2024-2025 MECHANICAL CAPACITY CONTAINMENT BERMS

TECHNICAL SPECIFICATIONS

PORT OF CLEVELAND'S SEDIMENT PROCESSING & MANAGEMENT FACILITY
N. MARGINAL ROAD
CLEVELAND, OHIO

March 2023

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Division 02 – Site Work

ATTACHMENTS

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PEOPLE FOCUSED FUTURE

Document 02110
Site Clearing

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Clearing, grubbing, scalping, removing trees and stumps, and removing all vegetation and construction debris from the limits shown on the plans, except such objects that are to remain or are to be removed according to other items of work. Clear and grub all trees and stumps marked for removal and all surface objects, brush, roots, and other protruding obstructions not designated to remain. Scalping includes removing surface material such as roots, sod, grass, residue of agricultural crops, sawdust, and decayed vegetable matter. The depth of scalping does include topsoil or other material below the scalping operation.

B. Removal of debris.

1.2 Related Sections

A. Section 02205 – Backfill Materials

B. Section 02223 – Embankment

1.3 Unit Price - Measurement and Payment

A. Reference the Prices to Include section for a description of this pay item.

1.4 Regulatory Requirements

A. Conform to all Federal, State and Local codes, for environmental requirements and disposal of debris.

B. Coordinate clearing Work with all utility companies before starting work and comply with their requirements.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

3.1 Preparation

A. Contact all utility companies at least two days before work commences.

B. Verify that existing plant life designated to remain is tagged or identified.

C. Identify a waste area and salvage area for placing removed materials.

3.2 Protection

A. Locate, identify, and protect utilities that remain, from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping.

C. Protect benchmarks, survey control points, and existing structures from damage or displacement.

3.3 Clearing

A. All areas as shown on the plans where placement of clean cover soil is required shall be cleared and grubbed.

B. Remove obstructions debris, grass, and other vegetation to permit installation of new construction.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. At all times, the Contractor shall remain within the property lines, easement areas, designated perimeter limits, or work areas shown on the Drawings.

E. Except in areas to be excavated or re-graded, all holes resulting from the clearing and grubbing operations shall be backfilled with approved borrow Backfill Materials- Section 02205 and compacted in accordance with Embankment- Section 02223.

F. Place fill material in horizontal layers not exceeding twelve (12) inch (200-mm) loose depth and compact each layer to a density equal to adjacent original ground.

3.4 Scalping

A. Unless otherwise specified, scalp all areas as needed where earthwork is required or as shown on the plans. Scalping shall include the removal of all sod, grass, other vegetation as directed. The scalped material from CDF 12 shall be stockpiled within the cell and buried during general grading activities of the cell floor.

3.5 Removal

A. Remove debris, rubbish, logs, other foreign articles, rock from site.

3.6 Disposal

A. Disposal: Remove all obstructions, debris, demolished materials, and waste materials, including trash and debris, and transport to a licensed waste disposal facility offsite in accordance with all local, state and federal regulations.

3.7 Topsoil Excavation

Not Used

END OF SECTION

Document 02205
Backfill Materials

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Fine Aggregate - ODOT Classifications A-3 or A-3a.

B. Natural Soils: Natural Soils as defined within ODOT Item 203 and Department Group Classifications A-4-a, A-4-b, A-6-a, A-6-b, and A-7-6.

C. Embankment Materials

1.2 Related Sections

A. Geotechnical Engineering and Monitoring Report to Support the Proposed Phased Vertical Expansion of the Sediment Processing & Management Facility. Hull & Associates Inc., May 2019 (Revision 1)

B. Section 02223 - Embankment

1.3 Unit Prices - Measurement and Payment

A. Backfill Materials: Reference the Prices to Include section for a description of this pay item.

1.4 References

A. ASTM D422 – Test Method for Particle – Size Analysis of Soils.

B. ASTM D698/AASHTO T99 – Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

C. ASTM D1556 – Test Method for Density of Soil in Place by the Sand Cone Method.

D. ASTM D1557/AASHTO T180 – Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

E. ASTM D2167 – Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

F. ASTM D2216 – Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

G. ASTM D2487 – Classification of Soils for Engineering Purposes. (Unified Soil Classification System).

H. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

I. ASTM D4318 – Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.5 Submittals for Review

Not used

1.6 Submittals for Information

Not used

1.7 Quality Assurance

A. Backfill materials shall meet the product requirements as outlined within Part 2 titled PRODUCTS.

B. Backfill materials' compaction shall meet requirements as delineated within Section 02223 - Embankment.

2.0 PRODUCTS

The Contractor shall utilize on-site Cleveland-Cuyahoga County Port Authority's approved borrow source. Should adequate on-site borrow source material not be available, the Contractor shall provide the following backfill materials for the Cleveland-County Port Authority's approval and perform all services and activities defined in this Section.

2.1 Fill Materials

A. In-situ material may be used for controlled (compacted) fill where approved by the Cleveland-Cuyahoga County Port Authority.

B. The materials will consist of acceptable in-situ dredged material at CDF12 exhumed during excavation activities. Material satisfactory for use as embankment fill includes lean clay, sandy clay, clayey sand, silty sand, and fine sand that is free from objectionable quantities of organic matter, frozen soil, stumps, foreign debris, and other unsuitable materials. Elastic clay (MH) is not considered a suitable embankment fill material.

2.2 Source Quality Control

A. Section 01400 – Quality Control: Testing and analysis of soil material.

B. Section 02223 – Embankment: Placement and compaction criteria.

C. Backfill materials shall be subjected to the following laboratory analyses:

   1. Grain-size distribution per ASTM D422 for sieve and hydrometer analyses, Atterberg limits per ASTM D4318, and moisture content per ASTM D2216 shall be determined for a least every 500 cubic yards of soil placed and recompacted.

   2. Moisture/density relationships per ASTM D698 (Standard Proctor) shall be determined for at least every 500 cubic yards of soil placed and recompacted.

D. If tests indicate materials do not meet specified requirements, change material and retest.

E. Provide materials of each type from same source throughout the Work.

3.0 EXECUTION

3.1 Stockpiling

A. Stockpile materials on site at locations as specified by the Cleveland-Cuyahoga County Port Authority.

B. Stockpile in sufficient quantities to meet the Project Construction Schedule and requirements.

C. Segregate/Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Prevent intermixing of soil types or contamination.

E. Direct surface water away from compacted stockpile areas to prevent erosion or deterioration of materials.

3.2 Stockpile Cleanup

A. Remove stockpile, leave area in a clean and neat condition. Grade Site surface to prevent free standing surface water.

B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water

3.3 Excavating

A. Excavate materials as described within Section 02222 – Excavating.

3.4 Embankment

A. Backfill with materials as described within Section 02223 – Embankment.

END OF SECTION

Document 02222
Excavating

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Excavation associated with approved Cleveland-Cuyahoga County Port Authority's Borrow Site and Site Improvement activities.

1.2 Related Sections

A. Section 02223 - Embankment

1.3 Unit Prices - Measurement and Payment

A. Reference the Prices to Include Section for a description of pay items.

1.4 Field Measurements

A. Contractor shall be required to conduct a post topographical survey after completed earthwork.

B. Verify that survey benchmarks and intended elevations for the Work are as indicated.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

The Contractor shall perform all excavating in accordance with the requirements of this Section.

3.1 Preparation

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities that remain from damage.

C. Notify all utility companies prior to working in the vicinity of their lines.

D. Protect plant life, lawns, rock outcroppings and other features remaining as a portion of final landscaping.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 Excavating

A. Underpin adjacent structures which may be damaged by excavating Work.

B. Excavate subsoil to accommodate building foundations, slabs on grade, paving, site structures, construction operations, etc.

C. Excavate to working elevations for piling Work. Coordinate special requirements for piling.

D. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 02223 – Embankment.

E. Slope banks with machine to angle of repose or less until shored.

F. Do not interfere with 45 degree bearing splay of foundations.

G. Grade top perimeter of excavation to prevent surface water from draining into excavation.

H. Hand trim excavation. Remove loose matter.

I. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. Any rock excavation larger than 1/3 cubic yard measured by volume which requires drilling or blasting for its removal shall be considered as a separate pay item to be negotiated between the Cleveland-Cuyahoga County Port Authority and Contractor. Any material which can be excavated using a hand pick and shovel, power operated excavator, power operated backhoe, or power operated shovel shall not be considered rock excavation.

J. Notify the Cleveland-Cuyahoga County Port Authority of unexpected subsurface conditions and discontinue affected Work in area until notified to resume Work.

K. Correct areas over excavated in accordance with Section 02223 – Embankment.

L. Stockpile excavated material in area designated on site in accordance with Section 02205 – Backfill Materials; remove excess or unsuitable material from site.

3.3 Field Quality Control

A. Provide for visual inspection of bearing surfaces.

3.4 Protection

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. The Contractor shall be responsible for all surveying associated with the Work. The Cleveland-Cuyahoga County Port Authority's surveyor may perform independent surveying: however, independent surveying does not relieve the Contractor's responsibility to layout, control and document the Work. The surveyor for the Contractor will cooperate with the other surveyors on the Project to the maximum degree possible.

D. Additional surveying required due to areas not being to the required lines and grades and/or thicknesses will be performed at the Contractor's expense.

END OF SECTION

Document 02223
Embankment

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section. The work shall consist of embankments and miscellaneous backfills constructed with excavated materials to the lines, grades, and dimensions shown on the plans, or as designated by the Cleveland-Cuyahoga County Port Authority, including construction of the silt mechanical capacity containment berms.

1.1 Section Includes

A. Site filling and embankment.

B. Fill for over-excavation.

C. All cavities created earthwork activities.

D. Consolidation and compaction as scheduled.

1.2 Related Sections

A. Geotechnical Engineering and Monitoring Report to Support the Proposed Phased Vertical Expansion of the Sediment Processing & Management Facility. Hull & Associates Inc., May 2019 (Revision 1)

B. Section 02205 – Backfill Materials

C. Section 02222 – Excavating

D. Section 02242 – Soil Cement Stabilization

E. Section 02245 – Lime Soil Stabilization

1.3 Unit Prices - Measurement and Payment

A. Reference the Prices to Include section for a description of pay items.

1.4 References

A. ASTM D698/AASHTO T99 – Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

B. ASTM D1556 – Test Method for Density of Soil in Place by the Sand Cone Method.

C. ASTM D1557/AASHTO T180 – Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

D. ASTM D2167 – Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

E. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

F. ASTM D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

G. ASTM D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

2.0 PRODUCTS

2.1 Backfill Materials

A. Reference Section 02205 – Backfill Materials for a description of these products.

2.2 Embankment Materials

A. In-situ material may be used for controlled (compacted) fill where approved by the Cleveland-Cuyahoga County Port Authority.

B. The materials will consist of acceptable in-situ dredged material at CDF12 exhumed during excavation activities. Material satisfactory for use as embankment fill includes lean clay, sandy clay, clayey sand, silty sand, and fine sand that is free from objectionable quantities of organic matter, frozen soil, stumps, foreign debris, and other unsuitable materials. Elastic clay (MH) is not considered a suitable embankment fill material.

2.3 Topsoil Materials

Not Used

3.0 EXECUTION

The Contractor shall perform all embankment fill in accordance with the requirements of this Section. Meet the applicable requirements for materials, equipment and construction as specified. Related Operations consists of excavation for the construction for structures and pipe and constructing sluiceway berms and other embankments as required.

3.1 Examination

A. Verify that existing Property conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

3.2 Preparation

A. The underlying ground shall be properly prepared prior to placing embankment material. Clearing and grubbing in embankment areas must be completed prior to embankment operations. Debris shall be removed, and surface depressions or holes shall be filled with suitable material to a level uniform surface and compacted before the embankment is constructed.

B. Compact subgrade to density requirements for subsequent backfill and embankment materials.

C. Cut out soft areas of subgrade not capable of compaction in place. Backfill with suitable backfill and compact to density equal to or greater than requirements for subsequent fill material.

D. Scarify and proof roll subgrade surface to identify soft spots as applicable; fill and compact to density equal to or greater than requirements for subsequent fill material.

E. The contractor should be prepared to manage perched saturated zones and saturated soil conditions during material excavation at CDF12. Consequently, the moisture conditions for the materials to be placed at CDF12 will more than likely be well above their optimum moisture content. As such, the contractor can consider chemical stabilization (lime or cement) of the embankment material if proper compaction and/or moisture conditions cannot be achieved due to weather, moisture condition of the existing material, and schedule at the contractor's expense.

F. Berms have historically been able to be constructed using site material during summer months of the year without requiring lime stabilization.

3.3 Embankment

A. Embankments shall be constructed to a reasonably smooth and uniform shape conforming to the lines, grades and cross sections indicated on the Drawings or as directed by the Cleveland-Cuyahoga County Port Authority.

B. Unless otherwise indicated on the plans, the surface of the ground of all areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4-inches. The loosened material shall be recompacted with the new embankment as hereinafter specified and shall not exceed 12-inches in total depth to ensure a proper bond between new materials and existing surfaces. Obtain prior approval of method to be used.

C. The material shall be placed in compacted layers of uniform 12-inches thickness. The layers shall be carried up full width from the bottom of the fill to avoid the widening of the edges after final grade has been reached. Each layer shall be spread and bladed evenly by means of a blade grader or other approved equipment so that rollers used for compaction will bear evenly at all times.

D. The compaction equipment may be of any type, provided it is capable of compacting each lift of the material to the specified density. The Cleveland-Cuyahoga County Port Authority has the right to order that any particular unit be removed from the work if it is not capable of compacting the material to the required density in a reasonable time. Hauling equipment will not be accepted in lieu of compaction equipment.

E. Subgrade areas, encountered in the construction of the embankment which are not sufficiently stable to properly support the embankment and any additional loading or site requirements, shall be scarified and re-compacted or removed as required by the Cleveland-Cuyahoga County Port Authority. Where directed by the Cleveland-Cuyahoga County Port Authority unsuitable material shall be removed and replaced with approved material at a cost to the contractor.

F. All subgrade and embankment fill materials shall be compacted in layers not exceeding 12-inches. The 12-inch layers shall be brought to within the limits of plus or minus three percent (± 3%) of optimum moisture content. Water shall be added and thoroughly mixed if required for proper compaction. If the soil contains excess moisture, it shall be aerated until the moisture content has been reduced to within the limits or chemically stabilized as stated above.

G. The 12-inch layers shall be compacted to a minimum of ninety-five percent (95%) of its maximum Standard Proctor dry density as determined by ASTM Test Designation D698.

H. Measurement of the field density and moisture content shall be in accordance with ASTM Test Designations D6938, for determination of Density and Moisture content of soil in place by Nuclear Methods.

I. Field density and moisture content tests may be made by the Cleveland-Cuyahoga County Port Authority to ensure and verify that the material is being compacted to the moisture content and density specified.

J. All soft, spongy or yielding spots and all organic or other objectionable material shall be entirely removed and the area recompacted with approved material. Proof roll the subgrade with available construction equipment or optional vehicle as approved by the Cleveland-Cuyahoga County Port Authority.

K. If the material delivered to the embankment area is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction or amended on site using lime or cement stabilization process. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

3.4 Tolerances

A. Top Surface of Embankment Areas: Plus or minus 0.1 feet from required elevations.

3.5 Field Quality Control

A. The Contractor is responsible for the control of the quality of materials incorporated into the construction and the quality of completed construction. The Cleveland-Cuyahoga County Port Authority will provide quality assurance testing and inspection in determining the acceptability of materials and completed construction. Quality assurance services provided by the Cleveland-Cuyahoga County Port Authority do not relieve the Contractor of his responsibility for quality control. The Engineer shall not have control of the means, methods, techniques, sequences, or procedures of construction selected by the Contractor.

B. The Cleveland-Cuyahoga County Port Authority will conduct visual inspection during material placement and compaction. If excessive pumping or rutting occurs during material placement, the area may need to be reworked or removed by undercutting the unsuitable soils and temporarily stockpiling within the work area until the material has time to decant free standing water.

C. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

D. Additional dewatering and stockpiling efforts; segregating fine- and coarse-grained soils during excavation so that the coarser, more permeable materials can be used during placement at CDF 12; or the blending of coarse-grained materials with fine-grained materials to increase permeability may be necessary at CDF 12 facility to facilitate subsequent placement.

E. Frequency of Tests: For Controlled Embankment Fill areas, perform at least one field density test per 2,000 cubic yards of embankment placed, or at an alternate frequency as approved by the Cleveland-Cuyahoga County Port Authority.

3.6 Protection of Finished Work

A. Reshape and re compact fills subjected to vehicular traffic.

3.7 Schedule

A. Reference the contract drawings for areas to be backfilled and embanked.

END OF SECTION

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Excavating, treatment, and placement of soil cement mix.

1.2 Related Sections

A. Section 02205 – Backfill Materials

B. Section 02222 – Excavating

C. Section 02223 – Embankment

D. Section 02245 – Lime Soil Stabilization

1.3 Unit Price – Measurement and Payment

A. Reference the Prices to Include section for a description of this pay item.

B. Based on a cement/soil mix ratio of six percent (6%). Includes supplying ingredient materials, mixing and placing where required, compacting and curing.

1.4 References

A. ASTM C150 – Portland Cement.

B. ASTM D1633 – Test Method for Compressive Strength of Molded Soil Cement Cylinders.

1.5 Submittals for Review

A. Submit mix design and materials mix ratio that will achieve specified (compaction) requirements.

1.6 Quality Assurance

A. Perform Work in accordance with ODOT Item 205 Chemically Stabilized Embankment.

1.7 Environmental Requirements

A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees F.

2.0 PRODUCTS

2.1 Mix Materials

A. Subsoil: Existing reused and embankment material.

B. Cement: Portland cement, per ODOT Item 701.04

2.2 Accessories

Not Used

2.3 Equipment

A. Equipment: Capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting material.

2.4 Soil Cement Mix

A. Perform Work in accordance with ODOT Item 205 Chemically Stabilized Embankment

3.0 EXECUTION

3.1 Examination

A. Do not fill over frozen or spongy subgrade surfaces.

3.2 Preparation

A. Coordinate requirements with piling operations.

3.3 Excavation

A. Protect adjacent structures from damage by this work.

B. Excavate subsoil to a depth sufficient to accommodate soil stabilization, construction operations, and compaction specifications.

C. Proof roll subgrade to identify soft areas; excavate those areas.

D. Remove lumped subsoil, boulders, and rock up to 1/4 cubic yard measured by volume. Larger material will be removed under Section 02222 – Excavating.

E. Notify Cleveland-Cuyahoga County Port Authority of unexpected subsurface conditions. Discontinue affected Work in area until notified to resume work.

F. Stockpile excavated material in area designated on site; remove excess material not being reused from site.

3.4 Soil Treatment and Embankment

A. Place mix material in continuous layers not exceeding 12 inches depth.

B. Maintain optimum moisture content of mix materials to attain required stabilization. If more than one layer, maintain lower layer at optimum moisture until next layer is placed.

C. Shape to required line, grade, and cross section.

D. Make grade changes gradual. Blend slopes into level areas.

E. At end of day, terminate completed Work by forming a straight and vertical construction joint.

F. Replace damaged fill with new mix to full depth of original mix.

G. Remove surplus mix materials from site.

3.5 Curing

A. Immediately following compaction of mix, seal top surface with curing seal.

3.6 Tolerances

A. Top Surface of Fill: Plus or minus 0.1 feet from required elevations.

3.7 Field Quality Control

Not used

END OF SECTION

Document 02245
Lime Soil Stabilization *(As Required)*

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Excavating, treatment, and placement of lime treated subsoil mix.

1.2 Related Sections

A. Section 02205 – Backfill Materials

B. Section 02222 – Excavating

C. Section 02223 – Embankment

D. Section 02242 – Soil Cement Stabilization

1.3 Unit Price – Measurement and Payment

A. Reference the Prices to Include Section for a description of this pay item.

B. Based on a lime/soil mix ratio of five percent (5%). Includes supplying ingredient materials, mixing and placing where required, compacting and curing.

1.4 References

A. AASHTO M216 – Lime for Soil Stabilization.

B. ASTM C977 – Quicklime and Hydrated Lime for Soil Stabilization.

C. ASTM D698 – Test Method for Moisture Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb (2.49 kg) Rammer and 12 Inch (304.8 mm) Drop.

D. NLA (National Lime Association) Bulletin 326 – Lime Stabilization Construction Manual.

1.5 Submittals for Review

A. Submit mix design and materials mix ratio that will achieve specified (compaction) requirements.

1.6 Quality Assurance

A. Perform Work in accordance with ODOT Item 205 – Chemically Stabilized Embankment.

1.7 Environmental Requirements

A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees.

2.0 PRODUCTS

2.1 Mix Materials

A. Subsoil: Existing reused and embankment materials.

B. Lime: Quicklime per ODOT Item 712.04.B.

2.2 Accessories

Not Used

2.3 Equipment

A. Equipment: Capable of excavating subsoil, mixing and placing materials, wetting, consolidation, and compaction of material.

2.4 Lime/Soil Mix

A. Mix materials in accordance with ODOT Item 205 – Chemically Stabilized Embankment

3.0 EXECUTION

3.1 Examination

A. Do not place fill over frozen or spongy subgrade surfaces.

3.2 Preparation

A. Coordinate requirements with piling operations.

3.3 Excavation

A. Protect adjacent structures from damage by this work.

B. Excavate subsoil to a depth sufficient to accommodate soil stabilization, construction operations, and compaction specifications.

C. Proof roll subgrade to identify soft areas; excavate those areas.

D. Remove lumped subsoil, boulders, and rock up to 1/4 cu yd measured by volume. Larger material will be removed under Section 02222 –Excavating.

E. Notify Cleveland-Cuyahoga County Port Authority of unexpected subsurface conditions. Discontinue affected Work in area until notified to resume work.

F. Stockpile excavated material in area designated on site; remove excess material not being reused from site.

3.4 Soil Treatment and Embankment

A. Site mix subsoil, backfill and compact. Blend treated subsoil mix to achieve mix formulation and required stabilization.

B. Place mix material in continuous layers not exceeding 12 inches depth.

C. Maintain optimum moisture content of mix materials to attain required stabilization.

D. Shape to required line, grade, and cross section.

E. Make grade changes gradual. Blend slope into level areas.

F. At end of day, terminate completed Work by forming a straight and vertical construction joint.

G. Replace damaged fill with new mix to full depth of original mix.

H. Remove surplus mix materials from site.

3.5 Curing

A. Immediately following compaction of mix, seal top surface with curing seal.

3.6 Tolerances

A. Top Surface of Fill: Plus or minus 0.1 feet from required elevations.

3.7 Field Quality Control

Not used

3.8 Schedule

Not Used

END OF SECTION

Document 02400
Storm Water Management, Erosion, and Sedimentation Control

1.0 GENERAL

A. Drawings and general provisions of the Contract apply to this section.

1.1 Section Includes

A. This work shall consist of temporary measures needed to control erosion and water pollution. These temporary measures shall include, but not be limited to, berms, dikes, dams, ditches, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the Project, and as directed by Cleveland-Cuyahoga County Port Authority, and as shown on the Drawings.

B. The Storm Water Management details presented in the Drawing serves as the anticipated erosion and sediment control measures that have potential of being implemented during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the Project. Therefore, if the provided plan is not working sufficiently to protect the Project areas, then Contractor shall provide additional measures as required to obtain the required protection.

C. The item will also include all activities associated with complying with the Ohio EPA NPDES Permit (Authorization to Discharge Strom Water Associated with Industrial Activity Under the National Pollutant Discharge Elimination System) as delineated within the Site Storm Water Management, Erosion, and Sediment Control Plan for Construction Activities. The Site Storm Water Management, Erosion, and Sediment Control Plan will be developed and implemented by the Contractor and shall be compatible with all applicable specifications outlined in the Contract Document.

D. The Site Storm Water Management, Erosion, and Sediment Control Plan shall be developed to minimize impact to storm water runoff and includes activities associated with implementing Best Management Practices for the complete and proper management of all storm water within the limits of the Contractor's work.

E. The Site Storm Water Management, Erosion, and Sediment Control Plan will be developed to promote site-wide positive drainage during construction activities. The Contractor will install, operate and maintain all necessary erosion and sediment controls as required by all applicable federal, state, and local laws and regulations. This responsibility shall include but is not limited to, implementing and maintaining erosion controls, structures and silt barriers.

F. Groundwater/Storm Water management is the responsibility of the Contractor and will include:

1. Properly restricting the accumulation of any water within excavated areas, demolition void areas; and

2. Properly containerizing, characterizing (by certified laboratory analytical testing), and dewatering and management of any water that accumulates within those areas accordingly. The Contractor shall assume non-hazardous water.

3. Contractor shall comply and implement all appropriate procedures out-lined in the

Site Storm Water Management, Erosion, and Sediment Control Plan prior to any construction activities for approval.

1.2 References

A. The following is a list of standards which may be referenced in this section:

1. Ohio EPA NPDES Permit No. OCH000004 (Authorization to Discharge Strom Water Associated with Industrial Activity Under the National Pollutant Discharge Elimination System) or other applicable permit.

1.3 Unit Price - Measurement and Payment

A. Reference the Prices to Include Section for a description of this pay item.

1.4 Submittals for Review

A. Storm Water Management, Erosion, and Sediment Control Plan.

B. Construction schedule for Erosion Control per Article Scheduling.

C. Sequencing Plan per Article Scheduling.

D. Plan for disposal of waste material per Article Scheduling.

E. Product data for materials proposed for use.

F. All applicable permits for Erosion Control.

1.5 Scheduling

A. Contractor shall submit a sequencing plan for approval for Storm Water management, erosion, and sediment control in conformance with Contractors overall Construction Plan for approval by the Cleveland-Cuyahoga County Port Authority.

B. Changes to the Erosion Control Sequencing Plan may be considered by Cleveland-Cuyahoga County Port Authority only if presented in writing by the Contractor.

C. When so indicated in the Drawing, or when directed by the Cleveland-Cuyahoga County Port Authority, the Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.

D. These schedules shall be applicable to clearing and grubbing, excavation, embankment, and site improvements work, construction activities, etc.

E. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.

F. Contractor shall be required to incorporate all permanent erosion control features into the Project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

2.0 PRODUCTS

2.1 Manufacturers

A. Manufacturers: As approved by the Cleveland-Cuyahoga County Port Authority.

2.2 Materials

A. All materials shall be submitted for approval prior to installation.

B. Materials may include hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel, and other suitable materials, and shall be reasonably clean, free of deleterious materials, and certified weed free.

C. Grass Seed:

1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.

2. All grass seed shall be approved by Cleveland-Cuyahoga County Port Authority and in accordance with local regulations prior to installation.

D. Fertilizer and soil conditioners shall be approved by Cleveland-Cuyahoga County Port Authority and in accordance with local regulations prior to installation.

3.0 EXECUTION

3.1 Installation

A. All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to ensure continued performance of their intended function.

B. Cleveland-Cuyahoga County Port Authority will monitor Contractor erosion control and work methods.

1. If the overall function and intent of erosion control is not being met, Cleveland-Cuyahoga County Port Authority will require Contractor to provide additional measures as required to obtain the desired results.

C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the Project is accepted.

3.2 Construction

A. Stabilization of Disturbed Areas:

1. Temporary sediment control measures shall be established within five (5) days from time of exposure/disturbance.

2. Permanent erosion protection measures shall be established within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:

1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.

2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.

3. Storm Water outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Construction Access Routes:

1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment-controlled disposal area.
4. Street washing shall be allowed only after sediment is removed in this manner.

3.3 Disposition of Temporary Measures

A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by Cleveland-Cuyahoga County Port Authority or their representative.

B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Substantial Completion of Erosion Control Measures:

1. At the time specified in the Contract Document, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the Drawings and Contract Document until such time as Work has been accepted byCleveland-Cuyahoga County Port Authority.

D. Final Completion and Acceptance of Erosion Control Measures:

1. After Cleveland-Cuyahoga County Port Authority have determined that the drainage area has stabilized, Contractor shall remove all remaining temporary erosion control measures.
2. Any damage to the site shall be repaired to the satisfaction of the Cleveland-Cuyahoga County Port Authority at no cost.

END OF SECTION

Document 02936
Seeding

1.0 GENERAL

A. Drawings, figures and general provisions of the Contract apply to this section.

1.1 Section Includes

A. Preparation of subsoil.

B. Seeding and fertilizing.

C. Maintenance.

1.2 Related Sections

A. Section 02223 – Embankment

1.3 Unit Price - Measurement and Payment

A. Reference the Prices to Include section for a description of pay items.

1.4 References

A. FS O-F-241 - Fertilizers, Mixed, Commercial

B. ODOT CMS Dated January 2013

1.5 Definitions

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Morning Glory, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nimble Will, Bindweed, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.6 Submittals at Project Closeout

A. Maintenance Data: Include grass types, application frequency, and recommended coverage of fertilizer.

1.7 Quality Assurance

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.8 Regulatory Requirements

A. Comply with regulatory agencies for fertilizer and herbicide composition.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

1.9 Delivery, Storage, and Protection

A. Material and Equipment: Transport, handle, store, and protect products.

B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.10 Maintenance Service

A. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition for at least two cuttings.

2.0 PRODUCTS

2.1 Seed Suppliers

A. Manufacturers: Approved by the Cleveland-Cuyahoga County Port Authority.

1. Materials and Equipment: Product options and substitutions.

2.2 Seed Mixture

A. Seed Mixtures: To be pre-approved by Cleveland-Cuyahoga County Port Authority.

B. Species List: or approve equivalent as not to attract unwanted wildlife.

- 55% Eureka II Hard Fescue
- 35% Maxima Creeping Red Fescue
- 10% Gulf Annual Ryegrass

2.3 Soil Materials

Not Used

2.4 Accessories

A. Fertilizer: As described within ODOT 659.

B. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass.

2.5 Tests

Not used

3.0 EXECUTION

3.1 Examination

A. Verify that prepared soil base is ready to receive the work of this section.

3.2 Preparation of Subsoil

A. Prepare surface to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify to a depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub soil.

3.3 Placing Topsoil

Not Used

3.4 Fertilizing

A. Apply fertilizer in accordance with manufacturer's instructions.

B. Apply after smooth raking of surface and prior to roller compaction.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix thoroughly into upper 2 inches of surface.

E. Lightly water to aid the dissipation of fertilizer.

3.5 Seeding

Not used

3.6 Hydroseeding

A. Apply seeded slurry with a hydraulic seeder at a rate as described within ODOT 659 and evenly in two intersecting directions.

B. Do not hydroseed area in excess of that which can be mulched on same day.

3.7 Seed Protection

Not used

3.8 Maintenance

A. Seeded areas shall be maintained by the Contractor until the areas are accepted and alive and healthy.

B. Water to prevent grass and soil from drying out.

C. Roll surface to remove minor depressions or irregularities.

D. Control growth of weeds. Submit weed growth control plan, prior to implementation.

E. Immediately reseed areas which show bare spots.

F. Protect seeded areas with warning signs during maintenance period.

3.9 Schedule

Not Used

END OF SECTION

ATTACHMENT A

Geotechnical Engineering and Monitoring Report to Support the Proposed Phased Vertical Expansion of the Sediment Processing & Management Facility.
Hull & Associates Inc., May 2019 (Revision 1)

GEOTECHNICAL ENGINEERING AND MONITORING REPORT

TO SUPPORT THE PROPOSED
PHASED VERTICAL EXPANSION OF THE:
SEDIMENT PROCESSING & MANAGEMENT FACILITY

LOCATED AT:
CONFINED DISPOSAL FACILITY 9 & 12
NORTH MARGINAL ROAD
CLEVELAND, CUYAHOGA COUNTY, OHIO

PREPARED FOR:
CLEVELAND-CUYAHOGA COUNTY PORT AUTHORITY
1100 W. NINTH STREET
SUITE 300
CLEVELAND, OHIO 44113

PREPARED BY:
HULL & ASSOCIATES, INC.
4 HEMISPHERE WAY
BEDFORD, OHIO 44146

MAY 2019 (REVISION 1)

HULL
Environment / Energy / Infrastructure

EXECUTIVE SUMMARY

The Cleveland Cuyahoga-County Port Authority (CCCPA) operates a sediment processing and management facility (SPMF) at the confined disposal facilities (CDFs) 9 and 12. CDF 9 was originally constructed in 1969 and is 11 acres with a design capacity of 2,000,000 cubic yards (CY). CDF 12 was originally constructed in 1974 and is 56 acres with a design capacity of 2,760,000 CY. The two CDFs are referred to collectively as the CDF 9/12 SPMF for the purposes of this report. CDF 10B was constructed in 1998 and is 68 acres with a design capacity of 2,900,000 CY. The CDFs are near or exceeding their original design capacity and the cost and challenges to locate, design, and construct a new CDF is not feasible in the near-term. These three CDFs annually accept approximately 250,000 CY of material dredged by the United States Army Corp. of Engineers (USACE) to maintain the federal channel of the Cleveland Harbor and Cuyahoga River. The locations of the Cleveland CDFs are illustrated in Figure 1.

GEOTECHNICAL ENGINEERING AND MONITORING REPORT

FIGURE 1

CONFINED DISPOSAL FACILITIES LAYOUT

On behalf of the CCCPA, Hull & Associates, Inc. (Hull) prepared this Geotechnical Engineering and Monitoring Report (Report) to support the CCCPA's 33 U.S.C. 408 application for permission to conduct on-going and future activities on top of the Federal government's CDFs 9 and 12. The 408 application and the information provided herein, has been prepared, as required by and in accordance with 33 U.S.C. 408, to demonstrate to the USACE that the CCCPA's surface activities will not alter or impair the underlying Federal structures (CDFs 9 and 12), in any way which could inhibit the CDF's ability to continue to serve their originally constructed and intended function. Although CDF 10B is an important component of the CCCPA's long-term plan, the intended use and operation of CDF 10B has been excluded from this report and a similar separate report specific to CDF 10B will prepared and provided in the future.

The primary site operations include hydraulic placement and segregation of the coarser (sand) dredged material (upper Cuyahoga River federal channel) within the CDF 9 sluiceway system for beneficial reuse, and mechanical placement of the finer dredged material (middle and lower Cuyahoga River federal channel) for placement within CDF 12. This Report summarizes historical geotechnical investigations and evaluations, and recently completed project-specific geotechnical investigations to evaluate the geotechnical stability and suitability of CDFs 9 and 12 to support the CCCPA's on-going site operations.

Based on the available information and stability evaluations completed, the CCCPA's proposed surface activities, in conjunction with the planned adaptive management program, will not alter or impair the underlying design objectives of the original Federal structures, nor, when operated and constructed as planned, do they present a hazard to the public health or welfare. This was primarily demonstrated through an evaluation and modeling of multiple representative SPMF sections that resulted in acceptable factors of safety (FOSs) when considering moderate dewatering and without relying on continued consolidation of placed fill and underlying geological strata.

In addition, the CCCPA will be implementing an ongoing geotechnical monitoring program that will include periodic inspections and testing to verify stability and structural integrity are maintained. As part of this program, the CCCPA will have several planned and potential geotechnical/mitigation improvement plans/actions that will ensure stability will be maintained and allow for adaptation based upon actual field conditions encountered as filling activities progress.

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1.0 INTRODUCTION

1.1 Overview

The Cleveland Cuyahoga-County Port Authority (CCCPA) has continued planning for their long-term dredged material management strategy for a sustainable program for the Cleveland Harbor. As part of this planning, the USACE has requested the CCCPA's "business plan" for operation of the Sediment Processing and Management Facility (SPMF) that will be implemented at confined disposal facilities (CDFs) 9 and 12 from 2018 to 2038. Hull & Associates, Inc. (Hull) was retained by the CCCPA to update and further develop the CCCPA's existing long-term management plans to create a comprehensive master plan for the SPMF. The SPMF master plan will include a summary of field investigation activities, assessments, and evaluations previously completed for the development of the Sustainable Sediment Management Report (SSMR 2013) and subsequent CCCPA-led Interim Dredged Material Management Plan (IDMMP 2013), which were prepared during the initial Water Resources Development Act (WRDA) Section 217 process. The SPMF master plan will also include the more recent engineering and design work completed to develop implementable improvements at the CDFs to support current and future operations at the SPMF including the sediment segregation system, limits of operations outside of the Burke Lakefront Airport (BKL)/Federal Aviation Administration (FAA) sensitive areas, projected storage capacity volumes, geotechnical analyses and phasing diagrams supporting the vertical placement of dredged material and construction of containment berms on the CDFs, and relative costs for capital investment and site operations.

During this process, the CCCPA received notification (letter dated June 5, 2018 – Appendix A) from the USACE stating that "the CCCPA's on-going operations at CDF 12 fall under jurisdiction of federal law 33 US Code 408 (Section 408), which provides the Secretary of Army authority to grant permission to alter for any purpose a USACE civil works project if it does not impair the usefulness of the project and is not injurious to the public interest." Therefore, the "USACE must review the CCCPA's on-going activities in relation to the usefulness and integrity of the Federal project and consider potential environmental impacts resulting from current operations, transfer to and use of confined sediments at off-site locations."

Consequently, the CCCPA requested Hull's services to support the CCCPA's response to address the USACE's concerns and to comply with the Section 408/Federal law. Specifically, on the behalf of the CCCPA, Hull has prepared this Geotechnical Engineering and Monitoring Report (Report) to include with the CCCPA's response package. This Report considers the overall integrity and stability of CDFs 9 and 12, when modified as proposed, and a proposed program to manage and monitor the long-term operations at the SPMF to ensure field conditions align with engineering models used to evaluate the proposed stability of the structures under proposed conditions.

1.2 Objective/Purpose

The CCCPA's near-term objective is related to the recent USACE's notification of actions that will need to be taken by the CCCPA to continue use of CDFs 9 and 12 including a written request and approval for the intended use and providing necessary documentation to support this use, which is currently assumed to be primarily related to geotechnical evaluations and stability analyses of modified site conditions to support long-term dredged material management.

The primary purpose of this Report is to address a recent determination of apparent non-compliance as detailed in a USACE notification referencing Section 408 and the activities being completed on CDF 12. This Report provides a comprehensive summation and assessment of the CCCPA's existing and planned future operations on CDFs 9 and 12 for subsequent review and submission in response to the USACE's request and to obtain a Section 408 approval. Although CDF 10B will be an important component of the CCCPA's long-term plan, this Report does not include the intended use and operation of CDF 10B due to multiple unknowns including ownership, schedule for availability, terms of use, etc., but rather focuses on the near-term needs of CDFs 9 and 12. The CCCPA plans to prepare a similar separate report specific to CDF 10B, which will be provided in the future. Section 408 requires a demonstration of whether the structural integrity and stability of the Federal government's originally designed containment dike will be maintained, and whether the CCCPA's actions will result in potential failure of the structure based on the assumptions that the SPMF is constructed and operated in accordance with the design, specifications, and design assumptions. This Report will consider the CCCPA's currently anticipated and planned operations at the SPMF, as discussed in Section 3.0.

2.0 EXISTING INFORMATION

2.1 General

While the CCCPA is not responsible for in-channel maintenance, the CCCPA has cooperated in serving as the local sponsor and partner for interim and long-term USACE studies relative to dredged material management and has taken a lead role in directly committing significant resources and stakeholder efforts to develop a sustainable dredged material management program for Cleveland Harbor.

Over the past several years, the CCCPA has collaborated with USACE to complete site management demonstrations to provide interim capacity and has investigated opportunities to conduct multiple long-term activities under the umbrella of a Section 217 agreement with the USACE. As a result, the CCCPA-directed long-term sustainable sediment strategy was developed and involves a three-tiered approach including existing CDF optimization, beneficial use, and additional sediment characterization.

Initially the CCCPA and their consultant (Hull) identified an achievable potential capacity of up to 30 years at the CDFs by implementing an adaptive management plan to address CDF stability and consolidation, through enhanced dewatering techniques, as described in the SSMR. The USACE subsequently requested that the CCCPA create a more modest plan with more moderate dewatering and a shorter-term capacity for comparative purposes with the USACE IDMMP and with a similar format and content topics to the USACE's IDMMP.

To comply with the USACE's request and to support the pursuit of a Section 217 agreement, the CCCPA directed Hull to develop a CCCPA-led IDMMP, which concentrated on a strictly short-term management scenario (similar to the USACE's IDMMP). The CCCPA-led IDMMP provided a similar timeframe of four years (2015-2018), which translated to approximately one million cubic yards of airspace capacity that would be needed in the CDFs starting from 2015.

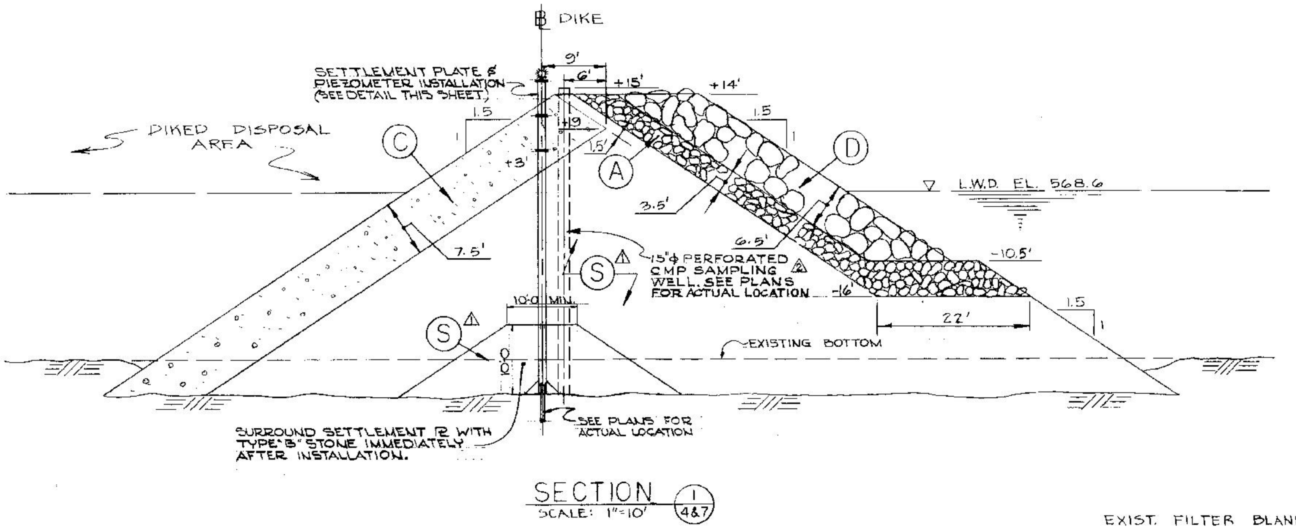
2.2 Historic As-Built Information

Based on a review of the provided as-built drawings for CDFs 9 and 12, the USACE originally constructed a perimeter dike within or along the shore of Lake Erie to define the outer limits of each CDF. CDF 9 was constructed in 1969 and is 11 acres with a design capacity of 2,000,000 CY. CDF 12 was constructed in 1974 and is 56 acres with a design capacity of 2,760,000 CY. The perimeter dikes consist of a stone or slag material for the core; an overlying filter stone facing the placement area side of the dike, and a primary and secondary armor stone facing the lake side of the dike. A typical section of the CDF 12 dike is provided below as Figure 2 for reference.

GEOTECHNICAL ENGINEERING AND MONITORING REPORT

FIGURE 2

TYPICAL SECTION OF CDF 12 DIKE (USACE, CONSTRUCTION PLANS REV 5/21/1973)



The dike stone was placed directly on the soft lacustrine deposits. It is anticipated that some mixing of the lower core material of the dike and the lake bottom likely occurred during and since construction. Similarly, it is anticipated that some mixing of the initial dredged material (typically containing coarser material) placed into the CDFs occurred with the soft lacustrine deposits. It is also anticipated that some consolidation and compression of the soft lacustrine deposits occurred during operations of the CDFs due to the increase in vertical stresses resulting from construction of the dikes and subsequent placement of the dredged materials.

Historically, the CDFs have been mostly filled by hydraulically offloading the dredged material, with some mechanical offloading, during both spring and fall dredging events. The USACE's dredging contractors regularly moved the location of the hydraulically offloading discharge points within the CDFs as evident by the deposition (vertically and laterally) of dredged material throughout the CDFs. For example, coarser (sand) dredged material is typically located near the edges of the CDFs as the "heavier" coarse material settled first and closer to the discharge points, versus the finer grained material (silt and clays) that deposited farther away from the discharge point. Prior to the CCCPA making significant improvements to water management at CDFs 9 and 12 in 2015, as the solids from the dredged material settled, the associated water would flow from the northeast corner of CDF 12 to CDF 9 through the exit weir between the western end of CDF 12 and the eastern end of CDF 9, and then to Lake Erie through the discharge weir within CDF 10B. The original perimeter dike designs and CDF capacities only considered filling of dredged material to the top of the dike. Since the CCCPA took operational control of CDF 12, significant improvements to water and dredged material management has been performed by the CCCPA through the construction of a network of sluiceways, silt cells and sediment ponds, and water control structures. A discussion of these improvements and the current conditions of CDFs 9 and 12 is provided in Section 2.6 of this Report.

2.3 Previous CDF Investigations

2.3.1 Investigations Performed by the CCCPA under Hull

To support the CCCPA's pursuit to develop a sustainable sediment management facility at the CDFs, Hull completed desktop reviews of existing information, topographic surveys, geotechnical explorations and laboratory testing, sediment characterizations, and an environmental compliance evaluation. An initial "then current" topography was obtained from field surveys performed by A. Kennerly in January and July 2011. This survey work was combined with miscellaneous field surveys by others from February 2008 to December 2010, and subsequently a field survey completed by KS Associates (and coordinated by Hull) in December 2012. In February 2015, Hull worked with Accurate Land Surveying, LLC to obtain updated survey information for CDF 9 and 12. In addition, TGC Engineering, LLC provided as-built information for the construction contractor for the CDF improvements completed in June 2015.

In May 2012, representatives from Ohio Environmental Protection Agency (Ohio EPA), the CCCPA, and Hull met to collaborate on developing a conceptual approach to identify additional sediment sampling and characterization activities that could be completed in the river and provide more reach-specific sediment management guidelines that might support the unrestricted beneficial use of all, or a portion of dredged material from the river in upland or open-lake placement locations. As a result of the meeting, Hull prepared a preliminary rationale, scope, and estimated cost for additional sediment characterization of Cuyahoga River sediment both within and outside of the federal navigation channel to facilitate the beneficial use of dredged material. The preliminary sampling approach (Hull, 2012) was considered in subsequent characterization approaches by Ohio EPA.

Between April 26 and May 9, 2012 Hull conducted geotechnical field exploration activities at CDF 9, 10B and 12 including soil borings, standard penetration tests, split-spoon recovery and Shelby tube sampling for laboratory analysis. The borings were spatially distributed across the dikes (e.g., on the outside portion of the CDFs) and within the CDFs themselves when considering locations of previously completed borings to obtain general subsurface conditions across the property. The purpose of the July 2012 geotechnical exploration and report (Appendix B) was to 1) obtain general geotechnical information to the depths of the borings to corroborate and supplement information previously gathered by others, 2) provide basic information relative to potential dewatering activities at the CDFs, and 3) provide information to assist in the slope stability analysis and design of the CDF vertical expansion currently being evaluated by the CCCPA. A geotechnical engineer planned and supervised the performance of the geotechnical engineering investigations, and considered the findings, and prepared this report in accordance with generally accepted geotechnical engineering practices.

In November 2014, Hull prepared a Material Characterization Plan (MCP) (Hull, 2014) to establish a sampling and characterization program for the evaluation of the suitability of coarser-grained materials placed at CDF 12 for unrestricted beneficial use as a commercial product. Harvesting of the coarser-grained material increases the volume and life capacity of CDF 12 and allows for future placement of material dredged from the harbor into the CDF. Hull coordinated and conducted collection of soil samples from test pits within CDF 12, with Ohio EPA, for concurrent analytical and geotechnical characterization. Final interpretations of the collected information of analyzed material were completed to evaluate the correlation between geotechnical and geochemical characteristics. This effort supported determination of the potential and/or limitations of unrestricted beneficial use for dredged material from CDF 12.

2.3.2 Investigations Performed under USACE Control

To support earlier construction and expansion activities at the CDFs, several historic subsurface explorations were performed, as coordinated by USACE. For the original design and construction of CDF 9 and 12, subsurface explorations consisting of drive sample borings and collection of undisturbed samples for laboratory testing were performed in 1967 and 1968. In 1972, additional borings and collection of undisturbed samples were performed to support repair (i.e., widening of the crest to 25 feet, enhancement of the toe of berms) of CDF 9 along the lake side. To support the original design and construction of CDF 10B, subsurface explorations consisting of drive sample borings and collection of undisturbed samples for laboratory testing were performed in 1992.

To support the subsequent raising of CDF 12, an additional subsurface exploration consisting of drive sample borings, test pits and collection of undisturbed samples was performed in 2004. To support further raising of CDF 12 (i.e., Phase 2 dike raising), additional explorations consisting of drive sample borings, collection of undisturbed samples, field vane shear testing and installation of open-tube piezometers were performed in 2009 and 2011.

To evaluate the feasibility of mechanically placing dredged material into the CDFs for the 2015 to 2018 dredging events, the USACE coordinated a geotechnical exploration by DLZ Corporation (DLZ) in 2011 (DLZ, 2011) and completed an engineering technical report titled “Mechanical Offloading and Storage of Dredged Material at the Cleveland Harbor Confined Disposal Facilities” dated September 2012 (USACE, 2012). The geotechnical exploration consisted of drive sample borings, collection of undisturbed samples, field vane shear testing and installation of open-tube piezometers.

2.3.3 Additional Relevant Information Obtained to Support Analyses

Reports and data from additional explorations performed near the CDFs were used to obtain supplemental information. Specifically, an exploration performed directly west of the CDFs by Professional Service Industries, Inc. (PSI) in 1991 as part of the Rock & Roll Hall of Fame construction, was used to obtain information regarding deep underlying soils since the CDF-specific borings were not extended to bedrock. Further, United States Geologic Survey (USGS) maps were used to determine bedrock elevations directly beneath the CDFs. Finally, Hull had an opportunity to perform borings within CDF 12 in 2016 as part of a proposed offshore wind demonstration project in the locality (Hull, 2016) and the collective geotechnical information was used to supplement the data obtained from the previous explorations. This exploration included drive sample borings and collection of undisturbed samples.

2.4 Previous Analyses

To support the evaluation of a sustainable sediment management program and to consider a maximization of the storage capacity at the CDFs, Hull identified potential dewatering techniques, evaluated the potential of dike construction using dredged material and considered impacts of mechanical placement of dredged material. Hull also developed vertical expansion design plans and completed a slope stability analysis based on the results of historic and initial supplemental geotechnical explorations.

The engineering evaluation of a conceptual maximal capacity of the CDFs was summarized in the January 2013 CDF 12 Vertical Expansion Engineering Report (Hull, 2013). That report included conceptual plans and methods for excavating dredged material from within the CDF and using it to raise the existing dikes. The evaluation was conducted in consideration of height restrictions that are imposed due to the proximity of BKL. The plans included site surficial drainage features (perimeter trenches, feeder ditches, etc.) that would promote enhanced removal of existing water through pumping which would promote dewatering and consolidation of the dredged material (creating additional capacity) and to enhance the geotechnical stability of a vertical expansion. The report also included an evaluation of mechanical placement methods, and volume occupied ratio (VOR) capacity gains relative to hydraulic placement, including placement methods to accelerate water removal from the dredged material.

The purpose of the January 2013 slope stability analysis (Appendix C) was to evaluate the stability of the proposed approach to maximize the potential airspace realized from a vertical expansion and recover potential capacity volumes that would not have been available based on previous placement and operation procedures conducted at CDF 12. The analysis evaluated the stability for the areas considered most susceptible to failure of CDF 12 during proposed conceptual filling operations and at the proposed final elevations upon completion of a maximum expansion. The determination of the most critical slopes was based on the height, length, grade steepness, and known and assumed subsurface conditions. As-built drawings for the construction of CDF 12 provided by the USACE were used to develop cross-sections of the existing perimeter dikes and fill material. Various soil conditions were analyzed to determine the stability of the CDF 12 during filling activities (i.e., short-term or undrained conditions - when pore water pressures have not had time to dissipate) and upon achieving final design grades (i.e., long-term or drained conditions - once pore water pressures have dissipated). It was understood that CDF 12 would continue to be used for the management of dredged material from the Cuyahoga River. Therefore, it was appropriate to analyze both short-term/undrained and long term/drained conditions when considering the filling operations and dewatering processes. The January 2013 slope stability analysis demonstrated that the CDFs can support a significant vertical expansion (up to an elevation of approximately 624 feet IGLD 1985) when the dredged material is placed in a phased and systematic approach, dewatering/consolidation activities are implemented, and geosynthetic reinforcement is used.

Although Hull and the CCCPA were confident that some combination of the multiple dewatering and placement phasing approaches would yield the assumed results from a capacity standpoint, the CCCPA requested the near-term expansion to focus on a volume capacity based on typical volume assumptions and more detailed analyses to back up the assumptions used. Consequently, after subsequent discussions with the USACE and the CCCPA, it was recommended that a vertical expansion and supplemental stability analysis be completed that did not depend on the adaptive management approach, but that such an analysis should rely on traditional means and methods, modeling and reconfigurations to determine a more conservative comparative volume without the use of an adaptive management strategy. To support demonstration of the CCCPA-led IDMMP that focused on what can be done in the near-term to provide an adequate capacity in the existing CDFs for short-term management of dredged material, Hull evaluated harvesting opportunities, and analyzed annual operations and construction costs, and considered moderate dewatering activities. Hull also developed near-term design plans and completed a supplemental slope stability analysis.

The purpose of the May 2013 supplemental slope stability analysis (Appendix D) was to address concerns the USACE initially expressed regarding the feasibility of the adaptive management strategies and the two-dimensional, limiting equilibrium analysis approach that was used in the previous analysis completed for the SSMR. The initial preliminary analysis presented in the SSMR was completed assuming that the failure mechanism analyzed (e.g., shallow rotational failure) would consider “blow outs” of the dike berm where the failure plane would be located within the upper portions of the lakebed material. Supplemental analyses were performed, unrestricted, to evaluate the stability of CDF 12 during filling operations and at the proposed final elevations upon completion of Phase II (approximate elevation of 604 feet International Great Lakes Data (IGLD 1985) of the proposed expansion, as presented in the SSMR, for the areas considered by the USACE as most susceptible to failure. The May 2013 supplemental analysis demonstrated that CDF 12 can support a vertical expansion for Phases I and II when the dredged material is mechanically unloaded and placed in a phased and systematic approach, and berms are constructed at a setback of distances greater than 50 feet at select sensitive locations from the existing perimeter dike, without the implementation of dewatering activities on the existing dredged material. It was also recommended that select initial dewatering activities, based on effectiveness and apparent relative cost, be completed early on to support future phases and maximization of capacity.

To support the CCCPA's implementation of the SPMF at the CDFs, Hull developed phasing plans for CDF improvements, conducted reconfiguration evaluations and prepared CDF improvement plans for the SPMF at CDFs 9 and 12 (Appendix E). During this process, Hull completed an updated slope stability analysis, proposed additional geotechnical verification activities, and developed a monitoring program that included the ability to implement adaptive management activities, as needed.

The purpose of the 2018 SPMF slope stability analysis (Appendix F) was to evaluate the stability of the proposed SPMF using the vertical expansion phasing plan design approach for CDF 9 and CDF 12. This analysis was used to locate the proximate location of the silt management berms, and evaluates the stability of CDF 9 and CDF 12 during dredged material management activities and filling operation, and at the proposed final elevations upon completion of development for the areas considered most susceptible to failure.

2.5 Previous USACE Review

The CCCPA's long-term strategy for the management of dredged material was discussed and shared with USACE in 2013 through several meetings, and by posting CCCPA-directed supporting studies to the USACE online automated submittal system, which facilitated the documentation of comments and responses from the USACE and the CCCPA's consultant's (the Hull team) review (including submittals of subsequent supporting studies, etc.). The USACE's feedback was further evaluated and/or explained during this exchange process, and these the topics were considered during the SPMF design and improvement work. This feedback was also referenced during the development of the additional confirmatory geotechnical exploration work and monitoring program discussed in Sections 5.0 and 6.0, respectively.

2.6 Previous Improvements

Knowing that the CDFs would be utilized over the long-term as part of the CCCPA's sustainable sediment management plan, once the CCCPA took operational control of CDFs 9 and 12, the CCCPA and their engineering consultant (Hull) identified several opportunities to make improvements to the CDFs to provide short- and long-term benefits in dredged material management. The objective of the CDF improvements and recent reconfiguration efforts was to create a sustainable solution for the CCCPA to responsibly manage dredged material from the Cuyahoga River that will be sustainable over the following decade or more. Historic methods were recognized as being inefficient in optimizing the efficiency of the dredging processes to accommodate dredged material storage volume needs, and to support and facilitate beneficial use efforts. An important design restriction to be considered during the initial development of CDF improvement plans related to the long-term placement of silts was the FAA air space regulations (14 CFR Part 77.25) due to the proximity of BKL Runway 24R.

To prepare the CCCPA-operated CDFs for acceptance of dredged material in 2015, the CCCPA retained Hull to develop CDF improvement plans that would minimize unnecessary application of water while also facilitating material harvesting and reuse. These plans followed CCCPA's sustainable sediment management program operations including engineering, permitting, planning, and contract administration for the implementation of dewatering/consolidation activities previously discussed in the CCCPA-led IDMMP and related to adaptive management approach options from the SSMR. Hull also worked with the CCCPA for acquisition and implementation of a Site Operator to prepare the CDFs for acceptance of and to manage the dredged material and subsequent harvesting for beneficial use.

Due to the uncertainty of ownership and operation of CDF 9, the original 2015 CDF Improvement Plans (Phase 1) focused the construction improvements within CDF 12 that consisted of a sluiceway and settling pond along the northern side of CDF 12, a sedimentation pond within CDF 9, a material recovery/future placement area at the northeast corner of CDF 12, and a stockpiling/dewatering area at the southeast corner of CDF 12. These modifications to the facility would allow for placement of the coarser grained dredged material to be hydraulically offloaded into the sluiceways and the associated water to flow to the CDF 12 exit weir or to the CDF 9 sedimentation pond. This layout would also support mechanical offloading of dredged material into the excavated/harvested area at the northeast corner of CDF 12.

The 2016 CDF Improvement Plans (Phase 2) were prepared to consist of a new (third) CDF 12 sluiceway, a CDF 12 silt basin, a potential Legacy sediment basin (to accommodate material from a related Great Lakes Legacy Act project), CDF 12 exit weir maintenance, mechanical offloading and access road improvements, and installation of operable weirs. Construction of an additional sluiceway adjacent to (south of) the two existing sluiceways constructed in Phase 1 (2015) increased the capacity for hydraulic placement of sand in 2016, and facilitated the harvesting of the granular material. The additional volume allowed all upper reach channel maintenance dredged material and local privately dredged material to be contained within the sluiceway system. The sluiceway and water management system were upgraded to include operable weirs that would meet the discharge requirements for multiple flow scenarios. The operable weirs could also be strategically operated to maintain a water elevation below the sluiceway water control overflow structures, which allowed for recirculation of water during hydraulic offloading without back-flooding the other sluiceways.

To accommodate the mechanical offloading, transportation and management of the projected finer dredged material, a silt basin was constructed along the southern portion of CDF 12 with an access road and an offloading platform to support the USACE dredging contractor's operations. Concurrent with the development of the 2016 CDF Improvement Plans, a preliminary feasibility study identified the need to accommodate approximately 65,000 CY of Legacy (from the proposed Great Lakes Legacy Project) sediment that would be dredged from the old river channel. To accommodate this material, a potential Legacy sediment basin was designed for the southwest corner of CDF 12, but was not elected to be initially constructed due to uncertainties related to the timing of the Legacy project.

The 2018 CDF Improvements/Reconfiguration Plan Set (Phase 3) (Appendix E) consists of phased construction of silt management cells within CDF 12, reconfiguration of the sluiceway system to CDF 9, water control structure modifications, installation of an elevated mechanically offloading platform, water management and roadway improvements. The 2018 CDF Improvements/Reconfiguration Plans will allow the CCCPA to increase handling capacity of coarse material (sands) and to become more efficient in their recovery and beneficial use. Additionally, relocation of the permanent sluiceways to CDF 9 maximizes the permanent silt placement in CDF 12, which has less FAA elevation restrictions.

To meet the USACE's near-term dredging needs, the 2018 improvements (Appendix E) were designed in phases to permit construction while utilizing the existing system to accommodate the fall 2017 and spring 2018 dredging events. The silt management cell construction and placement generally progressed from east to west, and back to the east. The east and west cells (phases 3, 5, 6, and 7) include a central separation containment berm, which will be used as a wider, central, access berm for USACE dredging contractors, the Site Operator, and construction contractors. The phase 4 silt management cell is created by removing/excavating the CDF 12 sluiceways. The final two phases (8 and 9) will be a single cell centrally located within CDF 12. The design plans relied on input from the Site Operator and the CCCPA regarding short-term and long-term considerations including berm sizes and access to mechanical placement areas via truck or another offloading/placement equipment. The location of the perimeter berms for each silt management cell were determined by an evaluation of representative sections included in the 2018 SPMF slope stability analysis (Appendix F).

TABLE 1

SILT MANAGEMENT CELL STORAGE/PHASING SCHEDULE

Work Item/ Phase	CDF 12 Location	Approx. Berm Height (ft)	Anticipated Storage Volume (CY)[1]	Design Storage Volume (CY)	Total Airspace Volume[2] (CY)	Add'l Freeboard Above Design Volume[3] (CY)	Top Berm Elev., IGLD 1985 (ft)
Phase 3 (2018)	East	**4 to 10**	90,000	96,796	120,985	20,759	595
Phase 4 (2019)[6]	West	**0 to 8**	90,000	122,338	122,338	14,642	590
Phase 5 (2020)	West	**4 to 12**	90,000	97,207	110,636	21,500	595
Phase 6 [4]	East	**5 to 6**	90,000	86,500	105,000	18,000	600
Phase 7 [4]	West	**5 to 6**	90,000	92,000	103,000	19,000	600
Phase 8 [4]	Central	**4 to 5**	135,000	125,500	142,250	32,500	604
Phase 9 [4]	Central	**8**	135,000	111,750	141,250	17,000	611

[1] Anticipated Storage Volume is based on the forecasted annual dredging schedule. Actual volumes may vary.

[2] Total Airspace Volume uses a simple assumption that total fill required for berm construction is equal to the additional airspace anticipated at the bottom of the specific phase. Additional airspace will likely occur due to consolidation after each phase, and harvesting loose material to be used for berm construction. Actual conditions may vary.

[3] Assume that each cell will be filled to a height one-foot below the top of berm. This column shows the freeboard volume within the top one-foot of each phase.

[4] The future phases and corresponding volumes listed in this table are based on preliminary conceptual designs, and are still subject to change based on actual construction and filling of the Phase 3 Work Items.

The proposed plans for the mechanical offloading platform reflected a retaining wall system near the previous "hexagonal" hydraulic offloading area at the front of the CDF 12 sluiceways. This centralized earthen structure was modified by the construction contractor who installed an improved retaining wall to allow more elevation relief closer to the lakeshore, and the upper pad was graded to support passive transfer of dredged material to the silt management cells.

3.0 CURRENT PLANS AND OPERATIONS

3.1 Overview

The overall objective of the SPMF is to accommodate placement of the anticipated volume of dredged material while implementing BMPs to effectively prolong the use of the SPMF in a cost-effective and environmentally beneficial manner. Dredged material management at the SPMF will be accomplished through the use of systematic material management, proactive water management during and after offloading activities in compliance with water quality permitting, and an adaptive management-based phasing and construction program. The SPMF operations include hydraulic sorting and processing of dredged material, mechanical offloading and operation of equipment from elevated platforms, construction of tiered elevated silt management cells, placement of stabilized contaminated sediments (legacy sediments) within a retention basin in the southwest quadrant of CDF 12, and storing/staging of processed material on a constructed process pad overlying the stabilized legacy retention basin.

3.2 Dredging Operations

Maintaining the federal channel requires annual dredging of approximately 250,000 “cut” CY of material (225,000 federal and 25,000 private). Historically all dredged material has been primarily managed through hydraulic placement into the CDFs. Due to several more recent circumstances, the Cuyahoga River dredging schedule has been modified from its typical routine. Recently, the SPMF has anticipated the annual receipt of 205,000 “cut” CY of dredged material at the CDFs by a combination of hydraulic and mechanical means. Since 2016, the coarser grained materials (sands), estimated to be approximately 90,000 CY (45,000 CY in Spring and 45,000 CY in Fall), are mechanically dredged from the upper portions of the channel and hydraulically offloaded into sluiceways at the CDFs, and the finer grained material (silts/clays), estimated to be approximately 90,000 CY (cut), are mechanically dredged from the intermediate portions of the channel and mechanically offloaded into silt management cells at the CDFs. An additional 25,000 CY of privately dredged coarser grained material is hydraulically offloaded at the CDFs during the summer months. The remaining volume of approximately 45,000 CY is mechanically dredged from the lower portions of the channel and hydraulically offloaded at CDF 10B, which is nearing its maximum capacity for hydraulic placement.

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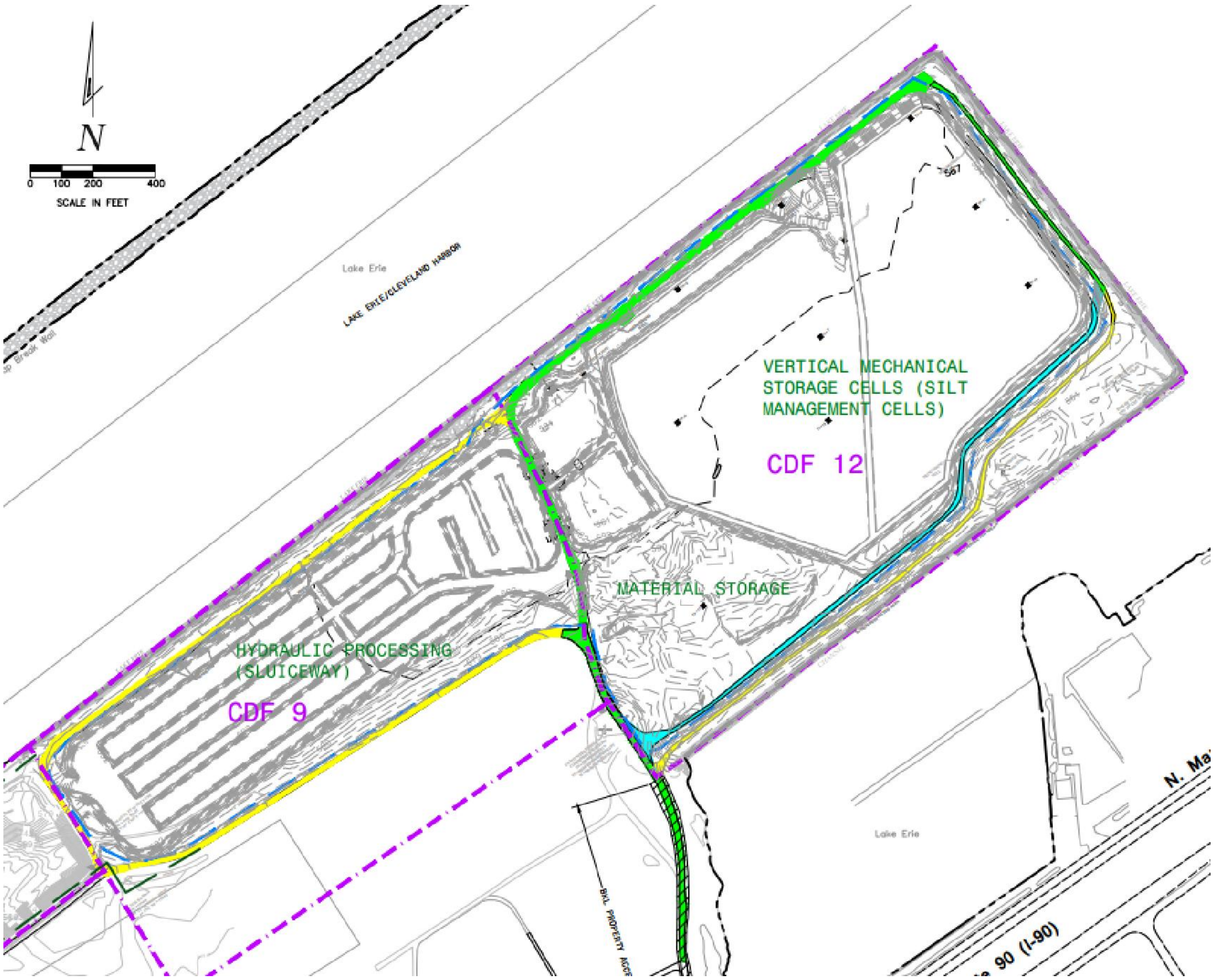
FIGURE 3

GENERAL LAYOUT SPMF AT CDF 9 AND 12



Over the long-term, the current SPMF is anticipating the annual receipt of 285,000 "cut" CY of federally dredged material, and approximately 30,000 "cut" CY of privately dredged material, as requested by the USACE to align with more recent USACE projections.

3.3 Hydraulic Offloading and Recovery

The coarse-grained material dredged during the USACE spring dredging event will be placed into the CDF 9 Sluiceway system (Sheet I7.0 of Appendix E – see Figure 4 below for reference), followed by the placement of privately dredged material in the summer. The Site Operator will harvest the dredged material placed during the spring/summer dredging event, prior to the USACE fall dredging event, allowing for the placement of the anticipated additional volume of coarse-grained material to be dredged in the fall.

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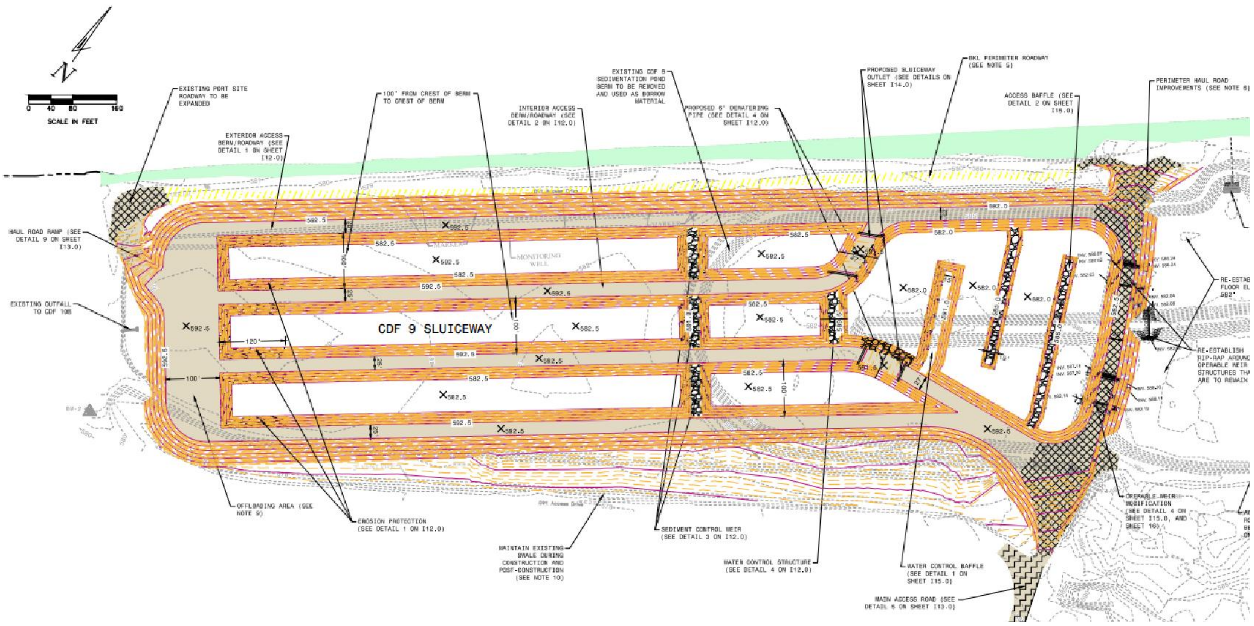
FIGURE 4

CDF 9 SLUICEWAY SYSTEM (SHEET I7.0 – APPENDIX E)



The CDF 9 Sluiceway system consists of three sluiceways with sediment control weirs and water controls structures, a CDF 9 Sediment Pond with water control baffles, a CDF 12 Settling Pond, and the CDF 12 Final Pond. The sluiceway berms were designed with the assumption that they will be utilized over the long-term to periodically manage hydraulically offloaded coarser grained materials (up to 45 days) and the sluiceways will be dewatered by the CCCPA within 72 hours of offload completion. The sluiceway berms are primarily constructed of well-compacted low-permeable (fine-grained) material to contain the placed dredged material and limit the amount of seepage forces that would otherwise develop in the berms. An aggregate access roadway was constructed over the sluiceway berms to facilitate dredged material recovery excavators , trucks, and maintenance of the sluiceways. The sluiceway system has a material storage capacity of approximately 80,000 CY and water storage capacity of approximately 30,000 CY.

During the dredging process, the coarser grained materials (sands) are hydraulically offloaded by the USACE dredging contractor into the three sluiceways for the separation of the finer sediments and necessary dilution water. The material offloading will commence at the western end of the sluiceway system and progress to the east as the sluiceways fill with material. Offloaded sands will settle within the water column and remain in the primary sluiceways and the finer sediments and water will flow from the primary sluiceway over the sediment control weir to the secondary sluiceway and into the CDF 9 Sediment Pond. The water will then flow through operable weirs into the CDF 12 Settling Pond and Final Pond, where the bulk of the remaining fines will settle out of the water (to meet effluent Total Suspended Solids metrics), prior to discharging back to the lake though the outlet weir structure.

The CCCPA will monitor the system during an offloading event to ensure it is functioning properly. Proper operation of the system will promote settlement of suspended solids in the sluiceways, and will minimize discharge of suspended solids to the lake. Additionally, the CCCPA and the Site Operator will have close coordination with the USACE dredging contractor to properly accept the coarser material, with higher percentage of sands and lower concentrations of pollutants, within the sluiceways for subsequent harvest and potential beneficial use opportunities. This material management plan will also minimize maintenance of the downstream sediment and settling ponds, as most settlement should occur within the sluiceways.

3.4 Mechanical Offloading and Management

The finer-grained materials (silts/clays) that are typically dredged toward the end of the USACE spring dredging event, will be managed at CDF 12 by mechanically offloading dredged material from the mechanical offloading platform and placing the dredged material into the Silt Management Cells. The USACE dredging contractor will then spread the offloaded dredged material generally from the northern end of the cell to the southern end of the cell toward the dewatering riser pipe. The excess water will flow from the riser pipe to a drainage ditch/swale to the CDF 12 Settling Pond where the bulk of the remaining fines will settle out of the water, prior to discharging back to the lake though the outlet weir structure. The Site Operator or Construction Contractor will segmentally construct containment berms to create storage capacity for that year’s projected incoming dredged material, as directed by the CCCPA. Source material selection and conditioning, berm construction, and quality assurance verification will follow the requirements of design plans and technical specifications prepared by the CCCPA’s engineer, similar to those developed for the 2018 CDF Improvements/Reconfiguration (Phase 3) (Appendix E). This finer grained material will remain in the Silt Management Cells. Prior to the subsequent year’s placement of new dredged material, the previously placed dewatered and consolidated material will be graded toward the dewatering riser pipe to promote surface drainage. Some of the more desirable materials placed within the Silt Management Cells may be recovered and processed or blended to meet specifications of a beneficial use material. See Figure 5 for an illustration of the CDF 12 silt management cells configuration.

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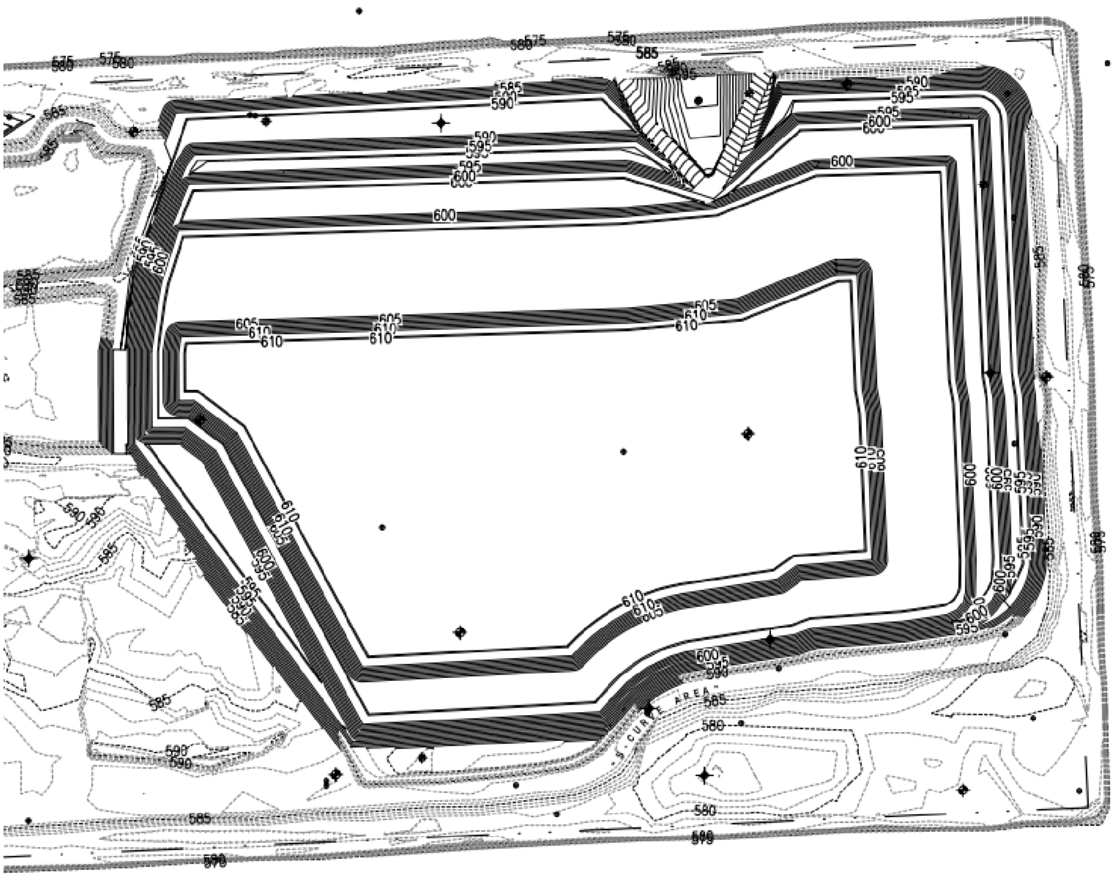
FIGURE 5

CDF 12 SILT MANAGEMENT CELLS THROUGH PHASE 9 (SHEET I21.0 – APPENDIX E)



The CDF 12 Silt Management Cells (Plan Sheets I6.0, I8.0, I9.0, and I19.0 through I21.0 of Appendix E) consist of perimeter berms constructed within alternating locations (east and west), a central separation berm/roadway, temporary access roadways, and water management features. The slit management cell berms were designed with the assumption that they will be utilized to permanently manage mechanically offloaded finer-grained materials. Therefore, the perimeter containment berms are primarily constructed of well compacted low-permeable (fine-grained) material (i.e., typically imported clayey material), or recovered and stabilized fine-grained dredged material (i.e., not unsuitable silts and sands), to contain the newly placed dredged material. Construction activities and embankment materials will be completed in accordance with the technical specifications including the use of selected and characterized soil types and textures for specific structures, compaction and moisture conditioning (achieving ninety-five percent of its maximum Standard Proctor dry density) or chemical modification, and field quality control requirements (visual inspection, in-situ testing and laboratory analysis). Similarly, subgrade preparation will also be completed in accordance with the technical specifications, which provide flexibility on implementation of necessary improvements, and will be approved by the CCCPA or its representative prior to placement of embankment material to verify suitable bearing capacity equal to, or greater than, the requirements for the subsequent fill material.

The central separation berm will include an aggregate roadway to be used as a wider, central, access berm for the Site Operators and contractors. Aggregate will be placed on some portions of the perimeter berm to improve access roads to facilitate material placement, transportation, and site access. Each Silt Management Cell will have a targeted material storage capacity of approximately 90,000 to 125,000 CY to accommodate the anticipated annual receipt of finer-grained dredged material. The Silt Management Cells will be designed to accommodate the annual dredged material placement while maintaining a one-foot freeboard. The CCCPA and the USACE dredging contractor will monitor the mechanical offloading placement process to ensure the berms maintain integrity, the material is passively draining, and that a sufficient capacity is available.

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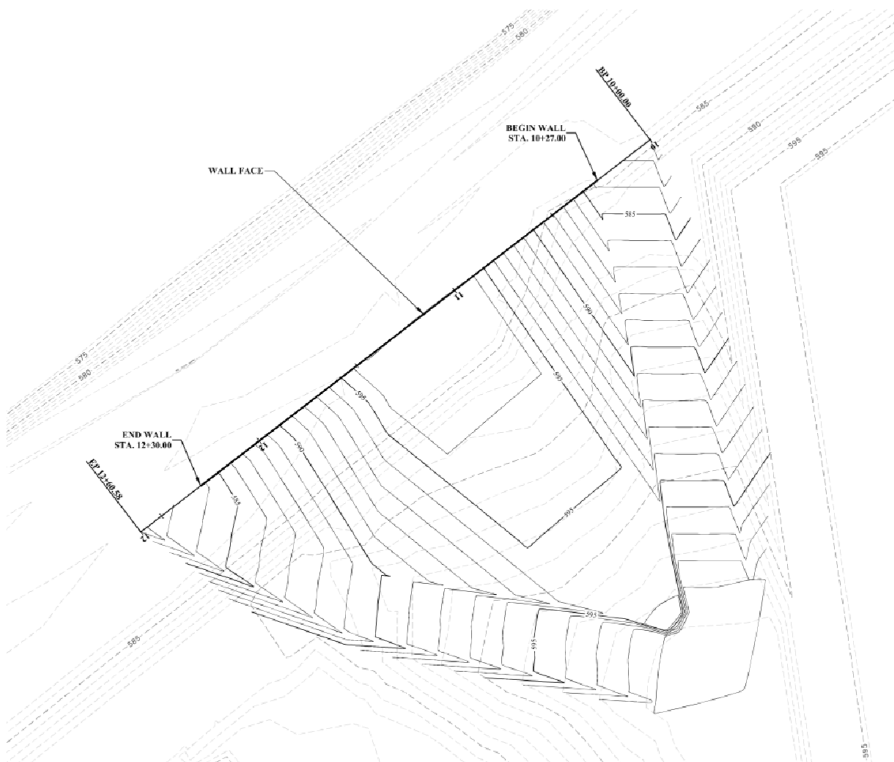
FIGURE 6

CDF 12 MECHANICAL OFFLOADING PLATFORM



The mechanical offloading platform (Plan Sheet I17.0 of Appendix E – see Figure 6 for reference) is an elevated earthen structure that is vertically supported by a retaining wall system. The retaining wall consists of facing units filled with crushed stone, horizontal layers of structural geogrids, and a perimeter rail/fence.

A network of access roads have been constructed throughout the CDFs to support truck and equipment access during material placement, transportation, site access, and material harvesting. Some of the access roads are built of embankment material to elevate the roads in an effort to keep them above low-lying areas, promote positive drainage, and to maintain specific grade changes.

3.6 Legacy Basin

The Legacy Sediments, estimated to be approximately 65,000 "cut" CY, based upon an early feasibility study, will be dredged from the Old River Channel as part of a Great Lakes Legacy Act (GLLA) project. Currently it is planned for the dredged sediments to be partially solidified and loaded onto trucks, or barged, to CDF 12. There the Legacy Sediments will be mechanically offloaded into a separate management basin, geotechnically stabilized, and capped to support future operations and improvements. See Figure 7 for an early concept layout of the Legacy Basin at CDF 12.

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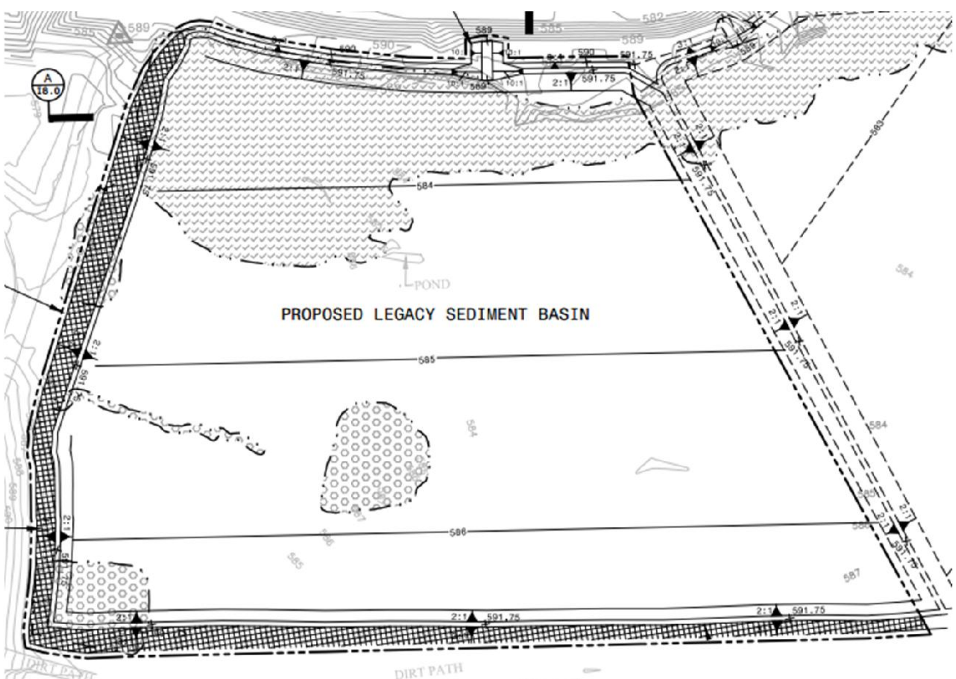
FIGURE 7

EARLY CONCEPT FOR LEGACY BASIN AT CDF 12



The most recent conceptual CDF improvement plans included accommodation of Legacy Sediment within a contained basin (Legacy Basin) that would be constructed/excavated below the existing CDF grades. Conceptual plans included creation of a sediment processing and stockpiling area over the filled and capped Legacy Basin area to support the Site Operator's activities at the CCCPA's recovery and reuse program. The process area would consist of layered aggregates overlying the capped sediments at an elevation relatively close to the top of the CDF's existing perimeter dike elevation. The Final design of the Legacy Basin cap and final volumes are outside the CCCPA's current scope and may be designed in coordination with the USACE and US EPA when more details are available.

3.7 Sediment Storage and Processing

The SPMF harvests, recycles and beneficially uses 120,000 to 150,000 CY of coarse-grained dredged material annually. The outbound material primarily consists of the hydraulically offloaded dredged material that is dewatered and recovered by the Site Operator under direction of the CCCPA. The recovered dredged material is transported to and stockpiled within the sediment storage and processing area, which is located in the southwestern corner of CDF 12. This material is then loaded onto dump trucks and removed from the SPMF for reuse.

The CCCPA requires the Site Operator to harvest and clear the hydraulically placed dredged material from the sluiceway system, and remove the dewatered material from the SPMF as long as the material is in compliance with the Ohio EPA Land Application Management Permit (LAMP) (See Appendix G). The Site Operator removes and markets this material in a timely manner to accommodate and not delay future USACE dredging cycles. The Site Operator is not permitted to stockpile more than 80,000 CY of material at the SPMF at any given time. Stockpiles have a maximum height of 15 feet, and no equipment is permitted to sit on top of staged or stockpiled material.

The CCCPA is responsible for maintenance of dredged material management structures, management and control of SPMF features (dust, mud, invasive species, vegetation, etc.) support and coordination during the dredged material offloading events, roadway and water management, and obtaining and maintaining necessary permits, licenses, and other approvals.

4.0 VERIFICATION AND CONSIDERATION OF EXISTING AND FUTURE PLANNED ACTIVITIES

4.1 Overview

The CCCPA is requesting to alter, impact, or encroach upon a Federally operated and maintained navigation project and seeks permission from the USACE to continue operation of the SPMF at CDFs 9 and 12. In accordance with 33 U.S.C. 408, the CCCPA's currently anticipated and planned operations of the SPMF were evaluated to demonstrate that the structural integrity and stability of the Federal government's existing containment dikes for CDF 9 and 12 will not be impacted, and that the CCCPA's actions will not result in failure of the structure based on the assumption that the SPMF is constructed and operated in accordance with appropriate design, specifications, and design assumptions. This report does not include the intended use and operation of CDF 10B, as the CCCPA plans to prepare a separate report specific to CDF 10B, which will be provided in the future, when appropriate. The primary existing and planned future activities that were considered include, hydraulic processing and sorting of dredged material, operation of material handling equipment from elevated mechanical offloading pads, construction of tiered elevated silt management cells, the potential accommodation of stabilized Legacy sediments within a retention basin in the SW quadrant of CDF 12, and future storing/staging of material on top of stabilized legacy dredged material and a designed and constructed process area pad.

The evaluation work involved reviewing, verifying, and updating, if necessary, stability models to reflect existing as-built conditions (augmented by additional geotechnical investigations) and the most recent phasing plans developed as part of the 2018 CDF improvements, material management plans, and verification and monitoring programs. Evaluations, calculations and models considered all identified and known standard SPMF operations including, hydraulic processing of dredged sediment on the surfaces of CDFs 9 & 12, typical (or specifically provided) surcharge loads from equipment, mechanical offloading in retention cells on CDF 12 and use of a storage/processing area.

4.2 Hydraulic Offloading and Recovery

The CDF 9 Sluiceway system will be used for temporary storage of hydraulically offloaded dredged material and to facilitate recovery and reuse of the more marketable materials. Final elevations of the sluiceway are between 592.5 feet (top of sluiceway berms/roadway) and 582.0 feet (bottom of the sedimentation pond). Typical recovery equipment includes long-reach excavators, articulated haul trucks or dump trucks, and pickup trucks. The sluiceway berms/roadways were specifically designed to accommodate the anticipated equipment loads. Although the sluiceways are only temporarily used to store dredged material, and the anticipated loads and elevations are considerably lower than the planned elevations of the Silt Management Cells, a typical section of the sluiceway was also modeled and analyzed for global and local stability. Results of this evaluation and the stability model demonstrate that the sluiceway structure and planned operations will not impact the structural integrity of the Federally constructed CDFs. Figure 8 is a typical detail of the CDF 9 sluiceway access berm.

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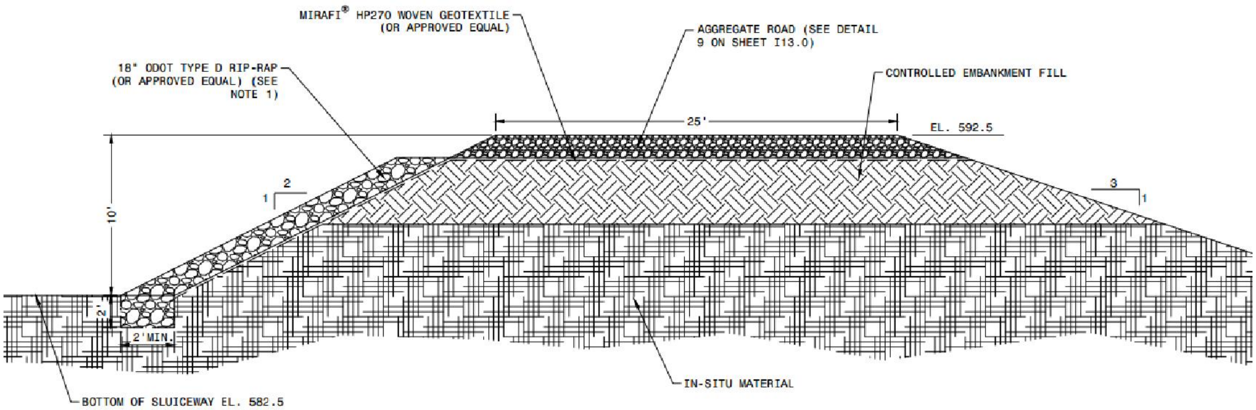
FIGURE 8

TYPICAL CDF 9 SLUICEWAY ACCESS BERM DETAIL



4.3 Mechanical Offloading and Management

The USACE dredging contractors will use the CDF 12 Mechanical Offloading Platform to unload docked scows and to place dredged material within the CDF 12 Silt Management Cells. The elevated earthen offloading structure is supported by a retaining wall that varies in elevation and has a top elevation of 597 feet. The retaining wall (see Figure 9) was designed by The Thrasher Group, Inc., who was the engineer of record during construction, and was periodically inspected by the CCCPA's construction quality assurance contractor. Specialized offloading equipment load distribution mats will be located on the top of the platform and used during the mechanical offloading process. The retaining wall and offloading platform were specifically designed to accommodate the anticipated equipment loads. A typical section of the mechanical offloading platform was modeled and analyzed for global and local stability. Although the mechanical offloading platform only has periodic operations, and temporary loading over a relatively small area, the stability evaluation used conservative loading assumptions, (e.g.; temporary equipment loads and relatively localized mechanical offloading pad load would likely be distributed laterally; distributed equipment loads were applied to the entire width of the platform and access road), to further verify that this critical area does not create stability concerns. Results of this evaluation and the stability model demonstrate that the mechanical offloading structure and planned operations will not impact the structural integrity of the Federally constructed CDFs (See Appendix F for 2018 SPMF slope stability analysis).

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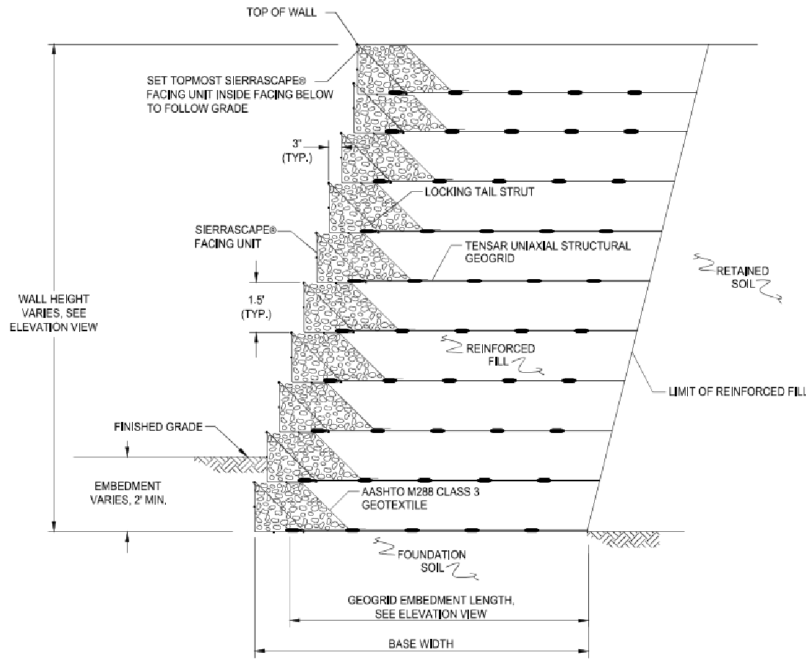
FIGURE 9

TYPICAL CROSS-SECTION OF CONTRACTOR PROPOSED RETAINING WALL SYSTEM

(SHEET I17.0 – APPENDIX E)



4.4 Silt Management Cells

The CDF 12 Silt Management Cells will be used for permanent storage of mechanically offloaded dredged material and to optimize the vertical management of the less marketable materials within FAA boundaries set by BKL. Final planned elevations for the silt management cells are up to 611 feet (top of berm for phase 9). Typical placement and transportation equipment includes draglines, stacking conveyors, dozers, excavators, articulated haul trucks or dump trucks, and pickup trucks. The access roads were specifically designed to accommodate the anticipated temporary equipment loads. Because anticipated material loads and elevations of the silt management cells are considerably higher than the other planned activities, several representative sections of the full expansion were modeled and analyzed for global and local stability. Results of this evaluation and the stability model demonstrate that the silt management cells and planned management operations will not impact the structural integrity of the Federally constructed CDFs. See Figure 10 for a typical detail of CDF 12 silt management cell perimeter containment berm (See Appendix F for 2018 SPMF slope stability analysis).

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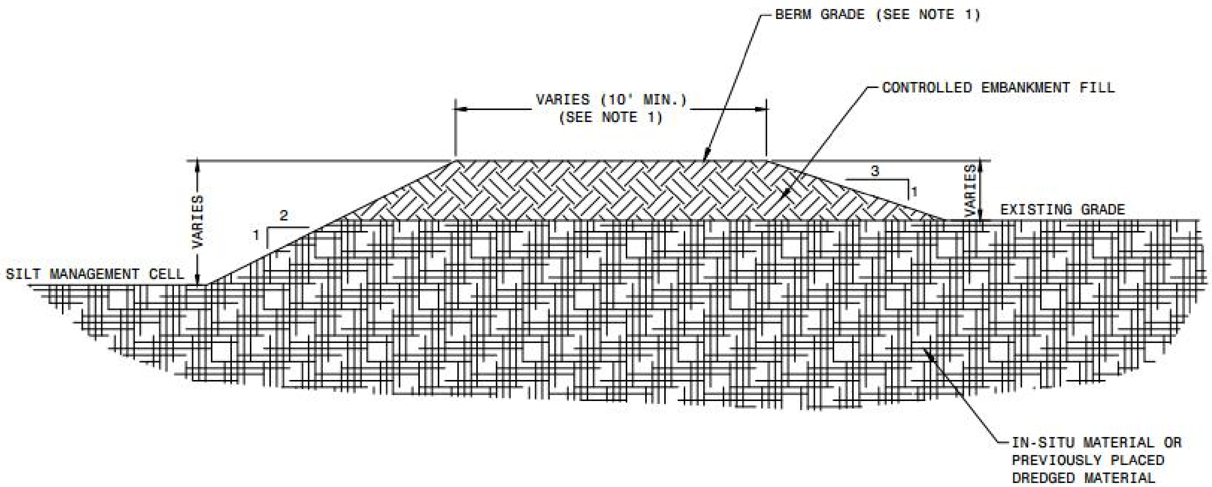
FIGURE 10

TYPICAL CDF 12 SILT MANAGEMENT CELL PERIMETER CONTAINMENT BERM

(SHEET I13.0 – APPENDIX E)



To further evaluate and verify the parameters used in the stability analyses, additional geotechnical sampling and testing of existing conditions, which reflect recent SPMF operations conducted over the last several years, have been implemented. The results of this confirmatory exploration work was used to review and confirm the earlier calculations and models, and the assumptions/parameters have been updated accordingly, as needed. Additional details of this more recent work are discussed in Section 5.0.

In addition, the CCCPA will be implementing a geotechnical monitoring program that will include periodic inspections and testing to further verify on-going stability and assess structural integrity. As part of this program, the CCCPA will have several planned and potential geotechnical/mitigation improvement plans/actions that will ensure stability will be maintained and allow for adaptation based upon actual long-term field conditions encountered. The monitoring program and contingency actions are discussed in Section 6.0 and 7.0.

<u>4.5 Legacy Basin</u>

It is assumed that the Legacy Basin will be constructed in the southwest corner of CDF 12 and will be used for permanent storage of sediments dredged from the Old River Channel as a result of implementation of a proposed GLLA project. The material will be mechanically placed into CDF 12 and structurally and geochemically stabilized prior to the placement of a cap. The basin will be constructed below exiting grade and have a base elevation of approximately 583 feet and final cap elevation of approximately 593 feet. Typical placement and transportation equipment includes dozers, excavators, and miscellaneous low-ground-pressure equipment. Although the anticipated loads and elevations will be similar to existing conditions at CDF 12, a potential section based on the current understanding of the Legacy Basin management plans was modeled and analyzed for global and local stability. Results of this evaluation and the stability model demonstrate that the basin structure and planned operations will not impact the structural integrity of the Federally constructed CDFs. Since the modeled section was developed based on the current understanding of the Legacy sediment management approach, and since the material management and site operations may be altered in the future, stability of this area may need to be monitored to verify appropriateness of the completed analysis, even though this area is not a critical stability concern. If necessary, the model may be modified to reflect the final Legacy sediment management approach.

4.6 Sediment Storage and Processing

The Site Operator will periodically process, stockpile and load out the recovered dredged material for beneficial reuse at the sediment storage and process area located in the southwest corner of CDF 12. Stockpile heights may reach an elevation of 606 feet. Typical processing and stockpiling equipment include dozers, excavators, loaders, and portable screening equipment. The storage and process area that will consist of a layered aggregate pad was specifically designed to accommodate the anticipated equipment and material loads. Current plans identify this area to be located over the Legacy Basin as reflected in the stability model. Hull anticipates that execution of the current Legacy sediment management approach will result in conditions similar to, or the assumed strength parameters used in the modeling will be lower than the actual strength, resulting in a conservative slope stability analysis approach. Therefore, the typical section of the storage and process area that was modeled for global and local stability is conservative and representative of the anticipated conditions, regardless of the likely final configuration of the Legacy Basin. Results of this evaluation and the stability model demonstrate that this area and planned operations will not impact the structural integrity of the Federally constructed CDFs (See Appendix F for 2018 SPMF slope stability analysis).

4.7 Slope Stability Analysis - Data Evaluation and Summary of Considerations

As-built information provided by USACE was used to model the existing CDF dike systems. Results from the geotechnical explorations performed by Hull in 2012 and 2016 were primarily used to characterize subsurface conditions underlying the existing CDFs. Information obtained from the USACE report titled "Mechanical Offloading and Storage of Dredged Material at the Cleveland Harbor Confined Disposal Facilities" dated September 2012 was used to supplement Hull's 2012 and 2016 explorations. Results from historically performed geotechnical explorations (i.e., explorations performed prior to 2011) were not readily available to Hull at the time of completion of the initial slope stability analysis. However, since then, appropriate data was obtained from the more recent geotechnical explorations that are considered more representative of existing conditions (earlier historic information should be considered secondary to this more recent information.)

Industry-accepted practices, such as applicable American Society for Testing and Materials (ASTM) standards (e.g., ASTM D1586, D1587, D2488, D4220, etc.) and Hull's standard operating procedures (SOPs) were utilized during performance of Hull's 2012 and 2016 geotechnical explorations to ensure the proper specimen acquisition and preservation/transportation of samples for lab characterization to provide representative information and data. Extreme care was taken to minimize sample disturbance during collection, transportation and extraction. Samples were tested at local AASHTO-accredited testing laboratories (i.e., Hull's laboratory and Resource International, Inc's laboratory). It is assumed that similar practices were utilized during performance of the exploration performed by USACE in 2011/2012, however it cannot be verified by Hull. Nonetheless, results from the USACE exploration and input parameters used in the associated slope stability analyses were very similar to those utilized as part of the SPMF slope stability analysis.

The 2018 SPMF slope stability analysis (Appendix F) was used to support the 2018 SPMF improvement/reconfiguration plans, and demonstrate stable slope conditions assuming implementation of moderate dewatering activities. As a conservative approach, strength increases were not assumed for previously dredged material below low water datum (LWD) or the underlying lakebed material. However, it is likely that these layers will continue to increase in strength as a result of consolidation due to increase in overburden pressures from subsequent phase expansions. Based on review of the previously completed slope stability analyses, feedback from USACE, and evaluation of available geotechnical information, the critical, or more sensitive, areas were identified and used to determine the location of the SPMF structures. As presumed, the SPMF slope stability analysis indicated that the offloading platform was the most critical area, as represented by the lowest resulting Factors of Safety (FOS). It should be noted that this offloading platform was constructed in 2017 and has not shown any indication of structural instability to the existing dike or the surrounding CDF improvements.

The USACE's engineering technical report (Mechanical Offloading and Storage of Dredged Material at the Cleveland Harbor Confined Disposal Facilities – September 2012) expressed stability concerns related to the development and vertical placement of material near the previous settling pond near the "S Curve Area" (see Plate 1 of Appendix F and Figure 11 below). Although, Hull was comfortable with the results of the slope stability analyses performed by Hull including a seismic analysis, which demonstrated stable slope conditions in this area, additional analyses were performed to further demonstrate stability and to address concerns expressed by the USACE, during earlier discussions on conceptual CDF reconfiguration approaches suggested by Hull. Furthermore, in line with the USACE recommendations, the planned expansion activities as part of the SPMF improvements were kept to a minimum of 100 feet from the previously utilized CDF 12 settling basin located in the southeast corner of the CDF.

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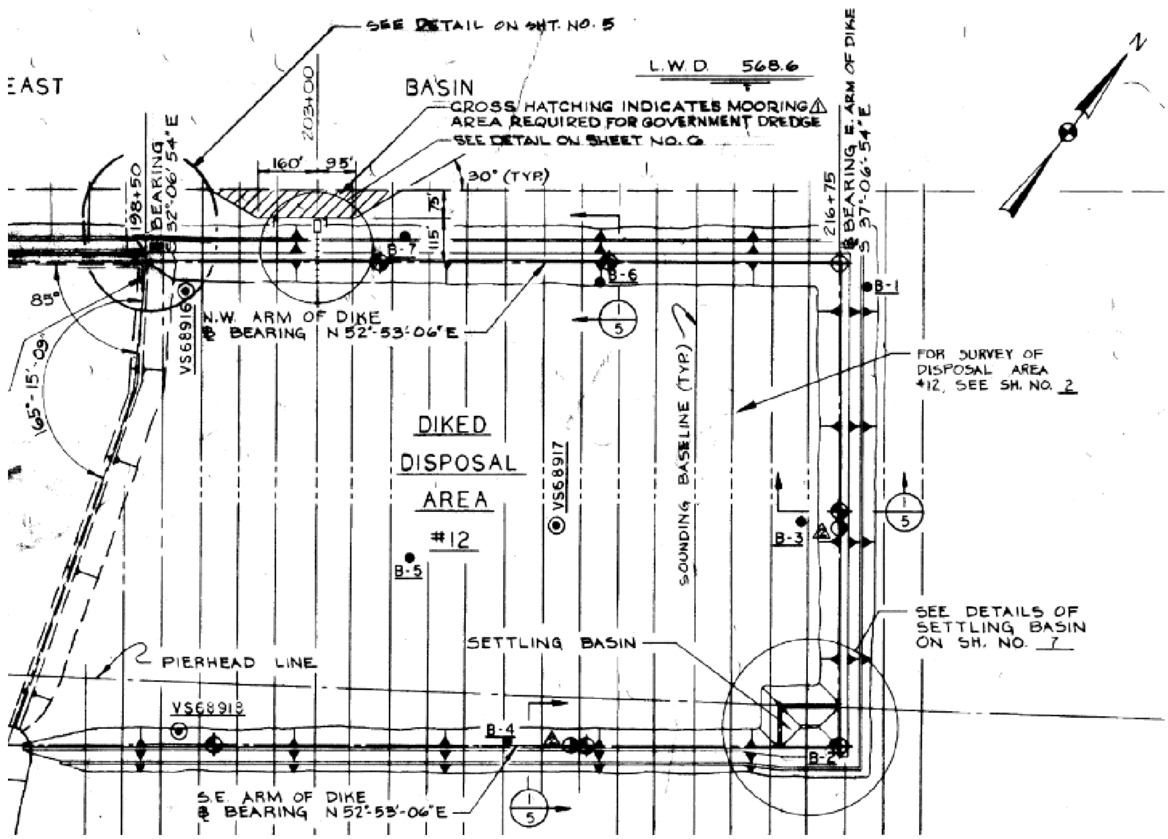
FIGURE 11

CDF 12 SITE PLAN (USACE, CONSTRUCTION PLANS REV 5/21/1973)



As discussed in Section 5.0 of this Report, it is recommended that continued periodic geotechnical evaluations and/or explorations be performed to further validate the assumptions made in this report and to evaluate the effectiveness of the material and water management activities being implemented. Results from these evaluations/explorations should be reviewed by Hull (or another geotechnical engineer) to verify the stability of the proposed improvement activities. If necessary, more aggressive dewatering, consolidation and/or stabilization activities can be implemented based on the results of the explorations/evaluations in order to improve stability of the SPMF.

5.0 SUPPLEMENTAL GEOTECHNICAL EXPLORATION AND ANALYSES

5.1 Overview

The CCCPA completed a supplemental geotechnical exploration and analyses to support the demonstration that the proposed operations and vertical design for the SPMF aligns with (or requires modifications to meet) current design assumptions and to confirm that if final design recommendations are appropriately implemented, that the SPMF can meet or exceed original performance expectations/models. The proposed work included additional geotechnical/subsurface field explorations at strategic locations, additional sample collection at specific strata, geotechnical laboratory testing, and updates to models, as needed, to further develop and support the site conceptual model for the SPMF in the 33 U.S.C. 408 application. This work plan was developed based on a comprehensive review of all available existing geotechnical information, completion of preliminary field visit/inspection to observe existing conditions, and to provide an expanded database for the more critical parameter assumptions used and the most critical areas identified in the stability models presented in Section 4.0.

On behalf of the CCCPA, Hull performed additional geotechnical drilling activities and subsurface investigation activities at the SPMF to further evaluate the more critical areas as identified in the initial stability analyses. The critical areas include the mechanical offloading platform on the north shoreline and the silt management cells near the "S Curve Area" within the southeast corner of CDF 12. Due to the raised embankment and the proposed equipment loading conditions, initial modeling of the mechanical offloading platform area resulted in calculated lower FOS as compared to the other areas evaluated around the SPMF. The "S Curve Area" was also identified as a critical area as the setback distance for each subsequent vertical phase is less (i.e., the final vertical elevation is achieved over a shorter lateral distance) as compared to the north side of CDF 12, and because the USACE has previously identified this portion of the CDF 12 to have nominally lower shear strength properties of the deeper subsurface materials. Furthermore, based on the stability analyses presented in the previous section, the existing dredged material historically placed within the CDFs and the lakebed material appear to be the most critical layers considered in the modeling (i.e., because the failure planes traverse the longest distance within these stratums, the shear strength parameter inputs used for these stratums are critical in the modeling efforts). It is also anticipated (based on the lower FOS initially calculated for undrained conditions) that development of pore water pressures can contribute to base failure conditions if dredged material is stacked and placed vertically in relatively short periods of time within each phase thus increasing the loading on the underlying stratums and creating undrained conditions as pore water pressures increase and are unable to dissipate fast enough to avoid a failure. Consequently, additional subsurface information was collected within these soil stratums at the two specified areas of the SPMF to support development of a more detailed staging analysis for CDF 12.

5.2 Subsurface Field Exploration and Collection Activities

The following was performed as part of the most recent subsurface field exploration and collection activities:

1. Prior to beginning drilling, Hull's drilling subcontractor will notify the Ohio Utility Protection Service (OUPS) and Ohio Oil and Gas Underground Protection Service (OGPUPS) at least two business days to mark utilities in the vicinity of the planned boring locations. In addition, Hull provided currently available information about the location of existing deep infrastructure, such as storm sewer outfalls, etc. to the drilling subcontractor.

2. The field assessment activities were performed in an iterative and phased approach. Hull explored subsurface soil and groundwater conditions by completing two explorations, one near each of the two most critical areas as shown on Plate 1. At each exploration location, the following was performed:

   i. A boring was advanced using hollow-stem auger drilling techniques. The boring was drilled to depths ranging from approximately 60 to 70 feet below existing ground surface (bgs) and was a minimum distance of 20 feet below the "muck" layer into the glacial lake deposits. The exploration sties were accessed with a track-mounted or all-terrain vehicle drilling rig. Split-barrel sampling of soil was performed in accordance with ASTM D 1586 for each boring continuously to the depth of the boring. Standard Penetration Test (SPT) data was developed and representative samples preserved. Field vane shear testing (ASTM D2573) was performed within the boring at select intervals (e.g., at approximately 15, 25, 35, 45, and 60 feet bgs) to determine in-situ undrained shear strengths for recently placed dredged material (mechanically offloaded), previously placed dredged material above the water table (hydraulically offloaded), previously placed dredged material below the water table (hydraulically offloaded), and within the glacial lake deposits below the muck layer. A second boring was offset 5 feet from each original location so relatively undisturbed Shelby tubes could be collected at select intervals within these same stratum types. Water level observations in the boreholes were recorded at the completion of drilling.

   ii. Both the original and the offset borings were finished as two-inch diameter piezometers and screened to monitor water levels, and increases in pore water pressures in the future, as the facility develops vertically. Initial water levels in the piezometers were documented at installation completion.

   iii. In addition to the boring, a Cone Penetration Test exploration was also performed at each site to a depth of 150 feet bgs or refusal. The cone penetration or cone penetrometer test (CPT) is an in-situ soil testing method used to determine the geotechnical engineering properties of soils and to delineate soil stratigraphy. The test method consists of pushing an instrumented cone, into the ground at a controlled rate – the cone measures tip resistance, dynamic pore pressure, static pore pressure, and sleeve friction continuously during penetration. The result provided an electronic continuous profile of soil data, to select design parameters, and direct design applications.

   Hull subcontracted experienced drilling contractors (Stock Drilling, Inc. and ConeTec, Inc.) to supply and operate the drilling and CPT equipment. Completion of the explorations was performed under the direction of an engineer or geologist from Hull who monitored the materials encountered, obtained representative samples of the various soils, and developed a detailed log of the explorations.

3. A geotechnical laboratory testing program was established based on the original data goals and reflected observations made during the drilling activities and site reconnaissance. Soils retained from the sampling were transported to Hull's geotechnical laboratory for further examination by a senior geotechnical engineer and assignment of index testing.

5.3 Geotechnical Laboratory Testing

The geotechnical laboratory testing program was established based on the original data goals as modified by the observations made during the drilling activities. Soils retained from the sampling were transported to Hull's local office that hosts a geotechnical laboratory for further examination by a geotechnical engineer and assignment of laboratory testing. The following laboratory tests were performed on samples retained during the drilling activities:

1. All samples were classified in the laboratory based on the visual-manual examination (ASTM D 2488) Soil Classification System and the laboratory test results. Formal boring logs were prepared using the field logs and the laboratory classifications.

2. Index laboratory testing included grain-size analyses (ASTM D422), moisture content determinations (ASTM D2216), and Atterberg limits tests (ASTM D4318) of a limited number of samples considered to be representative of the foundation materials encountered by the borings.

3. Consolidated undrained (CU) triaxial testing was performed on the relatively undisturbed samples obtained by the Shelby tubes. Each CU triaxial test was performed at 3 to 4 pressures (e.g., between 8 and 72 pounds per square inch) to simulate the overburden pressures resulting at the sample depth after implementation of Phases 3/5, 6/7, 8 and 9. [Note that the specimens collected within the mechanical offloading platform area did not consider Phase 9 loads as the berm for this phase is set back a lateral distance where the vertical expansion will not materially affect the stability of the platform area.] Each shear strength determined for each normal load, (after the material has consolidated), was evaluated as part of the staged loading analysis –providing the shear strength value at each loading condition for the specific phase modeled.

4. All laboratory testing was performed by experienced geotechnical laboratories (Resource International, Inc. and Geotechnics, Inc.) and in accordance with ASTM or other specified standards.

5.4 Data Evaluation

Hull revisited the 2018 SPMF slope stability analysis using the boring information and updated information collected from the supplemental investigation and laboratory testing completed between November 2018 and March 2019. The results of the analysis are summarized in Section 8.0 of this report and the supplemental geotechnical exploration reports (Appendix J and K), which includes the findings, conclusions and general recommendations. The S supplemental geotechnical exploration reports include appropriate supporting information, including; a site plan, boring logs, laboratory testing results, and CPT graphs. Resulting pertinent information and recommendations related to geotechnical design, construction and operation considerations/modifications for the SPMF, including the implementation of recommended additional improvements or modified phasing sequence and time interval, are incorporated into this Report.

6.0 PROPOSED GEOTECHNICAL MONITORING PROGRAM

6.1 Overview

This section describes the proposed on-going geotechnical monitoring program that has been developed to provide the CCCPA with recommendations to conduct a cost-effective annual inspection that will demonstrate the SPMF is maintaining stability and the structural integrity and has not been compromised by operations. In addition, the information collected during the monitoring program can be used to continue to corroborate the design assumptions/calculations and allow model refinement and remain accurate based on actual site conditions. This program includes visual inspections, installation of control devices, surveying and monitoring, and periodic confirmatory sampling and analysis. The CCCPA's program also incorporates the requirements outlined within the USACE's 1990 Operation and Maintenance Manual prepared for CDF 12, and additional operation and maintenance activities performed by the CCCPA or required of the Site Operator as discussed in Section 3.7. The CCCPA intends to initiate the geotechnical monitoring program in 2019 under an authorized agreement/contract with a qualified firm to implement the program. Any observed unanticipated conditions will be brought to the attention of the Design Engineer for discussion and impact.

6.2 Field Inspections

The CCCPA will coordinate a site reconnaissance and non-intrusive analysis to evaluate the real time conditions of the SPMF to verify that dike, structural berms, water control structures, internal drainage features, roadways, and other systems are stable and can perform as intended. This inspection will be performed at a minimum annually. More frequent visits may be warranted based on results of the field inspection and phase of operations or construction activities.

The inspection should be completed under the direction of an engineer specializing in geotechnical or large earthwork construction related projects. At a minimum, the inspector will observe and document the following:

- presence of wet or low-lying areas that do not promote positive drainage;
- areas along structural berms that are experiencing apparent total or differential settlement;
- presence of tension cracks along structural berms that may be a result of a slope failure or base failure from a localized or global failure;
- current conditions of the roadways (e.g., rutting, pumping, loss of aggregate surface, ponding water, etc.);
- presence of major erosion areas along structural berms and within the sluiceway berms;
- build-up of sediment within water control structures;
- condition of weir outfall;
- general conformance with construction and operational phasing; and

- any site operation or construction activities that may cause or lead to future stability issues.

The inspection form provided in Appendix H will be used during the inspection to document the observations made. The inspection record/report will include photo documentation of the site features accompanied with the completed inspection form. If slope or base failures are encountered, the features will be documented to obtain a better understanding of the probable landslide/base failure configuration and failure mechanism. The critical site and landslide features (e.g., head scarp, bulge, seeps, and extent of slope failure) will be initially located with a hand-held GPS unit and mapped. This information will be used to develop a basis for establishing more sophisticated monitoring and recommendations to support a repair design or operational modifications for the SPMF.

6.3 Monitoring Devices

In addition, the CCCPA is proposing to install several monitoring systems at the SPMF to monitor systems that cannot be solely verified by visual inspection (performed as part of the site inspections discussed in Section 6.2) and confirm the structural integrity of the systems have not been compromised. At this time, the CCCPA proposes the following monitoring devices described in 6.3.1 and 6.3.2:

6.3.1 Survey Monitoring Hubs

Survey monitoring hubs will be installed at several locations (e.g., sluiceway berms, silt management cell berms, mechanical offloading platform, sluiceway sediment control weir, and culverts) across the SPMF to provide a baseline to monitor potential vertical and horizontal displacement of the structures. Installation of multiple hubs along larger berm slopes (at crest, mid-slope, and at toe) should be considered to determine if the berm slope is increasing grade beyond unsafe conditions over time. Because the long-term management areas of the SPMF are primarily constructed with processed/stabilized dredged material or clayey soil over unconsolidated and undrained dredged material, it is anticipated that some level of settlement and displacement will occur during the life of the SPMF. The survey monitoring will determine if the amount of settlement and displacement is within acceptable/anticipated tolerances giving consideration to settlement as a result of initial consolidation of the materials. The northings, eastings, and elevation of the survey monitoring hubs will be compared to previous survey events to determine the amount of settlement and displacement the structure is experiencing. These comparisons will be evaluated by the Design Engineer.

General guidance on settlement and displacement tolerances are as follows:

- Sluiceway and Silt Management Cell Berms = total settlement (vertical displacement) > 3 inches over a year's period; side slopes that increase in steepness greater than 5% of the original design grade (and not due to apparent erosional losses).
    - It is anticipated that greater than 3 inches of settlement is expected of the dredged materials within the interior of the Sluiceway and Silt Management Cell Berms as

the material is placed as part of mass filling operations and is not being placed in compacted lifts. Settlement and compression of this material is expected and is not a concern for global stability.

- Mechanical Offloading Platform = total settlement > 3 inches over a year's period; grades maintain positive drainage.
- Sluiceway Sediment Control Weir = total settlement > 2 inches over a year's period; no more than 4 inches from original construction (or perform maintenance).
- Culverts = maintain positive grade.

If these general guidelines are exceeded and it is recommended by the Design Engineer based on an evaluation, the CCCPA will perform maintenance to address the displacements, as needed, and investigate and address probable causes.

6.3.2 Piezometers

Existing and/or new open standpipes throughout CDF 12 will be used to monitor general water levels within the interior of the CDF during operations. The initial piezometer locations were off-set and drilled near the two locations as previously discussed and as shown on Plate 1. Additional piezometers would be installed at locations based on current site conditions (levels in existing piezometers), what phase the facility is operating in, etc. Piezometers will be installed and be screened within specific material stratums (e.g., within existing dredged material below and above the water table) to monitor increases in pore water pressures during filling activities. Increases in excess pore water pressures due to induced stress from fill decreases effective stress and thus undrained shear strength, which increases the possibility of stability failure. Therefore, if greater than anticipated pore water pressure increases are observed, as discussed in Section 5.0, then modifications to operations will be made. This may include ceasing operations or moving the location of the dredged material placement towards the interior of the CDF until pore water pressures dissipate to safe levels. In addition, modifications to the SPMF can also be made including installing water control systems, such as wick drains, and pumping of the standpipes to facilitate alleviation of localized pore water pressures.

6.4 Annual Summary Report

Upon completion of the annual activities, the CCCPA's consultant will prepare a brief annual report/memorandum to summarize the results of the inspections, monitoring, and analysis. The report will include a table that provides a running tabulation of the survey monitoring points comparing the changes in the northing, easting, and elevations from the previous event and the original installation. A table of the historic piezometer water levels will also be provided as an attachment. The annual report could be made available to the USACE and other regulatory agencies, upon request, for review and confirmation that the SPMF is operated as authorized.

7.0 PROPOSED AND OPTIONAL GEOTECHNICAL IMPROVEMENT PLANS/ACTIONS

7.1 Overview

The construction specifications presented in the 2018 Improvements/Reconfiguration Plan Set (Appendix E) should be implemented as planned and the design parameters discussed in this Report must be achieved for the SPMF to maintain structural stability based on the current understanding of field/subsurface conditions, proposed site operations and available geotechnical information. The CCCPA will implement an adaptive management program, as summarized in this section, during execution of the construction and operation activities that allows for updates/modifications to existing means and methods, site operations, and improvements to the SPMF to achieve or exceed the safety and stability goals.

The potential geotechnical improvements discussed below were developed to identify some contingency approaches and actions that could be implemented if movement or instability is discovered as part of the Geotechnical Monitoring Program as discussed in Section 6.0, or if conditions exist where imminent structural failure of the containment dikes or other ancillary systems may occur if conditions are not modified or immediately addressed. In addition, these potential improvements may be implemented in conjunction with other modifications (e.g. relocated perimeter limits, or vertical limits) to increase volume and life capacity at the CDFs, if the cost to benefit comparison results are positive.

7.2 Subsurface/Geotechnical Stabilization Improvement Options

Specific proposed and potential geotechnical improvements may be modified/refined based upon cost, schedule for implementation, actual field conditions, newly identified technologies and the findings and results of the geotechnical exploration work to properly address geotechnical stability concerns, including potentially modifying the life/capacity of the CDFs. The potential geotechnical improvements are discussed in more detail below.

The CCCPA will consider the following improvements to the SPMF as contingency measures as part of the adaptive management strategy efforts. The CCCPA, with input from their engineering consultant, will select the work activity they consider most appropriate to achieve the design assumptions, construction specifications, and performance goals. Once the CCCPA selects an option, they will work with an engineer, vendors and contractors in developing a final design and final budgetary cost to support implementation.

7.2.1 Increase Berm-offset Distances or Heights

If localized base failure is observed, or if acceptable FOS cannot be calculated during subsequent design/phasing plans based on updated geotechnical information or as-built surveys, the silt management cell berms may be further offset a specific distance required to achieve acceptable FOSs and safe management conditions. These offsets may also include, or be in lieu of, a reduction of berm height and dredged material placement volumes. Similarly, if increased strength parameters are realized during subsequent planning and supplemental geotechnical exploration work, silt management cell berms may be adjusted outward to increase storage capacity. This berm modification can be completed by a general earthwork contractor, as directed by an engineer, and would not require a specialty contractor.

7.2.2 Use of Rubble Material

Recycled material (rip-rap, recycled concrete, etc.) may be stored at the CDF for potential placement at the base of a berm if localized base failure is observed. This type of material is regularly stockpiled at the CDF and has many potential uses (roadways, erosion protection, laydown areas, etc.). The recycled material may be quickly deployed by the Site Operator or a general earthwork contractor, as directed by an engineer, to support construction or addressing berm failures or movement. This berm modification can be completed by and would not require a specialty contractor.

7.2.3 Staged Loading Program

Since increased pore water pressures result in a reduction of effective stress and shear strength, which can lead to potential slope/base failure, pore water pressures will be monitored during and immediately after filling by mechanical offloading within the silt management cells via piezometers. If it is determined that the filling activities are increasing pore water pressures that may lead to undrained conditions and potential slope/base failure, the location, rate, and amount of filling will be adjusted such that pore water pressures are allowed to dissipate (or the area actively dewatered) and return to safe conditions. Once pore water pressures return to acceptable conditions, normal filling may resume, with more aggressive piezometer monitoring until conditions stabilize. Threshold levels for these pertinent parameters (vertical/lateral movements, excess pore water pressures, etc.) will be developed and based on the results of the supplemental geotechnical laboratory testing and stability modeling as part of the final design construction plans for each phase to reflect construction monitoring activities and data from previous phases.

7.2.4 Geosynthetic Reinforcement

If localized or global slope or base failure is observed, or if an acceptable FOS cannot be calculated based on supplemental geotechnical information obtained as part of the proposed or modified work activities discussed in Section 5.0, geosynthetic reinforcement can be incorporated into the silt management cell berms or within the mechanically offloaded dredged material at specified locations as it is being placed in order to increase tensile strength of the soil mass and achieve acceptable localized FOS. Based on preliminary slope stability analyses, a relatively strong reinforcement spaced every few lifts (horizontally) may be an option at specific locations or in conjunction with other stabilization improvements to provide additional tensile strength to the foundation soils and to further distribute loads as the dredged material is being sacked if needed for proposed future locations or if localized soft areas are evaluated during berm construction. This reinforcement installation can usually be completed by most general earthwork contractors, as directed by an engineer, and would not require a specialty contractor.

7.2.5 Isolated Shear Wall Auger Piles

If the foundation materials (i.e., previously placed dredged material below elevation ~580 feet) exhibit potential base failure or require structural reinforcement to achieve acceptable FOS, controlled modulus column augers can be used to construct isolated shear walls along the effected exterior portions of the SPMF. This construction technique would require a battery of shear walls consisting of aggregate or concrete columns that may require steel reinforcement (pending final design by a geotechnical engineer). The battery of shear walls is generally spaced at 7- to 9-foot centers perpendicular to the slope and may be up to 20 to 30 feet deep. Single augered piles can be installed in select locations to further provide support. The wall would provide support to the lower soils and areas above the wall. This option would require a specialty contractor to design and install the shear wall auger piles.

7.2.6 Retaining Wall

Stabilizing a berm, such as the sluiceway or silt management cell berms, can be achieved with the installation of a structural retaining wall. Based on the current site configuration and subsurface conditions, it is anticipated that the most cost effective and practical currently available commercial material options are wire facing geogrid reinforced (i.e., similar to current mechanical offloading platform wall), modular block or gabions, sheet pile, and Supernail® reinforced shotcrete walls. The sheet pile and modular block wall may require tie-back reinforcement, and would more than likely require a heavy earthwork contractor experienced in retaining wall installation. The Supernail® wall consists of a pattern of soil nails installed into the slope and beyond the critical failure surface - a reinforced shotcrete wall would then structurally tie into the soil nails to stabilize the slope/berm. The Supernail® wall would require a specialty contractor to design and install the soil nails and concrete wall, with the existing earthwork contractor needed for general grading and site access.

7.2.7 Deep Soil Mixing

If localized or global slope or base failure is observed, or if acceptable FOS cannot be calculated because shear strength of the subsurface soils will not likely be achieved during normal water control and operations, deep soil mixing can be considered to improve the characteristics of the subsurface soils to achieve acceptable FOS. This is achieved by mechanically mixing the soils, more than likely the previously placed dredged material below elevation ~580 feet, with cementitious binder slurry. This option could increase the bearing capacity, decrease settlement, and increase global stability. During deep soil mixing, a specialized drill advances a mixing tool as binder slurry is pumped through the connecting drill steel, mixing the soil to the target depth expected to be up to 30 feet bgs. This process can construct individual soilcrete columns, rows of overlapping columns, or 100% mass stabilization, as needed. Pre-production laboratory testing, including strength testing, would be performed to determine an appropriate mix design needed for stabilization and to verify that the prescribed mix design will meet the performance standards. Deep soil mixing would require a specialty contractor.

7.3 Surface Water Management and Passive Dewatering

Properly managing surface water to promote positive drainage and increase surface water runoff for the purpose of decreasing infiltration and minimizing increases in water content of the subsurface soils, is critical in maintaining stability of the SPFM. The CCCPA has expended significant resources to significantly improve surface water conditions at CDFs 9 and 12 since taking operational control. This has been accomplished through installing surface water swales, removing standing water as quickly as feasible, reducing the amount of large and permanent sedimentation basins, limiting hydraulic offloading to relatively small, contained and dewatered areas, installing dewatering trenches to lower the water table within the existing dredged material, performing maintenance on the outlet weir, and maintaining access roads to facilitate maintenance throughout the site. The CCCPA is dedicated to continuing these efforts to improve surface water management at the SPMF.

In addition, the CCCPA actively removes water as quickly as feasible from the sluiceways and settling ponds following hydraulically offloading activities. This is also necessary to facilitate harvesting activities of the dredged materials and to prepare the sluiceways and settling ponds for the next dredging event. Also, additional ditches may be constructed and directed towards an improved outlet located in the southeastern corner of CDF 12 (Outfall 002) to drain the southern half of the facility.

The CCCPA may implement more advanced passive and progressive dewatering efforts, such as the installation of wick drains, or larger dewatering caissons, within select areas of the SPFM that may benefit from accelerated drainage and consolidation times of subsurface materials (i.e., more than likely the previously placed dredged material below elevation ~580 feet) to address increases in pore water pressures and control undrained conditions that could result in base failure as previously discussed. Wick drains are installed to provide shortened drainage paths for pore water in soft compressible soil, such as dredged material. Wick drains, also known as Prefabricated Vertical Drains (PVD), consist of a prefabricated geotextile filter-wrapped plastic strips encasing molded channels. A pattern of drains is advanced to the design depth (~ 30 feet bgs) through a hollow mandrel mounted on an excavator. The wick drain would then be cut at the ground surface and connected to a drainage layer (typically a sand drainage blanket) that would outlet the collected water. Wick drains can be valuable tools as the silt management cells are being developed and the CDF 12 increases vertically, as they could accelerate subsurface drainage and reduce consolidation times from the additional surcharge loading, thus potentially increasing the strength of the subsurface soils and creating additional airspace capacity in the process. The staged loading analysis as previously discussed could accommodate the design and effectiveness of the wick drains. Implementation of an advanced passive and progressive dewatering system may require a specialty contractor.

7.4 Active and Aggressive Dewatering

Similar to the methodologies of the wick drains as discussed in the previous section, aggregate or caisson wet wells can be installed at design intervals throughout the facility to accelerate drainage and reduce consolidation times of the subsurface materials. Wet wells can be installed at select locations across the SPFM where active and aggressive dewatering is necessary for achieving stabilization goals and where significant additional capacity or accelerated phasing are desirable. Wet wells are typically constructed by the drilling of a large diameter borehole (2 to 3 feet diameter or greater) in which is installed a perforated vertical riser prior to backfilling the annular space with gravel and installing a submersible pump into the bottom of the pipe, so water can be withdrawn. The spacing and size of the wet wells and size of the pumps would be based on subsurface conditions and rate of consolidation required to achieve accelerated consolidation goals. Implementation of an aggressive dewatering system would require a specialty contractor/driller.

8.0 GEOTECHNICAL REVIEW FINDINGS AND RESULTS

8.1 Introduction

This Report was completed to provide a comprehensive summation and assessment of the CCCPA's existing and planned future operations on CDFs 9 and 12 for subsequent submission to and review by the USACE, to support consideration of a Section 408 approval for reconfiguration and reuse of the SPMF at the CDFs. Based on Hull's review of existing information, assessment of the planned and future operations, and the results of supplemental geotechnical evaluations and stability analyses, this Report demonstrates that the structural integrity and stability of the Federal government's originally designed containment dike will be maintained, and that the CCCPA's actions will not result in global failure of the structure. The 2018 SPMF slope stability analysis (Appendix F), which were used to develop the 2018 CDF Improvement/Reconfiguration Plans (Appendix E), demonstrated acceptable FOSs when considering moderate dewatering of newly placed dredged materials.

The primary existing and planned future activities that were considered during this evaluation include, hydraulic processing and sorting of dredged material, operation of material handling equipment from elevated mechanical offloading pads, construction of tiered elevated silt management cells, the potential of accommodation of stabilized Legacy sediments within a specified area in the southwest quadrant of CDF 12, and future storing/staging of material on top of stabilized historic dredged material, and a designed and constructed process area pad. Although Hull initially focused analyses on the more critical areas (development, operations, etc.), several scenarios for other representative areas were considered to further demonstrate stability and to address previous or potential concerns/scenarios that may have been identified. Results and findings from all the evaluated scenarios demonstrate that operation of the SPMF and planned management operations will not impact the structural integrity of the Federally constructed CDFs 9 and 12.

The CCCPA's currently anticipated and planned operations for the SPMF at CDFs 9 and 12 present a sustainable sediment management solution for the Cleveland Harbor dredged material that is practical, protective of human health and the environment, without negatively affecting the structural integrity or stability of the formally operated and maintained Federal structures (CDFs 9 and 12). The CCCPA's plan provides direction for implementation, a program for monitoring and verifying effectiveness, and reflect an adaptive management plan approach that other ports along Lake Erie can potentially use as a model to meet their specific needs long-term if they consider similar CDF modifications. Additional information related to the CCCPA's development of the long-term dredged material management strategy is included in Appendix I.

8.2 Supplemental Geotechnical Exploration Activities

A supplemental geotechnical exploration was performed to 1) assess geotechnical parameters to the limited depths of each test location; 2) collect additional subsurface information within the existing soil stratums to support development of a more detailed phasing and staging analysis for the CDF 12; 3) assist in demonstrating that the approach aligns with (or identifies modifications to meet) current design assumptions and can meet or exceed original performance expectations/models; 4) provide more details to support the proposed operations and vertical design for the SPMF; and 5) provide an expanded database for the more critical parameter assumptions used, and the most critical areas identified. The supplemental geotechnical exploration consisted of performing Cone Penetration Testing (CPT), completion of standard geotechnical test borings, and laboratory testing of collected samples at two critical locations within CDF 12 (near the mechanical offloading platform, and near the "S-curve area" within the southeast corner).

The results of the CPT are presented in a memorandum (Hull document #CCP021.600.0012) dated November 21, 2018, which is provided in Appendix J. In addition, standard geotechnical test borings were also performed that consisted of Standard Penetration Test (SPT) (ASTM D1586), downhole vane shear testing, collection of split-spoon and Shelby tube samples, and laboratory classification and strength testing of collected samples. Results of the geotechnical borings are provided in the Supplemental Subsurface Exploration and Geotechnical Engineering Report (Hull document #CCP021.600.0014) dated March 22, 2019, which is provided in Appendix K. In summary, the supplemental geotechnical exploration generally observed anticipated conditions when compared to previously completed explorations and historic data obtained by the USACE, with one significant exception (existence of muck layer). Both CPT and soil boring exploration locations observed alternating layers of silt, clay and sand mixtures within the upper 50 to 60 feet below existing ground surface representing the existing dredged material. Underlying the dredged material is the glacial lake clay deposits. The soft lacustrine upper "muck" layer that was previously observed directly below the dredged material could not be accurately demarcated with a high level of confidence based on the cone penetration resistance, SPTs, and/or undrained shear strength data. Although there does appear to be a slight reduction in the shear strength within the anticipated elevation of the originally observed muck layer, it was anticipated that the shear strength profile would indicate significantly lower shear strengths within the muck zone. Similarly, results of the supplemental geotechnical exploration indicated actual strength parameters slightly greater than those assumed in the 2018 SPMF slope stability analysis for the existing dredged material and underlying lacustrine material, as discussed in further detail in the following section.

8.3 Evaluation of 2018 SPMF Slope Stability Analysis Assumptions

The supplemental geotechnical exploration was performed primarily to verify the strength parameters of the existing dredged material and underlying lakebed material used in the 2018 SPMF slope stability analysis, as the strength parameters for these layers have the most significant impact on the overall stability of the proposed CDF expansion. The input parameters used in the 2018 SPMF slope stability analysis for these layers and a detailed comparison and evaluation for each material, as well as relevant comments provided by the third-party peer reviewer (Vik Gautam, P.E. with AECOM) are provided below:

8.3.1 Lakebed Material

The underlying lakebed material was modeled as three separate units (muck layer, upper glacial lake layer, and lower glacial lake layer):

<u>*Muck Layer*</u>

In early analyses, and based on USACE reported observations, the Muck Layer was assumed to occur between 535' to 545' MSL (IGLD, 1985). Conservative strength parameter values of 100 psf for cohesion and 0 degrees for friction angle were assumed for undrained conditions and strength parameter values of 0 psf for cohesion and 28 degrees for friction angle were assumed drained conditions.

Based on the results of the supplemental geotechnical exploration, it did not appear that there is a well-defined muck layer observed in the supplemental geotechnical test borings or CPT explorations, which suggests the muck layer may have compressed/consolidated and/or the overlying dredged material or underlying lakebed material may have infiltrated the muck layer. A consolidated undrained (CU) triaxial test (ASTM D4767) performed on a lakebed sample (boring B18-02B, sample SH-7/SH-8 at 52.8' to 55.9' BGS) collected directly beneath the existing dredged material indicated effective shear strength parameters of 14.2 degrees for friction angle and 272.2 psf for cohesion for the apparent muck layer. N-values of the lakebed material directly underlying the existing dredged material were generally in the 2 to 4 range, indicating undrained shear strength in the 250 psf to 500 psf range. Finally, a vane shear test was performed in boring B18-02A at 51' BGS, directly below the apparent existing dredged material, indicating a shear strength of 572 psf for the apparent muck layer zone.

Based on the lab testing results and observations from the supplemental geotechnical subsurface exploration, it is apparent that the undrained strength parameters used for the muck layer in the 2018 SPMF slope stability analysis were conservative and additional analyses do not need to be completed to support the proposed design. A more representative undrained cohesion value for this layer would be 300 psf, however, using 100 psf is a conservative approach. This conservative approach was further confirmed by the third-party reviewer, who concurred that "assigning the undrained properties of the muck layer as low as they are currently assumed" is a conservative approach. The drained strength parameter values assumed in the 2018 SPMF slope stability analysis are likely still appropriate. Further, the assumed thickness (ten feet) of the muck layer was much larger than what was encountered in the supplemental geotechnical exploration. The supplemental geotechnical exploration indicated that the muck layer is likely less than 5 feet in thickness.

Upper Glacial Lake Layer

The Upper Glacial Lake Layer extends for approximately 480' to 535' MSL. The Shansep normalized strength relationship method was used to model the undrained shear strength of the upper glacial lakebed layer in the 2018 SPMF slope stability analysis. A minimum undrained shear value of 500 psf, an over-consolidation ratio (OCR) of 1.0, and a normally consolidated ratio of 0.2 were assumed for this layer. In addition, drained strength parameters of 0 psf for cohesion and 30 degrees for friction angle were assumed for this layer.

N-values of the upper glacial lake layer material were generally in the 4 to 10 range, indicating shear strength in the 500 psf to 1,000 psf range. Finally, downhole vane shear tests performed in boring B18-02A at 65' and 75' BGS, directly below the apparent muck layer, indicated the shear strength values were 104 psf and 624 psf, respectively, for the upper glacial lake layer. The 65' BGS test value (104 psf) appears to have been performed in an abnormally localized soft zone (based on N-values encountered at this depth) and does not represent the entire upper glacial lake layer.

Based on these results, it appears that the undrained strength parameters used for the upper glacial lake layer in the 2018 SPMF slope stability analysis were slightly conservative. A more appropriate undrained shear strength value for this layer would be 600 psf. The remaining undrained strength parameter values and the drained strength parameter values assumed in the 2018 SPMF slope stability analysis are likely still appropriate.

Lower Glacial Lake Layer

The Lower Glacial Lake Layer extends from approximately 400' to 480' MSL. Conservative strength parameter values of 1,200 psf for cohesion and 0 degrees for friction angle were assumed for undrained conditions in the 2018 SPMF SSA. Strength parameter values of 0 psf for cohesion and 32 degrees for friction angle were assumed drained conditions.

Based on Hull's experience, the undrained shear strength for Northeast Ohio lacustrine clays are typically in the 1,500 to 2,000 psf range, and typically increase with depth. The third-party reviewer concurred that "Undrained strength of lower glacial deposits (1200 psf constant undrained shear strength) seems very conservative." The third-party reviewer also concurred that their "experience with NE Ohio lacustrine clays suggests that the strength would be higher in the 1,500-2,000 psf range" and would recommend "accounting for some strength increase with depth." This is corroborated by the results of the CPT explorations, which indicated significant strength increases of the glacial lake layer with depth, with shear strength values of ~1,500 psf for the lower glacial lake layer.

It should also be noted that several of the potential critical failures that have been calculated at several cross-sections are deep-seated failure surfaces passing into the lower glacial deposit, which have been assigned total strength properties. While it is understood that we have performed an undrained analysis, in our opinion it is very unlikely that large excess pore pressures will be generated from surface loadings in materials that are this deep. FOS for these models are being almost entirely controlled by the strength assumption in this lower glacial material. The third-party reviewer concurred that the "use of effective strength parameters would be more appropriate" and the current approach is a "conservative analysis". In addition, the calculated critical slip surfaces for undrained analysis in most cases, especially for Section A thru D, extend beyond the CDF dikes (i.e., 200 feet beyond in some cases). As previously discussed, surcharge stresses from the proposed expansion are likely to be very small at these modeled failure locations. In summary, it is our opinion that the assumed values and the calculated model surfaces are very conservative and therefore, supports the CCCPA's opinion that the proposed project is unlikely to affect the USACE Dike.

8.3.2 Existing Dredged Material

The existing dredged material was modeled as two separate units:

Material Above Low Water Datum (LWD) 569.2' as per IGLD 1985

Conservative initial strength parameter values of 1,000 psf for cohesion and 10 degrees for a friction angle were assumed for undrained conditions of cohesive material. Non-cohesive materials were assumed to have an initial internal friction angle value of 30 degrees. Strength parameter values of 0 psf for cohesion and 32 degrees for friction angle were assumed drained conditions. To account for increase in strengths over time through consolidation activities due to increase of overburden pressures and dewatering, these strength parameters were increased incrementally to model construction and filling of each subsequent expansion phase.

Two CU triaxial tests were performed on relatively cohesive samples (i.e., clayey silt with sand) collected from this layer (boring B18-01B, sample SH-1/SH-2 at 15.4' to 17.8' BGS and boring B18-02B, sample SH-1/SH-2 at 8.9' to 11.9' BGS). The B18-01B, SH-1/SH-2 sample indicated effective shear strength parameters of 10.3 degrees for friction angle and 961.9 psf for cohesion, which are in line with the initial values used for cohesive material in the 2018 SPMF slope stability analysis. The B18-02B, SH-1/SH-2 sample indicated effective shear strength parameters of 16.3 degrees for friction angle and 285.1 psf for cohesion. Note this sample comprised of an approximately 31.5% combination of sand and gravel, which likely reduced the cohesiveness of the sample. N-values of the dredged material above LWD ranged from 2 to 20 with a median value of 8.

Based on the results of the supplemental geotechnical exploration, the values and assumptions used in the 2018 SPMF slope stability analysis for the dredged material above LWD appear to be appropriate.

Material Below LWD

Cohesion values between 229 and 440 psf and an internal friction angle of 0 degrees were used in the undrained analyses for all the cohesive dredged material below LWD. A cohesion value of 0 psf and internal friction angle values ranging from 28 to 31 degrees were used in the drained analyses for all the cohesive dredged material below LWD. Non-cohesive materials were assumed to have an internal friction angle value of 30 degrees.

Three CU triaxial tests were performed on relatively cohesive samples (i.e., silty sand/elastic silt) collected from this layer. Boring B18-01B, sample SH-3/SH-4 at 41.4' to 43.9' BGS indicated effective shear strength parameters of 17.6 degrees for friction angle and 335.5 psf for cohesion. Boring B18-02B, sample SH-4 at 26.9' to 27.9' BGS indicated effective shear strength parameters of 24.1 degrees for friction angle and 0 psf for cohesion. Boring B18-02B, sample SH-5 at 40.8' to 41.4' BGS indicated effective shear strength parameters of 32.6 degrees for friction angle and 0 psf for cohesion, and total shear strength parameters of 16.5 degrees for friction angle and 147.3 psf for cohesion. N-values of the dredged material above LWD ranged from 0 to 18 with a median value of 4.

Averaging the CU triaxial effective strength testing results would provide approximate drained parameters of 24.8 degrees for friction angle and 111.8 psf for cohesion for the dredged material below LWD, which is comparable to the drained parameters assumed in the 2018 SPMF slope stability analysis (i.e., cohesion value of 0 psf and internal friction angle values ranging from 28 to 31 degrees) for this material. The total strength parameters provided by boring B18-02B, sample SH-5 of 16.5 degrees for friction angle and 147.3 psf for cohesion provide approximate undrained parameters for the material, which provides similar overall strength to the undrained parameters assumed in the 2018 SPMF slope stability analysis (i.e., cohesion values between 229 and 440 psf and internal friction angle value of 0 degrees) for this material. Therefore, based on the results of the supplemental geotechnical exploration, the values and assumptions used in the 2018 SPMF slope stability analysis for the dredged material below LWD appear to be appropriate.

Table 1 provides a summary comparison of the strength parameters used in the 2018 SPMF slope stability analysis and the supplemental geotechnical exploration suggested strength parameters for the most critical material layers, as explained in the previous sections.

GEOTECHNICAL ENGINEERING AND MONITORING REPORT

TABLE 2

COMPARISON OF MATERIAL PROPERTIES USED FOR THE 2018 SPMF SLOPE STABILITY ANALYSIS VS. SUPPLEMENTAL GEOTECHNICAL EXPLORATION SUGGESTED STRENGTH PARAMETER VALUES

Material Type	Scenario	2018 SSA Initial Strength Parameters		Supplemental Geotechnical Exploration Suggested Strength Parameters	
		Coh. (psf)	Phi (deg)	Coh. (psf)	Phi (deg)
Exist. Cohesionless Dredge Above LWD	Drained	0	30	0	30
	Undrained	0	30	0	30
Exist. Cohesive Dredge Above LWD	Drained	1,000	10	285.1-961.9	10.3-16.3
	Undrained	1,000	10	285.1-961.9	10.3-16.3
Exist. Cohesionless Dredge Below LWD	Drained	0	30	0	30
	Undrained	0	30	0	30
Exist. Cohesive Dredge Below LWD[1]	Drained	0	28-31	111.8	24.8
	Undrained	229-440	0	147.3	16.5
Muck	Drained	0	28	0	28
	Undrained	100	0	300	0
Upper Glacial	Drained	0	30	0	30
	Undrained	–	–	600	–
Lower Glacial	Drained	0	32	0	32
	Undrained	1,200	0	1,500	0

Coh. = Cohesion Phi = Friction Angle

1. The values listed vary from each cross-section based on description and/or consistency of material encountered, and/or testing results (where appropriate) at the specific locations.
2. The Shansep normalized strength relationship method was used to model the undrained shear strength of the upper glacial lakebed layer. A minimum undrained shear value of 500 psf, an OCR of 1.0, and a normally consolidated ratio of 0.2 were assumed in the 2018 SPMF slope stability analysis for this layer. Results of the supplemental geotechnical exploration indicated a minimum shear value of 600 psf (instead of 500 psf) for this layer would be appropriate.

As stated previously, the strength parameters of the existing dredged material and underlying lakebed material have the most significant impact on the overall stability of the proposed CDF expansion. As shown in Table 1 (and as discussed in previous sections), results from the supplemental geotechnical exploration indicate that the actual strengths of the muck layer, the upper glacial layer, and the lower glacial layer are likely greater than the assumed strength parameters used in the 2018 SPMF slope stability analysis. Results from the supplemental geotechnical exploration indicate the actual strengths of the existing dredged material (above and below LWD) are likely similar in overall strength to the parameters used in the 2018 SPMF slope stability analysis.

8.3.3 Summary of Findings

As discussed in the previous sections (section 8.3.1 and 8.3.2), while several assumptions used in the 2018 SPMF slope stability analysis are conservative, but all are appropriate. The assumed strength parameters for analysis of the most critical materials and sections are likely conservative (low), as compared to the findings of the supplemental geotechnical exploration. Furthermore, it should be noted that the Simplified Bishop's Method has been used in the analyses. Based on experience, the use of Spencer's Method is more routine in USACE projects, however, while Spencer's Method may be more robust it often results in somewhat higher FOS than Bishop's Method.

The findings from the supplemental geotechnical exploration verified that the assumptions and strength parameters used in the 2018 SPMF slope stability analysis are conservative. Because the 2018 SPMF slope stability analysis indicate that CDF 12 can support (i.e., achieve FOS of 1.3 or greater for undrained static conditions, 1.5 or greater for drained static conditions, and 1.0 or greater for seismic conditions) the proposed improvement activities (which include an increase of elevation to approximately 611' MSL, when the dredged material is mechanically unloaded and placed in a phased and systematic approach) even with these conservative assumptions, then there is no need to revise analyses/models performed. The analyses performed as part of the 2018 SPMF slope stability analysis can be considered conservatively appropriate for the existing CDF conditions and proposed improvement activities.

8.4 Adaptive Management Approach

As discussed in the Input Parameters section of the 2018 SPMF slope stability analysis, strength parameters for future dredged material were assumed based on anticipated material placement and management techniques. Additionally, strength parameters of dredged material above LWD were assumed to increase incrementally to account for dewatering of the material as well as consolidation as a result of the overburden pressure applied as subsequent layers are added above this material. However, as a conservative approach, previously placed dredged material below LWD and the underlying lakebed material were not assumed to increase in strength. It is recommended that continuous periodic geotechnical evaluations and/or explorations be performed to continue validation of the assumptions made in the 2018 SPMF slope stability analysis and to continue evaluation of the effectiveness of the constructed improvements, and stabilization and/or dewatering methods being implemented at the CDF. Results from these evaluations/explorations should be reviewed by Hull (or another geotechnical engineer) to further verify the stability of the proposed improvement activities. If results from these evaluations/explorations indicate the assumed material strength increases are not being realized as assumed, it may be appropriate to revise the 2018 SPMF slope stability analysis using the generally higher field determined strength parameters of existing materials in accordance with the findings of this report (as explained in sections 8.3.1 and 8.3.2), while incorporating findings of the evaluations/explorations. If deemed necessary, aggressive dewatering, consolidation and/or stabilization activities can be implemented based on the results of the on-going monitoring/evaluations and revised SSA in order to maintain stability of the facility. If results from these evaluations/explorations indicate the assumed material strength increases were met, or surpassed, the CCCPA may explore potential storage capacity increases by modifying silt management cell berm locations within future phasing plans that were initially developed in the 2018 CDF Improvements/Reconfiguration, as desired and based on results of a cost-benefit analysis.

8.5 Conclusion

Through the use of improved water and material management activities, which are currently being implemented at the CDF by the CCCPA and their Site Operator, and based on the conservative stability analysis, the planned improvements, material offloading and placement activities, and recovery and harvesting of material for beneficial reuse at the SMPF, pose no impacts to the structural or geotechnical integrity on the previously constructed federal structure (CDF). Similarly, this comprehensive summation and assessment of the CCCPA's existing and planned future operations on CDFs 9 and 12 has not identified any concerns or indications of potential impacts to the environment or safety.

The original basis of design used a conservative approach for identifying any potential concerns, and subsequent evaluation approaches confirmed those assumptions (as demonstrated by the further field and laboratory characterization of critical components as compared to early design assumptions). This modeling approach will also serve as a good template for evaluating on-going geotechnical or structural concerns with the planned activities at the SPMF. Furthermore, this approach would be appropriate for a basis to the development and implementation of management, operation and monitoring activities at CDF 10B and the subsequent 408 review process for that federal structure.

9.0 REFERENCES

A variety of existing studies, technical manuals, administrative documents, and publications were referred to in preparing this document. Some of the references consulted are presented below. Referenced documents and publications may or may not have been reviewed in their entirety. The guidelines and procedures presented in the documents and publications referenced have not been strictly adhered to unless stated otherwise.

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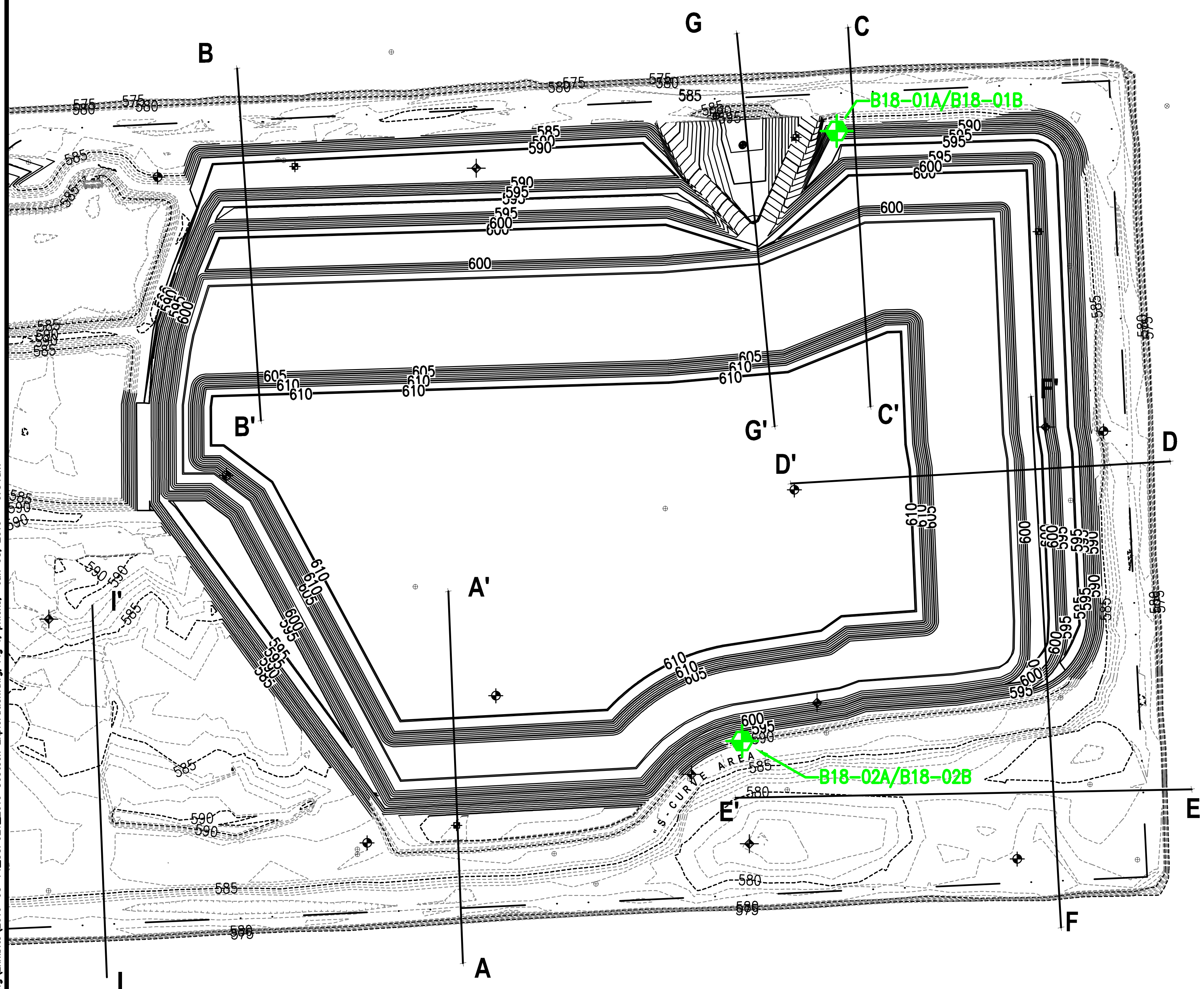
Hull. 2017. BKL Exhibits. December 2017.

PLATE



N

0 100 200
SCALE IN FEET

LEGEND

585 — EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

610 — SPMF MAJOR CONTOUR

SPMF MINOR CONTOUR

APPROXIMATE 2019 GEOTECHNICAL EXPLORATION AND PIEZOMETER LOCATION

APPROXIMATE LOCATION OF EXISTING PERIMETER DIKE

A — A' APPROXIMATE CROSS-SECTION LOCATION

B12-12-1 SOIL BORINGS COMPLETED BY HULL (APRIL/MAY 2012)

D11-12-1 SOIL BORINGS COMPLETED BY DLZ (OCTOBER/NOVEMBER 2011)

CL12D11-6 SOIL BORINGS COMPLETED BY DLZ (MARCH 2011)

BH-14 SOIL BORINGS COMPLETED BY HULL (DECEMBER 2016)

CD9DU09-19 BORING LEGEND:
- BORING NUMBER
- YEAR BORING DRILLED
- UNDISTURBED SAMPLES
- DRIVE SAMPLING
- CONFINED DISPOSAL FACILITY
- BORING SYMBOL

CD9TP09-6 TEST PIT

CDF2-U-72-24 ORIGINAL DIKE 2 (CDF9) PRECONSTRUCTION BORING DRILLED IN 1972

CDF2-V6-68-918 ORIGINAL DIKE 2 (CDF12) PRECONSTRUCTION BORING DRILLED IN 1968

NOTES:

1. THE TOPOGRAPHIC SURVEY SHOWN WAS PROVIDED BY TGC ENGINEERING, LLC IN AUGUST 2017.
2. THE SURVEY DATUM IS IN NAD 1983 OHIO NORTH ZONE FEET AND IGLD 1985 ELEVATIONS.
3. EXISTING SITE CONDITIONS MAY VARY FROM CONDITIONS AND GRADES SHOWN ON THESE PLANS DUE TO RECENT SITE OPERATOR'S ACTIVITIES.

PORT CLEVELAND

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FIGURE 1
2019 SUPPLEMENTAL GEOTECHNICAL EXPLORATION LOCATIONS

THE PORT OF CLEVELAND'S CONFINED DISPOSAL FACILITIES 12 & 9 SEDIMENT PROCESSING & MANAGEMENT FACILITY
CLEVELAND, CUYAHOGA COUNTY, OHIO

LAYOUT BY: SAH
CHECKED BY: PAH
DRAWN BY: SAH
DATE: 5/31/2019
PROJECT NO. CCP021
PLATE NO. 1