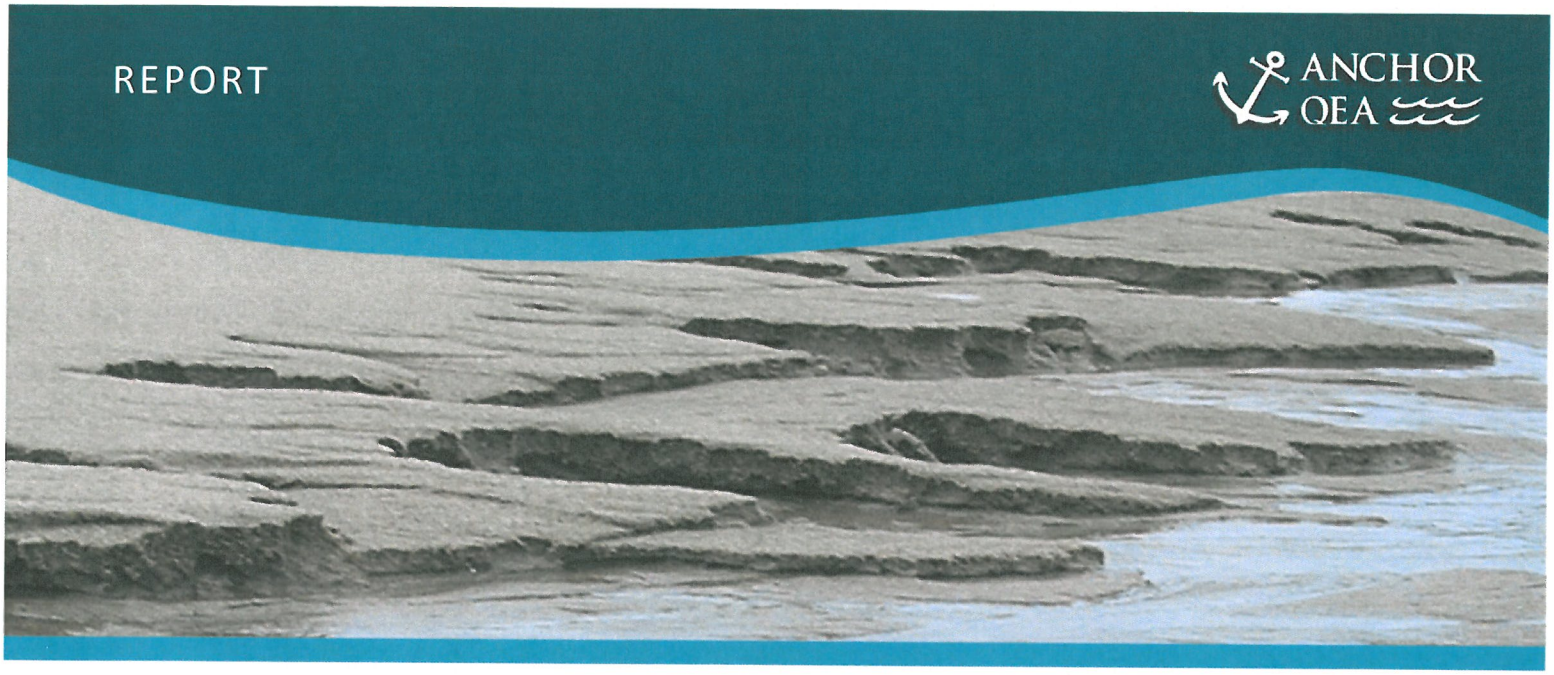
APPENDIX L

CAP MATERIAL SPECIFICATIONS

REPORT



CAP MATERIALS SPECIFICATIONS APPENDIX – ONONDAGA LAKE

Prepared for

Honeywell
PARSONS

Prepared by

Anchor QEA, LLC

March 2012

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Date: March 2, 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

CQAP	Construction Quality Assurance Plan
GAC	Granulated Activated Carbon
Lake	Onondaga Lake
mg/g	milligrams per gram
mm	millimeters
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency

1 INTRODUCTION

This document presents the process for developing specifications for capping and habitat materials for the Onondaga Lake (Lake) remediation project. In addition to the conventional aggregate materials necessary for cap construction, amended cap materials (e.g., Granulated Activated Carbon [GAC] and siderite) are incorporated into the design of the chemical isolation layer materials.

Materials to be used in the construction of caps in the Lake and adjacent wetlands can be categorized into habitat, chemical isolation, and erosion protection materials based on their function within the overall cap design. For habitat materials, general grain size characteristics were identified to provide the desired habitat substrate; additional details regarding habitat material development are included in Section 4.3 and Appendix K of the Onondaga Lake Capping, Dredging, and Habitat Final Design Report (Final Design). Similarly, chemical isolation material characteristics were identified to provide the selected isolation properties (primarily based on porosity) in conjunction with the design mixes of siderite and GAC. Appendix B of the Final Design provides additional details on the design of the chemical isolation layer. The general grain size characteristics of erosion protection materials were selected based on the hydrodynamic and wave conditions expected within each remediation area as discussed in Appendix D of the Final Design.

In general, the specifications for the capping materials for the Lake and adjacent wetlands were developed through a series of steps including the following:

- Initial design requirements based on habitat objectives and erosion protection evaluations
- Consideration of site-specific design factors
- Development of gradation specifications

These steps and the resulting specifications are discussed in detail below.

2 CONSIDERATIONS RELATED TO CAP MATERIAL GRADATIONS

Technical analyses completed as part of the Lake design included the initial development of general material classifications and mass median particle sizes (D_{50}: diameter at which 50 percent by weight is finer) required by the design. These initial design requirements are narrowly focused on the material type or D_{50} particle size and do not include a complete gradation specification. Therefore, a number of factors (including site-specific factors) were considered in developing the complete material specifications, including the following:

- Local availability of materials: The local availability of cap materials was considered to minimize transport distances and associated environmental impacts. Furthermore, use of a local source provides for "just-in-time" deliveries to the project site, which reduces the required on-site storage requirements. Though not a driver for cap design, locally available materials were considered when developing gradations so as not to unreasonably limit material sourcing. All potential influences of local materials were verified to pass design criteria prior to incorporation in gradation development.
- Material processing effort required to meet specifications: Honeywell has committed to focus on sustainability for the overall Syracuse portfolio of projects. As part of this focus, cap material specifications were aimed at minimizing the level of effort required to produce the materials as well as minimizing the amount of by-product generated by the processing that would not otherwise be used for the Onondaga Lake project or other local projects.
- Habitat considerations: The potential for cap materials to provide suitable habitat functionality was also considered during material specification development. Naturally occurring rounded or run-of-bank material is preferred over crushed rock to aid in habitat development. In addition, topsoil with an organic matter content requirement for specified habitat materials is included to provide suitable substrate in wetland areas and areas of the lake that will be planted.
- Cap material placement equipment and limitations: As discussed in Section 4.5 of the Final Design, the majority of capping materials will be placed using a hydraulic spreader system. Discussions with the selected contractor regarding the ability to hydraulically transport the materials without excessive pumping and pipeline issues lead to identifying an upper size limit (e.g., D_{100}) of approximately 2 to 3 inches in

diameter for gravels and sands. Larger diameter materials (e.g., gravelly cobbles and coarse gravels) will be placed mechanically; therefore, the restriction was not applied to those materials.

- Required quantities: Required quantities of material were reviewed to evaluate the feasibility for minimizing the total number of material types required. By evaluating the quantity of materials involved at different design sizes, it was possible to reduce the total number of specified material types by combining several required sizes under one specified material. For example, design requirements indicate that several areas require sand-sized particles with varying median diameters (D_{50} ranging between 0.03 and 0.08 inches for these areas). Because the median particle sizes for these areas were not significantly different, the design requirements for the areas were combined into a single specification where the specified D_{50} will be at least 0.08 inches, thereby satisfying the minimum sizing requirements for stability for the range of required materials.
- Well-graded materials: Development of gradations considered the design D_{50} values and criteria from the U.S. Army Corps of Engineers (USACE) Engineering Manual 1110-2-2300 - General Design and Construction Considerations for Earth and Rock-Fill Dams (USACE 2004). In addition, the potential for vertical migration of one granular material through another (often referred to as "piping") was considered, as recommended by the U.S. Environmental Protection Agency (USEPA)/USACE's "Guidance for In-Situ Subaqueous Capping of Contaminated Sediments" (Palermo et al. 1998). The potential for piping can be minimized through the use of well-graded gradations for the two materials. The compatibility of the two materials in combination was verified in accordance with geotechnical filter criteria (Terzaghi and Peck 1967).
- Fines content relative to water quality (turbidity): To minimize the potential for turbidity to impact water quality during material placement, the fines content (percent passing the U.S. no. 200 sieve) of each material type was considered. Section 3 discusses specification of a range of fines content and a target within that range that will achieve the objectives of minimizing water quality impacts while maintaining flexibility in individual loads.

- Layer thickness and over-placement allowance: The thickness of each layer within the cap is governed, in part, by the particle sizes of the material comprising that layer —for example, layer thickness is typically a function of the mass median and maximum particle sizes (D_{50} and D_{100}). In addition, an over-placement allowance will be provided for each layer of the cap to account for placement inaccuracies. The over-placement allowance will vary for each material based on the D_{50} and D_{100}. Based on a general objective to minimize cap thickness, grain size specifications (especially D_{100}) were developed with consideration of layer thickness and over-placement allowances.

3 SPECIFICATION DEVELOPMENT FOR AGGREGATE MATERIALS

Table 1 presents a description of the habitat material and the initial design requirements for erosion protection layer for each remediation area. As noted above, these initial design requirements form the basis for the material specifications with consideration of several site and operational factors summarized in Section 2. Remediation areas were divided into habitat modules representing different water depth ranges, with corresponding grain size and organic matter content requirements. For erosion protection materials, Table 1 presents the calculated D_{50} size requirements based on the design described in Sections 1 and 2 and described in Appendix D (Armor Layer Design) of the Final Design. Note that in some areas, habitat material size coincides with that of the erosion protection materials, while other areas require an additional layer of habitat material over the erosion protection layer to provide suitable habitat substrate.

Table 1

Habitat Material and Erosion Protection Layer D_{50}

Remediation Area	Habitat Module	Habitat Layer Material Description	Erosion Protection Layer – Design D_{50} (inches)	Organic Matter Content (percent)
A	6A	Topsoil	1.5	5 to 20
	5A	Topsoil	1.5	5 to 20
	4A	Topsoil	1.5	5 to 20
	3A (in 2- to 3-foot water depth)	Topsoil	1.5	5 to 20
	3A (in 3- to 7-foot water depth)	Fine Gravel [a]	0.51	N/A
	3B (NMC Channel)	Coarse Gravel [a]	1.0	N/A
	2B (NMC Channel)	Coarse Gravel [a]	1.0	N/A
	2A (in 7- to 10-foot water depth)	Fine Gravel [a]	0.51	N/A
	2A (in 10- to 20-foot water depth)	Medium Sand [a]	0.08	N/A
	1	Medium Sand [a]	0.08	N/A
B	5A	Fine Gravel	1.7	N/A
	3A (in 2-4 foot water depth)	Fine Gravel	1.7	N/A
	3A (in 4-7 foot water depth)	Fine Gravel [a]	0.67	N/A
	2A (in 7-10 foot water depth)	Fine Gravel [a]	0.2	N/A
	2A (in 10- to 20-foot water depth)	Medium Sand [a]	0.03	N/A
	1	Medium Sand [a]	0.03	N/A

Remediation Area	Habitat Module	Habitat Layer Material Description	Erosion Protection Layer – Design D_{50} (inches)	Organic Matter Content (percent)
C	8A	Fine Gravel	1.9	N/A
	5B	Fine Gravel	1.9	N/A
	5B (Boat Launch Area)	Coarse Gravel [a]	1.9	N/A
	3B (in 2- to 4-foot water depth)	Fine Gravel [a]	1.9	N/A
	3B (Boat Launch Area)	Coarse Gravel [a]	1.9	N/A
	3B (in 4- to 7-foot water depth)	Fine Gravel [a]	0.52	N/A
	2A (in 7- to 10-foot water depth)	Fine Gravel [a]	0.3	N/A
	2A (in 10- to 20-foot water depth)	Medium Sand [a]	0.08	N/A
	1	Medium Sand [a]	0.08	N/A
D	25-foot buffer [b]	Topsoil	1.9	5 to 20
	6A	Medium Sand	1.9	N/A
	5A	Medium Sand	1.9	N/A
	3B (in 2- to 4-foot water depth)	Medium Sand	1.9	N/A
	3B (in 4- to 7-foot water depth)	Fine Gravel [a]	0.52	N/A
	2A (in 7- to 10-foot water depth)	Fine Gravel [a]	0.3	N/A
	2A (in 10- to 20-foot water depth)	Medium Sand [a]	0.08	N/A
	1	Medium Sand [a]	0.08	N/A
E	25-foot buffer [b]	Topsoil	3.0	5 to 20
	6B	Coarse Gravel	3.0	N/A
	5B	Coarse Gravel	3.0	N/A
	3B (in 2- to 3-foot water depth)	Coarse Gravel	3.0	N/A
	3B (in 3- to 7-foot water depth)	Gravelly Cobbles [a]	3.0	N/A
	2B	Coarse Gravel [a]	1.1	N/A
	2A	Fine Gravel [a]	0.4	N/A
	2A (Navigation Channel)	Gravelly Cobbles [a]	3.0	N/A
	1	Medium Sand [a]	0.04	N/A
NMC Spits	6A	Topsoil	wetlands	5 to 20
	9B	Topsoil	wetlands	5 to 20
WB 1-8 Connected Wetland	6A	Topsoil	wetlands	5 to 20
	5A	Topsoil	wetlands	5 to 20

Remediation Area	Habitat Module	Habitat Layer Material Description	Erosion Protection Layer – Design D_{50} (inches)	Organic Matter Content (percent)
WBB Outboard Area	6A	Topsoil	wetlands	5 to 20
	5A	Topsoil	wetlands	5 to 20
	3A	Topsoil	wetlands	5 to 20
	8A	Topsoil	wetlands	5 to 20
	9B	Topsoil	wetlands	5 to 20

Notes:
N/A = not applicable
NMC = Ninemile Creek
WB = Wastebed
WBB = Wastebed B
a. Habitat layer and erosion protection layer will be comprised of the same material
b. 25-foot buffer – Habitat substrate from the shoreline to 25 feet offshore will be topsoil along Remediation Area D and the Wastebed B Outboard Area.
Wetlands – In the adjacent wetlands, the additional erosion protection that will be provided by the wetland vegetation was taken into consideration, resulting in an erosion protection layer of Coarse Gravel (Type B) with a minimum erosion protection layer thickness in the wetlands of 4.5 inches, as detailed in Appendix D

To advance the development of the specifications and reduce the required number of material types for cap construction, design sizes for the erosion protection material from Table 1 were grouped into similar size categories based on Unified Soil Classification System (USCS) material classifications. Table 2 presents a summary of the calculated D_{50} for the erosion protection layer material in each remediation area (from Table 1), with materials having similar required particle sizes grouped into four general categories: sand, fine gravel, coarse gravel, and gravelly cobbles.

Table 2

Erosion Protection Materials Initial Design D_{50} by Remediation Area

Material Type	Capping Area	Design Calculated D_{50}[a] (inches)
Sand	Remediation Area A	0.08
	Remediation Area B	0.03
	Remediation Area C	0.08
	Remediation Area D	0.08
	Remediation Area E	0.04
	Remediation Area F	0.08
Fine Gravel	Remediation Area A	0.51
	Remediation Area B	0.67
	Remediation Area C	0.52
	Remediation Area D	0.52
	Remediation Area E	0.4
	Remediation Area F	0.51
Coarse Gravel	Remediation Area A	1.5
	Remediation Area B	1.7
	Remediation Area C	1.9
	Remediation Area D	1.9
	Remediation Area E	1.1
	Remediation Area F	-
Gravelly Cobbles	Remediation Area A	-
	Remediation Area B	-
	Remediation Area C	-
	Remediation Area D	-
	Remediation Area E	3.0
	Remediation Area F	-

Note:

a. Design calculated D_{50} sizing indicated is a minimum size necessary for material stability; specifications will require material to have D_{50} greater than or equal to values shown.

After grouping materials into the categories listed in Table 2, the largest design D_{50} size for each category was selected for use in specification development. The selection of the maximum design D_{50} for each material type allows the use of one material specification to cover the range of design conditions found throughout the various remediation areas, thereby reducing the required number of material types and associated material processing.

Based on a review of design conditions outlined in Section 2, it was determined that additional material subdivisions would be required for sand material and coarse gravel material. The sand category was subdivided into two material types (i.e., medium sand and gravelly sand) based on geotechnical filter criteria consideration when used as isolation material underlying the erosion protection material. Specifically, use of the gravelly sand planned for the chemical isolation layer in Remediation Area E will minimize the potential for the sand portion of the chemical isolation layer material to wash out through the larger void spaces of the overlying gravelly cobble material. The medium sand will be used for the chemical isolation material in all other remediation areas, as well as for the habitat layer where sand is the required material type (see Table 1).

Similar to the sand category, the coarse gravel category was further subdivided into two types (A and B) based on the ability to hydraulically place the material. Approximately 80 percent of the total coarse gravel volume required for the project is located in Remediation Area E and requires a D_{50} of at least 1.1 inches; the remaining 20 percent requires a D_{50} of approximately 1.5 inches to 2 inches. By developing two separate specifications for coarse gravel (types A and B), the majority of the coarse gravel material (that with the smaller particle size) could likely be hydraulically placed, reducing cost and schedule implications of mechanical placement required of the larger materials.

The selected D_{50} sizing for each erosion protection material type is presented in Table 3.

Table 3
Final Design Material Types

Material Type	Capping Area	Required D_{50} [a] (inches)
Medium Sand	Remediation Areas A, B, C, D,E, and F	0.08
Gravelly Sand	Remediation Area E, DOT turnaround area steep slope	0.13 [b]
Fine Gravel	Remediation Areas A, B, C, D, E, and F	0.67
Coarse Gravel (Type A)	Remediation Areas A, B, C, and D	1.9
Coarse Gravel (Type B)	Remediation Area E	1.1
Gravelly Cobbles	Remediation Area E	3.0

Notes:
a. Required D_{50} based on largest required D_{50} from initial design analyses for each applicable remediation area (see tables 1 and 2). D_{50} sizing indicated is a minimum sizing, specifications will require material to have D_{50} greater than or equal to values shown.
b. Required D_{50} for gravelly sand based on geotechnical filter criteria (see below).

The selected D_{50} for each material type listed in Table 3 was compared against standard U.S. sieve sizes to select a standard sieve size to use in the specification. The specification was then developed around this selected sieve size such that no more than 50 percent (by weight) in the design gradation would pass this sieve, ensuring that material meeting the specification would have a D_{50} equal to or larger than the selected sieve size. A range was then included on the selected sieve size (e.g., 30 to 50 percent passing), allowing for some natural variation in the gradation specification while still ensuring that the required D_{50} would be achieved.

An upper bound maximum particle size (D_{100}) for each material type was selected based on design considerations such as hydraulic transport and overplacement tolerances, as discussed in Section 2. For example, the gravelly cobble specification includes a maximum stone size of 6 inches to maintain a 6-inch over-placement allowance. The maximum particle sizes for the coarse gravels (Type A and Type B) were selected to prevent excessive larger material in the specification while still allowing a broad range of materials to meet the specification (i.e., allowing a naturally occurring bank run material with minimal processing). The maximum particle size for the remainder of capping materials was limited to 2 to 3 inches to allow hydraulic transport and placement of the material.

The lower bound of the material types was selected to limit the fines content of the materials to minimize the potential for water quality (i.e., turbidity) impacts during placement. The specifications for each material type were developed to limit the fines content to a maximum of 10 percent (by weight) passing the U.S. no. 200 sieve. However, acquisition of materials will target a range of fines from 0 to 3 percent (by weight). Target ranges provide a goal for lower fines content material while the upper limit allows a greater flexibility in individual loads, preventing excessive load rejection based on fines content only.

Standard geotechnical filter criteria presented by Terzaghi and Peck (1967) provide recommended particle size ratios between base and overlying materials (e.g., sand chemical isolation and overlying erosion protection materials). The primary filter criteria particle size relationship primarily applicable to subaqueous capping materials is the ratio of D_{15} of the armor stone to the D_{85} of the base layer. This relationship relates to the ability of the base layer material (e.g., sand) to pass through the void spaces in the overlying larger material (e.g., erosion protection armor stone). Compliance with the recommended filter criteria minimizes the potential for wash out of the base material by the creation of internal filters in the armor stone voids. The Terzaghi filter criteria recommend the following relationship to prevent material loss through the armor layer:

$$d_{15(Armor)} < 5d_{85(Base)}$$

After reviewing the selected sizing of erosion protection and isolation materials relating to this filter criteria, additional gradation specifications were added to medium sand and gravelly sand to meet the filter criteria while also holding to the required D_{50} and general well-sorted sizing expectations. Table 4 presents a comparison of calculated D_{15} to D_{50} ratios for each armor material and the potential base isolation material.

Table 4
Armor and Isolation Material Filter Criteria Comparison

Armor Material	Armor D_{15} Range [a] (inches)		Base (Isolation) Material	Base D_{85} Range [a] (inches)		D_{15}/D_{85} Max Ratio [b]
	Min	Max		Min	Max	
Gravelly Cobbles	0.025	0.75	Gravelly Sand	0.625	1.2	1.2
			Medium Sand	0.21	0.3	3.6
Coarse Gravel Type A	0.007	0.75	Gravelly Sand	0.625	1.2	1.2
			Medium Sand	0.21	0.3	3.6
Coarse Gravel Type B	0.0065	0.5	Gravelly Sand	0.625	1.2	0.8
			Medium Sand	0.21	0.3	2.4
Fine Gravel	0.006	0.05	Gravelly Sand	0.625	1.2	0.08
			Medium Sand	0.21	0.3	0.24

Notes:
a. D_{15} and D_{85} size ranges, where not specified, were selected based on standard geotechnical gradation curves developed from the specified gradation.
b. Terzaghi criteria recommends a D_{15}/D_{85} ratio of less than 5 to prevent loss of base material through armor void spaces. Maximum ratio applies to the worst case scenario comparison of the maximum armor D_{15} compared to the minimum base D_{85}.

Figures 1 and 2 illustrate the design gradations; Figures 3 and 4 illustrate the D_{15} to D_{85} ratio relationships between the armor materials and underlying sand chemical isolation materials.

There are two additional materials that are also specified. An armor stone will be placed along the steep slope of the New York State Department of Transportation (NYSDOT) Turnaround Area to physically isolate the slag material. The armor cap over the isolation layer will consist of a layer of gravelly sand material as a bedding layer beneath the armor stone, to the extent possible, and an armor stone ranging in diameter size of 4 to 18 inches.

Additionally, material will be placed along a portion of the surf zone of Remediation Area B to address erosion of Solvay waste material along the shoreline of WB 1-8. Shoreline stabilization material consisting of a graded gravel, bank-run material will be placed at an average thickness of approximately 1.5 feet from elevation 365 feet to 362.5 feet (upland from the shoreline). Shoreline stabilization material consisting of Coarse Gravel (Type B)

will be placed at an average thickness of approximately 6 inches from elevation 362.5 feet to 360 feet (within the Lake).

Attachment A presents material specifications and gradation for each material type based on the requirements and considerations detailed above.

4 AMENDED CAP MATERIALS

Isolation materials utilized in cap construction will include amendment materials blended with the cap layer to provide appropriate isolation properties. Amendment materials include GAC and siderite for the chemical isolation layer. Application of these materials is based on an addition of specified quantities by weight per square foot of cap construction. Additional details regarding amendment rates and design are presented in Appendix B and Appendix I of the Final Design.

4.1 Granulated Activated Carbon

The GAC for use in the cap chemical isolation layer will be Calgon F400 or equivalent. The specifications that a supplier will have to meet, whether it is Calgon or another supplier, are the following Calgon F400 specifications:

- The material shall be virgin condition
- The base material must be bituminous coal
- Steam will be used as its activation method
- A minimum iodine number of 1,000 milligrams per gram (mg/g)
- A maximum moisture of 2 percent by weight
- A minimum abrasion number of 75
- An effective size of 0.55 to 0.75 millimeters (mm)
- A maximum uniformity coefficient of 1.9
- No more than 5 percent by weight greater than 12 mesh (1.7 mm)
- No more than 4 percent by weight less than 40 mesh (0.42 mm)

The size of the GAC particles (specified in the last two bullets above) will be subject to change following NYSDEC review and approval in the event that the GAC is not vertically well-mixed throughout the sand isolation layer.

4.2 Siderite

The siderite for use in the cap chemical isolation layer will be granular, composed of approximately sand-sized particles, and will meet the following specifications:

- The base material will be a siderite ore

- Gradations will conform to the following specifications:

U.S. Standard Sieve Size	Percent Passing (by weight)
U.S. No. 4	95 to 100
U.S. No. 30	0 to 5

- The target ferrous carbonate content will be 74 percent by weight. If the ferrous carbonate content is less than 74 percent by weight, then the siderite dosing in the sediment cap will be adjusted as appropriate. The method for verifying the ferrous carbonate will be provided independently following additional consultation and discussions with the selected siderite supplier.

5 EARTHEN MATERIAL CHEMICAL CRITERIA

Prior to the procurement of capping materials, borrow sources will be inspected and the materials characterized to ensure compliance with the specifications presented in Attachment A. Selected borrow sources will also be subject to materials testing requirements performed routinely throughout construction to verify continued compliance with project specifications. Suitable representative samples and test reports will be submitted to and approved prior to delivery of materials to the job site. The frequency and detailed procedures for sampling and analysis of cap materials will be provided in the Onondaga Lake Construction Quality Assurance Plan (CQAP).

Sampling will include standard geotechnical analyses (e.g., grain size, moisture content, and bulk density) in addition to chemical testing. Chemical testing will be performed to confirm that the materials comply with the Unrestricted Use Soil Cleanup Objectives listed in NYSDEC 6 NYCRR Part 375 (summarized in Table 5). Exceedance of any single chemical compound limit will mean that the entire material batch will be rejected unless subsequent testing on sub-sets of the batch demonstrates compliance with the criteria.

Table 5
Unrestricted Use Soil Cleanup Objectives

Contaminant	Unrestricted Use Criteria (parts per million)
Metals	
Arsenic	13
Barium	350
Beryllium	7.2
Cadmium	2.5
Chromium, hexavalent	1
Chromium, trivalent	30
Copper	50
Total Cyanide	27

Contaminant	Unrestricted Use Criteria (parts per million)
Lead	63
Manganese	1600
Total Mercury	0.18
Nickel	30
Selenium	3.9
Silver	2
Zinc	109
PCBs/Pesticides	
2,4,5-TP Acid (Silvex)	3.8
4,4'-DDE	0.0033
4,4'-DDT	0.0033
4,4'-DDD	0.0033
Aldrin	0.005
alpha-BHC	0.02
beta-BHC	0.036
Chlordane (alpha)	0.094
delta-BHC	0.04
Dibenzofuran	7
Dieldrin	0.005
Endosulfan I	2.4
Endosulfan II	2.4
Endosulfan sulfate	2.4
Endrin	0.014
Heptachlor	0.042
Lindane	0.1
Polychlorinated biphenyls	0.1

Contaminant	Unrestricted Use Criteria (parts per million)
Semivolatile Organic Compounds	
Acenaphthene	20
Acenapthylene	100
Anthracene	100
Benz(a)anthracene	1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	1
Benzo(g,h,i)perylene	100
Benzo(k)fluoranthene	0.8
Chrysene	1
Dibenz(a,h)anthracene f	0.33
Fluoranthene	100
Fluorene	30
Indeno(1,2,3-cd)pyrene	0.5
m-Cresol	0.33
Naphthalene	12
o-Cresol	0.33
p-Cresol	0.33
Pentachlorophenol	0.8
Phenanthrene	100
Phenol	0.33
Pyrene	100
Volatile Organic Compounds	
1,1,1-Trichloroethane	0.68
1,1-Dichloroethane	0.27
1,1-Dichloroethene	0.33
1,2-Dichlorobenzene	1.1

Contaminant	Unrestricted Use Criteria (parts per million)
1,2-Dichloroethane	0.02
cis -1,2-Dichloroethene	0.25
trans-1,2-Dichloroethene	0.19
1,3-Dichlorobenzene	2.4
1,4-Dichlorobenzene	1.8
1,4-Dioxane	0.1
Acetone	0.05
Benzene	0.06
n-Butylbenzene	12
Carbon tetrachloride	0.76
Chlorobenzene	1.1
Chloroform	0.37
Ethylbenzene	1
Hexachlorobenzene	0.33
Methyl ethyl ketone	0.12
Methyl tert-butyl ether	0.93
Methylene chloride	0.05
n - Propylbenzene	3.9
sec-Butylbenzene	11
tert-Butylbenzene	5.9
Tetrachloroethene	1.3
Toluene	0.7
Trichloroethene	0.47
1,2,4-Trimethylbenzene	3.6
1,3,5-Trimethylbenzene	8.4
Vinyl chloride	0.02
Xylene (mixed)	0.26

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FIGURES

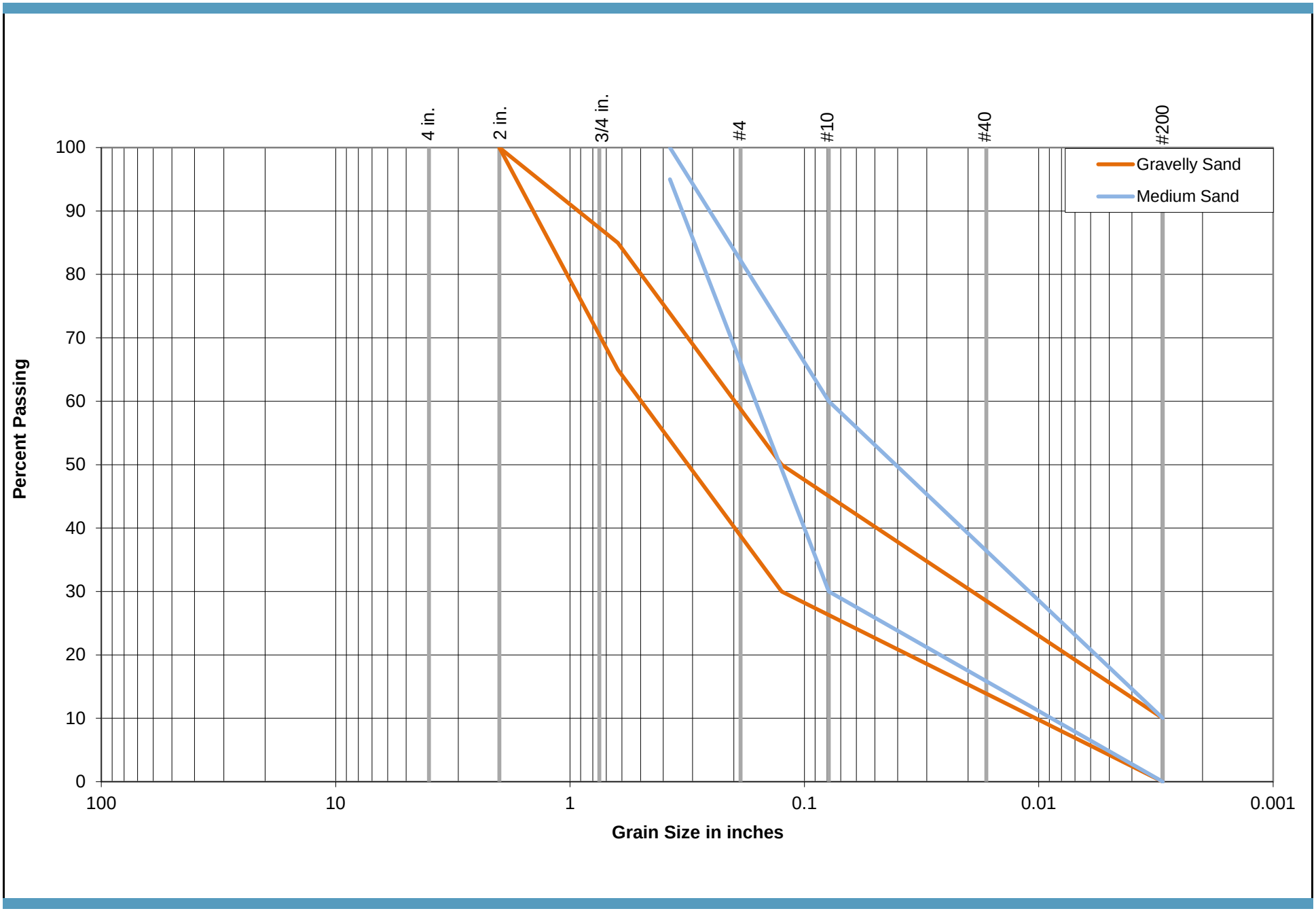

Figure 1
Sand Material Gradations
Cap Material Specifications
Onondaga Lake

ANCHOR QEA

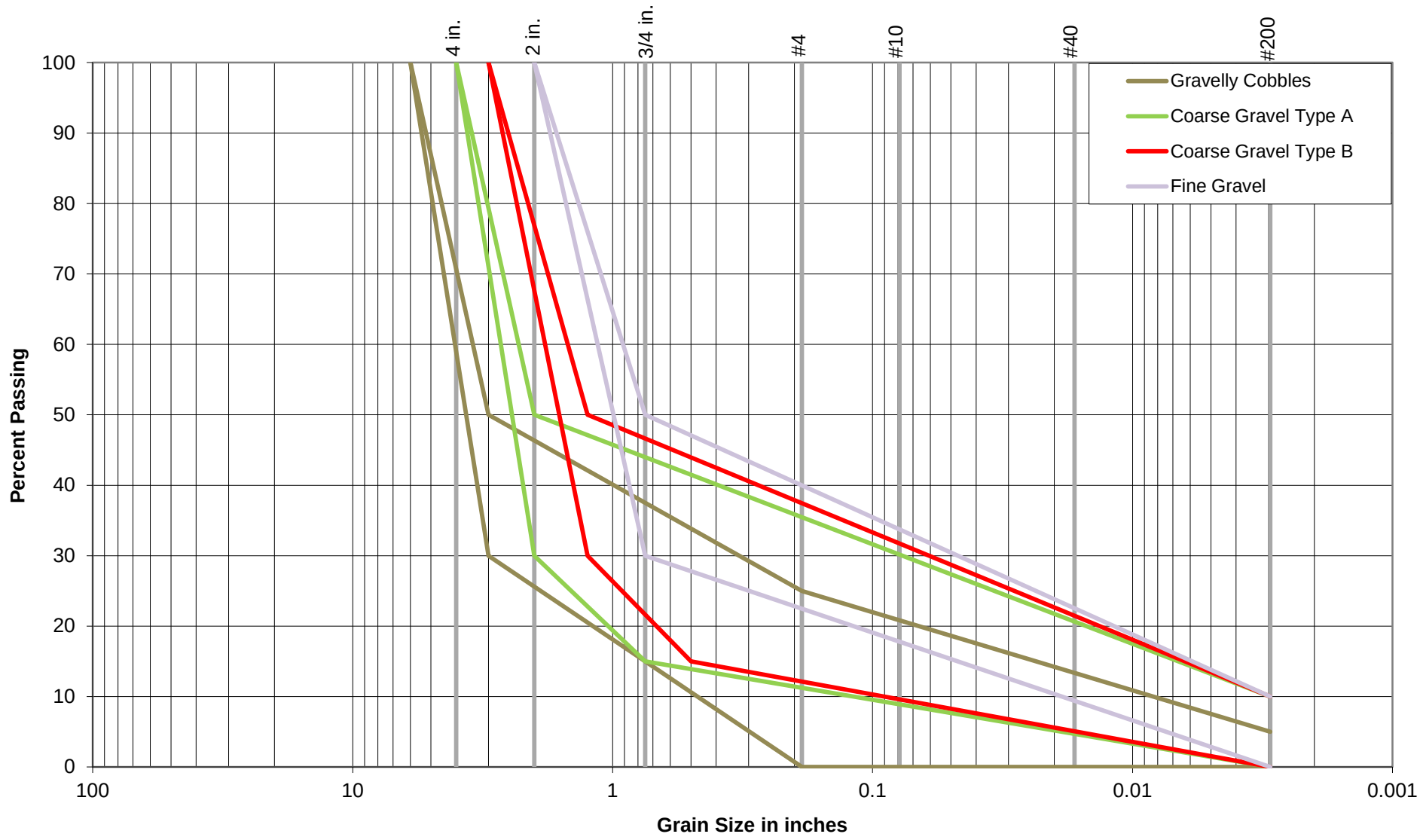

Figure 2
Gravelly Cobbles and Gravel Material Gradations
Cap Material Specifications
Onondaga Lake

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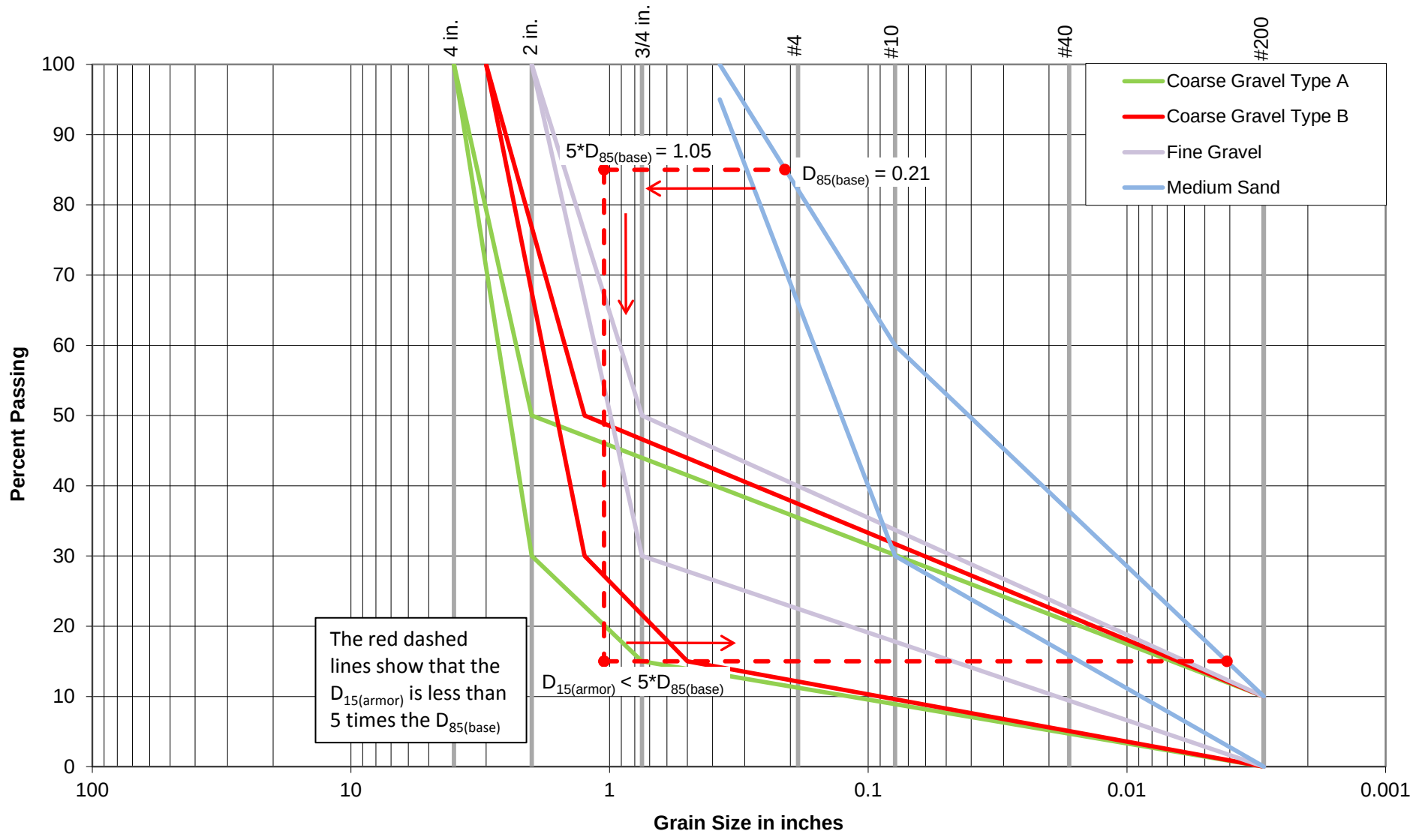

Figure 3
Gravel Filter Criteria Comparison
Cap Material Specifications
Onondaga Lake

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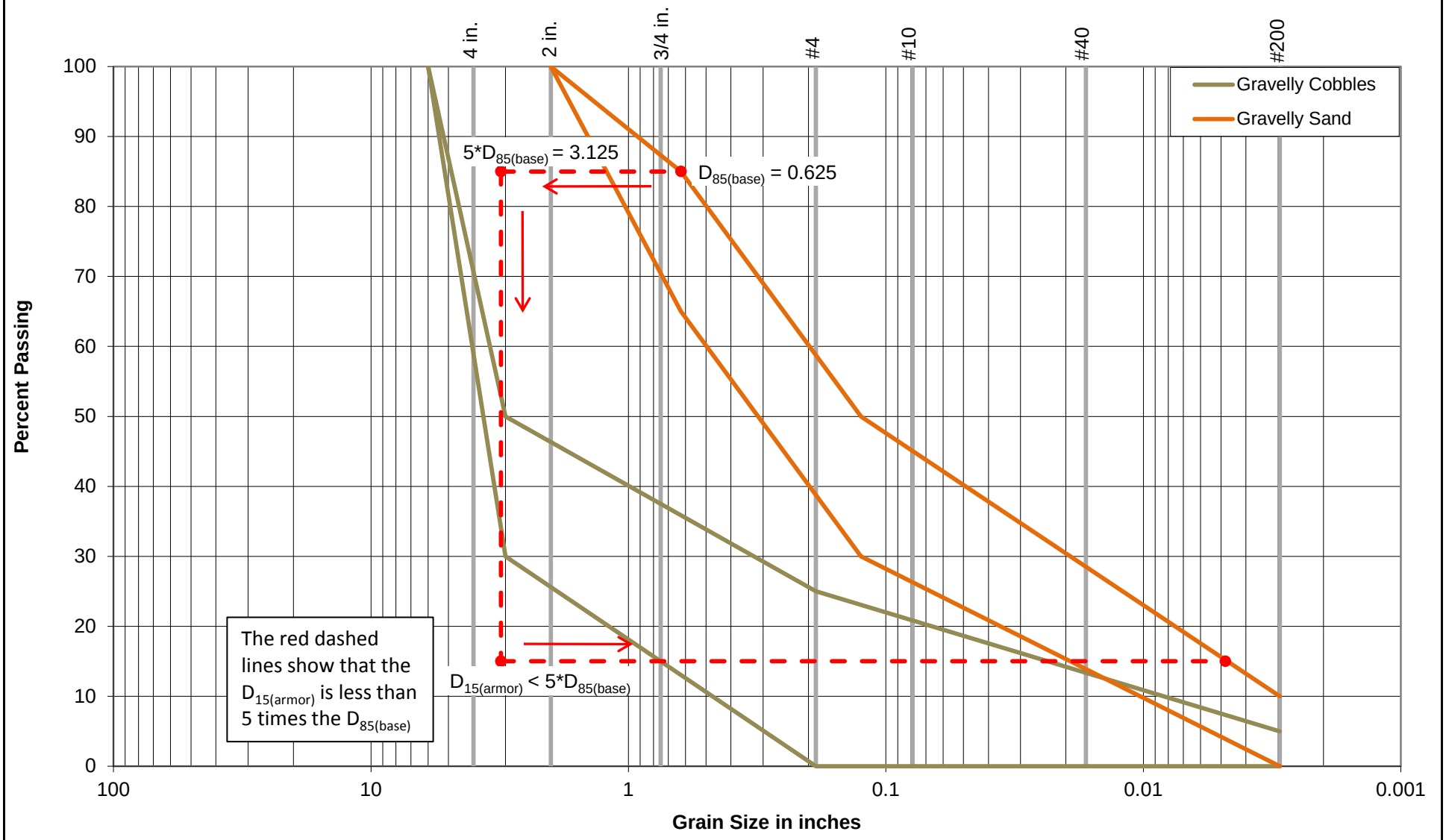

Figure 4
Gravelly Cobbles Filter Criteria Comparison
Cap Material Specifications
Onondaga Lake

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ATTACHMENT A
EARTHEN MATERIAL SPECIFICATIONS

All materials shall be of the quality, size, shape, and gradation or equal to that manufacture as specified herein. Materials will be procured from an approved borrow source in accordance with the Onondaga Lake Construction Quality Assurance Plan.

Gravelly Cobbles

Gravelly cobble material will consist of naturally occurring stone, gravel, screened gravel or run-of-bank material. Screened gravel or bank run material will consist of uncrushed particles. Gravelly cobble material designed below the top 12 inches of the cap may be a crushed product. Crushed stone and gravel will consist of clean, durable, sharp-angled rock fragments of uniform quality. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
6 inch	100
3 inch	30 to 50
U.S. No. 4	0 to 25
U.S. No. 200	0 to 5 (0 to 3 preferred)

Coarse Gravel – Type A

Coarse Gravel material will consist of naturally occurring screened or run-of-bank gravel or other acceptable granular material. Crushed stone would be acceptable when used below the top 12 inches of the cap. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
4 inch	100
2 inch	30 to 50
3/4 inch	>15
U.S. No. 200	0 to 10 (0 to 3 preferred)

Coarse Gravel – Type B

Coarse Gravel material will consist of naturally occurring screened or run-of-bank gravel or other acceptable granular material. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
3 inch	100
1 1/4 inch	30 to 50
1/2 inch	>15
U.S. No. 200	0 to 10 (0 to 3 preferred)

Fine Gravel

Fine Gravel material will consist of naturally occurring screened or run-of-bank gravel or other acceptable granular material. Crushed stone would be acceptable when used below the top 12 inches of the cap. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
2 inch	100
3/4 inch	30 to 50
U.S. No. 200	0 to 10 (0 to 3 preferred)

Gravelly Sand

Gravelly Sand material will be naturally occurring, clean, and free-draining. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
2 inch	100
5/8 inch	65 to 85
U.S. No. 6	30 to 50
U.S. No. 200	0 to 10 (0 to 3 preferred)

Medium Sand

Medium Sand material will be naturally occurring, clean, free-draining sand. Gradations must conform to the table below.

U.S. Standard Sieve Size	Percent Passing (by weight)
3/8 inch	95 to 100
U.S. No. 10	30 to 60
U.S. No. 200	0 to 10 (0 to 3 preferred)

Topsoil

Topsoil shall be natural or manufactured, friable, and fertile soil that meets the U.S. Department of Agriculture (USDA) basic soil texture classes of loam, silt loam, or sandy loam to be recovered from the A horizon of an in-place soil. Topsoil shall be capable of sustaining healthy plant life and be reasonably free of subsoil, heavy or stiff clay, brush, roots, weeds, other objectionable plant matter, foreign material, stones larger than 4 inches in greatest dimension, and any other materials unsuitable or harmful for plant growth. Topsoil as delivered to the site or stockpiled shall meet the following requirements:

- Gradations conforming to the table below:

U.S. Standard Sieve Size	Percent Passing (by weight)
4 inch	100
1 inch	85 to 100
¼ inch	65 to 100
U.S. No. 200	15 to 80

  The 2 micron particle size shall not be greater than 20 percent of the total sample mass, as determined by hydrometer analysis.
- pH between 5.5 and 7.6
- Percent organic matter:
  - For wetland modules, topsoil shall contain greater than or equal to 5 percent and less than 20 percent organic matter as determined by loss on ignition of moisture-free samples dried at 100° to 110° Celsius. A mean value of approximately 7.5 percent organic matter will be targeted in the wetland areas.
  - For non-wetland areas (planted areas within the lake and upland modules with topsoil), topsoil shall contain greater than 5 percent and less than 20 percent

organic matter as determined by loss of ignition of moisture-free samples dried at 100° to 110° Celsius.

- Contain no nuisance weeds including seeds, stems, or rhizomes of Purple Loosestrife, Phragmites, Japanese Knotweed, or any plants on the Federal Noxious Weeds list.

NYSDOT Turnaround Area Shoreline Armor Stone

The armor stone used for the NYSDOT Turnaround Area shoreline will be riprap conforming to the following gradations:

Stone Size	Percent Passing (by weight)
Heavier than 100 pounds	50 to 100
Larger than 12 inches	50 to 100
Larger than 18 inches	0
Smaller than 4 inches	0 to 10

Remediation Area B Graded Gravel

The graded gravel to be used for the Remediation Area B shoreline stabilization between an elevation of 362.5 and 365 feet will be screened or run-of-bank gravel or other acceptable granular material. The material shall contain greater than 0.5 percent but less than 6 percent organic content by weight as determined using ASTM D2974. Gradations must conform to the table below:

U.S. Standard Sieve Size	Percent Passing (by weight)
8 inch	100
4 inch	80 to 100
¼ inch	30 to 75
No. 40	15 to 60
U.S. No. 200	Less than or equal to 25

Below elevation 362.5 feet, coarse gravel will be used for the shoreline stabilization material.

Outfall Scour Protection

The stone used for the outfalls will be riprap conforming to the following gradations (based on the NYSDOT Standard Specification for Medium Stone Filling specified in Figure 620-1):

Stone Size	Percent Passing (by weight)
Heavier than 100 pounds	50 to 100
Smaller than 6 inches	0 to 10