, the cost for this disposal alternative may range widely, from $45 to $150 per cubic yard, plus additional costs to mobilize and demobilize equipment during each dredging stage (up to $1 million per dredging stage).

BENEFICIAL RE-USE FOR LAND REMEDIATION

One type of beneficial re-use of dredged materials is land remediation, where dredged material can be utilized as structural fill, grading material, landfill cover, etc., to remediate sites such as active and inactive landfills, former industrial (brownfield) sites, quarry sites, and abandoned mines. In this alternative, the Tappan Zee Bridge dredging contractor would be responsible for managing the processing of dredged material and its transport to its ultimate destination for placement.

Prior to use, the dredged material is typically processed with binding agents, such as cement, fly ash, coal ash, lime, and kiln dust, which also serves to contain any contaminants that may be present within the material. The stabilized dredged material can be manufactured to meet the material and engineering specifications of a specified use by adjusting the proportions and types of mixing agents.

Because the dredged material recovered from the Tappan Zee Bridge Hudson River Crossing Project site would require dewatering and processing for stabilization, any beneficial use options would require that the contractor establish a temporary staging and processing area, to manage the dredge spoils before transport to the beneficial use site. As described above, because of the

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[1] Alternative Scenarios for the Realization of a Dredged Material Public Processing or Storage Facility, USACE, August 2007.

logistical difficulties associated with transferring Tappan Zee Bridge Hudson River Crossing Project dredge spoils to trucks, the only practicable placement sites under this alternative are those that can receive dredged materials by barge.

To dewater and amend the dredged materials, the dredging contractor would have to establish a temporary dredge spoils management facility on the waterfront that could be accessed by the barges transporting the dredged materials. This facility would be established specifically for the project and utilized each year for the duration of each dredging stage. Such a facility would require a loading dock or pier to accept the hopper scows delivering dredged material and barges removing processed material; structures and equipment to pump or otherwise move the dredged material from the scows into a pugmill for dewatering; a drying area for the dewatered material; a water treatment plant to filter and treat the water removed from the dredged materials to address turbidity and potential contamination; a staging area to mix the dewatered material with appropriate amendments; and a stockpile for processed material waiting to be removed.

After dewatering and amendment, the dredged materials could be transported to the ultimate placement site by barge or rail, if rail connections are available at the staging area. If a site can be identified that can accommodate the removal of material by rail, the temporary processing facility would also require a railcar loading area and a connection to a rail spur or main line.

A range of waterfront sites may be available to receive dredge material as a beneficial re-use, and one example is discussed immediately below. However, as discussed in the DMMP, timing the availability of dredge spoils to a remediation site is challenging. At the very least, any given remediation or construction project would need to go through design, environmental review, and permitting before it can be ready to construct. The dewatered and processed dredged material delivery would have to be timed precisely to be available at the site in an appropriate quantity to comply with the conditions of the BUD approval. For the Tappan Zee Bridge construction, with limited windows of dredging, an imminent construction schedule, and large volumes of dredged materials, identifying a practicable BUD option that can be used at the times when it is needed would prove difficult. Moreover, developing a staging and processing site for use only during the limited dredging windows required for the Tappan Zee Bridge project would be less efficient and more costly than using the services of a dredged material processing facility.

The cost for this option would depend on the level of contamination found by the sampling program and on the chosen remediation site. Costs estimated for this option included the staging and drying of dredge material, amendment of material as needed, loading for off-site disposal, sampling and permitting, and transportation and disposal. Costs are estimated to range from $90 to $175 per cubic yard.

GATX SITE

One potential site identified by USACE for beneficial re-use of dredged materials is the site in northwestern Staten Island along the Arthur Kill waterfront known as the “GATX site.” This 440-acre site was historically occupied by industrial uses, including bulk oil storage and liquefied natural gas storage facilities. In 1998, the New York State Department of Environmental Conservation (NYSDEC) issued a Consent Order that required the property owner, GATX Terminals Corporation, to remediate contamination at the site and to restore wetland areas affected by the contamination and remediation work. A modification on the 1998 Consent Order is currently being proposed by NYSDEC; the public comment period on the modification ended in April 2011 and a Modified Consent Order is expected to be signed in late January 2012, at which time it is anticipated that a new owner will take over the site and begin to remediate the site in accordance with an Engineering Work Plan. Fill materials permitted on the site will have to meet specified chemical and physical standards, as set forth in the Modified

Order. The fill will include the use of dredged material that meets those standards and has qualified for and received a BUD from the NYSDEC. Overall, it is expected that 4.5 million cubic yards of fill will be required to cap the site and to raise the overall elevation, since the majority of the site is only a few feet above sea level. One potential owner/operator expects that an additional capacity of up to approximately 3.5 million cubic feet exists on the site, yielding a total capacity of 8 million cubic feet of fill.

That potential owner/operator also anticipates that after the execution of the Modified Consent Order, the site can begin accepting fill material in the first quarter of 2012. As with other beneficial reuse options, the dredged Tappan Zee Hudson River Crossing Project material would have to be amended before being placed at the site. This processing may happen in several ways. The project's contractor or sub-contractor may establish a staging and dewatering/processing area to amend the dredged material prior to delivery to the site. Alternatively, the project's contractor may utilize a private dredge processor, as described previously; the processor would then dispose of the material at the GATX site. In a third option, the Tappan Zee Hudson River Project may compensate the prospective site owner/operator for establishing a dedicated processing facility on the GATX site.

At this time, the prospective owner/operator contacted by the project team has declined to provide an estimate of costs associated with placing the Tappan Zee Hudson River Crossing Project dredge material on the site. Even assuming there would be no charge for disposal of material at this site, however, it is expected that this disposal option would cost significantly more than disposal at HARS due to the costs associated with the amendment and stabilization required prior to placement. In addition, the exact terms and conditions of placing Tappan Zee Hudson River Crossing Project dredge material (such as the logistics of offload and placement, and required treatment or processing) would also have to be negotiated once a new owner begins managing the site and the Modified Consent Order is executed.

BENEFICIAL RE-USE FOR HABITAT RESTORATION

Another beneficial re-use option involves using dredged material for habitat creation, enhancement, and restoration, e.g., creation of wetlands, bird and shellfish habitat, and restoration of degraded aquatic sites such as borrow pits. This option also requires that the dredged materials are of an appropriate consistency (i.e., sand, silt/clay) for placement. As with the above option, the contractor would assume the responsibility for dewatering, processing, and amending the dredged material to be appropriate for placement.

According to the USACE DMMP, several steps must be accomplished to implement most habitat restoration applications. For example, many applications would require a demonstration project before a full-scale implementation.[1] Demonstration projects are reviewed by an interagency team of experts and undergo extensive public review. Most habitat restoration projects would involve the identification of a site, design of a placement program appropriate for the site, environmental review (including a public input phase) and permitting. Given the likely duration of these steps, it is unlikely that this option would be available when dredging occurs for the Tappan Zee Bridge Hudson River Crossing Project, unless the resulting dredge material can be incorporated into a restoration project already designed and permitted by USACE; no such sites are known at this time. Moreover, the dredge materials from the Tappan Zee Bridge Hudson River Crossing Project would not be of an appropriate consistency for restoration of a

[1] Dredged Material Management Plan for The Port of New York and the State of New Jersey, *Beneficial Uses of Dredged Material*. http://www.nan.usace.army.mil/harbor/dmmp/index.php?benefic.

habitat where sand is required. For these reasons, use of Tappan Zee Bridge dredged materials for habitat restoration is not considered practicable.

TRANSPORT DIRECTLY TO A PERMITTED LANDFILL FACILITY

In this option, dredged materials would be transported by boat from the construction site to a waterfront site in the New York metropolitan area that would accept the materials as waste. Under this option it is not expected that the dredged material would be processed by the contractor before delivery to a landfill facility, since the material would be transferred just for disposal, not for use in site remediation. Dewatering would most likely have to take place before the dredged material is removed from the project site. As discussed previously, because of the logistical difficulties associated with transferring dredge spoils to trucks, the only practicable disposal sites under this alternative are those that can receive dredged materials by barge or rail. No waterfront permitted landfill sites are available for disposal of dredged materials in the New York metropolitan area. An option that would transfer materials to rail, for further transport to a permitted landfill, would involve the same processing and staging as described above for beneficial reuse—a waterfront staging area would have to be developed where the dredged materials could be dewatered and transferred to rail cars.

The cost of this alternative would therefore be similar to beneficial use for remediation, described above, except that this alternative would also involve a tipping fee at the landfill for disposal of the dredged materials. As discussed above, developing a staging and processing site for use only during the limited dredging windows required for the Tappan Zee Bridge project would be logistically complex, due to the difficulties in establishing available staging site and potential local impacts. This option would also be less efficient and even more costly than using the services of a dredged material processing facility. The cost for this option would depend on the level of contamination found by the sampling program and on the chosen remediation site. Costs estimated for this option included the staging and drying of dredge material, amendment of material as needed, loading for off-site disposal, sampling and permitting, and transportation and disposal. Costs are estimated to range from $90 to $175 per cubic yard.

TRANSPORT DIRECTLY TO A TO-BE-PERMITTED LANDFILL FACILITY

In this alternative, dredged materials would be transported by boat from the construction site to a waterfront site in the New York metropolitan area that would accept the materials as waste. This alternative also includes the possibility of transporting materials by barge to a waterfront site for processing and transfer to rail, after which the dredged materials would be transported to a site that would accept the materials as waste. In this alternative, it is assumed that the ultimate disposal site is not yet permitted to accept solid waste, but instead would be adapted specifically to accept dredge spoils from the Tappan Zee Bridge Hudson River Crossing Project. The site would need to receive all relevant permits, including a Part 360 permit from NYSDEC, to operate as waste management facility before the project's dredging program begins. This alternative would therefore require enough time to receive all required approvals for the landfill site and to develop the facilities to accept waste once approvals are in place. For the Tappan Zee Bridge construction, obtaining the required permits and developing the necessary facilities in time to meet the project's imminent construction schedule would prove difficult.

In undertaking this analysis, the three sites discussed below were suggested by USACE as potential sites to establish a facility specifically for the disposal of material dredged for the construction of the Tappan Zee Bridge Hudson River Crossing Project. These facilities could also be considered options under the Beneficial Reuse for Land Remediation alternative; they are grouped here because all three sites are currently operational and would closed and converted specifically to accept materials from the project.

TILCON SITES

The sites suggested are located in New York State and owned by Tilcon New York Incorporated: the Tompkins Cove Quarry near Stony Point, approximately 13 miles north of the construction zone; the West Nyack Quarry near the project site, and the Kingston Quarry, approximately 70 miles from the project site. To accept fill material, the sites' owner would have to obtain a Part 360 permit and would have to implement all needed capital improvements to accept and process dredge materials prior to receipt of any dredge materials from the Tappan Zee Bridge Hudson River Crossing Project. Such improvements may include additional infrastructure to transfer the delivered and processed dredge material, dewatering facilities, engineering controls for groundwater protection and leachate control, etc. In addition, converting to a waste management facility would require that the site's owner forego any residual value associated with mining the site and any associated potential revenue, which would increase the cost for this disposal option for the project.

Discussions with Tilcon regarding the various quarry sites they own and operate indicated that the only potential site for developing a landfill facility is at Stony Point. However, Tilcon has indicated that they are not prepared to discuss this option at this time. Because of the imminent project construction schedule, it is unlikely that this option would be available when it is needed for the project and therefore is discarded at this time as a disposal alternative.

CONCLUSION

Based on the foregoing it is concluded that there is no practicable alternative at this time to disposal of the project dredge materials at HARS. The HARS disposal alternative is identified at this time as being the most cost effective, as the best fit to the Tappan Zee Bridge Hudson River Crossing Project's dredging program schedule, and as being the most reliable and available, given the imminent need for the project and constraints on other potential sites. As mentioned above, the capacity of any one dredge materials management facility is not expected to be sufficient for a project of this size. Furthermore, while the alternative of using a private dredged materials management facility to process and dispose of the materials may provide a similar level of schedule fit and reliability, this option could cost nearly eight times the cost for disposal at HARS, which can add up to $221 million to the cost of the project, making the cost of upland disposal an unreasonable incremental cost to this publically funded project.

Other alternatives evaluated would also be much more costly than disposal at HARS, would require the contractor to establish a temporary dredge spoils processing facility dedicated to the project and/or require extensive, time-consuming, and potentially controversial permitting that may not be completed in time to satisfy the project's construction schedule. Finally, with respect to options involving disposal at the Tilcon and GATX sites, in view of the uncertainties indicated above, these sites are not considered practicable alternatives at this time.

Table 2 summarizes the conclusions of this analysis.

Table 2
Summary of Disposal Alternatives

Disposal Alternative	Approximate Total Cost	Ability to Meet Project Schedule	Reliability
Placement in HARS	$17 to $34 million.	**Good**	**Good**
Dredge Material Processing Facility	$77 to $255 million.	**Good**	**Good**
Beneficial re-use – land remediation	$153 to 297 million. Cost would depend on the selected restoration site, but is expected to be significantly more than HARS.	**Depends** Requires further negotiation with owner/operator of GATX. Requires processing of dredge material by project contractor.	**Depends** If a site is identified, reliability is dependent on the site's construction schedule
Beneficial re-use – habitat restoration	**Unknown** Cost would depend on the selected restoration site. Cost is expected to be significantly more than HARS	**Poor** Requires a designed and permitted site to be available before dredging begins. Requires processing of dredged material by project contractor.	**Poor** Unlikely to identify suitable site for Hudson River sediments
Permitted landfill facility	$153 to 297 million. Cost is expected to be significantly more than HARS.	**Depends** Depends on the location of the site and means of transport of dredge materials.	**Good** Dependent on the site's capacity and the general reliability of site's operations
To-be-permitted landfill facility	**Unknown** Cost would depend on the selected disposal site, but is expected to be significantly more than HARS.	**Poor** Site would need to receive all relevant permits before dredging program starts	**Depends** Once a site is operational it would be dedicated to accepting waste from the project.