III. QUALITY ASSURANCE/QUALITY CONTROL

A. General

The purpose of this plan is to establish standards that must be followed by the registered professional engineer or geologist in order to insure that the construction of the facility meets the specification given in the design documents. The professional engineer or geologist shall use sound judgment when determining what additional procedures may be required in order to further assure the construction quality.

The Quality Assurance/Quality Control shall be performed by personnel that are knowledgeable and proficient in material placement, sampling, testing and reporting.

Detailed in this plan are the minimum standards for soil selection, minimum testing programs, minimum construction standards, and the minimum documentation required to assure that the requirements of the plans and specifications are met.

Throughout this document, the word "clay" is used to mean material of low permeability. This may include soil classified as clay or mixtures of soil with additives as required to meet the specifications.

B. Cap Requirements

The soil in the lower 12" layer of the final cap for the dredge cell area will meet the following requirements:

- A saturated, vertically oriented hydraulic conductivity no greater than 1×10^{-7} cm/sec (Cover Option 1) or 1×10^{-6} cm/sec (Cover Option 2) after compaction within the density and moisture content range specified for construction as determined through laboratory testing.

- A classification of CH or CL as determined by the Unified Soil Classification System, ASTM standard D-24887-69.

- Any alternative soil proposed will include documentation proving that the soil can be compacted to achieve the hydraulic conductivity and engineering properties of the soil specified above.

Clay Source Verification: The clay source will be tested and verified by a registered professional engineer or geologist as meeting the standards specified. Random samples of the source material will be obtained every 3,000 cubic yards and whenever the texture, color, or location of the source of the soil changes significantly. Samples will be tested for the following such that a correlation to permeability may be made:

1. Moisture-density relationship of the soil by the Standard Proctor Test, (ASTM D698);

2. Grain size analysis (ASTM D422);

3. Atterberg Limits (ASTM D4318).

Cap Construction: The cap will be constructed as outlined below:

1. Lift thickness of no more than 8 inches, loose lift (prior to compaction).

2. Each lift is thoroughly and uniformly compacted to that density and within that moisture content range determined necessary to achieve a hydraulic conductivity less than 1×10^{-7} cm/sec (Cover Option 1) or 1×10^{-6} cm/sec (Cover Option 2).

3. Generally, soil will not be compacted at moisture contents less than optimum, nor less than 95% of the maximum dry density, as determined by the Standard Proctor Test, ASTM D698; unless based on testing, that compaction criteria greater than 85% saturation consistently achieves the performance for hydraulic conductivity

4. The cap will be continuous and completely keyed together at all construction joints. Where required, the previous lift or area of construction shall be scarified to facilitate bonding between lifts.

5. During construction, the clay will be protected from detrimental climatic effects by:

   - Protecting construction from extraneous surface water, sloped to facilitate drainage;

   - Removing all ice and snow prior to placing a lift,

and not using frozen soil in any part of cap;

- Recompacting any soil that has been subjected to a freeze and thaw cycle.

- Insuring that the cap is not subject to desiccation cracking by sprinkling the soil with water not less than twice per day, covering or tarping the soil, or other preventative measures;

- Removing soil which has experienced desiccation cracking before compacting the next lift or installing the next cap system component.

- By removing excessively wet soil or areas determined to be not acceptable by the registered professional engineer or geologist.

6. If the construction has areas determined to be not acceptable by the registered professional engineer or geologist, remedial actions shall be taken. As a minimum, additional tests may be required to locate the extent of the unacceptable area. It shall be remedied based on the engineer's or geologist's sound judgment. Actions may include recompaction or removal and replacement of unsatisfactory material with new material, compaction and retesting.

Documentation of these procedures shall be provided by the engineer or geologist.

Clay Construction Certification: A registered professional engineer or geologist will verify that a compacted cap is constructed in accordance with these criteria by performing all of the following quality control tests.

1. Field density-moisture measurements of the cap immediately after compaction, as specified by ASTM D2922 (nuclear methods), for each 3000 cubic yards placed, with a minimum of 1 test per day of construction of lift of soil. The location of the soil samples will be rotated with each lift to maximize the coverage of the tests. Field in-place density/moisture content tests will be conducted using a nuclear density gauge, sand cone or drive cylinder. If nuclear density methods are used sufficient numbers of the sand cone or drive cylinder tests will be performed to correlate and verify the nuclear gauge results. The moisture content of the fill materials will be kept within a range which allows the earthwork contractor to achieve the required

density and permeability. When, in the opinion of the certifying Engineer or Geologist the moisture content of the fill material is too high or too low, the material will be alternately dried or moistened to facilitate compaction to the specified density.

2. The undisturbed hydraulic conductivity of a soil sample will be conducted at a minimum once per 5 acres of the cap, by ASTM D5084. Permeability samples will be obtained by extracting a Shelby tube sample from the in-place compacted material and returning this sample to the laboratory for testing. The hole left by the Shelby tube will be carefully backfilled with bentonite mixture, hand tamped and compacted into place.

3. Upon completion of the clay construction, a minimum of one hand auger hole per acre will be made to confirm the final thickness of the soil layer. All auger holes will be backfilled as discussed above in section 2.

4. Provide documentation of the quality control measures performed with field notes and certifications.

5. The soil to be utilized for establishing the vegetative cover shall be capable of sustaining a healthy stand of vegetation, and shall consist of an ML, CL, SM, SC material as determined by ASTM D-2487-93. Material should contain less than 30% by weight of the fragment retained on a 3/4-inch sieve per ASTM D422-63. Once this soil has been applied and placed the area shall be seeded as soon as practical in order to minimize soil erosion. The soil for vegetation shall not be compacted such that vegetative growth is hindered. The top surface of the soil for vegetation may need to be roughened to create a favorable environment for vegetation to grow in. The seeding and fertilization schedule can be found in Appendix A of this manual.

The TVA specifications shown in Appendix A shall be modified to change the following: (1) reference to topsoil to read soil suitable for vegetative growth, (2) Section 580.3 shall be modified to provide 12" of soil suitable for vegetative growth to match the cap section detail shown on the plans (3) Section 580.4 - seed beds to be roughened or scarified shall be done in such a manner that will not damage the portion of the cap that consists of the 12" of soil with a maximum hydraulic conductivity of 1×10^{-7} cm/sec.

C. Documentation

1. Daily Logs

a. The personnel performing Quality Assurance/Quality

Control shall prepare a daily log giving the detailed descriptions of the cap construction operations.

b. The daily log shall include but not be limited to: Construction operations and their locations, operations and locations of other QA/QC engineers or geologists, all tests performed and their designation and location, all the locations and designations of samples taken, locations and findings of core sampling, meteorological conditions, and general comments and observations.

c. A copy of the daily logs shall be kept on site and made available to TVA, the QA/QC personnel, and the construction contractor.

d. All field and laboratory test data shall be accompanied by test/sampling data, location, reasons for the location, personnel and any comments.

2. <u>Approval Documentation</u>

a. All corrective measures taken to bring unsuitable work into conformance with the design specifications must be documented. This document must describe what is at fault and the exact location and test designation(s) that shows the work to be unsuitable, the corrective measures agreed upon to bring it into conformance with design specifications, the dates that corrective work was accepted, and the test designation that shows the work to be acceptable. All work shall be documented as to quality and verified by the engineer or geologist.

b. The documentation will be organized and indexed to enable easy access and retrieval of original inspection and testing data sheets and reports. During the construction period, originals of the documents will be maintained by the engineer or geologist and copies will be kept by the TVA. Once the construction quality assurance has been certified by a registered engineer or geologist and has been accepted by the Owner, originals of the documentation will be maintained by TVA through the closure and post closure period of the site.