On-Site Waste Disposal Facility (OSWDF)
CONSTRUCTION QUALITY ASSURANCE (CQA)
PROJECT PLAN

FINAL DESIGN

Portsmouth Gaseous Diffusion Plant
Decontamination & Decommissioning Project
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0442&D4

November 2021

This document is approved for public release per review by:

See PMA SS IS FOR 2130 Rev. 2 Sam Eldridge 11-30-2021

Classification & Information Officer — Date

See PMA SS IS FOR 2130 Rev. 2 Sam Eldridge 11-30-2021

Export Control — Date

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Under Contract to
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Revision Summary

Revision Number	Revision Date	Description of Changes	Affected/ Changed Pages
A	12/14/12	Initial submittal for FBP Review	All
B	2/28/13	Intermediate Revision D0 for DOE review	All
C	5/20/13	Intermediate Revision D1 for Ohio EPA review	All
D	4/30/15	Pre-Final Revision D1 for FBP review	All
E	6/12/15	Pre-Final Revision D2 for DOE review	All
F	8/27/15	Pre-Final Revision D2 for DOE review	All
G	10/14/15	Pre-Final Revision D2 for DOE review	All
H	11/16/16	Pre-Final Revision D2 for Ohio EPA review	All
I	1/25/18	Final Revision D3 for Ohio EPA review	All
J	4/3/18	Final Revision D3 for Ohio EPA review	All
K	4/4/18	Final Revision D3 for Ohio EPA review	All
L	11/20/19	Incorporated TPPFR Addendum APZ, pipe embedment and organizational clarifications	All

M	11/17/21	Changed job title of design engineering manager to design process manager. Reflected the change on org chart. Updated Section 3.2 photographic documentation requirements. Sections 10.4, 11.3.2, and 11.3.3 changed installation and storage requirements to manufacturing instructions.	i,9,10,20,23,89,91

CONTENTS

FIGURES

TABLES

ACRONYMS

ACI	American Concrete Institute
APZ	acceptable permeability zone
ARAR	applicable or relevant and appropriate requirement
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CQA	Construction Quality Assurance
CQC	Construction Quality Control
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOT	Department of Transportation
ECR	engineering change request
ES&H	environmental, safety, and health
FCN	Field Change Notice
GAI	Geosynthetic Accreditation Institute
GCI-ICP	Geosynthetic Certification Institute – Inspectors Certification Program
GCL	geosynthetic clay liner
HDPE	high density polyethylene
ILTS	Interim Leachate Treatment System
IMPP	Impacted Material Placement Plan
IMTA	Impacted Material Transfer Area
LCS	leachate collection system
LDS	leak detection system
LTS	leachate transmission system
NCR	Nonconformance Reports
OAC	*Ohio Administrative Code*
Ohio EPA	Ohio Environmental Protection Agency
OSWDF	On-Site Waste Disposal Facility
PLTS	Permanent Leachate Treatment System
PORTS	Portsmouth Gaseous Diffusion Plant
PQAP	Project Quality Assurance Plan
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SDR	standard dimension ratio
TPPFR	Clay Liner/Cap Test Pad Program Final Report
WAC	Waste Acceptance Criteria
WAO	Waste Acceptance Organization

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1. INTRODUCTION

1.1 OVERVIEW

In April 2010, the U.S. Department of Energy (DOE) and the Ohio Environmental Protection Agency (Ohio EPA) entered into *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (Ohio EPA 2012), termed the DFF&O. This agreement sets the stage for how the decontamination and decommissioning (D&D) and waste disposition decisions for the DOE Portsmouth Gaseous Diffusion Plant (PORTS) will proceed. The agreement adopts the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended 42 United States Code 9601 et. seq. as the regulatory framework under which decisions for D&D and Waste Disposition will take place.

The *Record of Decision for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (Waste Disposition ROD) (DOE 2015b) selected Alternative 2, on-site disposal with an off-site component, as the remedy for disposition of waste generated under the *Record of Decision for the Process Buildings and Complex Facilities D&D Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio* (Process Buildings D&D ROD) (DOE 2015c). The on-site disposal component of the remedy entails construction of the On-Site Waste Disposal Facility (OSWDF) in the northeast corner of PORTS.

This Construction Quality Assurance (CQA) Project Plan has been prepared based on the plans, specifications, calculations, and other supporting documents in support of the construction and operation of the on-site disposal remedy, as required by the DFF&O. This OSWDF CQA Project Plan specifies the necessary processes to ensure that the OSWDF meets or exceeds all design criteria and specifications that were developed in accordance with the OSWDF Design and the applicable or relevant and appropriate requirements (ARARs) contained in the Waste Disposition ROD. This CQA Project Plan describes the Construction Quality Control (CQC) monitoring, testing, and verification/compliance requirements for the OSWDF construction and requirements for the CQC support during the OSWDF construction, Infrastructure construction, and impacted material placement at the DOE PORTS D&D Project, Piketon, Ohio.

The OSWDF Design Package, which includes this document, has been prepared in accordance with the *Comprehensive OSWDF Waste Disposal Remedial Design/Remedial Action Work Plan* (DOE 2016a). ARARs specifically applicable to the CQA Project Plan are included in Appendix A.

1.2 PURPOSE AND SCOPE

The purpose of the OSWDF CQA Project Plan is to specify the necessary process to ensure the OSWDF meets or exceeds all design criteria and specifications and to establish requirements for the:

- CQC support during the OSWDF construction, Infrastructure construction, and impacted material placement. This includes CQC Contractor and project quality assurance roles and responsibilities and qualification requirements for field staff and on-site and off-site testing laboratories.

- Documentation and record keeping during the OSWDF construction, Infrastructure construction, and impacted material placement.

- CQC monitoring, testing, and verification/compliance based on the OSWDF construction documents.

1.3 DETAIL DESCRIPTION OF THE OSWDF PROJECT

The OSWDF project includes:

- OSWDF construction including OSWDF components;
- Infrastructure construction including the OSWDF Support Facilities and Utilities; and
- Impacted material placement.

Detailed descriptions of the OSWDF project are as follows:

1.3.1 OSWDF Construction

The major components of the OSWDF Construction include:

A. *Earthwork* (including trenching and backfilling):
This includes subgrade preparation for the OSWDF liner and final cover systems; trenching and backfilling for the valve houses, lift stations, monitoring manholes, and leachate transmission system (LTS) – North and South; and earthwork for the adjacent surface water channels, ditches, and culverts.

B. *Liner and Final Cover (Cap) Systems:*
The liner and final cover (cap) systems are constructed using both soil and geosynthetic components (refer to Figure 1-1). The liner system consists of a clay liner, double-composite liner that will have a leachate collection system (LCS) above the primary liner and a leak detection system (LDS) between the primary and secondary liners. The final cover (cap) system includes a composite cap overlain by the following layers: drainage layer; biointrusion barrier; granular filter layer; vegetative soil layer; and topsoil.

C. *Leachate Management System:*
The leachate management system collects leachate generated by the OSWDF and conveys it to a treatment facility. Components of the leachate management system within the OSWDF monitoring corridor include: double-walled gravity drain pipes from each OSWDF cell, valve houses for collection and transmission of liquids from the LCS and LDS, double-walled gravity transmission pipes, and lift stations.

D. *Surface Water Management System:*
The surface water management system manages surface water under both short-term (i.e., during construction and impacted material placement) and long-term (i.e., after OSWDF closure) conditions. The design addresses the management of surface water, perched ground water, other construction waters, and wastewaters from various sources such as the equipment wash facility.

E. *General Site Work:*
This includes construction of rip rap, base aggregate and installation of culverts, chain link fence and other miscellaneous site work activities within the OSWDF monitoring access road.

1.3.2 Infrastructure Construction

The major components of the Infrastructure construction are as follows:

A. *OSWDF Access Road and Support Facilities:*
Construction of OSWDF Access Road and Support Facilities includes: OSWDF Access Road and other roads to the OSWDF; Construction Office Area and parking; Temporary Construction

Access; Access Control Facilities; Surface Water Management System for OSWDF and support areas including construction runoff sedimentation and Detention Ponds, Surface Water Channels, pipes, culverts, and drainage structures; aggregate base surfacing and asphalt pavement; and chain link fencing.

B. *Impacted Material Transfer Area (IMTA) Haul Road and Support Facilities:*
Construction of IMTA haul road and support facilities includes: IMTA haul road; IMTA support facilities, wheel wash facility, impacted surface water and IMTA leachate management systems including channels, pipes, culverts, drainage structures, impacted surface water and leachate collection tanks and lift stations, liner system at IMTA (refer to Figure 1-2); aggregate base surfacing; and chain link fencing.

C. *Raw Water Pipe Line:*
Installation of raw water line including: raw water pipe lines; booster pump station; and water filling stations.

D. *Leachate Treatment Systems (ILTS and PLTS):*
Interim Leachate Treatment System (ILTS) and Permanent Leachate Treatment System (PLTS) including: installation of collection tanks, pumps, piping and leachate treatment systems, and associated utilities and general site work.

E. *Construction Power:*
Construction Power includes: installation of construction power to OSWDF valve houses, lift stations, and other support facilities.

F. *Construction Trailers:*
Includes: Trailers and trailer installation.

1.3.3 Impacted Material Placement

The major components of impacted material placement include placement of different types of impacted materials in the OSWDF, including monitoring and verification/compliance in accordance with the Impacted Material Placement Plan (IMPP).

1.4 CQA PROJECT PLAN - DETAILED SCOPE

1.4.1 General

In general, the CQA Project Plan describes requirements for the CQC activities to be performed during the construction of the OSWDF. In summary, CQC activities to be performed during OSWDF construction include: monitoring, testing and verification/compliance with the requirements of the construction documents and CQC support during the OSWDF construction, infrastructure construction, and impacted material placement. In the case of conflict between the CQA Project Plan and Technical Specifications in the construction documents, the Technical Specifications shall govern the CQC requirement.

1.4.2 Detail Scope

The detail scope of this CQA Project Plan is as follows:

A. *CQC – OSWDF Construction:*

1. Prepare monitoring requirements for each component of the OSWDF construction based on the construction documents and OSWDF CQA Project Plan.

2. Perform monitoring, testing, and verification/compliance activities described in this CQA Project Plan and in the OSWDF construction documents.

B. *CQC Support – OSWDF Construction, Infrastructure Construction, and Impacted Material Placement:*

1. Establish CQC Contractor Organization and project QA responsibilities.

2. Provide CQC field staff and on-site and off-site testing laboratories in conformance with the OSWDF CQA Project Plan.

3. Prepare testing procedures and perform testing in accordance with the construction documents.

4. Perform monitoring and verification/compliance

5. Submit test results and monitoring reports;

6. Comply with document control and record keeping requirements.

1.5 RELATED PLANS

Several other plans have been prepared for the OSWDF and include information relevant to the requirements of this CQA Project Plan. These other plans are listed below along with a brief statement of the relationship of the plan to this CQA Project Plan.

- *OSWDF Project Quality Assurance Plan (PQAP).* The PQAP is among the quality assurance flow down requirements of the OSWDF Project and addresses organization, responsibilities, documentation of qualifications and training, and other requirements for QA activities, including but not limited to, documentation and records keeping, work process (instructions, procedures, and drawings).

- *OSWDF Surface Water Management and Erosion and Sediment Control (SWMESC) Plan*. The SWMESC Plan addresses surface water and various aspects of erosion and sediment control.

- *OSWDF Impacted Material Placement Plan (IMPP)*. The IMPP includes information regarding the placement, compaction, and testing of impacted material within the OSWDF.

1.6 CQA PROJECT PLAN ORGANIZATION

The remainder of this CQA Project Plan is organized as follows:

- project organization and definitions, responsibilities, and qualifications of key entities involved with the construction of the OSWDF are presented in Section 2;

- requirements for CQC documentation are described in Section 3;

- CQC activities for the soils components of the OSWDF liner and final cover systems and general earthwork are presented in Section 4;

- CQC activities for geomembranes (including electric leak detection testing), geosynthetic clay liner and cap, and geotextiles, are presented in Sections 5 through 7, respectively;
- CQC activities for the installation of high density polyethylene (HDPE) pipes and fittings are presented in Section 8;
- CQC activities for the installation of concrete protective liner in the valve houses are presented in Section 9;
- CQC activities for the installation of pre-engineered buildings are presented in Section 10;
- CQC activities for appurtenant work items such as mechanical and electrical systems are described in Section 11;
- CQC activities for cast-in place concrete are presented in Section 12;
- CQC activities for aggregate base are presented in Section 13;
- CQC activities for OSWDF infrastructure are presented in Section 14;
- CQC activities for impacted material placement are presented in Section 15; and
- CQC activities for general site work are presented in Section 16.

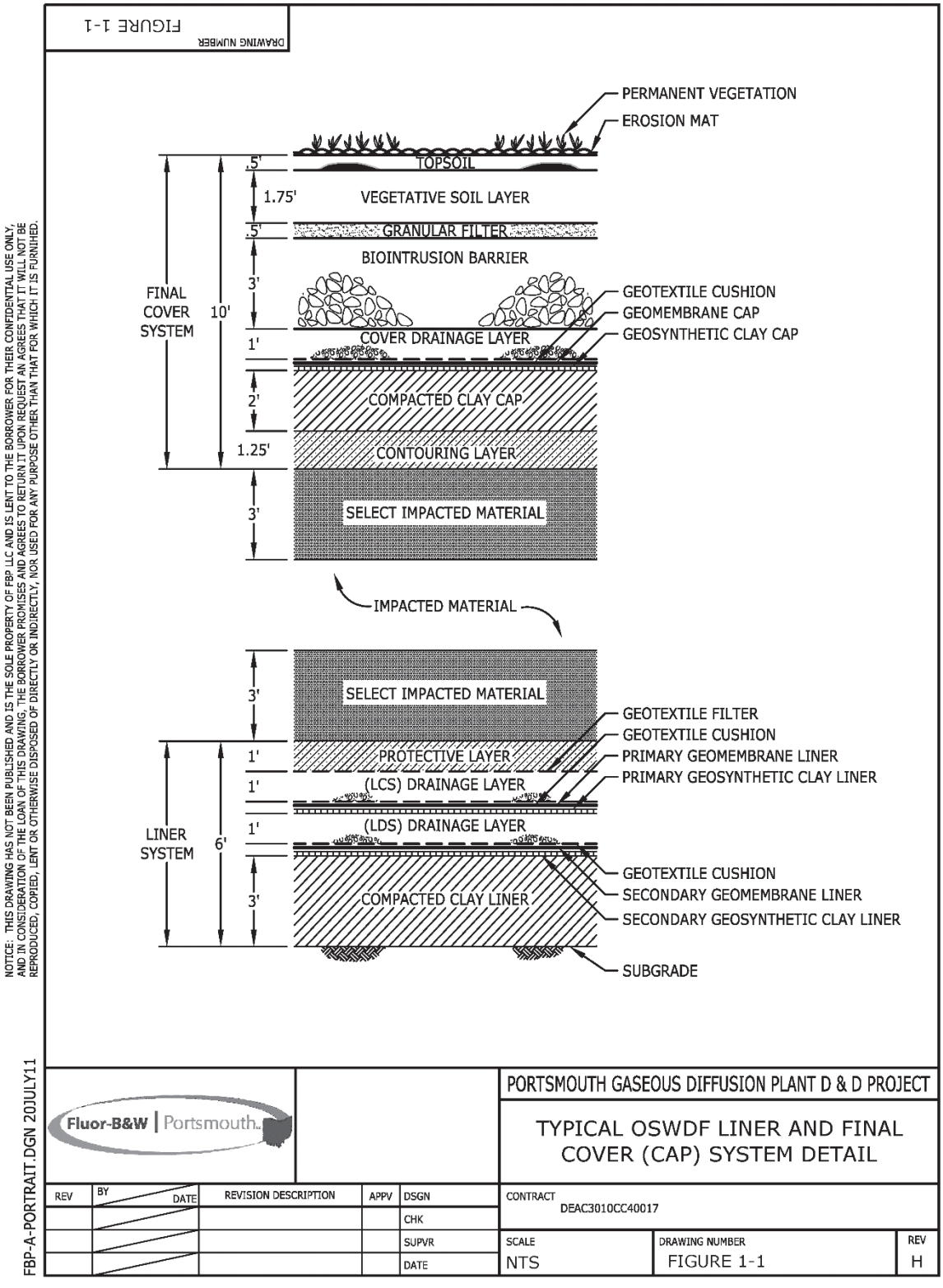

Figure 1-1. Typical OSWDF Liner and Final Cover (Cap) Systems Detail

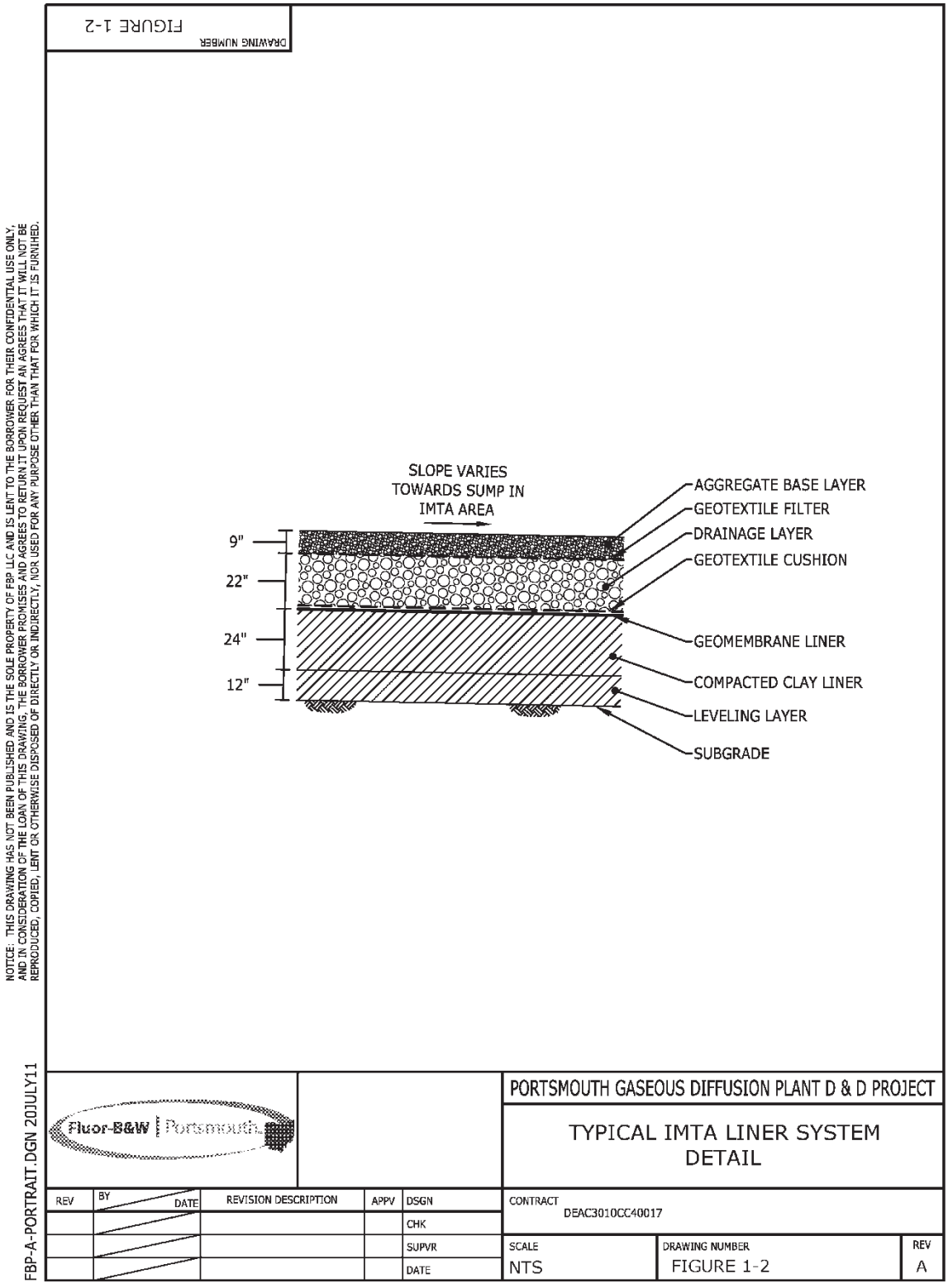

Figure 1-2. Typical IMTA Liner System Detail

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2. PROJECT ORGANIZATION AND PERSONNEL

2.1 OVERVIEW

The OSWDF Project organizational chart is shown in Figure 2-1. The intent of the organizational chart is to depict the high level organizational structure and relationships between the entities responsible to oversee and manage the construction, and construction quality control/assurance of the OSWDF project. Day-to-day construction activities at the OSWDF will be managed through the direct interaction of those entities. The definitions, qualifications, and responsibilities of the personnel responsible for oversight and implementation of the OSWDF project are described below. The lines of communication and responsibilities are as defined in the contract documents between the entities.

2.2 OSWDF PROJECT TEAM – D&D CONTRACTOR

2.2.1 OSWDF Project/Deputy Director

The OSWDF Project Director and Deputy Director have the responsibility for planning and implementing the work, including scheduling and estimating, obtaining resources, conducting field work, documenting the plans and the work, enforcing contract provisions, and providing DOE information in a timely manner. The OSWDF Project Director and Deputy Director also has responsibility for overall project environmental, safety, health and quality.

2.2.2 OSWDF Environmental, Safety, and Health (ES&H) Manager

The OSWDF Safety and Health Representative is responsible for providing the necessary information and guidance to the OSWDF Project Director, OSWDF Construction Manager, and the OSWDF Operations Manager to ensure the safe performance of work during the construction and operation of the OSWDF.

2.2.3 OSWDF Waste Acceptance Organization (WAO) Representative

The WAO provides independent oversight from the point of waste generation to final disposition in the OSWDF. The WAO is responsible for verifying compliance with the Waste Acceptance Criteria (WAC), complying with waste tracking protocols, and tracking anomalous conditions.

2.2.4 OSWDF Construction Manager

The OSWDF Construction Manager has overall responsibility to complete the construction scope safely, within budget, and on schedule. The Construction Manager will coordinate with support organizations and personnel, including the CQC and functional groups, to ensure resources are available for completion of work. Additionally, the Construction Manager is the primary interface for subcontracted construction resources.

2.2.5 OSWDF Design Process Manager

The OSWDF Design Process Manager is responsible for development of the OSWDF Design packages and maintaining configuration control of the OSWDF design documents including field change notices (FCNs).

2.2.6 OSWDF Field Engineering Manager

The OSWDF Field Engineering Manager is responsible for providing field engineering support during construction and waste placement. The Field Engineering Manager is responsible for providing technical responses to contractor requests for information, technical disposition of Nonconformance Reports (NCRs), and preparation of engineering change requests (ECRs).

2.2.7 OSWDF Operations Manager

The OSWDF Operations Manager has responsibility for overall logistics and scheduling support including waste transportation, receipt, placement, and compaction. Responsibilities also include operations and maintenance of IMTA and the Haul Road. Operation of the ILTS will be performed by others, but will be coordinated with OSWDF Operations.

2.2.8 OSWDF Project QA Manager

The Project QA Manager has overall responsibility for quality assurance/quality control activities during construction and waste placement for the OSWDF project. The Project QA Manager is responsible for oversight during all phases of the OSWDF project through the performance of audits, assessments, inspections, and surveillances; including supplier assessments and surveillances.

2.3 ARCHITECT-ENGINEER CONTRACTOR

The Architect-Engineer contractors serve as the design engineer-of-record for their respective designs. Project designs include the preparation of design documents for regulatory approval and preparation of certified for construction documents. The Architect-Engineer contractors may perform Title III Engineering services.

2.4 CQC CONTRACTOR

2.4.1 CQC Contractor

2.4.1.1 Definition

The CQC Contractor will be a firm specialized in performing CQC activities for disposal facilities including liner and final cover systems and support facilities. The CQC Contractor is independent from OSWDF management, OSWDF engineering management, OSWDF operations management, OSWDF construction management, and OSWDF construction contractor. The CQC Contractor is responsible for monitoring, testing, verification/compliance, and documenting activities related to the construction and filling of the OSWDF project. The responsibilities for the CQC Contractor are included in this CQA Project Plan and contract documents.

2.4.1.2 Qualifications

The CQC Contractor will have minimum of ten years' experience in performing CQC activities for the construction of disposal facilities. The CQC Contractor will demonstrate its capabilities to perform CQC activities and to provide equipment, qualified personnel, and licenses required to perform CQC for the construction and filling of the OSWDF. The CQC Contractor will also demonstrate experience in the preparation of CQC documentation including CQC plans, field documentation, field testing methods, laboratory testing methods, and CQA certification reports; and interpretation of Technical Specifications, construction drawings, support plans for liner and cover systems, and impacted material placement.

The CQC Contractor will submit a Quality Assurance Project Plan (QAPP) as required by contract documents.

The CQC Contractor will establish soils and geosynthetics testing laboratories having qualifications as specified in this section of the CQA Project Plan.

2.4.1.3 Responsibilities

The CQC Contractor field personnel will work under the management of the Project QA Manager and will be responsible for monitoring, testing, confirmation of compliance, and documenting the activities of

the Contractor relative to the construction and filling of the OSWDF. The CQC Contractor will be responsible for monitoring, testing, and verification/compliance of construction materials delivered to the site with the submittals and/or approved shop drawings. The CQC Contractor will monitor, confirm, and document that the OSWDF construction and filling is performed in accordance with the construction documents. The CQC Contractor will be responsible for obtaining samples of the various construction materials in accordance with the testing frequencies identified in this plan. The CQC Contractor will also be responsible for obtaining, labeling, and shipping samples for off-site laboratory testing in accordance with the requirements of this plan.

The CQC Contractor will administer the CQC program through the CQA Officer including but not limited to approving assignments and management of on-site CQC personnel; review field reports; and review of CQC related activities.

The CQC Contractor will also be responsible for CQC of impacted material placement in the OSWDF in accordance with the IMPP and Section 15 of this CQA Project Plan.

The CQC Contractor will be responsible for the quality control of its laboratory testing program and for documenting the calibration of the soils and geosynthetics laboratory testing equipment. Equipment calibration certificates will be maintained in the CQC Contractor's project files. Tests will be performed in accordance with the latest version of American Society for Testing and Materials (ASTM) or other recognized standards. Test results will be submitted to the Project QA Manager within a time frame that will not impede or delay construction activities.

The CQC Contractor will be responsible for soils and geosynthetics quality control testing to be performed by the testing laboratory. The CQC Contractor will be responsible for operating and staffing the on-site and off-site soils and geosynthetics laboratories. Test results from the on-site and off-site laboratories will be submitted to the Project QA Manager within a time frame which will not impede or delay construction activities.

The soils laboratory will be equipped to perform routine index testing as shown in Tables 4-5 and 4-8.

The CQC Contractor will also be responsible for performing routine performance tests during construction of the OSWDF liner and final cover systems, which will include:

- in-situ soil moisture content and in-situ density by nuclear methods (ASTM D6938);
- lift thickness by direct measurement; in-place density by sand cone (ASTM D1556) or drive cylinder (ASTM D2937);
- peel adhesion of geomembrane field seams (ASTM D6392); and
- bonded seam strength of geomembrane field seams (ASTM D6392).

2.4.2 CQA Officer

2.4.2.1 Definition

The CQA Officer will serve as the CQC Contractor's lead official for the OSWDF project and will be in responsible charge of the CQC Contractor's engineering work product. The CQA Officer will have and will exercise the authority to review and to reject or approve both the construction work in progress and

the final work product. The CQA Officer will be responsible for construction certification of each phase of construction and is responsible for ensuring and certifying that the CQA Project Plan has been successfully carried out and the OSWDF has been constructed to the design documents. The CQA Officer will be a registered Professional Engineer in the State of Ohio.

2.4.2.2 Qualifications

The CQA Officer will be registered as a Professional Engineer in the State of Ohio and have a minimum of five years' relevant experience. The CQC Contractor shall provide certification, authenticated by the designated contractor authority, that the individual has met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.2.3 Responsibilities

The responsibilities of the CQA Officer include but are not limited to as follows:

- monitor, confirm compliance, and document construction of the OSWDF and related field activities;
- review and provide quality assurance of CQC documentation;
- review submittals, certification and documentation from the Contractor, vendors for the construction materials, equipment, and Installer to confirm compliance with the construction documents;
- review changes to the OSWDF construction documents;
- responsible for preparing Interim Construction Certification Reports for each cell liner, as described in Section 3.5 of this plan, for structural fill and compacted clay liner construction, secondary liner and leak detection layer construction, and primary liner and leachate collection layer construction;
- responsible for preparing the OSWDF CQA Construction Certification Report;
- sign and seal the OSWDF CQA Construction Certification Report;
- familiarize CQC Lead/Field Technicians with the conditions, construction documents, and the CQC requirements;
- manage the daily activities of the CQC Lead/Field Technicians;
- attend regularly-scheduled CQC-related meetings on-site;
- manage CQC (monitoring, testing, and verification/compliance) of impacted material placement;
- review the ongoing preparation of the construction as-built Drawings;
- review test results provided by the Lead/Field Technicians, Contractor, and vendor for construction materials;
- verify the calibration and condition of testing equipment, including but not limited to, required records, maintenance, usage, and logging in accordance with approved quality assurance manuals;
- review the CQC Lead/Field Technicians' daily reports and logs;

- report to the Project QA Manager and document relevant reported observations by the CQC Lead/Field Technicians;
- prepare a daily report for the project;
- oversee the collection and shipping of laboratory test samples;
- review results of laboratory testing and confirm compliance;
- report deviations from the construction documents to the Project QA Manager;
- review the construction materials vendor's quality control (QC) documentation; and
- review required qualification for the Geosynthetics Installer's personnel and confirm compliance.

The CQA Officer may delegate some of the responsibilities listed above to qualified Lead Field Technicians as appropriate and as approved by the QA Manager.

2.4.3 CQC Lead Soils Field Technician

2.4.3.1 Definition

The Lead Soils Field Technician is the individual in charge of field monitoring, testing, and documentation for the earthwork components of the OSWDF. The Lead Soils Field Technician may also serve as the Lead Geosynthetics Field Technician provided that the technician meets the qualifications listed in Section 2.4.4.2.

2.4.3.2 Qualifications

The Lead Soils Field Technician will have a minimum of five years' documented experience in CQC activities on similar waste disposal facilities, and will have performed documented CQC activities on similar projects. The Lead Soils Field Technician will have performed CQC activities for the installation of low-permeability clay liner or cap. The CQC Contractor shall provide certification, authenticated by the designated contractor authority, that the individual has met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.3.3 Responsibilities

The Lead Soils Field Technician may perform some or all of the activities related to earthwork which are described in Section 2.4.6.3 provided the technician meets the qualifications of Section 2.4.6.2.

2.4.4 Lead Geosynthetics Field Technician

2.4.4.1 Definition

The Lead Geosynthetics Field Technician is the individual in charge of field monitoring, testing, and documentation for the geosynthetic components of the OSWDF. The Lead Geosynthetics Field Technician may also serve as the Lead Soils Field Technician provided that the technician meets the qualifications listed in Section 2.4.3.2.

2.4.4.2 Qualifications

The Lead Geosynthetics Field Technician will have a minimum of five years' experience in CQC activities on similar waste disposal facilities and will have performed CQC activities on at least two similar projects. The Lead Geosynthetics Field Technician will have performed CQC activities for the installation of HDPE geomembrane. Holding NICET and/or GCI-ICP certification is considered "added value" for the position; however, these certifications are not required as a qualification. The CQC Contractor shall provide certification, authenticated by the designated contractor authority, that the individual has met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.4.3 Responsibilities

The Lead Geosynthetics Field Technician may perform some or all of the activities related to geosynthetics which are described in Section 2.4.6.3 provided the technician meets the qualifications of Section 2.4.6.2.

2.4.5 Lead Field Technician for Mechanical, Electrical, and Civil Activities

2.4.5.1 Definition

The Lead Field Technician for mechanical, electrical, and civil activities is the individual in charge of field monitoring and documentation for these components of the OSWDF Project. The Lead Field Technician for mechanical, electrical, and civil activities may also serve as the Lead Soils Field Technician and/or the Lead Geosynthetics Technician provided that the technician meets the qualifications listed for those positions.

2.4.5.2 Qualifications

The Lead Field Technician for mechanical, electrical, and civil activities will have a minimum of five years' experience in CQC activities on similar type facilities, and will have performed CQC activities on at least two similar projects. The Lead Field Technician for mechanical, electrical, and civil activities (or a designated field technician performing concrete placement activities) will be American Concrete Institute (ACI) Grade I certified for testing concrete. The CQC Contractor shall provide certification, authenticated by the designated contractor authority, that the individual has met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.5.3 Responsibilities

The Lead Field Technician for mechanical, electrical, and civil activities may perform some or all of the activities related to mechanical, electrical, and civil which are described in Section 2.4.6.3 provided the technician meets the qualifications of Section 2.4.6.2.

2.4.6 Field Technicians

2.4.6.1 Definition

Field Technicians support the Lead Soil, Geosynthetics, and Mechanical-Electrical Field Technicians.

2.4.6.2 Qualifications

Field Technicians are personnel who are specifically trained in the CQC of geosynthetics and low permeability clay liner or cap, and/or mechanical, electrical, and civil activities; and have documented CQC monitoring experience and/or a technical degree in accordance with applicable DOE Orders. The CQC Contractor shall provide certification, authenticated by the designated contractor authority, that the

individual has met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.6.3 Responsibilities

The duties of the CQC Field Technicians are monitoring, testing, confirming compliance, and documenting construction of the OSWDF Project including soils, geosynthetics, mechanical, electrical, and other civil components of the OSWDF Project which include liner and cover systems, mechanical, electrical, and civil components, impacted material placement, and other support activities, as assigned by the CQA Officer.

It is noted that the construction contractor for mechanical, electrical, piping, manholes, road construction and other civil activities will perform the required testing for these components in accordance with contract documents. Duties of the CQC Contractor for these components of the OSWDF Project are limited to monitoring and documenting these installations and testing activities for compliance with contract documents. With these limitations, the duties of the Field Technicians include but are not limited to:

- monitoring the installation and testing of mechanical, electrical, and civil components of the OSWDF Project, such as concrete testing, HDPE pipe welding, and testing of HDPE pipe welds;
- performing tests on completed earthwork activities (e.g., in-situ moisture/density tests, etc.);
- monitoring material stockpiles for non-compliant materials;
- monitoring surface water drainage in the areas of soil and geosynthetic material stockpiles;
- preparing daily field reports;
- recording CQC activities on field logs;
- collection of soils samples from site work activities in accordance with this CQA Project Plan;
- monitoring soil placement and compaction to confirm compliance with the Technical Specifications and this CQA Project Plan;
- monitoring the unloading, on-site handling, and storage of the geosynthetics;
- monitoring repairs;
- monitoring geosynthetic material deployment and installation operations;
- monitoring and documenting testing activities; and
- collecting pre-conformance and conformance samples for testing by CQC laboratories.

2.4.7 Geotechnical CQC Laboratory

2.4.7.1 Definition

The Geotechnical CQC Laboratory is the entity, independent from the Construction Manager and Contractor, responsible for performing geotechnical laboratory tests in accordance with standards referenced in the Construction Drawings, Technical Specifications, and this CQA Project Plan. The testing results provided by the Geotechnical CQC Laboratory will be used by the CQC Contractor to confirm compliance of the soils construction materials with the construction documents.

The Geotechnical CQC Laboratory will be required to perform pre-conformance, conformance, and performance testing of the various soils components of the OSWDF.

2.4.7.2 Qualifications

The Geotechnical CQC Laboratory will have a minimum three years' experience in testing of soils similar to those proposed for use in the construction of the OSWDF in accordance with ASTM and other applicable soil test standards. The Geotechnical CQC Laboratory will be capable of providing test results within a maximum of 7 days of receipt of samples and will maintain that capability throughout the duration of the earthwork construction.

Prior to construction, the Geotechnical CQC Laboratory will submit their qualifications and quality assurance/quality control (QA/QC) procedures for review and approval. The qualifications presented by the Geotechnical CQC Laboratory will, as a minimum, include:

- corporate background and statement of qualifications;
- lists of equipment and testing capabilities including reference to ASTM or other applicable test methods;
- a laboratory QA/QC plan which includes but is not limited to, required records, maintenance, usage, and logging activities;
- information on staff size and experience;
- information regarding test result turnaround time; and
- certification, authenticated by the designated contractor authority, that individual laboratory technical/testing staff members have met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.7.3 Responsibilities

The Geotechnical CQC Laboratory will be responsible for testing various soils components of the OSWDF liner and final cover systems and support facilities. These tests will include, but not be limited to, pre-conformance, conformance, and performance tests performed in accordance with the construction documents. The CQC Contractor will be responsible for the Geotechnical CQC Laboratory testing.

2.4.8 Geosynthetics CQC Laboratory

2.4.8.1 Definition

The Geosynthetics CQC Laboratory is the entity, independent from the Construction Manager, Contractor, Geosynthetics Manufacturer, and Geosynthetics Installer, responsible for performing laboratory conformance and geomembrane seam tests on samples of geosynthetic materials in accordance with the Construction Drawings, Technical Specifications, and this CQA Project Plan. The testing results provided by the Geosynthetics CQC Laboratory will be used by the CQC Contractor to confirm compliance with the construction documents.

The Geosynthetic CQC Laboratory will be required to perform conformance and performance testing on geosynthetic material samples.

2.4.8.2 Qualifications

The Geosynthetics CQC Laboratory will hold current accreditation by the Geosynthetic Accreditation Institute (GAI) for each test method performed and have a minimum of three years' experience in testing geosynthetics similar to those proposed for use during construction of the OSWDF. The Geosynthetics CQC Laboratory will be familiar with ASTM and other applicable geosynthetic test methods. The Geosynthetics CQC Laboratory will be capable of providing destructive test results for geomembrane field seams within 24 hours of receipt of samples and will maintain that capability throughout the duration of geosynthetic material installation.

Prior to construction, the Geosynthetics CQC Laboratory will submit their qualifications for review and approval. The qualifications presented by the Geosynthetics CQC Laboratory will, as a minimum, include:

- corporate background and statement of qualifications;
- lists of equipment and testing capabilities including reference to ASTM or other applicable test methods;
- a laboratory QA/QC plan which includes but is not limited to, required records, maintenance, usage, and logging activities;
- information on staff size and experience;
- information regarding test result turnaround time;
- proof of current GAI accreditation; and
- certification, authenticated by the designated contractor authority, that individual laboratory technical/testing staff members have met qualification requirements through a combination of education, experience, and examination or capability demonstration.

2.4.8.3 Responsibilities

The Geosynthetics CQC Laboratory will be responsible for testing various geosynthetic components of the liner and cover systems. These tests will include, but not be limited to, geosynthetic conformance and performance testing in accordance with the construction documents. The CQC Contractor will be responsible for the Geosynthetics CQC Laboratory testing.

2.5 CONTRACTOR

The Contractor is an entity entering into contract for construction of any portion of the OSWDF project or for providing any contracted services for the OSWDF Project (e.g., geosynthetic installation, electrical leak detection services, etc.).

2.6 SURVEYOR

The Surveyor is an entity responsible for surveying and documenting and verifying the location (coordinates and elevations) of all significant components of the OSWDF project as described in the Technical Specifications and Construction Drawings. The Surveyor is responsible for issuing as-built drawings for each phase of construction.

2.7 GEOSYNTHETICS MANUFACTURERS

2.7.1 Definition

The Geosynthetics Manufacturers are the firms or corporations responsible for production of the geosynthetic materials to be used in construction of the OSWDF.

2.7.2 Qualifications

The Geosynthetics Manufacturers will be able to provide sufficient production capacity and qualified personnel to meet the project schedule. The geosynthetic manufacturers will meet the qualifications outlined in Sections 02714, 02770, 02772, and 03110 of the OSWDF and infrastructure Technical Specifications.

2.7.3 Responsibilities

Each Geosynthetics Manufacturer will be responsible for the production and quality control of its respective geosynthetic product. Each Geosynthetics Manufacturer will provide a product which shall meet the requirements of the Technical Specifications. Each Geosynthetics Manufacturer will submit quality control documentation for its respective products as required by the Technical Specifications and contract documents.

2.8 GEOSYNTHETICS INSTALLERS

The Geosynthetics Installer will be experienced and qualified to install geosynthetic materials of the type specified for this project. The minimum installer qualifications/experience shall be in accordance with Technical Specifications, Part 1.04 Submittals for each geosynthetic type. Refer to Technical Specifications Sections, as follows:

- Section 02714 – for minimum qualifications/experience for the Geotextile Installer and Installer's Superintendent.

- Section 02770 – for minimum qualifications/experience for the Geomembrane Installer, Installer's Superintendent, and Installer's Seamer. Additionally, as required by Section 02770, the Installer shall submit a letter of approval or license from the Geomembrane Manufacturer.

- Section 02772 – for minimum qualifications/experience for the Geosynthetic Clay Liner (GCL) Installer and Installer's Superintendent.

2.9 HDPE PIPE INSTALLER

The HDPE Pipe Installer will be experienced and qualified to install HDPE pipe materials of the type specified for this project. The minimum installer qualifications/experience shall be in accordance with Technical Specifications, Section 02605, Part 1.04 Submittals.

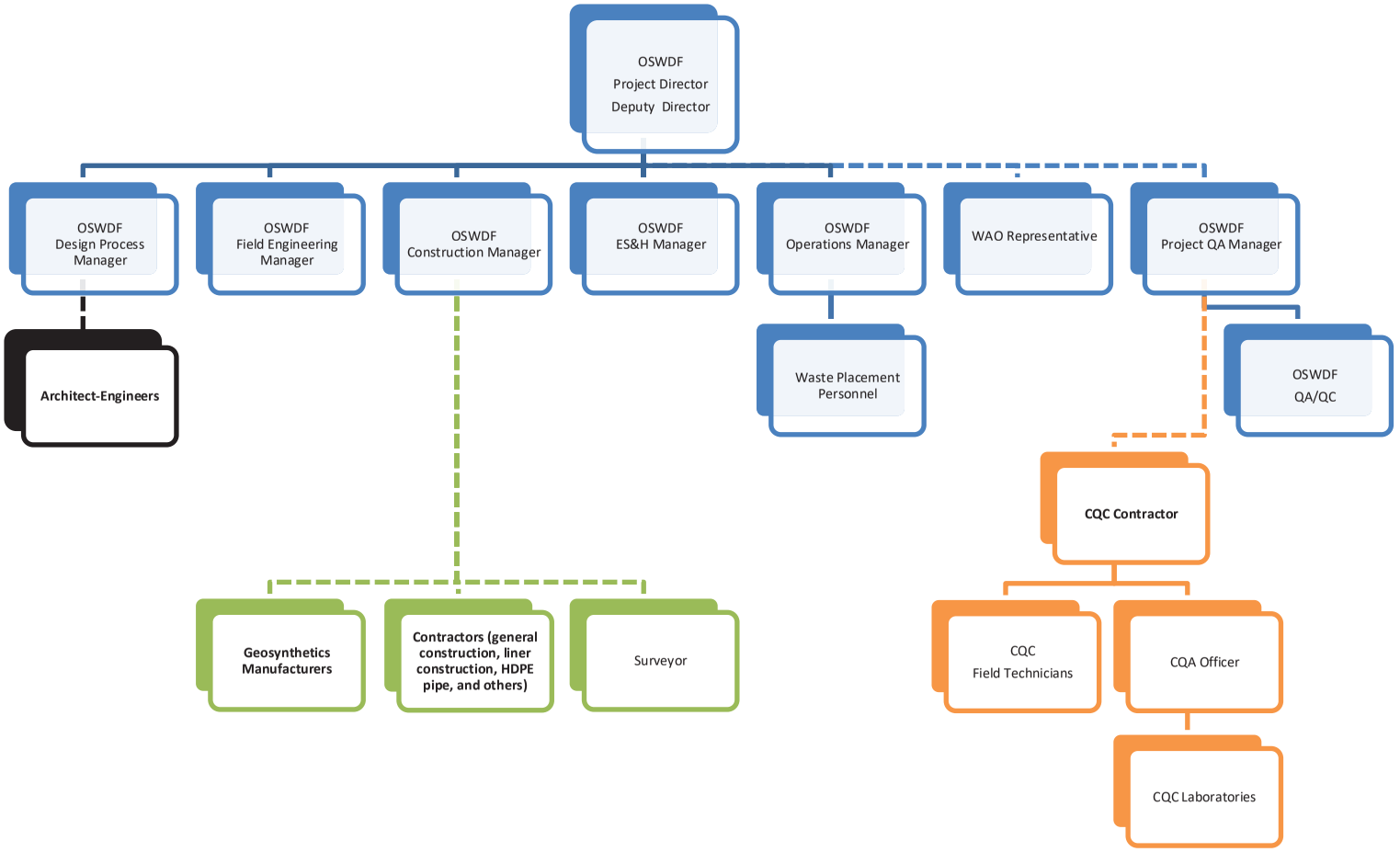

Figure 2-1 OSWDF Organizational Chart

3. DOCUMENTATION

Documentation will be in accordance with the approved OSWDF Project Quality Assurance Plan (PQAP). The PQAP and required procedures will be in accordance with the site Quality Assurance Program Description.

The CQC Contractor will complete field forms including daily field reports and CQC forms documenting CQC activities. Examples of some of the forms that will be used to document CQC activities are included in Appendix B; however, the CQC Contractor will provide the actual forms to be used with approval of the QA Manager. The CQA Officer will submit weekly reports to the Project QA Manager summarizing daily field reports produced during the preceding week. Monitoring and data forms will be provided to the Project QA Manager as monitoring and testing are completed or at a frequency directed by the Project QA Manager. All field forms, including daily reports, will be available for review at the site. Likewise, field forms and daily reports regarding impacted material placement will be provided to the Project QA Manager and available for review at the site. The CQA Officer shall also maintain at the job site a complete and current file of Construction Drawings, ECRs, Technical Specifications, Support Plans, As-Built Drawings, Contractor's Quality Control and Work Plans, checklists, test methods, completed field forms, daily and weekly field reports, and other pertinent construction and CQC documents.

3.1 DAILY RECORD KEEPING

3.1.1 Daily Field Reports

The CQC Contractor's daily field reports will include the following information as applicable:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other pertinent project identification;
- summary on meetings held and their results;
- description(s) and location(s) of construction;
- descriptions and specific locations of areas, or units, of work being tested and/or monitored and documented;
- description of locations where tests and samples were taken;
- a narrative summary of field test results;
- off-site materials received, including quality control documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard testing results;
- identifying sheet numbers of data sheets and/or nonconformance identification and corrective measures reports used to substantiate the decisions described above; and
- signature of CQA Officer and/or appropriate CQC Lead Technician or CQC Field Technician.

Corrections to the Daily Field Reports will be single line crossed out, initialed by the correcting personnel, CQA Officer, and dated. Electronic reports/forms shall have a means of electronically tracking changes/corrections. Documentation of field activities will also be included on monitoring logs and test data sheets. When appropriate, the Daily Field Reports can reference information recorded on these logs or data sheets instead of reporting information in the Daily Field Report.

3.1.2 Daily CQC Monitoring and Data Forms

Daily field monitoring reports, sampling information, and test results will be recorded on appropriate monitoring and data forms. The CQC Contractor will use the monitoring and data forms to confirm completeness of the required CQC activities. Corrections to the monitoring and data forms will be single line crossed out, initialed by the CQC personnel responsible for the correction, CQA Officer, and dated. Electronic reports/forms shall have a means of electronically tracking changes/corrections. Examples of relevant monitoring and data forms that may be used during the OSWDF construction are presented in Appendix B.

The CQC Contractor's daily monitoring and data forms will include the following information as applicable:

- project specific information such as project name and location;
- the date the CQC activity was performed;
- a unique identifying sheet number for cross-referencing and document control;
- location of the CQC activity or location from which the sample was obtained;
- type of CQC activity or method used (reference to standard method when appropriate);
- test results, with necessary calculations;
- results of the CQC activity and comparison with specification requirements (pass/fail); and
- the initials or signature of personnel involved in the CQC monitoring activity.

3.1.3 Electronic Forms

The CQC Contractor may use electronic forms and/or a project specific database for collection and storage of the data provided the requirements in Sections 3.1.1, 3.1.2, and 3.1.3 are met. The CQC Contractor is responsible for providing the equipment and resources necessary for electronic record keeping.

3.2 PHOTOGRAPHIC DOCUMENTATION

The CQC Contractor will be responsible for obtaining photographic documentation of the Contractor's activities, materials installation, and testing in accordance with approved Site Procedures. Photographs will serve as a pictorial record of work progress, problems, and corrective measures. A photographic log will be utilized to organize and document photographs obtained during construction of the OSWDF. As appropriate, such data sheets will be cross-referenced or appended to summary reports, CQC monitoring forms, or data forms and/or nonconformance identification and corrective measures reports. At a minimum, photographic logs should include the following information:

- a unique identifying number on data sheets and photographs for cross-referencing and document control;

- the date and location where the photograph was taken; and

- location and description of the work.

Photographs will be obtained using digital cameras with sufficient resolution, in .pdf and original electronic format as required by contract documents.

Photographs will be subject to the storage and backup requirements outlined in Section 3.6.

3.3 DESIGN AND/OR SPECIFICATIONS CHANGES

Design and/or specifications changes may be required during construction. In such cases, the individual requesting the change will submit written requests for such changes to the Construction Manager or to the Operations Manager for impacted material placement. The Field Engineering Manager will review and respond to these requests in accordance with PORTS site procedures. Any design changes will take the form of an ECR. ECRs may require concurrence of Ohio EPA prior to implementation. If required, Ohio EPA concurrence will be obtained through the Field Change Notice (FCN) process.

3.4 NONCONFORMANCES

A nonconformance is defined herein as material or workmanship that does not meet the specified requirement(s) and will be reported in accordance with the site procedure for control of nonconforming items. The Construction Manager should be promptly notified of known nonconformance. Likewise, the Operations Manager should be promptly notified of known nonconformance of impacted material placement. In accordance with site procedure, nonconformance reports will include:

- description of the nonconforming condition,
- immediate actions taken,
- engineering disposition,
- reinspection,
- final acceptance.

3.5 CQA CONSTRUCTION CERTIFICATION REPORT

At the completion of construction phases the CQC Contractor will submit a construction phase final construction certification report to the Construction Manager. This report will acknowledge: (i) that the work has been performed in compliance with the construction documents; (ii) physical sampling and testing have been conducted at the appropriate frequencies; and (iii) that the summary document provides the necessary supporting information. The report shall be signed and sealed by the CQA Officer.

At a minimum, this report will include:

- summaries of CQC activities;
- CQC monitoring forms and data forms including sample location plans;
- laboratory test results;
- problem identification and corrective measures reports;
- a descriptive summary of changes from the construction documents; and
- a summary statement indicating compliance with the construction documents which is signed and sealed by the CQA Officer.

Construction completion and certification of cell liners is time sensitive due to the potential exposure of the liner materials to temperature and weather; therefore, the process for cell liner construction certification reporting is provided in greater detail in the following paragraphs. The Construction Certification Report process for each construction event will consist of a series of submittals demonstrating compliance with construction quality assurance requirements followed by a final Construction Certification Report summarizing the liner and engineered components for which DOE is seeking concurrence. The first submittal will identify the scope of the "construction event," which may consist of annual construction activities, construction of an individual cell, or construction of multiple cells/final covers. The following are some examples of interim reports that may be provided to Ohio EPA for concurrence:

- Valve House Construction;
- structural fill and compacted clay liner construction;
- secondary liner and leak detection layer construction; and
- primary liner and leachate collection layer construction.

The interim reports will include all of the relevant ECRs, FCNs, survey, and CQC data. Ohio EPA review of these interim reports and timely feedback will allow DOE the opportunity to address any potential issues during construction and minimize schedule impact when required.

The final Construction Certification Report (provided cell by cell) will provide a summary of the liners/engineered components for which DOE is seeking concurrence, references to the interim reports submitted, and a certification from the CQA Officer indicating the liner is acceptable for receiving waste (the interim reports provided for each cell earlier in this review process will not be resubmitted, but will be incorporated by reference in this final report). This process will be followed for each construction event. The CQA Officer will also provide a representation, with the first Construction Certification Report to Ohio EPA, that all other engineered components related to leachate management are operational and functional.

The Contractor's As-Built Drawings, which include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, pipe elevations, geomembrane panel layout including destructive sample and repair locations, etc.) will be included as part of the interim and final certification reports.

3.6 STORAGE OF DOCUMENTS

Documents and records shall be kept and maintained in accordance with Section 4 of the OSWDF Project *Quality Assurance Program Description* in accordance with flow down requirements of contract documents. This includes, but is not limited to, the CQC Contractor's controlled copy of the construction documents, and all the data sheets and reports that they produce. Required documents will include, but not be limited to field and laboratory reports, equipment calibration records, drawings, specifications, and associated forms and reports, as applicable.

4. EARTHWORK

4.1 INTRODUCTION

CQC monitoring and testing will be performed during construction of the various soil components of the OSWDF and IMTA, including the soil components of the liner and final cover systems. Criteria to be used for determination of acceptability of the various soil layers are identified in the Construction Drawings, Technical Specifications, and Support Plans.

This CQA Project Plan includes CQC requirements for the protective layer and contouring layer as part of the CQC requirements for the liner and final cover systems. The CQC requirements for the impacted material protective layer will be in accordance with Section 15 of this plan and as described in the IMPP.

4.2 RELATED CONSTRUCTION DRAWINGS, TECHNICAL SPECIFICATIONS AND SUPPORT PLANS

Several sections of the Construction Drawings, Technical Specifications, and Support Plans will be referenced by the CQC Contractor for pertinent soil materials physical properties and construction requirements. Related specifications and support plans include the following:

- Section 02100 – Surveying;
- Section 02110 – Clearing, Grubbing, and Stripping;
- Section 02200 – Earthwork;
- Section 02215 – Trenching and Backfilling;
- Section 02225 – Compacted Clay Liner and Cap;
- Section 02230 – Aggregate Base;
- Section 02240 – Protective and Contouring Layers;
- Section 02250 – Vegetative Soil Layer;
- Section 02270 – Surface Water Management and Erosion Control;
- Section 02271 – Riprap;
- Section 02280 – Biointrusion Barrier;
- Section 02710 – Granular Drainage Material;
- Section 02712 – Granular Filter Material;
- Section 02920 – Topsoil;
- Section 02930 – Vegetation;
- Section 13010 – Impacted Material Placement; and
- Impacted Material Placement Plan (IMPP).

4.3 REVIEW AND ACCEPTANCE OF SURVEYS

During construction of the soil components of the OSWDF and IMTA, the CQC Contractor will routinely review Construction Drawings. The Construction Drawings are used to verify location of work, layer thickness and/or final grades, and for determination of acceptability of the various soil layers in the liner and final cover systems. Prior to the placement of successive soil or geosynthetic layers, the CQC Contractor will review, for acceptance, the Contractor's survey results for each layer. The survey results will indicate the preceding layer thickness, lines, and grades, as appropriate. After the survey results have been reviewed and accepted by the CQC Contractor it will be the responsibility of the Construction Manager to notify the Contractor of acceptance or noncompliance.

Likewise, survey results for impacted material placement will be provided to the Operations Manager and the Operations Manager will notify the Contractor of acceptance or noncompliance.

4.4 GENERAL SOIL CONSTRUCTION

4.4.1 Overview

General soil construction includes earthwork and trenching and backfilling. Earthwork consists of excavation, subgrade preparation, fill, and contouring layer preparation. Trenching and backfilling consists of construction of trenching, embedment fill and trench backfill.

During construction, conformance testing, construction monitoring, and performance testing of the fill, backfill, and embedment fill materials will be performed by the CQC Contractor. Pre-conformance testing will be performed on potential clay liner and cap material sources. Conformance testing will be performed by the Contractor on materials from off-site borrow sources, if used. The testing and monitoring activities associated with the general soil construction of the OSWDF are described subsequently. Monitoring and testing activities associated with the subgrade and top of contouring layer preparation are also described.

4.4.2 Pre-Conformance and Certification Testing

Materials used for general soils construction, with the exception of pipe and manhole embedment fill, will be obtained from the on-site sources including, but not limited to, OSWDF excavation, trenching, and on-site stockpiles approved by the Construction Manager. Pre-conformance testing of the material will be conducted to identify materials suitable for clay liner and cap material, which is described in Section 4.6.2. Off-site materials identified for possible use will also be included in pre-conformance testing. Generally, material from the on-site source that is not suitable for clay liner and cap material is candidate material for fill and backfill. Therefore, the pre-conformance testing for the clay liner and cap material can be used to identify candidate material for general soil construction.

The Contractor will provide conformance test results for proposed off-site sources of materials, including pipe and manhole embedment fill as specified in the Technical Specifications. The Construction Manager may require the CQC Contractor to perform tests on samples of material from the proposed sources as part of the approval process.

4.4.3 Conformance Testing

The conformance testing requirements for general soil construction are summarized in Table 4-1. These requirements are based on the Technical Specifications and in case of conflict between these tables and Technical Specifications, the Technical Specifications will supersede. During general soil construction, conformance tests will be used to evaluate the compliance of materials with the Technical Specification. Tests will be performed in accordance with the current version of ASTM test procedures indicated in Table 4-2 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. The properties of the various soil materials required by the Technical Specifications are included in Table 4-1**.**

The frequency of conformance tests will conform to the minimum frequencies presented in Table 4-2. The testing frequencies described herein for fill will also apply to materials used by the Contractor in areas outside the limits of the final cover system of the OSWDF.

4.4.4 Construction Monitoring

During placement of the various soil components, the CQC Contractor will visually monitor and document the Contractor’s activities during earthwork and other general soil construction for the following:

- type of soil;
- changes in the soil type and consistency;
- the thickness of lifts as loosely placed;
- soil-moisture conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (e.g., sheepsfoot penetration, pumping, cracking, etc.);
- the number of passes used to compact each lift;
- the presence of ponded water; and
- other soil construction activities shown on the Construction Drawings.

4.4.5 Performance Testing

Performance testing during general soil construction will be conducted in accordance with the Technical Specifications and this CQA Project Plan. The CQC field testing methods, used to confirm compliance during general soil construction, will be performed by the CQC Contractor in accordance with current ASTM or other applicable test. Test results will be documented and reported to the Construction Manager.

Performance testing will be conducted during the progress of the work. The minimum construction performance testing frequencies are presented in Table 4-3. The frequency may be increased at the discretion of the Construction Manager or if variability of the materials is observed by the CQC Contractor. Sampling locations will be selected by the CQC Contractor. If necessary, the location of routine in-place density tests will be determined using a non-biased sampling approach.

The standard Proctor compaction test (ASTM D698) will be used for the determination of moisture/density relationships. In-place surface moisture/density nuclear test method (ASTM D6938) will be used for in-situ field testing. The sand cone test method (ASTM D1556) or drive cylinder test method (ASTM D2937) will be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear moisture/density gauge calibration. In cases where material in the vicinity of the nuclear moisture/density gauge (e.g., metal or steel pipe in a trench) may interfere with the accuracy of readings, appropriate correction procedures shall be implemented.

Additional testing may be required when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas or an increased test frequency will be considered when:

- soil-clogged rollers are used to compact the material;
- fill materials are substantially different;
- the degree of compaction is doubtful;
- adverse weather conditions; and
- a developing trend of reworking of materials due to failing to meet Technical Specifications.

4.5 CONSTRUCTION OF LEVELING LAYER (OUTSIDE OF IMPACTED MATERIAL DISPOSAL LIMITS) AND SEALING THE 680 SANDSTONE LAYER

4.5.1 Overview

Construction of the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer includes earthwork consisting of excavation, subgrade preparation, and clay material placement.

During construction, pre-conformance and conformance testing, construction monitoring, and performance testing of the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer components will be performed. These activities are described subsequently.

The prepared subgrade that will support these layers will be as specified in the Technical Specifications prior to the installation of these materials. The subgrade preparation will be monitored and tested in accordance with Section 4.4 of this CQA Project Plan.

4.5.2 Pre-Conformance Testing

Clay materials used for leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer construction will be obtained from the on-site sources including, but not limited to, OSWDF excavation, trenching, and on-site stockpiles approved by the Construction Manager. Pre-conformance testing of soils from on-site borrow sources will be performed to identify candidate materials to be stockpiled for potential use as clay material. Off-site materials identified for possible use will also require pre-conformance testing. Moisture content measurements, Atterberg limits, particle size (sieve) analysis, classification, and standard Proctor will be performed on bulk samples.

4.5.3 Conformance Testing

The conformance testing requirements for the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer are summarized in Table 4-4. Conformance tests used to evaluate the suitability of soil materials during construction of the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer will be performed in accordance with the current version of ASTM test procedures indicated in Table 4-5 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. The frequency of conformance tests will conform to the minimum frequencies presented in Table 4-5.

Clay materials identified for use as a seepage control barrier for exposed sandstone layers shall be tested in accordance with ASTM D4647, *Standard Test Methods for Identification and Classification of Dispersive Clay Soils by the Pinhole Test* at a minimum of one test per soil source.

The CQC Contractor will be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

4.5.4 Construction Monitoring

During placement of the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer, the CQC Contractor will visually monitor and document the Contractor's activities during earthwork and construction of the these layers for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed;
- soil-moisture conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- equipment used;
- the number of passes used to compact each lift; and
- desiccation cracks or the presence of ponded water.

4.5.5 Performance Testing

Performance testing during construction of the leveling layer (outside the limits of impacted material disposal limits) and sealing the 680 sandstone layer will be conducted in accordance with the Technical Specifications and CQA Project Plan. The CQC field testing methods, used to confirm compliance of soils during construction, will be performed by the CQC Contractor in accordance with the current version of ASTM test procedures indicated in Table 4-6 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. Test results will be documented and reported to the Construction Manager.

Performance testing will be conducted during the progress of the work. The minimum construction performance testing frequencies are presented in Table 4-6. Sampling locations will be selected by the CQC Contractor.

The standard Proctor compaction test (ASTM D698) will be used for the determination of moisture/density relationships. In-place soil moisture/density nuclear test methods (ASTM D6938) will be used for in-situ field testing. The sand cone test method (ASTM D1556) or drive cylinder test method (ASTM D2937) will be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear moisture/density gauge calibration.

Additional testing may be required when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas or increased test frequency will be considered when:

- rollers slip during rolling operation;
- soil-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- the degree of compaction is doubtful;
- adverse weather conditions; and
- a developing trend of reworking of materials due to failing to meet Technical Specifications.

4.6 LEVELING LAYER (WITHIN IMPACTED MATERIAL DISPOSAL LIMITS) AND SELECT FILL CONSTRUCTION

4.6.1 Overview

Leveling layer (within impacted material disposal limits) and select fill construction includes earthwork consisting of excavation, subgrade preparation, and leveling layer and select fill placement. Select fill is material that is to be placed under the OSWDF compacted clay liner within the impacted material disposal limits.

During construction, pre-conformance and conformance testing, construction monitoring, and performance testing of the select fill component will be performed. These activities are described subsequently.

The prepared subgrade that will support the select fill will be as specified in the Technical Specifications prior to the installation of the select fill materials. The subgrade preparation will be monitored and tested in accordance with Section 4.4 of this CQA Project Plan.

4.6.2 Pre-Conformance Testing

Materials used for leveling layer and select fill construction will be obtained from the on-site sources including, but not limited to, OSWDF excavation, trenching, and on-site stockpiles approved by the Construction Manager. Pre-conformance testing of soils from on-site borrow sources will be performed to identify candidate materials to be stockpiled for potential use as leveling layer and select fill material. Off-site materials identified for possible use will also require pre-conformance testing. Moisture content measurements, Atterberg limits, particle size (sieve) analysis, classification, standard and modified Proctor, and hydraulic conductivity testing will be performed on bulk samples.

4.6.3 Conformance Testing

The conformance testing requirements for the leveling layer and select fill material are summarized in Table 4-4. Conformance tests used to evaluate the suitability of soil materials during construction of the leveling layer and select fill will be performed in accordance with the current version of ASTM test procedures indicated in Table 4-5 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. The frequency of conformance tests will conform to the minimum frequencies presented in Table 4-5.

The stockpile specific acceptable permeability zone (APZ) for select fill material will be established as described in the Clay Liner/Cap Test Pad Program Final Report (TPPFR) (DOE 2015a) and the Addendum to Clay Liner/Cap Test Pad Program Final Report (TPPFR) (DOE 2019). Specimens for hydraulic conductivity testing, per ASTM D5084, will be remolded near the lower left-hand corner of the established APZ and tested at a confining stress of 5 psi. Acceptance of stockpiles will be documented by submitting an approval letter to the Construction Manager.

The CQC Contractor will be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

4.6.4 Construction Monitoring

During placement of the leveling layer and select fill materials, the CQC Contractor will visually monitor and document the Contractor's activities during earthwork and construction of the select fill for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed;
- soil-moisture conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- equipment used;
- the number of passes used to compact each lift; and
- desiccation cracks or the presence of ponded water.

4.6.5 Performance Testing

Performance testing during construction of the leveling layer and select fill will be conducted in accordance with the Technical Specifications and CQA Project Plan. The CQC field testing methods, used to confirm compliance of soils during construction, will be performed by the CQC Contractor in accordance with the current version of ASTM test procedures indicated in Table 4-6 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. Test results will be documented and reported to the Construction Manager.

Performance testing will be conducted during the progress of the work. The minimum construction performance testing frequencies are presented in Table 4-6. Sampling locations will be selected by the CQC Contractor.

The standard and modified Proctor compaction tests (ASTM D698 and D1557) will be used for the determination of moisture/density relationships. In-place soil moisture/density nuclear test methods (ASTM D6938) will be used for in-situ field testing. The sand cone test method (ASTM D1556) or drive cylinder test method (ASTM D2937) will be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear moisture/density gauge calibration.

Additional testing may be required when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas or increased test frequency will be considered when:

- rollers slip during rolling operation;
- test results indicate a substantially inconsistent moisture content;
- it is suspected that less than the specified number of roller passes are made;
- soil-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- the degree of compaction is doubtful;
- adverse weather conditions; and
- a developing trend of reworking of materials due to failing to meet Technical Specifications.

4.7 LINER SYSTEM CONSTRUCTION

4.7.1 Overview

There are several soil components included in the OSWDF liner system as shown on Figure 1-1. The soil components or layers of the OSWDF liner system include the following, from top to bottom:

- granular LCS drainage layer and LCS drainage corridor having a hydraulic conductivity of 1 cm/s or greater and 10 cm/s or greater, respectively;

- granular LDS drainage layer and LDS drainage corridor having a hydraulic conductivity of 1 cm/s or greater and 10 cm/s or greater, respectively; and

- compacted clay liner having a hydraulic conductivity of 1×10^{-7} cm/s or less.

Prior to the start of liner system construction, the CQC Contractor will review and understand the related Construction Drawings, Technical Specifications, and Support Plans. During construction, pre-conformance and conformance testing, construction monitoring, and performance testing of the above soil components will be performed. These activities are described subsequently.

The prepared subgrade that will support the OSWDF liner system will be as specified in the Technical Specifications prior to the installation of the liner system materials. The subgrade preparation will be monitored and tested in accordance with Section 4.4 of this CQA Project Plan.

The liner system for the IMTA shall receive the same CQC testing as the equivalent layers of the OSWDF liner system (i.e., same testing at the same frequency).

4.7.2 Pre-Conformance Testing

Pre-conformance testing of soils from on-site borrow sources may be performed to identify candidate materials to be screened and stockpiled for potential use as compacted clay liner and cap material. The CQC Contractor will collect samples from test pits excavated by the Contractor. Approximately 1 test pit will be excavated for every 1.5 acres of on-site borrow sources to be developed. Samples will be collected to assess moisture content variation with depth as test pit excavation progresses. Moisture content measurements will be made on grab samples collected at approximately 2-ft depth intervals. A minimum of two bulk samples will be collected from each test pit. Moisture content measurements, Atterberg limits, and particle size (sieve) analysis will be performed on bulk samples. Hydrometer tests will be performed on approximately 25 percent of the bulk samples to determine percent clay content.

The CQC Contractor will provide pre-conformance test results for proposed off-site sources of materials. The Construction Manager may require the CQC Contractor to perform additional tests on samples of material from proposed off-site sources as part of the approval process.

4.7.3 Conformance Testing

The conformance testing requirements for the soil components of the OSWDF liner system and protective layer are summarized in Table 4-4. Conformance tests used to evaluate the suitability of soil materials during construction of the OSWDF liner system will be performed in accordance with the current version of ASTM test procedures indicated in Table 4-5 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. The properties of the various soil materials are included in Table 4-4. The frequency of conformance tests will conform to the minimum frequencies presented in Table 4-5.

As shown in Table 4-5, hydraulic conductivity (permeability) tests will be conducted on materials proposed for use as the compacted clay liner material as well as the granular materials for the LDS and LCS drainage layers and corridors.

The stockpile specific APZ for clay liner material will be established as described in the Clay Liner/Cap Test Pad Program Final Report (TPPFR) (DOE 2015a) and the Addendum to Clay Liner/Cap Test Pad Program Final Report (TPPFR) (DOE 2019). Specimens for hydraulic conductivity testing, per ASTM D5084, will be remolded near the lower left-hand corner of the established APZ and tested at a confining stress of 5 psi. Acceptance of clay stockpiles will be documented by submitting an approval letter to the Construction Manager.

Permeability testing of the LDS and LCS drainage layers and corridors will be performed in accordance with ASTM D2434.

The CQC Contractor will be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

4.7.4 Construction Monitoring

During placement of the various OSWDF liner system soil components and the protective layer, the CQC Contractor will visually monitor and document the Contractor's activities during earthwork and construction of the soil components of the liner system for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed;
- soil-moisture conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- equipment used;
- the number of passes used to compact each lift; and
- desiccation cracks or the presence of ponded water.

4.7.5 Performance Testing

Performance testing during construction of the soil components of the OSWDF liner system will be conducted in accordance with the Technical Specifications and CQA Project Plan. The CQC field testing methods, used to confirm compliance of soils during construction, will be performed by the CQC Contractor in accordance with the current version of ASTM test procedures indicated in Table 4-6 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. Test results will be documented and reported to the Construction Manager.

Performance testing will be conducted during the progress of the work. The minimum construction performance testing frequencies are presented in Table 4-6. Sampling locations will be selected by the CQC Contractor.

The standard and modified Proctor compaction tests (ASTM D698 and D1557) will be used for the determination of moisture/density relationships. In-place soil moisture/density nuclear test methods (ASTM D6938) will be used for in-situ field testing. The sand cone test method (ASTM D1556) or drive cylinder test method (ASTM D2937) will be used to establish correlations of moisture and density in cases of uncertainty, and as a check of the nuclear moisture/density gauge calibration.

Additional testing may be required when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas or an increased test frequency will be considered when:

- rollers slip during rolling operation;
- test results indicate a substantially inconsistent moisture content;
- it is suspected that less than the specified number of roller passes are made;
- soil-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- the degree of compaction is doubtful;
- adverse weather conditions; and
- a developing trend of reworking of materials due to failing to meet Technical Specifications.

4.8 FINAL COVER SYSTEM CONSTRUCTION

4.8.1 Overview

There are several soil components in the OSWDF final cover (cap) system as shown on Figure 1-1. The soil components or layers of the OSWDF final cover (cap) system include the following, from top to bottom:

- topsoil layer;
- vegetative soil layer;
- granular filter layer;
- biointrusion barrier with choking layer;
- cover drainage layer having a hydraulic conductivity of 1 cm/s or greater;
- compacted clay cap having a hydraulic conductivity of 1×10^{-7} cm/s or less; and
- contouring layer

Prior to the start of final cover system construction, the CQC Contractor will review and understand the related Construction Drawings, Technical Specifications, and Support Plans. During construction, pre-conformance and conformance testing, construction monitoring, and performance testing of the above soil components will be performed. These activities are described subsequently.

The top of contouring layer that will support the OSWDF final cover (cap) system will be prepared as specified in the Technical Specifications prior to the installation of the final cover system materials. The top of contouring layer preparation will be monitored and tested in accordance with Section 4.4 of this CQA Project Plan.

4.8.2 Pre-Conformance Testing

Pre-conformance testing of the borrow area will be conducted to identify materials suitable for the clay liner and cap material. This pre-conformance testing is described in Section 4.6.2.

The Contractor will provide conformance test results for the proposed off-site sources of materials. The Construction Manager may require the CQC Contractor to perform tests on samples of material from the proposed off-site sources as part of the approval process.

4.8.3 Conformance Testing

The conformance testing requirements for the soil components of the OSWDF final cover (cap) system and contouring layer are summarized in Table 4-7. Conformance tests used to evaluate the suitability of soil materials during construction will be performed in accordance with the current version of ASTM test procedures indicated in Table 4-8 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. The properties of the various soil materials are summarized in Table 4-7.

The frequency of conformance tests will conform to the minimum frequencies presented in Table 4-8. The testing frequencies described herein for fill material will also apply to materials used by the Contractor in areas outside the limits of the final cover system of the OSWDF.

As shown in Table 4-8, hydraulic conductivity (permeability) tests will be conducted on materials proposed for use as the compacted clay cap material as well as the granular material that will comprise the cover drainage layer.

The stockpile specific APZ for clay cap material will be established as described in the TPPFR (DOE 2015a and DOE 2019). Specimens for hydraulic conductivity testing, per ASTM D5084, will be remolded near the lower left hand corner of the established APZ and tested at a confining stress of 5 psi.

Permeability, sieve analysis, and carbonate content tests of the cover drainage layer will be performed in accordance with the test methods listed in Table 4-9.

The CQC Contractor will be responsible for documenting pertinent sampling information including the date the sample was obtained, sample identification number, and location.

4.8.4 Construction Monitoring

During placement of the various soil components of the OSWDF final cover (cap) system and contouring layer, the CQC Contractor will visually monitor and document the Contractor's activities during earthwork and construction of the soil components of the final cover system for the following:

- changes in the soil consistency;
- the thickness of lifts as loosely placed;
- soil-moisture conditioning prior to placement including general observations regarding moisture distribution, clod size, etc.;
- the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);

- the number of passes used to compact each lift; and

- desiccation cracks or the presence of ponded water.

4.8.5 Performance Testing

Performance testing will be conducted in accordance with the Technical Specifications and CQA Project Plan. The CQC field testing methods, used to confirm compliance of soils during construction, will be performed by the CQC Contractor in accordance with the current version of ASTM test procedures indicated in Table 4-9 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager. Test results will be documented and reported to the Construction Manager.

Performance testing will be conducted during the progress of the work. The minimum construction performance testing frequencies are presented in Table 4-9. Sampling locations will be selected by the CQC Contractor.

Unless otherwise specified, the standard Proctor compaction test (ASTM D698) will be used for the determination of moisture/density relationships. In-place soil moisture/density nuclear test method (ASTM D6938) will be used for in-situ field testing. The sand cone test method (ASTM D1556) or drive cylinder test method (ASTM D2937) will be used to establish correlations of moisture and density in cases of uncertainty and as a check of the nuclear moisture/density gauge calibration.

Additional testing may be required when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas or an increased test frequency will be considered when:

- rollers slip during rolling operation;
- test results indicate a substantially inconsistent moisture content;
- it is suspected that less than the specified number of roller passes are made;
- soil-clogged rollers are used to compact the material;
- rollers may not have used optimum ballast;
- the degree of compaction is doubtful;
- adverse weather conditions; and
- a developing trend of reworking of materials due to failing to meet Technical Specifications.

4.9 PERFORATIONS IN SOIL COMPONENTS

Perforations that must be filled with soil meeting Technical Specifications of the soil component or with soil-bentonite mix will include, but not be limited to, the following:

- in-place density test probe locations;
- sand cone or drive cylinder test locations;
- survey stake locations; and
- test pit locations.

Perforations in the compacted clay liner and cap resulting from field tests or other construction activities, as described above, will be filled with soil-bentonite mix in accordance with the requirements of Section 02225 of the Technical Specifications and this CQA Project Plan. In addition, perforations in the select fill, leveling layer, and contouring layer will be filled in accordance with the requirements of

Sections 02200 and 02240, respectively. Perforations in other soil layers will be filled in accordance with the Technical Specifications.

4.10 FIELD EQUIPMENT DECONTAMINATION

The CQC Contractor will perform decontamination of field equipment used in the sampling and testing of soils known or suspected of containing low-level radioactive wastes in accordance with the procedures outlined in ASTM D5608. PORTS site procedures shall be followed when decontaminating and moving equipment out of radiological controlled areas. The practice of decontamination is applicable to most conventional sampling or field testing equipment constructed of metallic and hard, smooth synthetic materials. Materials with rough or porous surfaces, or having a sorption rate, should not be used due to the difficulties with decontaminations.

4.11 DEFICIENCIES

If a defect is discovered in the soils construction, the CQC Contractor will immediately determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQC Contractor will determine the extent of the deficient area by additional tests, observations, a review of records, or other means that the CQC Contractor deems appropriate. The CQC Contractor will take steps to confirm that measurement error (either human or instrument) is checked and eliminated as a source of error before requiring corrective action. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQC Contractor will define the limits and nature of the defect.

After determining the extent and nature of non-conforming condition, the CQC Contractor will verbally notify the Construction Manager and Contractor of deficiency.

The CQC Contractor will verify that the Contractor has corrected noted deficiencies. If a specified criterion cannot be met, or unusual weather conditions hinder work, the Contractor shall submit suggested repair methods to the Construction Manager for review.

At locations where the field testing indicates in-situ conditions which do not comply with the requirements of the Technical Specifications, the failing area shall be reworked to achieve the requirements of the Technical Specifications. Retests performed by the CQC Contractor must verify that the deficiency has been corrected before additional work is performed by the Contractor in the area of the deficiency.

The CQC Contractor will monitor the repair and rework of subgrade and top of contouring layer which may contain excess or insufficient moisture. If such conditions are found to exist, the CQC Contractor will confirm the suitability of the subgrade and top of contouring layer by the following methods as applicable:

- moisture/density testing; and
- continuous visual inspection during proof rolling.

Table 4-1. Conformance Testing, Monitoring, and Performance Testing Requirements for General Soil Construction

GENERAL SOIL CONSTRUCTION (TRENCHING AND EARTHWORK)			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
SUBGRADE (SECTION 02200)	1. Fill for areas where unsuitable subgrade has been removed shall meet the requirements of fill.	Monitor subgrade work activities to confirm compliance with Construction Drawings, support plans, and Section 02200.	1. Fill areas from which subgrade has been removed with fill material compacted to a minimum 95 percent of standard Proctor maximum dry density per ASTM D698. Compact the uppermost lift of fill beneath road and access corridor alignments to a minimum 98 percent of standard Proctor maximum dry density per ASTM D698. 2. Compact fill at a moisture content within 3 percent of the standard Proctor optimum moisture content per ASTM D698. 3. Proof roll as described in Section 02200. Soils shall not exhibit pumping or develop ruts more than 2 inches in depth. 4. Tolerance for subgrade shall be +/- 0.1 feet of the elevations indicated on the Construction Drawings.
FILL (SECTION 02200)	1. Classified as GC, SC, SM, ML, CL, CL-ML, or CH per ASTM D2487; 2. Maximum visible rock particle size is half the loose lift thickness. 3. Maximum clod size is 3 inches or half the thickness of the lift, whichever is less.	Monitor material, placement, and compaction of fill activities to confirm compliance with Construction Drawings, support plans, and Section 02200.	1. Compact fill material in each lift to at least 95 percent (98 percent for the uppermost lift for roads) of standard Proctor maximum dry density per ASTM D698. 2. Compact fill at a moisture content within 3 percent of the standard Proctor optimum moisture content per ASTM D698. 3. Tolerance for earthwork construction shall be +/- 0.1 feet of the elevations indicated on the Construction Drawings.

Table 4-1. Conformance Testing, Monitoring, and Performance Testing Requirements for General Soil Construction (Continued)

GENERAL SOIL CONSTRUCTION (TRENCHING AND EARTHWORK)			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
PIPE EMBEDMENT FILL (SECTION 02215)	1. Structural Backfill Type 2 per 703.11 of the Ohio DOT specification. 2. Gradation testing shall be in accordance with ASTM C136 and the gradation shall meet the requirements of Item 703.02.A or 703.05.A of the Ohio DOT specifications. These gradations are as follows: 703.02.A Gradation **SIEVE SIZE** — **TOTAL PERCENT PASSING** 3/8 inch — 100 No. 4 — 90-100 No. 8 — 70-100 No. 16 — 38-80 No. 30 — 18-60 No. 50 — 5-30 No. 100 — 0-10 No. 200 — 0-5 703.05.A Gradation **SIEVE SIZE** — **TOTAL PERCENT PASSING** 3/8 inch — 100 No. 4 — 90-100 No. 8 — 65-100 No. 16 — 40-85 No. 30 — 20-60 No. 50 — 7-40 No. 100 — 0-20 No. 200 — 0-10	Monitor material, placement, and compaction of pipe embedment fill for compliance with Construction Drawings, support plans, and Section 02215.	1. The tolerance for the pipe embedment fill shall be within 0 to +0.2 feet of the minimum thicknesses indicated on the Construction Drawings.

Table 4-1. Conformance Testing, Monitoring, and Performance Testing Requirements for General Soil Construction (Continued)

GENERAL SOIL CONSTRUCTION (TRENCHING AND EARTHWORK)			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
MANHOLE EMBEDMENT FILL (SECTION 02215)	1. No. 57 stone per 703.01 of the Ohio DOT specification. 2. Gradation testing shall be in accordance with ASTM C136 and the gradation shall meet the requirements of Table 703.01-1 of the Ohio DOT specifications. This gradation is as follows: **SIEVE SIZE — TOTAL PERCENT PASSING** 1 1/2 inch — 100 1 inch — 95-100 1/2 inch — 25-60 No. 4 — 0-10 No. 8 — 0-5	Monitor material, placement, and compaction of manhole embedment fill for compliance with Construction Drawings, support plans, and Section 02215.	1. The tolerance for the manhole embedment fill shall be within 0 to +0.2 feet of the minimum thicknesses indicated on the Construction Drawings.
TRENCH BACKFILL (SECTION 02215)	1. Conformance requirements are the same as fill as specified in Section 02200.	Monitor material, placement, and compaction of trench backfill to confirm compliance with Construction Drawings, support plans, and Section 02215.	1. Compact fill material in each lift to at least 95 percent of standard Proctor maximum dry density per ASTM D698. 2. Compact fill at a moisture content within +/- 3 percent of the standard Proctor optimum moisture content per ASTM D698. 3. Trench backfill material shall be placed to within -0.0 to +0.1 feet of the depth indicated on the Construction Drawings.

Table 4-2. Minimum Conformance Testing Frequencies for General Soil Construction

TEST NAME/TEST METHOD	SOIL TYPE[1, 2]			
	FILL	PIPE EMBEDMENT FILL	MANHOLE EMBEDMENT FILL	TRENCH BACKFILL
Specification Section	02200	02215	02215	02215
Particle Size Analysis/ASTM D6913	1 test per 10,000 yd^3	N/A	N/A	1 test per 10,000 yd^3
Particle Size Analysis/ASTM C136	N/A	1 test per 1,000 yd^3	1 test per 1,000 yd^3	N/A
Atterberg Limits/ASTM D4318	1 test per 10,000 yd^3	N/A	N/A	1 test per 10,000 yd^3
Moisture Content/ASTM D2216 or ASTM D4643	1 test per 10,000 yd^3	N/A	N/A	1 test per 10,000 yd^3
Soil Classification/ASTM D2487	1 test per 10,000 yd^3	N/A	N/A	1 test per 10,000 yd^3
Standard Proctor/ASTM D698	1 test per 10,000 yd^3	N/A	N/A	1 test per 10,000 yd^3

N/A = Not Applicable

NOTES: 1. More frequent testing may be required when indicated by soil variability.
2. Volumes for test frequency are based on in-place volume of material after compaction to specified density.

Table 4-3. Minimum Performance Testing Frequencies for General Soil Construction

TEST NAME/TEST METHOD	SOIL TYPE			
	FILL	PIPE EMBEDMENT FILL	MANHOLE EMBEDMENT FILL	TRENCH BACKFILL
Specification Section	02200	02215	02215	02215
In-situ Moisture/Density ASTM D6938	5 tests per acre per lift(1)	N/A	N/A	1 test per 150 lineal ft per lift
Sand Cone/ASTM D1556 or Drive Cylinder/ASTM D2937	1 test per 25 nuclear tests	N/A	N/A	N/A

N/A = Not Applicable

NOTE: 1. A minimum of two nuclear moisture and density tests shall be performed on each day of active soils construction.

Table 4-4. Conformance Testing, Monitoring, and Performance Testing Requirements for Liner System Construction

LINER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
SUBGRADE (outside impacted material disposal limits) (SECTION 02200)	1. Fill for areas where unsuitable subgrade has been removed shall meet the requirements of fill in Section 02200.	Monitor subgrade work activities to confirm compliance with Construction Drawings, support plans, and Section 02200.	1. Fill areas from which subgrade has been removed with fill material compacted to a minimum 95 percent of standard Proctor maximum dry density per ASTM D698. 2. Compact fill at a moisture content within 3 percent of the standard Proctor optimum moisture content per ASTM D698. 3. Proof roll as described in Section 02200. Soils shall not exhibit pumping or develop ruts more than 2 inches in depth. 4. Tolerance for subgrade shall be +/- 0.1 feet of the elevations indicated on the Construction Drawings. Note: Subgrade within the impacted material limits shall be filled with select fill in accordance with Table 4-4.
LEVELING LAYER (outside impacted material disposal limits) AND SEALING THE 680 SANDSTONE LAYER (SECTION 02200)	1. Materials shall be classified as CH or CL per ASTM D2487. 2. Materials shall be tested in accordance with ASTM D6913 and the results shall meet the particle size requirements: • 100 percent of the particles, by weight, having a maximum dimension not greater than 3 inches; 3. Materials identified for sealing the 680 sandstone layer shall be tested once per source in accordance with ASTM D4647.	Monitor material placement and compaction to confirm compliance with support plans, Construction Drawings, and Section 02200.	1. Compact material in each lift to at least 95 percent of standard Proctor maximum dry density per ASTM D698. 2. Compact material at a moisture content between 0 to +4 percent of the standard Proctor optimum moisture content per ASTM D698. 3. Tolerance for construction shall be +/- 0.1 feet of the elevations indicated on the Construction Drawings. 4. Backfill for perforations shall be bentonite mix in accordance with Section 02225 and shall be placed in approximately 3-inch-thick loose lifts and rod tamped to compact.

Table 4-4. Conformance Testing, Monitoring, and Performance Testing Requirements for Liner System Construction (Continued)

LINER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
LEVELING LAYER (within impacted material disposal limits) AND SELECT FILL (SECTION 02200)	1. Material shall be classified as CH or CL per ASTM D2487. 2. Material shall be tested in accordance with ASTM D6913 and the results shall meet the particle size requirements: • 100 percent of the particles, by weight, having a maximum dimension not greater than 3 inches; 3. Standard and modified Proctor tests (ASTM D698 and ASTM D1557 respectively) to determine APZ. 4. Material shall have hydraulic conductivity (ASTM D5084), to determine APZ, not more than $3.2x10^{-7}$ cm/sec when tested in a laboratory at a confining pressure of 5 pounds per square inch..	Monitor processing, placement, moisture conditioning, and compaction to confirm compliance with support plans, Construction Drawings, and Section 02200.	1. The moisture and dry unit weight of material placed shall be within the APZ defined as those combinations of moisture content and dry unit weight that meet the following criteria: • Moisture content that is on or to the right (in the direction of increasing moisture content) of the best fit line of optimums determined by connecting the optimum moisture contents from the standard and modified Proctor tests (ASTM D698 and ASTM D1557 respectively); • Moisture content not greater than 4 percentage points wet of the average standard Proctor optimum moisture content (ASTM D698); and • Dry unit weight of at least 95% of the average standard Proctor maximum dry unit weight (ASTM D698). 2. Backfill for perforations shall be bentonite mix in accordance with Section 02225 and shall be placed in approximately 3-inch-thick loose lifts and rod tamped to compact.
CLAY LINER (SECTION 02225)	1. Clay liner material shall be classified as CH or CL per ASTM D2487. 2. Clay liner shall be tested in accordance with ASTM D6913 and D7928 and the results shall meet the particle size requirements: • 100 percent of the particles, by weight, having a maximum dimension not greater than 2 inches; • not more than 10 percent of the particles, by weight, having a dimension greater than 0.75 inches; and	Monitor clay liner screening, placement, moisture conditioning, and compaction, to confirm compliance with support plans, Construction Drawings, and Section 02225.	1. The moisture and dry unit weight of clay liner placed shall be within the APZ defined as those combinations of moisture content and dry unit weight that meet the following criteria: • Moisture content that is on or to the right (in the direction of increasing moisture content) of the best fit line of optimums determined by connecting the optimum moisture contents from the standard and modified Proctor tests (ASTM D698 and ASTM D1557 respectively);

Table 4-4. Conformance Testing, Monitoring, and Performance Testing Requirements for Liner System Construction (Continued)

LINER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
	• not less than 50 percent of the particles, by weight, passing through the standard U.S. sieve No. 200. 3. Plasticity index (ASTM D4318) of greater than or equal to 10 and a liquid limit greater than 30. 4. Material shall have hydraulic conductivity (ASTM D5084), to determine APZ, not more than $1x10^{-7}$ cm/sec when tested in a laboratory at a confining pressure of 5 pounds per square inch.		• Moisture content not greater than 4 percentage points wet of the average standard Proctor optimum moisture content (ASTM D698); and • Dry unit weight of at least 95% of the average standard Proctor maximum dry unit weight (ASTM D698). 2. Clay liner shall be constructed to within 0.0 to +0.2 feet of the thicknesses shown on the Construction Drawings. 3. Backfill for perforations shall be bentonite mix in accordance with Section 02225 and shall be placed in approximately 3-inch-thick loose lifts and rod tamped to compact.
GRANULAR DRAINAGE MATERIAL (for LCS Drainage Layer, LDS Drainage Layer, and Protective Layer in Leachate Catchment Area) (SECTION 02710)	1. Material shall be tested in accordance with ASTM C136 and the gradation shall meet the following gradation requirement for modified No. 78 stone: **SIEVE SIZE — TOTAL PERCENT PASSING** ¾-inch — 100 ½-inch — 85-100 3/8-inch — 40-75 No. 4 — 5-25 No. 8 — 0-10 No. 16 — 0-5 No. 200 — 0-2 2. Material shall have a minimum hydraulic conductivity of 1 cm/sec when tested in accordance with ASTM D2434; 3. Material shall be classified a GP when classified in accordance with ASTM D2487; and 4. Material shall have less than 1 percent by weight loss when tested in accordance with ASTM D3042 at a pH of 4.	Monitor the placement and compaction of the material to confirm compliance with support plans, Construction Drawings, and Section 02710.	1. Tolerance for construction shall be within 0.0 to +0.1 feet of the thickness indicated on the Construction Drawings.

Table 4-4. Conformance Testing, Monitoring, and Performance Testing Requirements for Liner System Construction (Continued)

LINER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
GRANULAR DRAINAGE MATERIAL (for IMTA Drainage Layer, 720 Sandstone Monitoring Trench, LCS Drainage Corridor, and LDS Drainage Corridor) (SECTION 02710)	1. Material shall be tested in accordance with ASTM C136 and the gradation shall meet the AASHTO M 43 gradation requirement for No. 57 stone: **SIEVE SIZE — TOTAL PERCENT PASSING** 1 1/2 inch — 100 1 inch — 95-100 1/2 inch — 25-60 No. 4 — 0-10 No. 8 — 0-5 No. 200 — 0-2 2. Material shall have a minimum hydraulic conductivity of 10 cm/sec when tested to ASTM D2434; 3. Material shall be classified a GP when classified in accordance with ASTM D2487; and 4. Material shall have less than 1 percent by weight loss when tested in accordance with ASTM D3042 at a pH of 4.	Monitor the placement and compaction of the material to confirm compliance with support plans, Construction Drawings, and Section 02710.	1. Tolerance for construction shall be within 0.0 to +0.1 feet of the thickness indicated on the Construction Drawings.
PROTECTIVE LAYERS (outside leachate catchment area) (SECTION 02240)	1. Material shall conform to fill material requirements specified in Section 02200; and 2. Material shall not contain visible rock particles greater than 4 inches.	Monitor the placement and compaction of the protective layer to confirm compliance with support plans, Construction Drawings, and Section 02240.	1. The protective layer shall be constructed to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings.

Table 4-5. Minimum Conformance Testing Frequencies for OSWDF Liner System Construction

TEST NAME/TEST METHOD	SOIL TYPE [3,4]			
	LEVELING LAYER, SELECT FILL, AND SEALING 680 SANDSTONE LAYER	COMPACTED CLAY LINER	GRANULAR DRAINAGE MATERIAL	PROTECTIVE LAYER [5] (Outside Leachate Catchment Area)
Specification Section	02200	02225	02710 and 02240	02240
Particle Size Analysis/ASTM D6913 and D7928	1 test per 5,000 yd^3 (D6913 Only)	1 test per 1,500 yd^3	N/A	1 test per 10,000 yd^3 (D6913 Only)
Particle Size Analysis/ASTM C136	N/A	N/A	1 test per 3,000 yd^3	N/A
Atterberg Limits/ASTM D4318	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	1 test per 10,000 yd^3
Moisture Content/ASTM D2216 or ASTM D4643	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	N/A
Soil Classification/ASTM D2487	1 test per 5,000 yd^3	1 test per 1,500 yd^3	1 test per 3,000 yd^3	1 test per 10,000 yd^3
Standard Proctor/ASTM D698	1 test per 5,000 yd^3	1 test per 1,500 yd^3	N/A	N/A
Modified Proctor/ ASTM D1557[1]	1 test per 5,000 yd^3	1 test per 5,000 yd^3	N/A	N/A
Pinhole Test/ ASTM D4647	1 test per source	N/A	N/A	N/A
Hydraulic Conductivity/ASTM D5084	1 test per 10,000 yd^3 (remold sample)	1 test per 10,000 yd^3 (remold sample)	N/A	N/A
Hydraulic Conductivity/ASTM D2434	N/A	N/A	1 test per 3,000 yd^3	N/A
Carbonate Content/ASTM D3042[2]	N/A	N/A	1 test per 3,000 yd^3	N/A

N/A = Not Applicable

NOTES:
1. Modified Proctor test is used in determining the moisture content range meeting APZ criteria.
2. Sample to be tested at pH of 4.
3. More frequent testing may be required when indicated by soil variability.
4. Volumes for test frequency are based on in-place volume of material after compaction to specified density.
5. Test frequencies are for protective layer material outside the leachate catchment area. Type 1 impacted material meeting the requirements of Section 13010 and IMPP may be used for protective layer material outside the leachate catchment area. Type 1 impacted materials shall be compacted as described in Section 7.2.2 of the IMPP using tracking with a bulldozer with ground pressure of 5 psi or less.

Table 4-6. Minimum Performance Testing Frequencies for OSWDF Liner System Components and Granular Protective Layer

TEST NAME/ TEST METHOD	SELECT FILL	COMPACTED CLAY LINER	GRANULAR DRAINAGE MATERIAL	PROTECTIVE LAYER (2) (Outside Leachate Catchment Area)
Specification Section	02200	02225	02710 and 02240	02240
In-situ Moisture/Density ASTM D6938	5 tests per acre per lift (1)	5 tests per acre per lift (1)	N/A	N/A
Sand Cone/ASTM D1556 or Drive Cylinder/ASTM D2937	1 test per 25 nuclear tests	1 test per 25 nuclear tests	N/A	N/A

N/A = Not Applicable

NOTES: 1. A minimum of two nuclear moisture and density tests each day of active soils construction.
2. Test frequencies are for protective layer material outside the leachate catchment area. Type 1 impacted material meeting the requirements of Section 13010 and IMPP may be used for protective layer material outside the leachate catchment area. Type 1 impacted materials shall be compacted as described in Section 7.2.2 of the IMPP using tracking with a bulldozer with ground pressure of 5 psi or less.

Table 4-7. Conformance Testing, Monitoring, and Performance Testing Requirements for Construction Final Cover System

COVER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
CONTOURING LAYER (SECTION 02240)	1. Shall be fill in accordance with Section 02200 and with visible rock particles not greater than 4 inches. The final lift of contouring layer shall not be classified SM or ML per ASTM D2487.	Monitor the placement and compaction of the contouring layer to confirm compliance with Section 02240	1. Place the contouring layer in two loose lifts. The first lift is 10 inches ±1 inch thick. The second lift is 8 inches ±1 inch thick. 2. Dry unit weight of at least 95 percent of standard Proctor maximum dry density per ASTM D698. 3. Moisture content within 3 percent of the standard Proctor optimum moisture content per ASTM D698. 4. Construct to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings. 5. Construct to within -0.3 to +0.1 feet of the elevations shown on the Construction Drawings.
CLAY CAP (SECTION 02225)	1. Clay cap shall be classified as CH or CL per ASTM D2487. 2. Clay cap shall be sieved in accordance with ASTM D6913 and D7928 and the results shall meet the particle size requirements: • 100 percent of the particles, by weight, having a maximum dimension of not greater than 2 inches; • not more than 10 percent of the particles, by weight, having a dimension greater than 0.75 inches; and • not less than 50 percent of the particles, by weight, passing through the standard U.S. sieve No. 200. 3. Plasticity index (ASTM D4318) greater than or equal to 10 and a liquid limit greater than 30. 4. Material shall have hydraulic conductivity (ASTM D5084), to determine APZ, not more than $1x10^{-7}$ cm/sec when tested in a laboratory at a confining pressure of 5 pounds per square inch.	Monitor clay cap screening, placement, moisture conditioning, and compaction, to confirm compliance with support plans, Construction Drawings, and Section 02225.	1. The moisture and dry unit weight of clay liner placed shall be within the APZ defined as those combinations of moisture content and dry unit weight that meet the following criteria: • Moisture content that is on or to the right (in the direction of increasing moisture content) of the best fit line of optimums determined by connecting the optimum moisture contents from the standard and modified proctor tests (ASTM D698 and ASTM D1557 respectively); • Moisture content not greater than 4 percentage points wet of the average standard Proctor optimum moisture content (ASTM D698) 2. Dry unit weight of at least 95% of the average standard Proctor maximum dry unit weight (ASTM D698). 3. Clay cap shall be constructed to within 0.0 to +0.2 feet of the thicknesses shown on the Construction Drawings. 4. Backfill for perforations shall be bentonite mix in accordance with Section 02225 and shall be placed in approximately 3-inch-thick loose lifts and rod tamped to compact.

Table 4-7. Conformance Testing, Monitoring, and Performance Testing Requirements for Construction Final Cover System (Continued)

COVER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
COVER DRAINAGE LAYER (SECTION 02710)	1. The granular drainage material will be tested in accordance with ASTM C136 and the gradation shall meet the following gradation requirement for Modified No. 78 Stone: **SIEVE SIZE — TOTAL PERCENT PASSING** ¾-inch — 100 ½-inch — 85-100 3/8-inch — 40-75 No. 4 — 5-25 No. 8 — 0-10 No. 16 — 0-5 No. 200 — 0-2 2. The minimum hydraulic conductivity shall be 1 cm/sec when tested in accordance with ASTM D2434. 3. Granular drainage material shall be classified as GP per ASTM D2487. 4. Granular drainage material shall have less than 1 percent by weight loss when tested per ASTM D3042 at a pH of 4.	Monitor the placement and compaction of the cover drainage layer to confirm compliance with support plans, Construction Drawings, and Section 02710.	1. The cover drainage layer shall be constructed within 0.0 to +0.1 feet of the thickness indicated on the Construction Drawings.
BIOINTRUSION BARRIER (SECTION 02280)	1. Shall be Type D dumped rock fill specified in Ohio C&MS Item 703.19. 2. Shall be tested for specific gravity in accordance with ASTM C127 and have a minimum bulk specific gravity of 2.60. 3. Shall be tested for maximum absorption in accordance with ASTM C127 and shall have a maximum absorption of 2.0 percent.	Monitor the placement of the biointrusion barrier to confirm compliance with support plans, Construction Drawings, and Section 02280.	1. The biointrusion barrier with choke stone shall be constructed to within –0.1 to +0.3 feet of the thickness shown on the Construction Drawings.

Table 4-7. Conformance Testing, Monitoring, and Performance Testing Requirements for Construction Final Cover System (Continued)

COVER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
BIOINTRUSION BARRIER CHOKE STONE (SECTION 02280)	1. Shall be tested in accordance with ASTM C136 and shall meet the requirements of AASHTO M 43 for No. 57 coarse aggregate; 2. Shall be tested for specific gravity in accordance with ASTM C127 and have a minimum bulk specific gravity of 2.60. 3. Shall be tested for maximum absorption in accordance with ASTM C127 and shall have a maximum absorption at 2.0 percent.	Monitor the placement of the biointrusion choke stone layer to confirm compliance with support plans, Construction Drawings, and Section 02280.	1. The biointrusion barrier with choke stone shall be constructed to within –0.1 to +0.3 feet of the thickness shown on the Construction Drawings.
GRANULAR FILTER LAYER (SECTION 02712)	1. Shall conform to the gradation requirements of Ohio C&MS Item 703.06, but modified to allow only 0 to 5 percent passing the No. 200 sieve, when tested in accordance with ASTM C136.	Monitor the placement and compaction of the granular filter layer to confirm compliance with support plans, Construction Drawings, and Section 02712.	1. The granular filter shall be constructed to within 0.0 to +0.1 feet of the thickness shown on the Construction Drawings.
VEGETATIVE SOIL LAYER (SECTION 02250)	1. Shall be relatively free of debris, foreign objects, large rock fragments, roots, and organics. Also, shall be free of visible rock particles larger than 4 inches. 2. Shall be classified CL, SC, or GC in accordance with ASTM D2487.	Monitor the placement and compaction of the vegetative soil layer to confirm compliance with Construction Drawings, support plans, and Section 02250.	1. Shall be compacted to between 85 and 90 percent of maximum dry unit weight (ASTM D698); 2. Shall have a moisture content within +/- 4 percent of the standard Proctor optimum moisture content (ASTM D698). 3. Construct to within 0.0 to +0.2 feet of the thickness shown on the Construction Drawings.

Table 4-7. Conformance Testing, Monitoring, and Performance Testing Requirements for Construction Final Cover System (Continued)

COVER SYSTEM			
DESCRIPTION OF COMPONENT	**CONFORMANCE TESTING REQUIREMENTS**	**MONITORING REQUIREMENTS**	**PERFORMANCE TESTING REQUIREMENTS**
TOPSOIL (SECTION 02920)	1. Shall be a loose, friable loam, clay loam, silty clay loam, silt loam, or sandy clay loam, as classified by the U.S. Department of Agriculture Natural Resources Conservation Service. 2. Fraction passing the U.S. Standard No. 10 sieve shall contain no more than 40 percent clay-sized fraction as determined in accordance with ASTM D7928. 3. Shall be free of metal, debris, foreign objects, rock fragments larger than 3 inches, stumps, and other deleterious material. 4. Shall contain at least 3 percent organic matter as determined by loss on ignition of samples oven dried to constant weight (per ASTM D2974 Method A for moisture content determination and Method C for ash content determination). 5. Shall have a pH between 6 and 7.5 as determined in accordance with ASTM D4972. 6. Shall have soluble salt content of less than 500 ppm as determined in accordance with ASTM D4542. 7. Nutrient content shall be determined in accordance with ASTM D5268.	Monitor the placement of the topsoil to confirm compliance with Construction Drawings, support plans, and Section 02920.	1. The topsoil layer shall be constructed to within +/-0.1 feet of the thickness shown on the Construction Drawings. 2. The topsoil layer shall be constructed to within 0.0 to +0.5 feet of the elevations indicated on the Construction Drawings.

Table 4-8. Minimum Conformance Testing Frequencies for OSWDF Final Cover (Cap) System Components and Contouring Layer

TEST NAME/TEST METHOD	SOIL TYPE[3,4]							
	COMPACTED CLAY CAP	COVER DRAINAGE LAYER	BIOINTRUSION BARRIER		GRANULAR FILTER	VEGETATIVE SOIL LAYER	TOPSOIL	CONTOURING LAYER
			PRIMARY BIOINTRUSION BARRIER	CHOKE STONE				
Specification Section	02225	02710	02280	02280	02712	02250	02920	02240
Particle Size Analysis/ ASTM D6913 and D7928	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	1 per 5,000 yd^3 (D6913 Only)	1 per 5,000 yd^3 (D6913 Only)	1 test per 10,000 yd^3 (D6913 Only)
Particle Size Analysis/ ASTM C136	N/A	1 test per 3,000 yd^3	N/A	1 test per 10,000 yd^3	1 test per 5,000 yd^3	N/A	N/A	N/A
Atterberg Limits/ASTM D4318	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3	N/A	1 test per 10,000 yd^3
Moisture Content/ ASTM D2216 or ASTM D4643	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	N/A	N/A	1 test per 10,000 yd^3
Soil Classification/ ASTM D2487	1 test per 1,500 yd^3	1 test per 3,000 yd^3	N/A	N/A	N/A	1 test per 5,000 yd^3	N/A	1 test per 10,000 yd^3
Standard Proctor/ ASTM D698[2]	1 test per 1,500 yd^3	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3	N/A	1 test per 10,000 yd^3
Modified Proctor/ ASTM D1557[1]	1 test per 5,000 yd^3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydraulic Conductivity/ ASTM D5084	1 test per 10,000 yd^3 (remold)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hydraulic Conductivity/ ASTM D2434	N/A	1 test per 3,000 yd^3	N/A	N/A	N/A	N/A	N/A	N/A
Carbonate Content/ ASTM D3042[2]	N/A	1 test per 3,000 yd^3				N/A	N/A	N/A
Organic Content/ ASTM D2974[5]	N/A	N/A	N/A	N/A	N/A	N/A	1 test per 5,000 yd^3	N/A
Bulk Specific Gravity/ ASTM C127	N/A	N/A	1 test per 10,000 yd^3	1 test per 10,000 yd^3	N/A	N/A	N/A	N/A
Maximum Absorption/ ASTM C127	N/A	N/A	1 test per 10,000 yd^3	1 test per 10,000 yd^3	N/A	N/A	N/A	N/A

NA = Not Applicable

NOTES:

1. Modified Proctor test is used in determining the moisture content range meeting APZ criteria
2. Sample to be tested at pH of 4.
3. More frequent testing may be required when indicated by soil variability.
4. Volumes for test frequency are based on in-place volume of material after compaction to specified density.
5. ASTM D4972, ASTM D4542, and ASTM D5268 shall be performed at the same frequency as organic content testing for topsoil.

Table 4-9. Minimum Performance Testing Frequencies for OSWDF Cover System Components and Contouring Layer

TEST NAME/TEST METHOD	SOIL TYPE							
	CONTOURING LAYER[2,4]	COMPACTED CLAY CAP	COVER DRAINAGE LAYER	BIOINTRUSION BARRIER		GRANULAR FILTER	VEGETATIVE SOIL LAYER	TOPSOIL
				PRIMARY BIOINTRUSION BARRIER	CHOKE STONE[3]			
Specification Section	02240	02225	02710	02280	02280	02712	02250	02920
In-situ Moisture/Density ASTM D6938	5 tests per acre per lift	5 tests per acre per lift[1]	N/A	N/A	N/A	N/A	2 tests per acre per lift[1]	N/A
Sand Cone/ASTM D1556 or Drive Cylinder/ASTM D2937	1 test per 25 nuclear tests	1 test per 25 nuclear tests	N/A	N/A	N/A	N/A	1 test per 25 nuclear tests	N/A

N/A = Not Applicable

NOTES: 1. A minimum of two nuclear moisture and density tests each day of active soils construction.
2. A minimum of 1 in-situ moisture/density (ASTM D6938) will be performed for each 100 ft x 100 ft (30m x 30m) grid element per lift.
3. Compact with 4 passes of bulldozer as specified in Section 02280 of Technical Specifications.
4. Nuclear density probe depth for the first lift of contouring layer shall be 4”.

5. GEOMEMBRANE LINER AND CAP

5.1 INTRODUCTION

The CQC Contractor will perform conformance testing and will monitor the installation of geomembranes as required by Section 02770 of the Technical Specifications and this CQA Project Plan. The testing used to evaluate the conformance of the geomembrane with the requirements of the Technical Specifications will be carried out by the CQC Contractor in accordance with the current versions of the ASTM or other applicable test procedures indicated in Tables 5-1 and 5-2 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager.

5.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The Contractor and Geosynthetics Installer shall comply with the Construction Drawings and Section 02770 of the Technical Specifications. This specification shall be referenced for the various properties, manufacturing quality control, and installation requirements of the geomembrane materials.

5.3 MANUFACTURING QUALITY CONTROL

5.3.1 Manufacturer's Testing and Certification

The Manufacturer shall sample and test the geomembrane using test methods and frequencies specified in Section 02770 to demonstrate that the material's properties conform to the values specified in Section 02770. The Manufacturer shall submit test results and Manufacturer's quality control certificates documenting the materials comply with the specified properties. Materials will not be released for shipment until conformance sampling and testing has been completed to verify compliance with Technical Specifications in accordance with Section 5.5 of this Plan.

5.3.2 Manufacturing Plant Visit

Representatives from the OSWDF Project Engineering and Project QA will visit the plant that will be used to manufacture geomembrane to confirm manufacturing quality control methods are in compliance with Section 02770 of the Technical Specifications. If possible, such a visit will be performed during the manufacturing of the geomembrane rolls for the OSWDF project so that conformance samples can be collected. The review entity will review the manufacturing process, quality control procedures, laboratory facilities, and testing procedures.

During the project specific plant visit, the review entity will:

- confirm that properties and quality control certificates provided in writing by the Geosynthetics Manufacturer meet all specifications;
- confirm that the measurements of properties by the Geosynthetics Manufacturer are properly documented and test methods used are acceptable;
- spot inspect the rolls and confirm that they are free of holes, blisters, or any sign of contamination by foreign matter;
- review packaging and transportation methods to confirm that these methods are not damaging the geomembrane;
- confirm that all rolls are properly labeled; and

- confirm that extrusion rods and/or beads manufactured for the field seaming of the geomembrane are derived from the same base resin type as the geomembrane.

Upon completion of the manufacturing plant visit, a report describing the findings and observations will be prepared by the QA Representative.

5.4 TRANSPORTATION, HANDLING, AND STORAGE

The CQC Contractor will monitor the transportation, handling, and storage of the geomembrane on-site. The Contractor shall designate a laydown area for the geomembrane storage location. Rolls of geomembrane shall not be stacked upon one another to the extent that deformation of the core occurs, to the point where accessibility for sampling is inhibited, or the height of the stack exceeds recommendation of the Manufacturer. It will be the responsibility of the Contractor to protect the geomembrane stored on-site from theft, vandalism, and damage.

Upon delivery at the site, the Contractor and CQC Contractor will monitor the rolls for defects and damage and will perform an inventory of the materials. This monitoring will be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Contractor will indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe or non-repairable flaws which may compromise geomembrane quality; and

- rolls, which include minor or repairable flaws, which do not compromise geomembrane quality.

The CQC Contractor will also monitor that equipment used to handle the geomembrane on-site is adequate and does not pose risk of damage to the geomembrane when used properly.

5.5 CONFORMANCE TESTING

5.5.1 Sampling Requirements

Geomembrane conformance samples will be taken across the entire width of the roll and will not include the first 3 ft of material. The required minimum geomembrane conformance sampling frequencies are provided in Table 5-1. The sample will be marked to indicate the machine direction with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- identification of individual witnessing sampling.

5.5.2 Testing Requirements

Conformance testing of the geomembrane materials delivered to the site will be conducted to confirm compliance with both the Technical Specifications and the manufacturer's list of minimum average roll values. As a minimum, the geomembrane conformance test requirements listed in Table 5-1 will be performed by the CQC Contractor's Geosynthetics CQC laboratory. Conformance testing and frequency listed in Table 5-1 is in addition to testing required by the Manufacturer for Manufacturing Quality Control per Section 02770.

5.5.3 Test Results

All conformance test results will be reviewed, accepted, and reported by the CQC Contractor before delivery of the geomembrane. Nonconformance of the material's properties with the requirements of the Technical Specifications will be reported to the Construction Manager. In all cases, the test results will meet or exceed the property values listed in Table 02770 of the Technical Specifications.

5.5.4 Conformance Test Failure

In the case of failing test results, the CQC Contractor, Project QA Manager, or Manufacturer may request that another sample from the failing roll be retested by the Geosynthetics CQC Laboratory with the manufacturer's technical representative present during the test. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples will be obtained by the CQC Contractor. These isolation samples will be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fall numerically between the passing roll numbers will be rejected. The CQC Contractor will verify that the Manufacturer has replaced all rejected rolls. The CQC Contractor will document actions taken in conjunction with geomembrane conformance test failures.

5.6 ANCHOR TRENCH

The CQC Contractor will confirm and document that the anchor trench has been constructed in accordance with Construction Drawings. Geosynthetic materials in the anchor trench shall be temporarily anchored with sandbags or other suitable methods approved by the Construction Manager. The anchor trench shall be backfilled with suitable material as indicated in the Construction Drawings and Technical Specifications. In-place moisture/density by nuclear methods testing of the compacted anchor trench backfill will be performed at the frequencies given in Table 4-3.

The anchor trench shall be constructed with a slightly rounded inside corner where the geosynthetics enter the trench. No loose soil shall be allowed to underlie the geosynthetics in the anchor trench. The CQC Contractor will confirm that all temporary ballast (i.e., sandbags) and deleterious materials are removed from the anchor trench prior to backfilling. Backfilling of the anchor trench shall be performed when the geomembrane is in its most contracted state to prevent stress inducement (i.e., trampolining) and using extreme care to prevent damage to the geosynthetic materials.

5.7 GEOMEMBRANE PLACEMENT

5.7.1 Field Panel Identification

A field panel is the unit area of geomembrane, which is to be seamed in the field, i.e., a field panel is a roll or a portion of roll cut in the field.

The CQC Contractor will confirm that each field panel is given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Construction Manager, Geosynthetics Installer, and CQC Contractor. This field panel identification code shall be as simple and logical as possible. The Geosynthetic Manufacturer's roll numbers shall be traceable to the field panel identification code.

The CQC Contractor will document the correspondence between roll numbers and field panel identification codes. The field panel identification code will be used for quality assurance/quality control records.

5.7.2 Field Panel Placement

The CQC Contractor will monitor that field panels are installed at the location indicated in the Geosynthetics Installer's layout plan, as approved or modified. The CQC Contractor will record the field panel identification code, manufacturer's roll number, location, date of installation, and dimensions of each field panel.

Geomembrane placement shall not proceed at an ambient temperature below 40°F or above 104°F unless authorized in writing by the Construction Manager. Geomembrane placement shall not proceed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. The CQC Contractor will monitor that the above conditions are fulfilled and that the supporting soil has not been damaged by adverse weather conditions.

The CQC Contractor will monitor geomembrane deployment for the following:

- equipment used does not damage the geomembrane by handling, trafficking, excessive heat, leakage of hydrocarbons or other means;
- the prepared surface underlying the geomembrane has not deteriorated since previous acceptance, and is still acceptable immediately prior to geomembrane placement;
- adjacent geomembrane panels are shingled in the direction of slope;
- geosynthetic elements immediately underlying the geomembrane are clean and free of foreign objects or debris;
- personnel working on the geomembrane do not smoke, wear damaging shoes, or engage in other activities which could damage the geomembrane;
- the method used to unroll the panels does not cause scratches or crimps in the geomembrane and does not damage the supporting soil;
- the method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels);
- adequate temporary loading and/or anchoring (e.g., sandbags), not likely to damage the geomembrane, has been placed to prevent uplift by wind. Continuous loading, by adjacent sandbags or other approved objects is recommended along edges of panels to minimize risk of wind uplifting the panels; and
- direct contact with the geomembrane is minimized; i.e., the geomembrane is protected by geotextiles, extra geomembrane, or other suitable materials, in areas where excessive traffic may be expected.

The CQC Contractor will monitor the geomembrane panels, after placement and prior to seaming, for damage. The CQC Contractor will advise the Construction Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected will be marked and their removal from the work area recorded by the CQC Contractor. Repairs shall be made according to procedures described in this Section and the Technical Specifications.

5.8 FIELD PANEL SEAMING

5.8.1 Panel Layout

The CQC Contractor will review the panel layout drawing previously submitted to the Construction Manager by the Geosynthetics Installer and verify that it is consistent with accepted state of practice. In general, seams shall be oriented parallel to the line of maximum slope, i.e., oriented along, not across, the slope. In corners and odd-shaped geometric locations, the number of seams should be minimized. Horizontal seam shall be at least 10 ft from the toe or crest of the slope, or areas of potential stress concentrations, unless otherwise authorized by the Construction Manager. A seam numbering system compatible with the field panel identification numbering system shall be agreed upon prior to seaming.

5.8.2 Seaming Equipment and Products

Approved processes for field seaming are extrusion welding and fusion welding. Proposed alternate processes shall be documented and submitted to the Construction Manager for approval. Only equipment which has been specifically recommended by the Manufacturer by make and model shall be used. Seaming equipment shall be permanently marked with an identification number.

5.8.2.1 Filet extrusion process

The filet extrusion-welding apparatus shall be equipped with gauges showing the preheat and extrudate temperatures. The CQC Contractor will establish where the temperature sensors are located and record the information on a form (e.g., trial weld log). The CQC Contractor will confirm that the extrudate is comprised of the same resin as the geomembrane sheeting. The CQC Contractor will monitor ambient temperatures. When ambient temperature is below 50°F the CQC Contractor will monitor the geomembrane surface temperature at appropriate intervals but not to exceed four hours of welding.

The CQC Contractor will also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;
- equipment used for seaming is not likely to damage the geomembrane;
- the extruder is purged prior to beginning a seam until all heat-degraded extrudate has been removed from the barrel;
- the electric generator is placed in a drip pan to contain spillage from the fuel tank and to prevent damage to the geomembrane; and
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage.

5.8.2.2 Fusion process

The fusion-welding apparatus must be automated, self-propelled devices. The fusion-welding apparatus shall be equipped with gauges giving the applicable temperatures and welding speed. The CQC Contractor will monitor ambient temperatures and apparatus temperatures.

The CQC Contractor will also monitor that:

- the number of spare operable seaming apparatus agreed by the Construction Manager are maintained on site;

- equipment used for seaming will not damage the geomembrane;
- the electric generator is placed in a drip pan to contain spillage from the fuel tank and to prevent damage to the geomembrane;
- a smooth insulating plate or fabric is placed beneath the hot welding apparatus after usage; and
- a movable protective layer is used, as necessary, directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between the sheets.

5.8.3 Seam Preparation

The CQC Contractor will monitor that:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris of any kind, and foreign material;
- seams are overlapped a minimum of 4 inches;
- if seam overlap grinding is required, the process is completed according to the Technical Specifications, prior to the seaming operation, and in a way that does not damage the geomembrane;
- the grind depth shall not exceed 10 percent of the geomembrane thickness;
- grinding marks shall not appear beyond the extrudate after it is placed; and
- seams are aligned with the fewest possible number of wrinkles and “fishmouths”.

5.8.4 Weather Conditions for Seaming

The normally required weather conditions for seaming are as follows:

- Between ambient temperatures of 40°F and 50°F, seaming is possible if the geomembrane is preheated by either sun or hot air device, and if there is no cooling of the geomembrane to below 50°F resulting from wind.
- Unless authorized in writing by the Construction Manager, no seaming shall be attempted at an ambient temperature below 40°F or above 104°F.
- In all cases, the geomembrane seam areas shall be dry and protected from wind.

The CQC Contractor will confirm that methods used by the Geosynthetic Installer for seaming at ambient temperatures below 40°F or above 104°F will produce seams that are equivalent to seams produced at ambient temperatures between 40°F and 104°F and protect the overall quality of the geomembrane. The CQC Contractor will monitor that seaming conducted during abnormal weather conditions is performed in accordance with the methods approved by the Construction Manager.

5.8.5 Overlapping and Temporary Bonding

The CQC Contractor will monitor that:

- the panels of geomembrane have a finished overlap of a minimum of 4 in. for both extrusion and fusion welding, but in any event sufficient overlap shall be provided to allow peel tests to be performed on the seam;

- no solvent or adhesive is used unless the product is approved in writing by the Construction Manager (samples shall be submitted to the Construction Manager for testing and evaluation); and

- the method used to temporarily bond adjacent panels together does not damage the geomembrane; in particular, the temperature of hot air at the nozzle of any spot welding apparatus is controlled such that the geomembrane is not damaged.

5.8.6 Trial Seams

The CQC Contractor will confirm that the Geosynthetics Installer performs trial seam tests in accordance with Section 02770 of the Technical Specifications. The CQC Contractor will monitor and document the Geosynthetic Installer's trial seam testing procedures. The trial seam samples will be assigned an identification number and marked accordingly by the CQC Contractor. Each sample will be marked with the date, time, machine temperature(s) and setting(s), number of seaming unit, and name of seaming technician. Trial seam samples shall be maintained by the Geosynthetics Installer until a passing destructive test is achieved on seam represented by the trial seam sample.

5.8.7 General Seaming Methods

No geomembrane seaming shall be performed unless the CQC Contractor is on-site. The CQC Contractor will monitor the general seaming methods used by the Geosynthetics Installer as follows:

- If required, a firm substrate shall be provided by using a conveyor belt, or similar hard surface directly under the seam overlap to achieve proper support.

- Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and portions where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane extending a minimum of 6 in. beyond the cut in all directions.

- If seaming operations are carried out at night, adequate illumination shall be provided by the Contractor to the satisfaction of the Construction Manager.

- Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

5.9 NONDESTRUCTIVE SEAM CONTINUITY TESTING

The CQC Contractor will monitor that the Geosynthetics Installer nondestructively test field seams over their full length using a vacuum test unit or air pressure test (for double fusion seams only). Spark testing may be performed when specifically approved by the Construction Manager if the seam cannot be tested using the vacuum or air pressure test methods. The purpose of nondestructive tests is to check the continuity of seams. The nondestructive seam testing shall be carried out as the seaming work progresses, not at the completion of all field seaming.

The CQC Contractor will:

- monitor nondestructive testing;
- document the results of the nondestructive testing and the method of testing; and

- inform the Geosynthetic Installer, Contractor, and Construction Manager of noncompliance.

Required seam repairs shall be made in accordance with the Technical Specifications. The CQC Contractor will:

- monitor the repair methods;
- monitor the retesting methods; and
- document the results.

The seam number, date of observation, dimensions and/or descriptive location of the seam length tested, name of person performing the test, and outcome of the test will be recorded by the CQC Contractor.

5.10 DESTRUCTIVE TESTING

Destructive seam testing shall be performed during the geomembrane installation. The purpose of this testing is to evaluate seam strength. Destructive seam testing shall be done as the seaming work progresses, not at the completion of all field seaming.

5.10.1 Location and Frequency

The CQC Contractor will select all destructive seam test sample locations. Sample locations will be established as follows:

- A minimum frequency of one test location per 500 ft of seam length. This minimum frequency is to be determined as an average taken throughout the entire facility.

- Test locations will be determined during seaming at the CQC Contractor's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or other potential cause of imperfect welding.

The Geosynthetics Installer will not be informed in advance of the locations where the seam samples will be taken.

5.10.2 Sampling Requirements

Destructive seam testing shall be performed as the seaming progresses in order to obtain the Geosynthetics CQC Laboratory test results before the geomembrane is covered by overlying materials. The CQC Contractor will:

- observe sample cutting;
- assign a number to each sample, and mark it accordingly; and
- record sample location on layout drawing.

Holes in the geomembrane resulting from destructive seam test sampling shall be repaired in accordance with repair methods described in Section 02770 of the Technical Specifications. The continuity of the new seams in the repaired area shall be nondestructively tested according to Section 5.9.

5.10.3 Size of Samples

At a given sampling location, two types of samples (field test samples and laboratory test samples) shall be taken. First, a minimum of two field samples or test strips shall be taken for field testing. Each of these test strips shall be 1 in. wide by 12 in. long, with the seam centered parallel to the width. The distance between these two specimens shall be 42 in. If both specimens pass the field test described in

this Section, a second full laboratory destructive sample will be taken for testing by the Geosynthetics CQC Laboratory.

The full destructive sample shall be located between the two field test strips. The sample shall be 12 in. wide by 42 in. long with the seam centered lengthwise. The sample will be cut into three parts and distributed as follows:

- one 12 in. by 12 in. portion to the Geosynthetics Installer;
- one 12 in. by 12 in. portion to the Construction Manager for archive storage; and
- one 12 in. by 18 in. portion for Geosynthetics CQC Laboratory testing.

5.10.4 Field Testing

The test strips shall be tested in the field, for peel adhesion, using a calibrated gauged tensiometer. In addition to meeting the strength requirements as specified in Section 02770 of the Technical Specifications, specimens shall not fail in the weld (see Note 3, Table 5-2). If a field test sample fails to meet these requirements, the destructive sample has failed.

The CQC Contractor will witness field tests and mark samples and portions with their number. The CQC Contractor will also log the date, number of seaming unit, seaming technician identification, destructive sampling, and pass or fail description.

5.10.5 Geosynthetics CQC Laboratory Testing

Destructive test samples will be tested by the Geosynthetics CQC Laboratory. Testing will include "Bonded Seam Strength" and "Peel Adhesion" (ASTM D6392). The minimum acceptable values to be obtained in these tests are presented in Section 02770 of the Technical Specifications. At least five specimens will be tested for each test method. Specimens will be selected alternately by test from the samples (i.e., peel, shear, peel, shear...). Both the inside and outside tracks of the double track fusion seams will be tested for peel adhesion. A passing test will meet the minimum required values in at least four out of five specimens.

The Geosynthetics CQC Laboratory will demonstrate the ability to provide test results no more than 24 hours after they receive the samples. The CQA Officer or Lead Geosynthetics Field Technician will review laboratory test results as soon as they become available, and make appropriate recommendations to the Construction Manager.

5.10.6 Requirement for Destructive Test Failure

The following requirements will apply whenever a sample fails a destructive test, whether that test was conducted in the field or by the Geosynthetics CQC Laboratory. The CQC Contractor will monitor that the Geosynthetics Installer follow one of two options:

- The Geosynthetics Installer can reconstruct the seam (e.g., remove the old seam and reseam) between two passed destructive test locations.

- The Geosynthetics Installer can trace the welding path to an intermediate location a minimum of 10 ft from the point of the failed test in each direction and take a small sample for additional field testing in accordance with the destructive test procedure at each location. If these additional isolation samples pass the field test, then full laboratory samples are taken at both locations. If these laboratory samples meet the specified strength criteria, then the seam is reconstructed between these locations. If either

sample fails, then the process is repeated to establish the zone in which the seam should be reconstructed.

Failed seams will be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from the zone in which the seam has been reconstructed must pass destructive testing. Repairs shall be made in accordance with this Section. The CQC Contractor will document all actions taken in conjunction with destructive test failures.

5.11 DEFECTS AND REPAIRS

5.11.1 Identification

Seams and panel areas of the geomembrane will be examined by the CQC Contractor for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The Construction Manager will require the geomembrane surface to be broomed or washed by the Contractor if the amount of dust or mud inhibits examination.

5.11.2 Repair Requirements

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetics Installer in accordance with Section 02770 of the Technical Specifications. Several methods exist for the repair of these areas. The final decision as to the appropriate repair methods shall be agreed upon between the Contractor and Construction Manager.

In addition, the following conditions will be monitored by the CQC Contractor:

- surfaces of the geomembrane which are to be repaired shall be abraded no more than one hour prior to the repair;
- surfaces must be clean and dry at the time of the repair;
- seaming equipment used in repairing methods must be approved;
- patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.; and
- the geomembrane below large caps should be appropriately cut to avoid water or gas collection between the two sheets.

5.11.3 Verification of Repairs

Each repair shall be numbered and logged. Each repair shall be non-destructively tested using approved methods. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Large caps may be of sufficient extent to require destructive test sampling, at the discretion of the Construction Manager or as specified in Table 5-2. The CQC Contractor will observe non-destructive testing of repairs and will record the number of each repair, date, and test outcome.

5.12 ELECTRICAL LEAK DETECTION TESTING

Electrical leak detection testing of the geomembrane liners and the geomembrane caps shall be conducted as supplemental CQC testing by the Electrical Leak Detection Testing Contractor who will be

independent from the Geosynthetics Installer. This testing shall be conducted in a manner to protect the installation of geomembrane and geosynthetic clay liner (GCL) components of the liner and final cover (cap) systems. The Electrical Leak Detection Testing Contractor shall perform the work, document the results of the work, and delineate detected leaks for repair.

The CQC Contractor will monitor the Electrical Leak Detection Testing Contractor's electrical leak detection testing of the geomembrane liners and the geomembrane caps. The CQC Contractor will:

- confirm adequate water supply and pressure during the testing;
- maintain a location map delineating areas completed by electrical leak detection testing;
- document monitoring of the electrical leak detection testing; and
- inform the Electrical Leak Detection Testing Contractor and Construction Manager of Electrical Leak Detection non-compliance.

The CQC Contractor will confirm that required repairs are made in accordance with Section 02770 of the Technical Specifications and Section 5.11 of this CQA Project Plan.

5.13 LINER AND CAP SYSTEM ACCEPTANCE

The Contractor shall retain all responsibility for the geosynthetics from site delivery until in-place acceptance by the Construction Manager. The terms for liner and cap systems acceptance are described in Section 02770 of the Technical Specifications.

5.14 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

The methods outlined in this section are intended to confirm that the installation of materials in contact with the geomembrane do not cause damage. Additional quality control methods are necessary to confirm that systems built with these materials will be constructed in a way that proper performance is achieved.

5.14.1 Soils

The CQC Contractor will monitor that the Contractor takes necessary precautions to prevent damage to the geomembrane during installation or during the installation of other components of the liner or cover system or by other construction activities. The CQC Contractor will monitor the following:

- placement of granular drainage materials above the geomembrane which shall not proceed at an ambient temperature below 40°F or above 104°F unless otherwise approved by the Construction Manager;
- granular drainage material placement operations above the geomembrane which shall be made by the Contractor to minimize wrinkles in the geomembrane;
- equipment shall not be driven directly on the geomembrane;
- the specified minimum granular drainage material or protective layer thickness is used between a light track-mounted dozer and the geomembrane;

- the specified minimum granular drainage material, protective layer, or select impacted material thickness is used between rubber-tired vehicles and the geomembrane; and

- the specified minimum soil thickness is used in heavily trafficked areas such as access ramps.

5.14.2 Appurtenances

The CQC Contractor will monitor that:

- installation of the geomembrane in appurtenant areas, and connection of geomembrane to sumps and appurtenances have been made in accordance with the Construction Drawings and Technical Specifications;

- extreme care is taken by the Geosynthetics Installer when seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and

- the geomembrane has not been visibly damaged when making connections to sumps and appurtenances.

Table 5-1. Geomembrane Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY (1)
Density	ASTM D792 Method A or ASTM D1505	1 test per 100,000 ft^2
Thickness	ASTM D 5994	1 test per 100,000 ft^2
Tensile Strength at Yield	ASTM D6693	1 test per 100,000 ft^2
Tensile Strength at Break	ASTM D6693	1 test per 100,000 ft^2
Elongation at Yield	ASTM D6693	1 test per 100,000 ft^2
Elongation at Break	ASTM D6693	1 test per 100,000 ft^2
Carbon Black Content	ASTM D4218 (2)	1 test per 100,000 ft^2
Carbon Black Dispersion	ASTM D5596	1 test per 100,000 ft^2
Direct Shear (3)	ASTM D6243-09	1 test per 200,000 ft^2

Notes:
1. Test shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot shall be as defined by ASTM D4354.
2. Other methods such as ASTM D1603 (tube furnace) or ASTM D6370 (TGA) are acceptable if an appropriate correlation to ASTM D4218 (muffle furnace) can be established.
3. Direct Shear testing shall be implemented in accordance with approved recommendations from the Soil/Geosynthetics Direct Shear Testing Program.

Table 5-2. Geomembrane Seam Testing Requirements

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY
Peel Adhesion [5]	ASTM D6392 [1,3, 4]	1 test every 500 ft of seam length
Bonded Seam Strength [5]	ASTM D6392 [2,3,4]	1 test every 500 ft of seam length
Vacuum Testing	ASTM D5641	100 percent of extrusion welded seams and repairs
Air Pressure Testing	ASTM D5820	fusion welded seams [7]
Electrical Leak Detection		See Note 6

Notes:
1. For peel adhesion, seam separation shall not extend more than 10 percent into the seam interface. Testing shall be discontinued when the sample has visually yielded.
2. For shear tests, the sheet shall yield before failure of the seam.
3. Seams shall have maximum 10% incursion. In addition, the weld shall conform to the minimum strength requirements and exhibit the following location of breaks:
   Fusion Welded Seams – BRK, SE1, SE2, and AD-BRK
   Extrusion Welded Seams – SE1, SE2, SE3, BRK1, and BRK2.
4. Where conditioning of the test sample is required, conditioning shall be minimum 1 hr. at standard laboratory atmosphere.
5. Minimum values for peel adhesion and bonded seam strength are included in Technical Specification Section 02770.
6. Electrical leak detection testing of exposed geomembrane liners (all fusion and extrusion welded seams) and geomembrane liners after placement of drainage aggregate is required. Electrical leak detection testing of exposed geomembrane caps (all fusion and extrusion welded seams) is also required.
7. One hundred percent (100%) of fusion welded seams must be tested by Air Pressure Testing.

6. GEOSYNTHETIC CLAY LINER AND CAP

6.1 INTRODUCTION

The geosynthetic clay liner and cap layers of the OSWDF are comprised of GCL material. The CQC Contractor will perform conformance testing and will monitor the installation of the GCL as required by Section 02772 of the Technical Specifications and this CQA Project Plan. The testing used to evaluate the conformance of the GCL with the requirements of the Technical Specifications will be performed by the CQC Contractor in accordance with the current versions of the ASTM or other applicable test procedures indicated in Table 6-1 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Field Engineering Manager.

6.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The Contractor and Geosynthetics Installer shall comply with the Construction Drawings and Section 02772 of the Technical Specifications. The CQC Contractor will reference these documents for the various properties, manufacturing quality control, and installation requirements of the GCL materials.

6.3 MANUFACTURING QUALITY CONTROL

6.3.1 Manufacturer's Testing and Certification

The Manufacturer shall sample and test the GCL using test methods and frequencies specified in Section 02772 to demonstrate that the material's properties conform to the values specified in Section 02772. The Manufacturer shall submit test results, and Manufacturer's quality control certificates documenting the materials comply with the specified properties. Materials will not be released for shipment until conformance sampling and testing have been completed to verify compliance with Technical Specifications in accordance with Section 6.5 of this Plan.

6.3.2 Manufacturing Plant Visit

Representatives from the OSWDF Project Engineering and the Project QA will visit the plant of the GCL Manufacturer for the purpose of confirming that manufacturing quality control procedures are in conformance with Section 02772 of the Technical Specifications. If possible, such a visit will be performed prior to or during the manufacturing of the GCL rolls for the OSWDF project so that conformance samples can be collected. The review entity will review the manufacturing process, quality control methods, laboratory facilities, and testing procedures.

During the project specific plant visit, the review entity will:

- confirm that properties and quality control certificates provided in writing by the GCL Manufacturer meet specifications;
- confirm that the measurements of properties by the GCL Manufacturer are properly documented and test methods used are acceptable;
- spot inspect the rolls and confirm that they are free of defects, or any sign of contamination by foreign matter;
- review packaging and transportation methods to confirm that these methods are not damaging the GCL; and
- confirm that all rolls are properly labeled.

Upon completion of the manufacturing plant visit, a report describing the findings and observations by the review entity will be prepared by the CQC Organization.

6.4 TRANSPORTATION, HANDLING, AND STORAGE

The CQC Contractor will monitor the transportation, handling, and storage of the GCL on-site. Handling of the rolls shall be performed in a competent manner such that damage does not occur to the GCL or its protective wrapping. Protective wrapping that is damaged or stripped off the rolls shall be repaired immediately to the satisfaction of the Construction Manager. Rolls of GCL shall not be stacked upon one another to the extent that deformation of the core occurs, to the point where accessibility is inhibited, or the height of the stack exceeds the Manufacturer's recommendation. During transportation, handling, and storage the GCL rolls shall be protected from ultraviolet light exposure, precipitation or ponding water, mud, dirt, dust, puncture, cutting or other damaging or deleterious conditions. Stored GCL shall be covered with tarp.

Upon delivery at the site, the Contractor and CQC Contractor will monitor the rolls for defects and damage and perform an inventory of materials delivered. This monitoring will be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Contractor will indicate to the Construction Manager:

- rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and

- rolls, which include minor repairable flaws.

The CQC Contractor will also monitor that equipment used to handle the geosynthetics on-site is adequate and does not pose any risk of damage to the geosynthetics when used properly.

6.5 CONFORMANCE TESTING

6.5.1 Sampling Requirements

Conformance samples will be a minimum of 3-ft long by the roll width. The sample shall be marked to indicate the machine direction and tape or otherwise secure the cut edges of the sample to eliminate the loss of the granular bentonite. The required minimum GCL sampling frequencies are provided in Table 6-1. The rolls shall be immediately re-wrapped and replaced in their shipping trailers or in the temporary field storage area. The sample will be marked to indicate the machine direction with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- identification of the individual witnessing the sampling.

6.5.2 Testing Requirements

Conformance testing of the GCL materials to be delivered to the site will be conducted to confirm compliance with Section 02772 of the Technical Specifications. As a minimum, the GCL conformance test methods listed in Table 6-1 will be performed by the CQC Contractor's Geosynthetics CQC Laboratory. Conformance testing and frequency listed in Table 6-1 will be performed by the

Geosynthetic CQC Laboratory and is in addition to testing required by the Manufacturer for Manufacturing Quality Control per Section 02772.

6.5.3 Test Results

The CQC Contractor will review results from laboratory conformance testing and report nonconformance to the Construction Manager. The GCL conformance test results will meet or exceed the minimum property values presented in Section 02772 of the Technical Specifications.

6.5.4 Conformance Test Failure

In the case of failing test results, the Manufacturer, Project QA Manager, or CQC Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQC Laboratory with the manufacturer's technical representative present during the test. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples will be obtained by the CQC Contractor. These isolation samples will be taken from rolls, which have been determined by correlation with the manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. Rolls which fall numerically between the passing roll numbers will be rejected by the Construction Manager. The CQC Contractor will verify that the Manufacturer has replaced all rejected rolls. The CQC Contractor will document actions taken in conjunction with GCL conformance test failures.

6.5.5 Conformance Test Results Reporting

The CQC Contractor shall provide the GCL conformance test results for each phase of construction to the Construction Manager for submittal to Ohio Environmental Protection Agency (Ohio EPA) Southeast District office no later than seven days prior to installation of the GCL for the OSWDF project. The conformance test results to be reported to Ohio EPA Southeast District office shall include the following as required by Rule 3745-27-08(D)(9)(c) of the *Ohio Administrative Code (OAC)*:

- Internal drained shear strength using a direct shear test method (ASTM D6243) at the frequency listed in Table 6-1 to meet or exceed the minimum property values presented in Section 02772 of the Technical Specifications and in accordance with the approved Direct Shear Testing Program Final Report [paragraph (i)].

- The dry bentonite mass or bentonite content (at zero percent moisture content) per square foot (ft^2) of GCL tested according to ASTM D5993 at a minimum frequency of 1 test per 50,000 ft^2 to meet or exceed the minimum property values presented in Section 02772 of the Technical Specifications. Manufacturer's quality control test results performed in accordance with Section 02772 of the Technical Specifications for each phase of construction may be used to meet this reporting requirement [paragraph (ii)].

- Interface shear strength using a direct shear test method (ASTM D6243) at the frequency listed in Table 6-1 to meet or exceed the minimum property values presented in Section 02772 of the Technical Specifications and in accordance with the approved Direct Shear Testing Program Final Report [paragraph (iii)].

It should be noted that results of the Direct Shear Testing Program Final Report approved by the Ohio EPA fulfills the primary requirement of *OAC* 3745-27-08(G). The first and third bullets above satisfy the requirements of *OAC* 3745-27-08(G) for reporting for each subsequent construction event. In addition, the CQC Contractor shall include the GCL test results in the CQA Construction Certification Report for each phase of construction.

6.6 SURFACE PREPARATION

The GCL shall not be placed on surfaces which are softened due to high water content or have desiccation cracks as defined in Technical Specification Sections 02225 and 02772. The CQC Contractor and the Geosynthetics Installer will jointly verify that the surface on which the GCL will be installed is acceptable. The Contractor shall comply with the compacted clay liner surface preparation and acceptance requirements identified in Sections 02225 and 02772 of the Technical Specifications. The CQC Contractor will notify the Construction Manager of any observed change in the supporting soil condition that may require repair work and verify that compacted clay liner repair work is completed in accordance with the requirements of the Technical Specifications and this CQA Project Plan.

6.7 PLACEMENT

The CQC Contractor will confirm that the Geosynthetics Installer has taken all necessary precautions to protect the underlying compacted clay liner or cap and top of LCS layer during GCL installation operations and that placement of GCL are in accordance with Manufacturer's recommendations and/or Technical Specifications, whichever is most stringent. The CQC Contractor will confirm that the GCL are handled in such a manner that they are not damaged, and the following conditions are met:

- on slopes, the GCL are secured and then rolled down the slope in such a manner as to continually keep the GCL panel in tension and prevent loss of bentonite;
- adjacent GCL panels are shingled in the direction of the slope;
- GCL are kept continually under tension to minimize the presence of wrinkles;
- GCL are cut using a utility blade in a manner recommended by the Manufacturer;
- during placement, care is taken not to entrap fugitive clay, sand, stones, or debris under the GCL;
- the exposed GCL are protected from damage in heavily trafficked areas;
- a visual examination of the GCL is carried out over the entire surface, after installation, to confirm that damaged areas, if any, are identified and repaired; and
- if a white colored GCL is used, take appropriate measures to protect against "snowblindness" of personnel.

6.8 OVERLAPS

The CQC Contractor will monitor and confirm the GCL overlapping procedures conform to the requirements of Section 02772 of the Technical Specifications and Manufacturer's recommendations, whichever is more stringent.

6.9 REPAIR

The CQC Contractor will monitor the repair of holes or tears in the GCL or the geotextile backing. Patching requirements will conform to the most stringent of Manufacturer's recommendations and Technical Specification Section 02772 requirements.

The CQC Contractor will monitor for hydrated GCL. GCL hydrated to a moisture content in excess of 40 percent, when measured in accordance with ASTM D4643, will be marked for removal and replacement by the Geosynthetics Installer.

Table 6-1. GCL Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY(1)
Direct Shear(2)	ASTM D6243	1 test per 200,000 ft^2
Hydraulic Conductivity(3)	ASTM D5887	1 test per 200,000 ft^2

Notes:

1. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM D4354.

2. Each sample will be tested using the most recent version of the ASTM for the following: (i) internal shear strength; (ii) interface shear strength of geosynthetic clay liner and clay liner soil; and (iii) interface shear strength of geosynthetic clay liner and the geomembrane liner or the geomembrane cap.

3. Section 10 of ASTM D5887 provides the equations to calculate the index flux. Hydraulic conductivity will also be calculated using average of three thickness measurements on the clay component of the GCL. The thickness measurements will be taken at the completion of the test within 30 minutes after dismounting the test specimen. Calipers or similar devices will be used for measuring after carefully cutting the test specimen with a sharp razor knife

7. GEOTEXTILES

7.1 INTRODUCTION

The CQC Contractor will perform conformance testing and will monitor the installation of geotextile filters, cushions, and separators (geotextiles) as required by Section 02714 of the Technical Specifications and this CQA Project Plan. The testing used to evaluate the conformance of the geotextiles with the requirements of the Technical Specifications will be performed by the CQC Contractor in accordance with current versions of the ASTM or other applicable test methods indicated in Tables 7-1 and 7-2 which are in effect at the time of award of construction contract, unless otherwise specified or approved by the Construction Manager.

7.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The Contractor and Geosynthetics Installer shall comply with Section 02714 of the Technical Specifications. The CQC Contractor will reference this specification for specific details of the geotextile material properties, manufacturing quality control, and installation requirements of the geotextiles.

7.3 MANUFACTURING QUALITY CONTROL

Manufacturer shall sample and test the geotextile materials using test methods and frequencies specified in Section 02714 to demonstrate that the material properties conform to the values specified in Section 02714. Manufacturer quality control testing of geotextile will be conducted by the Manufacturer as part of the geotextile quality control certificate submittal process. In addition, for geotextiles used in OSWDF liner system, IMTA liner, for the OSWDF cover/cap system, samples will be obtained from the manufacturing plant by a representative of the CQC Contractor for conformance testing and approved prior to material shipment to the site. A manufacturing plant visit by representatives of the OSWDF Project and the CQC Contractor may be conducted.

For geotextiles used in general construction or road construction, additional CQC Contractor conformance testing is not required. These materials may be accepted by the CQC Contractor based on satisfactory manufacturer quality control testing results.

7.4 TRANSPORTATION, HANDLING, AND STORAGE

The CQC Contractor will monitor the transportation, handling, and storage of the geotextile on-site. The Construction Manager will designate a geotextile storage location. During transportation, handling, and storage, the geotextile shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting, or any other damaging or deleterious conditions.

Handling of the geotextiles rolls shall be performed in a manner such that damage does not occur to the geotextile or to its protective wrapping. Rolls of geotextiles shall not be stacked upon one another to the extent that deformation of the core occurs, to the point where accessibility can cause damage in handling, or to a height that exceeds the recommendation of the Manufacturer. Furthermore, geotextile rolls shall be stacked in such a way that access for conformance sampling is possible. Protective wrappings shall be removed less than one hour prior to unrolling the geotextile. After unrolling, a geotextile shall not be exposed to ultraviolet light for more than 10 calendar days or in accordance with Manufacturer's recommendations, unless otherwise authorized in writing by the Construction Manager.

Upon delivery at the site, the Contractor and CQC Contractor will monitor the rolls for defects and damage and perform an inventory of delivered materials. Monitoring will be conducted without unrolling the materials unless defects or damages are found or suspected. The CQC Contractor will indicate to the Construction Manager:

- rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws; and

- rolls that include minor repairable flaws.

The CQC Contractor will also monitor that equipment used to handle the geotextiles on-site is adequate and does not pose any risk of damage to the geotextiles when used properly.

7.5 CONFORMANCE TESTING

7.5.1 Sampling Requirements

Samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long by the roll width. The required minimum geotextile conformance sampling frequencies are provided in Tables 7-1 and 7-2. The sample shall be marked to indicate the machine direction with an arrow and affix a label, tag, or otherwise mark each sample with the following information:

- date sampled;
- project number;
- lot/batch number and roll number;
- conformance sample number; and
- identification of individual witnessing sampling.

The geotextile rolls that are sampled shall be immediately rewrapped in their protective coverings to the satisfaction of the Construction Manager.

7.5.2 Testing Requirements

Conformance testing of the geotextile materials delivered to the site will be conducted to confirm compliance with both the Technical Specifications and the Manufacturer's list of minimum average roll values. As a minimum, the geotextile conformance test requirements listed in Tables 7-1 and 7-2 will be performed by the CQC Contractor's Geosynthetics CQC Laboratory. Conformance testing and frequency listed in Tables 7-1 and 7-2 is in addition to testing required by the Manufacturer for Manufacturing Quality Control per Section 02714 of the Technical Specifications.

7.5.3 Test Results

The CQC Contractor will review laboratory conformance test results and verify compliance of the test results with the property values in Section 02714 of the Technical Specifications prior to deployment of the geotextiles. Nonconformance will be reported to the Construction Manager.

7.5.4 Conformance Test Failure

In the case of failing test results, the Manufacturer, Project QA Manager, or CQC Contractor may request that another sample from the failing roll be retested by the Geosynthetics CQC Laboratory with the Manufacturer's technical representative present during the test. If the retest fails or if the option to retest is not exercised, then two isolation conformance samples will be obtained by the CQC Contractor. These isolation samples will be taken from rolls, which have been determined by correlation with the Manufacturer's roll number, to have been manufactured prior to and after the failing roll. This method for choosing isolation rolls for testing should continue until passing tests are achieved. All rolls which fall numerically between the passing roll numbers will be rejected by the Construction Manager. The

CQC Contractor will verify that the Manufacturer has replaced all rejected rolls. The CQC Contractor will document actions taken in conjunction with geotextile conformance failures.

7.6 PLACEMENT

The CQC Contractor will monitor the placement of geotextiles to confirm they are not damaged in any way, and the following conditions are met.

- On slopes, the geotextiles shall be securely anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the geotextile sheet in tension.

- In the presence of wind, geotextiles shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with earth cover material.

- Trimming of the geotextiles shall be performed using only an upward cutting hook blade. Special care must be taken to protect other materials from damage that could be caused by the cutting of the geotextiles.

- The CQC Contractor will monitor that the Geosynthetics Installer is taking necessary precautions to prevent damage to underlying layers during placement of the geotextile.

- During placement of geotextiles, care shall be taken not to entrap in the geotextile stones, excessive dust, or moisture that could damage the geomembrane, generate clogging of drains or filters, or hamper subsequent seaming.

- A visual examination of the geotextile shall be carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, (e.g., stones, sharp objects, small tools, sandbags, etc.) are present.

7.7 SEAMS AND OVERLAPS

Geotextile filter and cushion shall be continuously sewn (i.e., spot sewing is not allowed).

Geotextile separator for roads and surface water features shall be overlapped a minimum of 12 inches; sewing is not required.

The CQC Contractor will monitor geotextile seaming procedures to confirm that seams and overlaps are in accordance with Section 02714 of the Technical Specifications.

7.8 REPAIR REQUIREMENTS

The CQC Contractor will monitor that holes or tears in the geotextile are repaired in accordance with Section 02714 of the Technical Specifications. The CQC Contractor will observe repairs and assure that noncompliance with the above requirements is corrected.

7.9 PLACEMENT OF SOIL MATERIALS

The CQC Contractor will monitor the Contractor’s placement of soil materials located on top of a geotextile, to verify:

- that no damage occurs to the geotextile;

- that no shifting of the geotextile from its intended position occurs and underlying materials are not exposed or damaged;

- that on side slopes, soil backfill are placed over the geotextile from the bottom of the slope upward; and

- that bridging of the geotextile at toes of slopes (i.e., trampolining) is avoided.

Soil backfilling or covering of the geotextile with another geosynthetic shall be completed within 10 days of unrolling the geotextile, or in accordance with the Manufacturer's recommendations, unless otherwise authorized in writing by the Construction Manager.

Table 7-1. Geotextile Filter Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY(3)
Mass per Unit Area	ASTM D5261	1 test per 100,000 ft^2
Grab Strength	ASTM D4632(1)	1 test per 100,000 ft^2
Trapezoidal Tear Strength	ASTM D4533(2)	1 test per 100,000 ft^2
Puncture Resistance	ASTM D6241	1 test per 100,000 ft^2
Apparent Opening Size	ASTM D4751	1 test per 100,000 ft^2
Permittivity	ASTM D4491	1 test per 100,000 ft^2

Notes:
1. Minimum of values measured in machine and cross machine directions with 1 inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM D4354.

Table 7-2. Geotextile Cushion and Separator Conformance Testing Requirements

TEST NAME	TEST METHOD	MINIMUM TESTING FREQUENCY(3)
Mass per Unit Area	ASTM D5261	1 test per 100,000 ft^2
Grab Strength	ASTM D4632(1)	1 test per 100,000 ft^2
Trapezoidal Tear Strength	ASTM D4533(2)	1 test per 100,000 ft^2
Puncture Resistance	ASTM D6241	1 test per 100,000 ft^2

NOTES:

1. Minimum of values measured in machine and cross machine directions with 1-inch clamp on Constant Rate of Extension (CRE) machine.
2. Minimum value measured in machine and cross machine direction.
3. Testing shall be performed at a frequency of one per lot or at listed frequency, whichever is greater. A lot is defined by ASTM D4354.

8. HDPE PIPES AND FITTINGS

8.1 INTRODUCTION

The CQC Contractor will confirm compliance of the materials and equipment and monitor installation of the HDPE pipes and fittings to confirm compliance with the Construction Drawings and Technical Specifications. The CQC Contractor will review and be familiar with the Construction Drawings and Technical Specifications related to these work elements prior to the Contractor beginning this work.

8.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The work performed by the Contractor will comply with the Construction Drawings and relevant Sections of Divisions 2, 3, and 13 of the Technical Specifications. Specifications within these Divisions will be referenced by the CQC Contractor for specific details and requirements for transporting, handling, and installation of HDPE pipes and fittings.

8.3 TRANSPORTATION, HANDLING, AND STORAGE

HDPE pipes and fittings shall be placed on wooden pallets and bundled together with plastic straps for bulk handling and shipment. The packing will be such that either fork lifts or cranes equipped with slings can be used for safe handling. HDPE pipes and fittings shall be segregated by wall thickness or standard dimension ratio (SDR) and inside diameter.

The CQC Contractor will monitor the offloading of the palletized pipes and fittings to confirm that handling of the pallets is done in a competent manner and that the pallets are not placed in areas where water can accumulate. A numbering system will be agreed upon between the CQC Contractor and Construction Manager and each pipe individually numbered at the time of offloading. The pallets will not be stacked more than three high or in such a manner that could cause damage to the pipe. Outdoor storage should be no longer than 12 months. For outdoor storage periods longer than 12 months CQC Contractor will confirm a temporary cover is placed over the pipes and fittings, or they have been moved to within an enclosed facility.

The maximum allowable depth of cuts, gouges, or scratches on the exterior surface of the HDPE pipes or fittings is 10 percent of the wall thickness. The interior of the pipes will be free of cuts, gouges, and scratches. HDPE pipes and fittings that become excessively gouged, twisted, or crimped, will be identified by the CQC Contractor and replaced in accordance with the Technical Specifications.

The CQC Contractor will monitor the proper handling and storage of the HDPE pipes and fittings and protection of the HDPE pipes and fittings from excessive heat or cold, dirt or other damaging or deleterious conditions and that any additional storage measures required by the Manufacturer are provided by the Contractor.

8.4 INSTALLATION REQUIREMENTS

Care will be taken during installation of the HDPE pipes and fittings such that they will not be cut, kinked, or otherwise damaged. Fabric or rubber-protected slings and straps will be used by the Contractor when installing HDPE pipes and fittings. The use of chains, cables, or hooks inserted into the pipe ends is not permitted.

The Contractor will install the HDPE pipes and fittings in such a manner that the materials are not damaged. Slings for handling the pipeline will not be positioned at butt-fused joints. Sections of the pipes with deep cuts and/or gouges exceeding the allowance, as identified in Section 02605 of the

Technical Specifications, will be removed and the ends of the pipeline rejoined. Care shall be exercised when lowering pipe into the trench to prevent damage or twisting of the pipe.

The Contractor will not lay pipe until the Construction Manager has approved the bedding conditions.

The CQC Contractor will be present during HDPE pipes and fittings installation to confirm compliance with Section 02605 of the Technical Specifications and Contract Drawings.

8.5 HDPE PIPE JOINING REQUIREMENTS

8.5.1 Butt-Fusion Joining

The CQC Contractor will monitor the assembling of lengths of HDPE pipe into suitable installation lengths by the butt-fusion process. All pipes and fittings shall be joined by the butt-fusion process unless an alternate method is specifically approved by the Construction Manager. Butt-fusion means the butt-joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure. Butt-fusion joining of the HDPE pipes and fittings shall be performed by the Contractor in accordance with the HDPE pipes and fittings Manufacturer's recommendations as to equipment and technique.

The CQC Contractor will be trained to the approved butt-fusion joining installation procedures submitted by the Contractor. Conflicts between the approved joining procedures and these CQC methods are to be brought to the immediate attention of the Construction Manager. The CQC methods to be followed during butt-fusion joining are summarized below.

- Trial fusion joints will be monitored in the same manner as production joints. The CQC Contractor will monitor destructive testing of trial fusion joints.

- Each butt-fusion joint will be assigned a number. The number will be recorded on the pipe using either a crayon or other approved marker. The number will be recorded on both sides of the joint and on the Butt-Fusion Welding Log.

- CQC Contractor will monitor the joining of all butt-fusion joints. CQC will sign off on Hold Points indicated in the Contractor's approved Work Plan, where applicable. The CQC Contractor will record the following information from the Butt-Fusion Joining Data-Logger and as welding is performed unless otherwise recommended by the welder manufacturer:

    - joint number;
    - pipe diameter and SDR;
    - machine identification number and calibration records;
    - operator identification;
    - gauge pressure during fusion;
    - gauge pressure during cool down;
    - joining plate temperature;
    - pipe alignment; and
    - approximate amount of "roll-back".

- Joints that are not acceptable will be cut out and rewelded. The CQC Contractor will document the rewelding procedures for the new weld as described above.

- The approximate location of the butt-fusion joints relative to bounding structures such as pre-engineered buildings or valves will be recorded.

8.5.2 Electrofusion Joining

When specifically approved in writing by the Construction Manager, Field Engineering, and Project QA Managers, HDPE pipes used for surface water management may be joined using an electrofusion coupling. An electrofusion coupling for any application other than surface water management pipes is prohibited except for joining perforated pipe to solid pipe at liner penetration boxes as shown on the OSWDF Construction Drawings. Electrofusion couplings shall be installed by the Contractor using approved written procedures in strict compliance with Manufacturer's recommendations.

The CQC Contractor will be familiar with approved electrofusion joining procedures submitted by the Contractor and approved by the Construction, Field Engineering, and Project Managers. Conflicts between approved installation procedures and these CQC methods are to be brought to the immediate attention of the Construction Manager. The CQC methods to be followed during electrofusion joining are summarized below:

- Electrofusion joining will be fully monitored.

- The CQC Contractor will review and be familiar with the approved joining procedures submitted by the Contractor.

- Electrofusion couplings will be assigned a number. The number will be recorded using a crayon or other approved marker on the coupling.

- The CQC Contractor will document that the pipe is fully installed into the coupling before joining commences. CQC will sign off on Hold Points indicated in the Contractor's approved Work Plan, where applicable.

- At a minimum, the following joining information will be recorded on the Electrofusion Joining Log:

    - joint number;
    - pipe diameter and SDR;
    - machine identification number and calibration records;
    - operator identification;
    - serial and model number on coupling;
    - joint preparation includes scraping and cleaning;
    - proper seating of pipe in coupling;
    - alignment of pipe;
    - heating time;
    - cool down time;
    - monitor and document that joint was not disturbed during cool down time; and
    - acceptability of joint as shown on computer output (i.e., Weld OK, Abort, etc.).

- Any extrusion welding of the coupling to the pipe will be noted on the form.

- The approximate location of the electrofusion joints relative to bounding structures such as pre-engineered buildings or valves will be recorded. The approximate locations will be shown on the as-built drawings for the pipe.

8.5.3 Extrusion Welded Sleeves

When specifically approved in writing by the Construction Manager, HDPE pipes used for surface water management may be welded using extrusion welded sleeves. Extrusion welded sleeves for any application other than surface water management pipes is prohibited. Extrusion welded sleeves shall be installed by the Contractor using written procedures approved in advance by the Construction Manager.

The CQC Contractor will be familiar with the extrusion welded sleeves installation procedures submitted by the Contractor and approved by the Construction Manager. Conflicts between approved installation procedures and these CQC methods are to be brought to the immediate attention of the Construction Manager. The CQC methods to be followed during pipe joining using extrusion welded sleeves are summarized below:

- All extrusion welds will be fully monitored.
- The CQC Contractor will review and be familiar with the approved installation procedures.
- All extrusion welded sleeves will be assigned a number. The number will be recorded using a crayon or other approved marker on the sleeve and adjoining pipe and on the Extrusion Welded Sleeve Log (see Appendix B).
- Check to see that pipe ends are free and sufficient space beneath pipe has been excavated.
- Document diameter and SDR of sleeve.
- Check the length of sleeve and beveling of sleeve ends.
- Document pipe has been cleaned, properly ground and cleaned again.
- Check to see sleeve is centered and aligned vertically and horizontally.
- Check to see moisture is removed and observe welding procedure.
- The CQC Contractor will document the pipe is fully installed into the sleeve before welding commences.
- The following welding information will be recorded on the Extrusion Welded Sleeve Log:
    - joint number;
    - pipe diameter and SDR;
    - machine identification number;
    - operator identification;
    - joint preparation including scraping, grinding and cleaning;
    - seating of pipe at center of sleeve;
    - preheat and extrude temperature;
    - joint not disturbed during cool down time; and
    - acceptability of weld (i.e., Accept or Reject).

- The approximate location of the sleeve relative to bounding structures such as pre-engineered buildings or valves will be recorded.

8.5.4 Liner Penetration Box Installation

The CQC Contractor will monitor installation and testing of liner penetration boxes to confirm compliance with Section 13005 Part 3.04 of the Technical Specifications and with Contract Drawings.

8.6 PRESSURE TESTING REQUIREMENT

The Contractor shall conduct field testing and inspection of installed HDPE pipes, fittings, and valves as specified in Section 02605 of the Technical Specifications. Pressure testing of liner penetration boxes will be in accordance with Section 13005 Part 3.05 of the Technical Specifications. Hydrostatic pressure testing shall be the preferred method of pressure testing. A pneumatic pressure testing method may be used when approved in writing by the Construction Manager.

The CQC Contractor will be familiar with the pressure testing procedures submitted by the Contractor and approved by the Construction Manager. Conflicts between approved testing procedures and these CQC methods are to be brought to the immediate attention of the Construction Manager. The CQC methods to be followed during pressure testing are summarized below:

- Prior to testing, the CQC Contractor will become familiar with the testing requirements.
- Pressure testing will be fully monitored.
- A separate pressure test log will be completed for each section of pipe to be tested.
- Prior to filling, make sure valves are closed and fittings are in place.
- Observe location of pressure gauge.
- Observe pressure build-up in pipe.
- Check to see that target pressure is applied.
- Observe and document that pressure is stable.
- Record pressure at least every 30 minutes during course of test.
- Indicate on form if pipe section passed or failed.

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9. CONCRETE PROTECTIVE LINER

9.1 INTRODUCTION

The CQC Contractor will confirm compliance of the materials and equipment and monitor installation of the concrete protective liner in the valve houses to confirm compliance with the Construction Drawings and Technical Specifications. The CQC Contractor will review and be familiar with the Construction Drawings and Technical Specifications related to these work elements prior to the Contractor beginning this work.

9.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The work performed by the Contractor will comply with the Construction Drawings and relevant Sections of Divisions 2, 3, and 13 of the Technical Specifications. Specifications within these Divisions will be referenced by the CQC Contractor for specific details and requirements for transporting, handling, and installation of the concrete protective liner.

9.3 TRANSPORTATION, HANDLING, AND STORAGE

Transportation, handling, and storage of concrete protective liner will be in accordance with the Manufacturer's recommendations. CQC Contractor will confirm that the materials are transported, handled, and stored in such a manner that they are not damaged; and the materials are delivered bearing the Manufacturer's labels identifying material type, project name, and lot production information.

9.4 INSTALLATION REQUIREMENTS

The CQC Contractor will confirm the materials to be used meet the requirement of the Technical Specification and installation of the concrete protective liner to confirm proper installation and welding as required by Section 03110 of the Technical Specifications. The concrete protective liner installation includes but is not limited to:

- valve house foundation excavation, rebar placement, and forms with concrete protective liner sheeting construction;
- placing concrete for the foundation walls and floor and the addition of concrete protective liner sheeting on the floor slab; and
- extrusion welding sheeting together at the joint and spark testing extrusion welds.

Installation of concrete protective liner will conform to Manufacturer's installation requirements. The CQC Contractor will monitor the installation and document damages, necessary repairs and/or replacements made during installation.

The CQC Contractor will monitor a trial weld performed at the beginning of each day. Trial weld coupon will be accepted by passing spark test as required by the Manufacturer at the recommended voltages provided by the Manufacturer as part of the Manufacturer's installation requirements. In the event of humidity in excess of 80 percent, a "cold strength" test as indicated in Section 03110 of the Technical Specifications will be performed. If the weld breaks, welding operations will be suspended until relative humidity drops and a successful "cold strength" test is performed.

Prior to welding of concrete protective liner panels, the CQC Contractor will verify and document: (i) the absence of moisture on or behind the joining surfaces; (ii) climate conditions are conducive to joining

panel sections per the Manufacturer's instructions; (iii) joining surfaces are clean; and (iv) beveled edges have been prepared where required.

Spark tests will be performed as recommended by the Manufacturer at the recommended voltages provided by the Manufacturer on the root pass of the weld. Portions of the weld that display failure through the spark test shall be reworked and re-tested until passing results are achieved. Additionally, this test will be repeated on completed welds. Spark testing will be required on 100 percent of all welds.

CQC Contractor will confirm and document the concrete protective liner installer is approved, or licensed by Manufacturer in accordance with Section 03110 of the Technical Specifications.

10. PRE-ENGINEERED BUILDINGS

10.1 INTRODUCTION

CQC will confirm compliance of the materials and equipment and monitor installation of pre-engineered buildings to confirm compliance with the Construction Drawings and Technical Specifications. CQC will review and be familiar with the Construction Drawings and Technical Specifications related to these work elements prior to the Contractor beginning this work.

10.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The work performed by the Contractor will comply with the Construction Drawings and relevant Sections of Divisions 2, 3, and 13 of the Technical Specifications. Specifications within these Divisions will be referenced by CQC for specific details and requirements for transporting, handling, and installation of pre-engineered buildings.

10.3 TRANSPORTATION, HANDLING, AND STORAGE

CQC will confirm that the pre-engineered building pre-fabricated components, sheets, panels, and other manufactured items are transported, handled, and stored in such a manner that materials are not damaged; and that materials will be stored on platforms or pallets above grade or on concrete slab, covered with opaque tarpaulins or other approved weather-resistant ventilated covering. Metal sheets and panels will be stored in a manner to allow drainage of potential water accumulation. Sheets and panels will not be stored such that they are in contact with other materials that might cause staining.

10.4 INSTALLATION REQUIREMENTS

CQC will monitor installation and performance verification to confirm compliance with Section 13120 of the Technical Specifications and the Contract Documents. CQC will confirm the following:

- Installation will conform to the Manufacturer's requirements for installation and erection of the pre-engineered buildings.

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11. MECHANICAL AND ELECTRICAL

11.1 INTRODUCTION

CQC will confirm the materials used for the installation of mechanical and electrical systems comply with the Construction Drawings and Technical Specifications. CQC will review and become familiar with the Construction Drawings and Specifications related to these work elements prior to Contractor beginning the Work. The mechanical and electrical systems include, but are not limited to, the following:

- process piping and appurtenances;
- tanks and appurtenances;
- valves;
- heating;
- fans;
- valve house and control valve house control panels and associated instrumentation, alarm lights, and all other work; and
- power wiring, including power circuit connections for pump motors, and equipment mounting boards.

11.2 RELATED CONSTRUCTION DRAWINGS AND TECHNICAL SPECIFICATIONS

The mechanical work performed by the Contractor shall comply with Division 15 of the Technical Specifications. These specifications will be referenced for specific details of the mechanical equipment requirements and installation. The electrical work performed by the Contractor shall comply with Construction Drawings and Division 16 of the Technical Specifications. These specifications shall be referenced for specific details of the electrical requirements and installation.

11.3 TRANSPORTATION, HANDLING, AND STORAGE

11.3.1 Process Piping and Appurtenances

CQC will confirm and document the delivery of process piping and appurtenances to the site without damage. Pipes shall arrive with plastic end caps on each length of pipe. Storage and on-site handling shall be in accordance with Manufacturer's recommendations and Section 15060 of the Technical Specifications.

11.3.2 Tanks and Appurtenances

CQC will confirm and document delivery of materials in original, unbroken pallets, packages, containers, or bundles bearing the label of the Manufacturer. Storage of materials shall be in accordance with Manufacturer's recommendation, and Section 15070 of the Technical Specifications.

11.3.3 Valves

CQC will confirm and document delivery of materials in original, unbroken, pallets, packages, containers, or bundles bearing the label of the Manufacturer and storage of materials are in accordance with Section 15080 of the Technical Specifications.

11.3.4 Heating
CQC will confirm and document delivery of heaters and associated equipment free from apparent physical damage and on-site storage is provided in accordance with Manufacturer's recommendation, and Section 15500 of the Technical Specifications.

11.3.5 Fans
CQC will confirm and document delivery of ceiling fans and cabinet fans and associated equipment free from apparent physical damage and on-site storage is provided in accordance with Manufacturer's recommendation.

11.3.6 Testing Requirements
CQC will monitor the work of the Contractor in the installation of all mechanical and electrical appurtenances. CQC will observe and document construction acceptance testing procedures performed by the Contractor. CQC will also observe and document operational testing procedures performed by the Contractor.

11.4 INSTALLATION AND TESTING REQUIREMENTS

11.4.1 Process Piping and Appurtenances
CQC will monitor the assembling joints between process piping and HDPE piping to confirm compliance with Sections 02605 and 15060 of the Technical Specifications.

CQC will confirm that the Contractor provided a qualified inspector certified to inspect welds in accordance with American Society of Mechanical Engineers (ASME) B 31.3 or otherwise approved by the Construction Manager. CQC will confirm Contractor's weld inspection procedures in accordance with Section 15060 of the Technical Specifications.

CQC will monitor the installation of the process piping and appurtenances to confirm installation in accordance with Section 15060 of the Technical Specifications and Construction Drawings.

CQC will be familiar with the pressure testing procedures submitted by the Contractor. The CQC methods to be followed during pressure testing are summarized below:

- prior to testing, CQC will become familiar with the testing requirements;
- confirm valves that may be directional/flow sensitive are installed correctly and tank HDPE piping is isolated from carbon steel piping being tested;
- pressure testing will be fully monitored;
- confirm calibration of pressure gauge in accordance with NIST standards within one year of test data in accordance with Section 02605 of the Technical Specifications;
- observe pressure build-up in pipe;
- confirm hydrostatic pressure testing in accordance with Section 02605 of the Technical Specifications; and

- observe and document that the test pressure is stable and indicate on form if pipe section passed or failed.

11.4.2 Tanks and Appurtenances

CQC will confirm that tanks, material and equipment identified in Section 15070 of the Technical Specifications are installed in accordance with the Manufacturer's written installation instructions and recommendations.

CQC will confirm that the connections are free of leaks and the installed system functions in accordance with Section 15070 of the Technical Specifications.

11.4.3 Valves

CQC will confirm that valves are installed in accordance with the Manufacturer's written installation instructions and recommendations and Section 15080 of the Technical Specifications.

CQC will monitor the working of each valve to confirm it is functional.

CQC will monitor pressure testing, as identified in Section 13.3.1 of this Plan, of valves and confirm valves are free of leaks.

CQC will be present during installation and testing of valves.

11.4.4 Heating

CQC will confirm unit heaters are installed in accordance with Manufacturer's installation instructions and Section 15500 of the Technical Specifications. After completion of installation, CQC will monitor the testing of each unit heater as specified in Section 15500 of the Technical Specifications.

11.4.5 Fans

CQC will confirm ceiling fans and cabinet fans are installed in accordance with Manufacturer's installation instructions and Section 15865.

CQC will confirm Contractor's testing that evaluates required operation and performance as defined in Section 15865 of the Technical Specifications.

11.4.6 Instrumentation

CQC will monitor installation to confirm and document compliance with Section 16900 of the Technical Specifications.

After completion of installation, CQC will confirm and document that the Contractor has calibrated instrument equipment to the Manufacturer's standards or requirements.

11.4.7 Ground

Testing and inspection will be monitored by CQC and CQC will confirm and document that inspection and testing conforms to the requirements of International Electrical Testing Association (NETA) Acceptance Testing Specification (ATS).

CQC will monitor grounding installation to confirm and document compliance with Section 16450 of the Technical Specifications.

11.5 AS-BUILT DRAWINGS

CQC will monitor the maintenance by the Contractor of As-Built Drawings on which the actual installation of all mechanical and electrical work shall be accurately shown, indicating any variation from Construction Drawings. Changes in layout or circuitry shall be clearly and completely indicated as the work progresses. These As-Built Drawings shall be reviewed by the Construction Manager and CQA Officer and used to determine the progress and completion of mechanical and electrical work.

12. CONCRETE

12.1 INTRODUCTION

The CQC Contractor will monitor the construction and perform conformance testing of concrete materials and finished products to confirm compliance with Construction Drawings and Technical Specifications. The CQC Contractor will review and be familiar with the Construction Drawings and Technical Specifications related to this work prior to Contractor beginning the work. The Field Technician used by the CQC Contractor to perform concrete monitoring and testing shall be ACI Certified Concrete Field Testing Technician Grade I.

12.2 MONITORING

The CQC Contractor will monitor prepared subgrade, formwork, reinforcing steel layout and other scheduled structures specified in Section 03100 of the Technical Specifications and in the Construction Drawings. The CQC Contractor will monitor concrete workmanship to confirm that the Contractor does not place concrete until foundations, forms, reinforcing steel, pipes, conduits, sleeves, anchors, hangers, inserts, and other work required to be built into concrete has been inspected and approved by the Construction Manager. The CQC Contractor will also monitor concrete curing times, curing temperatures, and placement methods on delivery and during placement of concrete. The Contractor is required to notify the Construction Manager and CQC Contractor at least 24 hours in advance of concrete placement activities and scheduling the inspections activities described above.

12.3 CQC TESTING

Concrete CQC testing will be the responsibility of the CQC Contractor. The concrete CQC testing program will meet the following requirements:

- Concrete samples will be obtained by the CQC Contractor at a minimum frequency of one for each 50 cubic yards of each concrete mix design placed in any one day. A set of test specimens will consist of at least five 6-inch by 12-inch cylinders. A single cylinder will be tested for 7-day and 14-day compressive strength and two cylinders will be tested for 28-day compressive strength. One cylinder will be retained as a reserve.

- CQC Contractor will obtain concrete samples in accordance with ASTM C172.

- Samples will be taken for temperature (ASTM C1064), slump (ASTM C143), air entrainment (ASTM C231), unit weight (ASTM C138), and test cylinders will be made (ASTM C31) for compressive strength tests.

- Concrete cylinders will be cured and tested in accordance with ASTM C39.

- Core drilling, if required, and testing will be in accordance with ASTM C42.

The CQC Contractor will be responsible for reporting test results to the Contractor and the Construction Manager. Materials that fail to meet the requirements of the Construction Drawings and Technical Specifications will be rejected.

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13. AGGREGATE BASE CONSTRUCTION

13.1 INTRODUCTION

The CQC Contractor will monitor and test materials used in the construction of the aggregate base for roads to assure compliance with the construction documents.

13.2 SUBGRADE PREPARATION

In-place moisture/density testing by nuclear method (ASTM D6938) will be performed by the CQC Contractor for fill materials as indicated in Section 4 of this CQA Project Plan. Fill placement and compaction will be performed in accordance with Section 02200 of the Technical Specifications. For access corridor subgrades, nuclear moisture/density tests will be performed at a minimum frequency of 1 test per 500 lineal ft per lift. The CQC Contractor will monitor the Contractor's proof rolling of cut sections in accordance with the requirements in Section 4.4 of this CQA Project Plan.

13.3 GEOTEXTILE CONFORMANCE TESTING AND PLACEMENT

Conformance of the geotextile separator will be limited to reviewing the manufacturer's quality control test results to confirm compliance with property values listed in Section 02714 of the Technical Specifications. The CQC Contractor will monitor the Contractor's geotextile installation methods and procedures in accordance with the requirements of Section 7 of this CQA Project Plan.

13.4 AGGREGATE BASE

The CQC Contractor will monitor the construction of the aggregate base for the OSWDF monitoring corridor to confirm it is constructed to the thickness, grades, and limits shown on the Construction Drawings and the requirements of Section 02230 of the Technical Specifications. The CQC Contractor will monitor the test strip required in Section 13.5 of this CQA Project Plan.

13.5 CQC TESTING

CQC testing of the materials used in construction of the aggregate base for roads will be the responsibility of the CQC Contractor. The frequency of CQC testing for the base aggregate materials is as follows:

- particle-size analysis (ASTM C136) at a frequency of one test per 5,000 yd^3; and
- in-place density and moisture content (ASTM D6938) at a frequency of one test per 100 lineal ft per lift.

Requirements for in-situ density of base aggregates used in access corridor roads shall be defined during the compaction of a test strip. The test strip for base aggregate shall be compacted in accordance with the requirements of Item 304.05 of the Ohio DOT *Construction and Materials Specifications*, 2013 Edition (Ohio C&MS).

13.6 REPAIR

If a defective area is discovered, the CQC Contractor will evaluate the extent and nature of the defect. The Contractor shall correct the deficiency area to comply with the Construction Drawings and Technical Specifications Section 02230. The Contractor shall not perform additional work in the area until the Construction Manager approves the correction of the defect. In the event of damage, the Contractor shall immediately make repairs and replacements as necessary to comply with the Construction Drawings and Technical Specifications Section 02230.

13.7 TEST RESULTS REPORTING

The CQC Contractor will be responsible for reporting test results to the Contractor and the Construction Manager. Materials that fail to meet the requirements of the Construction Drawings and Technical Specifications will be rejected.

14. OSWDF INFRASTRUCTURE

14.1 INTRODUCTION

The OSWDF Project includes the required infrastructure to support construction, operations, filling and closure of the OSWDF. This CQA Project Plan includes specific CQC requirements for construction of the various components of the OSWDF and the Impacted Material Transfer Area (IMTA) liner system of the IMTA Haul Road project. Technical Specifications include the CQC requirements for infrastructure construction related to the remainder of the IMTA Haul Road Project and the Access Roads and Support Facilities, the Raw Water Line, Construction Power, and Construction Trailers.

14.2 OSWDF PROJECT ORGANIZATION

The OSWDF project organization as described in Section 2 of this CQA Project Plan is applicable to OSWDF infrastructure construction.

14.3 GEOSYNTHETIC PRODUCTS

Geomembrane, GCL, and geotextile products and CQC requirements for OSWDF construction and the IMTA liner system are covered by Sections 5, 6, and 7 of this CQA Project Plan. Geosynthetic products and CQC requirements for geosynthetic installation for other infrastructure construction are governed by contract documents and the Technical Specifications.

14.4 COMPACTED CLAY COMPONENTS

Compacted clay liner for the OSWDF, compacted clay liner for the IMTA, and compacted clay cap material testing and the associated CQC requirements are described in Section 4 of this CQA Project Plan. Compacted clay materials and CQC requirements for construction for other compacted clay components (e.g., compacted clay seals for sandstone lenses) are governed by contract documents and Technical Specifications.

14.5 OTHER OSWDF INFRASTRUCTURE PROJECTS

Other OSWDF infrastructure projects will be constructed (e.g., electrical power, office areas, stockpile areas, and parking areas). The CQC Contractor may be included for specific monitoring and testing activities. Required CQC services will be included in contract documents and Technical Specifications.

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15. IMPACTED MATERIAL PLACEMENT

15.1 INTRODUCTION

This section describes the activities which will be undertaken throughout impacted material placement in the OSWDF to confirm the acceptance, filling, and compaction of the impacted materials in the OSWDF are in compliance with requirements established in the IMPP, Technical Specifications, and this CQA Project Plan. This section contains requirements and methods specifically applicable to impacted materials after they are brought into the OSWDF.

15.2 IMPACTED MATERIALS MONITORING

15.2.1 WAO Waste Tracking Verification

WAO will check to confirm that the impacted materials entering the OSWDF are accompanied by appropriate waste tracking documentation (i.e., paper copy or electronic copy) in accordance with the WAC Implementation Plan (DOE 2016b) and the OSWDF Operations and Maintenance Plan. If a special concern exists for the specific impacted material (e.g., classified waste) appropriate documentation shall be included and the hauling unit shall have specific instructions as to the impacted material type and final disposition. Impacted material types as defined in Section 4.3 of the IMPP shall be annotated on the waste tracking documentation. If no material type has been entered, the WAO representative will contact the waste generator to verify the impacted material type prior to allowing entry into the OSWDF. The WAO representative will review waste tracking documentation and complete portions regarding placement within the OSWDF prior to releasing the hauling unit to the placement area. If the impacted material type cannot be identified the material will be rejected and the hauling unit will be returned to its point of origin. WAO will verify that the waste tracking documentation contains all information relating to the impacted material origin as specified by WAC Implementation Plan. WAO will complete the waste tracking documentation by recording any pertinent notes, comments, or observations about the load.

15.2.2 Visual Inspection

The CQC Contractor will perform a visual review of the impacted materials after dumping to confirm that the contents match the visual description entered on the waste tracking documentation as communicated by WAO.

15.2.3 Monitoring for Moisture Content

Type 1 impacted materials accepted at the OSWDF should be at a moisture content suitable for placement and compaction in accordance with the IMPP. If the moisture content of Type 1 impacted materials received at the OSWDF is excessively wet of optimum, then the material shall either be allowed to sufficiently dry to meet placement requirements or be returned to the generation point at the discretion of the Operations Manager. If the moisture is excessively dry of optimum, then a sufficient amount of water shall be added to meet impacted material placement requirements.

15.2.4 Demolition Debris Monitoring

15.2.4.1 General

The CQC Contractor will monitor demolition debris delivered to the OSWDF. Additional information regarding waste classification and special handling of specific types of demolition debris is presented in the following sections.

15.2.4.2 Broken concrete

Most concrete demolition debris will fall into Type 2 (*en mass*e placement). Loads of concrete containing concrete pieces that cannot be spread into 21 in. ±3 in. loose lifts will be classified as Type 3 items (individual items).

15.2.4.3 Steel sidings

Steel siding material delivered to the OSWDF in appropriately packaged stacks not greater than 4 ft high will be classified as Type 3 material for individual placement. Loose truckloads of miscellaneous demolition debris containing steel sidings that can be spread in lifts not higher than 21 in. ± 3 in. will be classified as Type 2 materials (*en mass*e placement).

15.2.4.4 Steel beams

Steel beams, which can be spread or placed into a lift no higher than 21 in. ±3 in. will be classified as Type 2 materials (*en mass*e placement).

15.2.4.5 Wood

Demolition debris consisting primarily of wood that can be spread in lifts no higher than 18 in. will be classified as Type 4 materials.

15.2.4.6 Miscellaneous demolition debris

Miscellaneous demolition debris (doors, plumbing, wiring, wood, etc.) that can be spread in lifts no higher than 21 in. ±3 in. will be classified as Type 2 materials (*en masse* placement). Miscellaneous demolition debris that can be placed individually such that the highest part of the debris is not more than 4 ft above the ground surface will be classified as Type 3 material (individual items).

15.2.4.7 Tanks

Tanks that cannot be placed such that void space can be filled and Type 1 material placed and compacted around them shall be placed in the OSWDF in accordance with Type 5 material (large PGE) placement requirements. Tanks that can be crushed shall be crushed by the waste generator prior to delivery to the OSWDF. Cylinders that have not been processed to remove pressurized material and processed to eliminate future potential for pressurization will not be accepted at the OSWDF. A visual inspection of cylinders shall be performed prior to placement in the OSWDF. Cylinders that have either the cylinder cap or valve attached shall be removed and returned to the point of generation. Cylinders with nominal diameter of 12 in. or greater will be split in half. Tanks acceptable for placement in the OSWDF and with maximum dimension of 4 ft will be classified as Type 3 items (individual items).

15.2.4.8 Pipes

Steel pipes which can be spread or placed into a lift no higher than 21 in. ±3 in. will be classified as Type 2 materials (*en masse* placement). Process piping with a nominal diameter greater than 12 in. will be split in half before disposal. Alternatively, the process piping may be crushed before disposal if methodology is demonstrated to the satisfaction of the Operations Manager. Piping containing asbestos up to 18 in. diameter does not need to be split lengthwise or crushed. Piping used as surface water drainage conduit (e.g., corrugated metal pipe, concrete pipe, and vitrified clay pipe) and non-process piping will be crushed or split in half in length to reduce void space; maximum size will be 10 ft in length.

15.3 IMPACTED MATERIAL PLACEMENT AND COMPACTION

15.3.1 Type 1 Material (Soils and Soil-Like Materials)

15.3.1.1 General Monitoring Requirements

Monitoring the placement, compaction, and testing of impacted soil and soil-like materials includes the following:

- Monitoring materials to confirm sizing criteria and content meet criteria specified in Section 4.3 of the IMPP.
- Testing to determine the compaction characteristics of the impacted soil materials during processing, placement, and compaction.
- Monitoring the thickness of lifts as loosely placed and as compacted.
- Monitoring the action of the compaction and heavy hauling equipment on the construction surface (e.g., sheepsfoot penetration, pumping, cracking, etc.).

15.3.1.2 Placement and Compaction Quality Control

Placement and Compaction of Type 1 Material is described in Section 6 of the IMPP. Type 1 impacted material placement and compaction requirements for the protective soil layers, select impacted material layers, and for general soil and soil-like materials is described along with other activities associated with achieving moisture/density requirements and the filling of potential voids in other types of impacted material.

The standard Proctor test (ASTM D698) shall be used for the determination of moisture/density relationships of the Type 1 material to be disposed in the OSWDF. The standard Proctor compaction tests will be performed in the geotechnical laboratory. The standard Proctor compaction testing will be performed with each change in material type.

The dry density and moisture content of Type 1 materials shall be measured at a minimum frequency of once per 10,000 ft^2 or once per 100 ft by 100 ft grid element per lift; measurement of dry density and moisture content are to be in accordance with ASTM D2922 and D3017 (nuclear methods). To establish correlations of moisture and density with the nuclear methods, the sand cone test method (ASTM D1556, Density and Unit Weight of Soil in Place by the Sand-Cone) or the Drive Cylinder Method (ASTM D2937, Density of Soil in Place by the Drive-Cylinder Method) shall be used once per 25 nuclear density tests when Type 1 materials are placed. This correlation will also be used to evaluate the effect impacted materials may have on the nuclear gauge.

Compaction testing for Type 1 materials will be documented in accordance with requirements established in Section 4 of this plan.

15.3.1.3 Rework

At locations where the field testing indicates densities below the requirements of the IMPP, the failing area shall be reworked and retested.

15.3.1.4 Lines and Grades

Surveying of lines and grades shall be conducted by the Waste placement personnel on a periodic basis during the placement and compaction of the impacted materials as specified in the Technical Specifications (Section 02100). The CQC Contractor will confirm that slopes are properly constructed to promote drainage and confirm that required separation distances are maintained. Any deviation from the IMPP requirements will be reported to the Operations Manager or designee for corrective action.

15.3.2 Type 2 Materials (En Masse Placement)

15.3.2.1 Placement Quality Control

The CQC Contractor will monitor and document that the placement of Type 2 materials is in accordance with the IMPP.

Monitoring the placement by the CQC Contractor will include verification that:

- Loose lift thickness is no more than 21 in. ±3 in.
- Type 1 materials are worked into the lift as much as practical.
- Horizontal extent of a lift is no more than 100 ft and each lift is surrounded with 10 ft of Type 1 material.
- Horizons are limited to two lifts and separated vertically by at least the minimum 2 ft required thickness of the intervening horizon of Type 1 material.

15.3.2.2 Compaction Quality Control

The CQC Contractor will monitor and document that the Type 2 materials have received the compaction effort specified by the IMPP. Type 1 materials used to surround the Type 2 material will be tested in accordance with Section 15.3.1 of this Plan, but at a frequency as follows:

- For side berms, once per 250 ft length but not less than twice per lift; and
- For soil cover over Type 2 material, no testing is required aside from monitoring proof-rolling of the final surface.

Compaction testing of Type 1 materials surrounding the Type 2 material will be documented in accordance with requirements established in Section 4 of this Plan.

15.3.2.3 Rework

At locations where the field testing indicates densities below the requirements of the IMPP, the failing area shall be reworked and retested as specified in Section 7 of the IMPP.

15.3.3 Type 3 Items (Individual Items)

15.3.3.1 Placement Quality Control

The CQC Contractor will monitor and document that the placement methods presented in Section 8 of the IMPP are followed by the Contractor in the placement of Type 3 items. Monitors will observe and document that the maximum lift thicknesses of Type 1 materials placed around the individually placed items are in accordance with the IMPP.

15.3.3.2 Compaction Quality Control

The CQC Contractor will monitor and document that the Type 1 materials used in the placement of Type 3 items have received the compaction effort specified by the IMPP. Type 1 materials used in the placement of Type 3 materials shall be tested in accordance with Section 15.3.1 of this plan, but at a minimum frequency as follows:

- For soil cover lifts, once per each soil cover lift; and
- For side berms, once per 250 ft length but not less than twice per grid element.

Compaction testing of Type 1 materials used in the placement of Type 3 items will be documented in accordance with requirements established in Section 4 of this plan.

15.3.3.3 Rework

At locations where the field testing indicates densities below the requirements of the IMPP, the failing area shall be reworked and retested as specified in Section 8.3 of the IMPP.

15.3.4 Type 4 Materials

15.3.4.1 Placement Quality Control

The CQC Contractor will monitor and document that the placement methods presented in Section 9 of the IMPP are followed by the Contractor in the placement of Type 4 materials. Monitors will observe and document that maximum loose lift thicknesses are in accordance with the IMPP. Additionally, the CQC Contractor will record the total volume of Type 4 impacted material placed in each cell of the OSWDF and the entire OSWDF to confirm that the maximum allowable volume of Type 4 impacted material does not exceed the volumes listed in Section 9.2 of the IMPP.

15.3.4.2 Compaction Quality Control

The CQC Contractor will monitor and document that the Type 4 materials, and the Type 1 materials used in the placement of Type 4 materials, have received the compaction effort specified by the IMPP. Type 1 materials used in the placement of Type 4 materials will be tested in accordance with Section 15.3.1 of this plan, but at a frequency as follows:

- For side berms, once per 250 ft length but not less than twice per grid element; and
- For cover 12- to 15-in. thick loose lift, once per each soil cover lift.

Compaction testing of Type 1 materials will be documented in accordance with requirements established in the CQA Plan.

15.3.4.3 Rework

At locations where the field testing indicates densities below the requirements of the IMPP, the failing area shall be reworked and retested as specified in Section 7.3.4 of the IMPP.

15.3.5 Type 5 Materials (Special Handling, Placement and Compaction)

15.3.5.1 Placement Quality Control

The CQC Contractor will monitor and document that the placement methods, trench/excavation dimensions or berm heights, maximum loose lift thickness, and compacted height of final soil lifts are in accordance with the IMPP.

15.3.5.2 Compaction Quality Control

The CQC Contractor will monitor and document that the Type 1 materials used in the placement of Type 5 materials have received the compaction effort specified in the IMPP. Type 1 materials used in the placement of Type 5 materials shall be tested in accordance with Section 15.3.1, but at minimum frequency as follows:

- For initial soil cover lifts in trenches or excavations, no testing is necessary or desired aside from observing the compaction passes; and

- For subsequent soil cover lifts in trenches or excavation, once per each soil cover lift in each trench or excavation.

Compaction testing of Type 1 materials used in the placement of Type 5 materials will be documented in accordance with requirements established in Section 4 of this plan.

15.4 AS-BUILT DOCUMENTATION

The CQC Contractor will prepare daily placement sketches showing impacted material type, lift numbers, and grid destination. Daily sketches will be provided to the Operations Manager. The CQC Contractor will keep track of placement locations by grid, lift, and type of material.

Daily placement sketches prepared by the CQC Contractor will be used to verify and/or resolve inconsistencies in CADD impacted material placement model generated from survey data and waste tracking (by WAO).

The Waste placement personnel shall coordinate impacted material placement survey activities in accordance with the Technical Specifications (Section 02100). The Contractor shall provide survey information to the Operations Manager within 24 hours of completion of survey. The Contractor shall also keep track of placement locations by grid, lift, type of material and submit surveyed volumes by impacted material type to the Operations Manager.

16. GENERAL SITE WORK

16.1 INTRODUCTION

The CQC Contractor will monitor the activities which are to be performed for various general site work items including, but not limited to riprap, culverts, and chain link fences and gates, for compliance with the Construction Drawings and Technical Specifications.

16.2 RIPRAP MONITORING

Performance testing of riprap is not required. The CQC Contractor will monitor placement of the riprap to confirm that the placement requirements of Technical Specifications Section 02271 are met.

16.3 CULVERTS

16.3.1 CQC Testing

CQC testing of culverts is not required. CQC testing of backfill material will be in accordance with the requirements of Technical Specifications Section 02215 and Section 4 of this CQA Project Plan.

16.3.2 Performance Testing and Monitoring Requirements

Performance testing is required of only material used to backfill culverts. Performance testing of the backfill material will be in accordance with the requirements of Technical Specifications Section 02215 and Section 4 of this CQA Project Plan. The CQC Contractor will verify/confirm and document that the culverts are of the type and size shown on the Construction Drawings.

16.4 CHAIN LINK FENCE

16.4.1 CQC Testing

CQC testing of the chain link fence is not required.

16.4.2 Performance Testing and Monitoring Requirements

Performance testing of chain link fence is not required. The CQC Contractor will randomly monitor the installation of the chain link fence. Monitoring will include, but is not limited to, plumbness of posts, embedment of posts, post dimensions, connection of fabric to posts, and installation of barbed wire. If deficiencies are found, the CQC Contractor will increase the frequency of monitoring and notify the Construction Manager.

16.5 TEST RESULTS REPORTING

The CQC Contractor will be responsible for reporting test results to the Contractor and the Construction Manager. Materials that fail to meet the requirements of the Construction Drawings and Technical Specifications will be rejected.

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17. REFERENCES

DOE 2015a, *On-Site Waste Disposal Facility Clay Liner/Cap Test Pad Program Final Report (TPPFR)* Rev. D, DOE/PPPO/03-0391&D1, U.S. Department of Energy, Piketon, Ohio, March.

DOE 2015b, *Record of Decision for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0513&D2, Piketon, Ohio, June.

DOE 2015c, *Record of Decision for the Process Buildings and Complex Facilities D&D Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0425&D2, Piketon, Ohio, July.

DOE 2016a, *Comprehensive On-Site Waste Disposal Facility Remedial Design/Remedial Action Work Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0751&D0, U.S. Department of Energy, Piketon, Ohio, May.

DOE 2016b, *Waste Acceptance Criteria Implementation Plan for the On-Site Waste Disposal Facility at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0728&D1, U.S. Department of Energy, Piketon, Ohio, February.

DOE 2019, Addendum to *On-Site Waste Disposal Facility Clay Liner/Cap Test Pad Program Final Report (TPPFR)* Rev. D, DOE/PPPO/03-0391&D1/A1, U.S. Department of Energy, Piketon, Ohio, November.

Ohio EPA 2012, *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action including the July 16, 2012 Modification thereto, DFF&O*, Ohio Environmental Protection Agency, July 16.

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APPENDIX A: ARARS

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ARARs

#	Title	Requirements	Section of CQAPP Addressing ARAR
		HAZARDOUS WASTE	
1	Code of Federal Regulations – Hazardous Waste Treatment, Storage, and Disposal Facilities, Monitoring and Inspection 40 CFR 264.303(a) *and* Ohio Administrative Code – Monitoring and Inspection OAC 3745-57-05(A)	During construction or installation, liners and cover systems must be checked for uniformity, damage, and imperfections (e.g., holes, cracks, thin spots, etc.).	Sections 5.3 – 5.8
		Immediately after construction or installations, synthetic liners must be checked to ensure tight seams and joints and the absence of tears, punctures, or blisters; soil based and mixed liners and covers must be checked for imperfections, including lenses, cracks, channels, or other structural nonuniformities.	Sections 5.9 – 5.13
2	Code of Federal Regulations – Hazardous Waste Treatment, Storage, and Disposal Facilities, Construction Quality Assurance Program 40 CFR 264.19(a) through (d) *and* Ohio Administrative Code - General Facility Standards-New Facilities OAC 3745-54-19(A) through (D)	A CQA program is required for all surface impoundment, waste pile, and landfill units that are required to comply with paragraphs (C) or (D) of OAC 3745-56-21, 3745-56-51, and 3745-57-03. The program must ensure that the constructed unit meets or exceeds all design criteria and specifications, must be developed and implemented under the direction of a CQA officer who is a registered engineer, and must address the physical components listed in OAC 3745-54-19(A)(2) where applicable.	Section 2.11 and Entire Plan
		Must develop and implement a written CQA plan as detailed in OAC 3745-54-19(B).	
		The CQA program must include the observations, inspections, tests and measurements sufficient to meet the assurances listed in OAC 3745-54-19(C)(1)(a) to (c) and must include the test fill requirements detailed in OAC 3745-54-19(C)(2).	Section 4.6, OSWDF Clay Liner/Cap Test Pad Program Final Report (DOE 2015) and the Addendum to OSWDF Clay Liner/Cap Test Pad Program Final Report (DOE 2019), and Section 3.5
		Waste must not be received in a unit until the owner or operator has submitted to the Director by certified mail or hand delivery a certification signed by the CQA officer that the approved CQA plan has been successfully carried out and that the unit meets the requirements of paragraphs (C) or (D) of OAC 3745-56-21, 3745-56-51, or 3745-57-03; and the procedure in OAC 3745-50-58(L)(2)(b) has been completed. Documentation supporting the CQA officer's certification must be furnished to the Director upon request.	
		SOLID WASTE	
3	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(5)	The unconsolidated or consolidated stratigraphic units that will underlie the OSWDF shall comply with the following requirements of OAC 3745-27-08(D)(5)(a) through (f):	Section 4.6 and Technical Specification Section 02200
		• Be free of debris, foreign material, and deleterious material	
		• Not be comprised of solid waste	
		• Not have any abrupt changes in grade that may result in damage to the composite liner system	
		• Be proof-rolled, if applicable	

		• Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements	
		• Have control testing of any stratigraphic units that have not been anticipated and that are more susceptible to slope failure than the stratigraphic units that were tested and reported in the permit to install. This testing shall be in accordance with the following: o The effective shear strength of each unconsolidated stratigraphic unit that may be susceptible to slope failure and the recompacted soil liner shall be determined using American Society for Testing and Materials (ASTM) D3080-98 (direct shear test) or ASTM D4767-95 (consolidated-undrained triaxial compression test), or ASTM D6467-99 (torsional ring shear test) o The undrained shear strength of all applicable unconsolidated stratigraphic units using fully saturated samples shall be determined using ASTM D2850-95 (unconsolidated-undrained triaxial compression)	Pretesting reported in OSWDF Soil/Geosynthetic Direct Shear Testing Program Final Report (DOE 2016)
4	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(6)	The unconsolidated or consolidated stratigraphic units that will underlie the OSWDF shall comply with the following requirements of OAC 3745-27-08(D)(6)(a) through (h):	Sections 4 and 13, and Technical Specification Sections 02200 and 02230
		• Be durable rock for rock fills only	
		• Be free of debris, foreign material, and deleterious material	
		• Not be comprised of solid waste	
		• Not have any abrupt changes in grade that may result in damage to the composite liner system	
		• For soil fills, have pre-construction testing of the borrow soils performed on representative samples to determine the maximum dry density and optimum moisture content according to ASTM D698 00a (standard proctor), or ASTM D1557-00 (modified proctor) at a frequency of no less than once every ten thousand cubic yards	
		• Be constructed in lifts to achieve uniform compaction of soil fills. Each lift shall comply with the following: o be constructed in loose lifts of twelve inches or less o be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00a (standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (modified proctor)	
		• Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements	
		• Have quality control (QC) testing of the soil fills on the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (nuclear methods), ASTM D1556-00 (sand cone), ASTM D2167-94 (rubber balloon), or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area.	
5	Ohio Administrative Code – Sanitary	The compacted soil liner comply with the requirements of *OAC* 3745-27-08(D)(8)(b) through (j), listed as follows:	Section 4.6 and Technical

	Landfill Facility Construction OAC 3745-27-08(D)(8)	• Be free of debris, foreign material, and deleterious material	Specification Section 02225
		• Not be comprised of solid waste	
		• Be placed beneath all areas of waste placement	
		• Not have any abrupt changes in grade that may result in damage to the geosynthetics	
		• Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material in the construction of the recompacted soil liner. The pre-construction testing shall determine the following: o The maximum dry density and optimum moisture content according to ASTM D698-00a (standard proctor), or ASTM D1557-00 (modified proctor) at a frequency of no less than once for every one thousand five hundred cubic yards o The grain size distribution according to ASTM D422-63 (sieve and hydrometer) at a frequency of no less than once for every one thousand five hundred cubic yards o The Atterberg limit according to ASTM D4318-00 at a frequency of no less than once for every one thousand five hundred cubic yards o The recompacted laboratory permeability according to ASTM D5084-00e1 (falling head) at a frequency of no less than once for every ten thousand cubic yards	
		• Be constructed in lifts to achieve uniform compaction. Each lift shall include the following: o Be constructed with qualified soils and the corresponding construction details established by written concurrence from Ohio EPA with the test pad certification report required by OAC 3745-27-08 (E) and the following specifications or an alternative to qualifying soils with a test pad if it is demonstrated to the satisfaction of the director or his authorized representative that the materials and techniques will result in each lift having a maximum permeability of $1x10^{-7}$ cm/s and the following specification ▪ With loose lifts of eight inches or less ▪ With a maximum clod size of three inches or half the lift thickness, whichever is less ▪ With one hundred percent of the particles having a maximum dimension not greater than two inche ▪ With not more than ten percent of the particles, by weight, having a dimension greater than 0.75 inches o Be compacted to at least ninety-five percent of the maximum dry density as determined by ASTM D698-00a (standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 or an alternative compaction specification approved by the director o Be placed with a minimum soil moisture content that shall not be less than the optimum moisture content as determined by ASTM D698-00a or ASTM D1557-00 or an alternative soil moisture content specification approved by the director	

		○ Have a maximum permeability of 1 x 10-7 cm/s	
		• Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction and operation	
		• Be determined to have adequate strength to satisfy bearing capacity and slope stability strength requirements	
		• Have QC testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (nuclear methods), ASTM D1556-00 (sand cone), ASTM D2167-94 (rubber balloon), or other methods acceptable to the director or his authorized representative at a frequency of no less than five times per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.	
6	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(9)	GCLs shall comply with the requirements of *OAC* 3745-27-08(D)(9)(a) through (d), listed as follows:	Section 6 and Technical Specification Section 02772
		• Be negligibly permeable to fluid migration	
		• Have a dry bentonite mass per unit area of at least 0.75 pounds per square foot at zero percent moisture content	
		• Have pre-construction testing of the GCL material performed on representative samples and the results submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the material. The pre-construction testing shall determine: ○ the internal drained shear strength using ASTM D6243-98 (direct shear test) at least twice for the initial use and at least once for each subsequent construction event. Tests involving GCL material shall be conducted with hydrated samples. (Comment: If a shear stress point plots below the Mohr-Coulomb shear strength failure envelope defined by the required factor of safety, it will be considered a failed test); ○ the dry bentonite mass (at zero percent moisture content) per square foot of GCLs according to ASTM D5993-99 at a frequency of no less than once per fifty thousand square feet; and ○ the interface shear strength according to paragraph (G) of this rule [OAC 3745-27-08(G)]	
		• Be installed in the following manner: ○ To allow no more than negligible amounts of leakage by a minimum overlap of six inches, or, for end-of-panel seams, a minimum overlap of twelve inches. Overlap shall be increased in accordance with manufacturer's specifications or to account for shrinkage due to weather conditions ○ In accordance with the manufacturer's specifications in regards to handling and the use of granular or powdered bentonite to enhance bonding at the seams ○ Above the recompacted soil liner when used in liner systems or above an engineered subbase pursuant to paragraph (d)(22) of this rule when used in cap systems. GCLs without internal reinforcement shall not be used in areas beneath leachate collection piping, in sump areas,	

		or on any slope with a grade that is steeper than ten percent o On a surface that shall not have any sharp edged protrusions or any particles protruding more than one quarter of one inch	
7	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(10)	The geomembrane component of the liner system shall comply with the requirements of *OAC* 3745-27-08(D)(10)(a) to (f), listed as follows:	Section 5 and Technical Specification Section 02770
		• Be, at a minimum, a 60-mil HDPE geomembrane for composite liner systems or be, at a minimum, a 40-mil geomembrane for composite cap systems or other materials and/or thicknesses acceptable to the director	
		• Be physically and chemically resistant to attack by the solid waste, leachate, or other materials that may come in contact with it using EPA method 9090 or other documented data	
		• Have pre-construction interface testing performed according to paragraph (G) of this rule [OAC 3745-27-08(G)]	
		• Be placed above and in direct and uniform contact with the recompacted soil liner or the recompacted soil barrier layer or the GCL	
		• Be seamed to allow no more than negligible amounts of leakage; the seaming material shall be physically and chemically resistant to chemical attack by the solid waste, leachate, or other materials that may come in contact with the seams	
		• Have QC testing in accordance with the following, unless the manufacturer's specifications for testing are more stringent, in which case the manufacturer's specifications shall be used: o For the purpose of testing every seaming apparatus in use each day, peel tests according to an appropriate method shall be performed on scrap pieces of flexible membrane liner when an apparatus is started, operators change, an apparatus is restarted, or at the beginning of each seaming period o Nondestructive testing shall be performed on one hundred percent of the flexible membrane liner seams o Destructive testing for peel according to the appropriate ASTM method shall be performed on randomly selected samples at a frequency of no less than once per five hundred feet of seam completed by a particular seaming apparatus. An alternate means may be used if it is demonstrated to the satisfaction of the director or his authorized representative that the alternate means meets the requirements of this paragraph.	
8	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(11)	A liner cushion layer shall be placed above the flexible membrane liner and protect it from damage that may be caused by construction materials and activities and have pre-construction interface testing performed.	Section 7 and Technical Specification Section 02714
9	Ohio Administrative Code – Sanitary Landfill Facility Construction	For the leachate collection layer: the leachate collection layer shall be placed above the composite liner system which may be protected by the cushion layer and shall comply with the following:	

	OAC 3745-27-08(D)(12)	• Have a minimum thickness of one foot	
		• Have no more than five percent of the particles, by weight, passing through the 200-mesh sieve	
		• Have no more than five percent carbonate content by weight	
		• Have a minimum permeability of one times ten to the negative two centimeters per second (1 X 10-2cm/sec)	
		• Granular materials shall have quality control testing in accordance with the following at a frequency of no less than once for every three thousand cubic yards of material: o Permeability using ASTM d2434-68 (constant head) o Grain size distribution using ASTM d422-63 (sieve) o Carbonate content using ASTM d3042-97 at a ph of 4.0	
		• An alternate material and/or thickness may be used provided that it is demonstrated to the satisfaction of the director or his authorized representative that the material meets the requirements of this paragraph. The appropriate quality control testing and frequency of testing needs to be approved by Ohio EPA prior to use.	
10	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(21)	Design and construction of a recompacted soil barrier layer in the composite cap system shall comply with *OAC* 3745-27-08(D)(21)(b) through (g) as follows:	Section 4.6 and Technical Specification Section 02225
		• Be free of debris, foreign material, and deleterious material.	
		• Not be comprised of solid waste.	
		• Be placed above all areas of waste placement.	
		• Not have any abrupt changes in grade that may result in damage to the geosynthetics	
		• Have pre-construction testing of the borrow soils performed on representative samples and the results submitted to Ohio EPA no later than 7 days prior to intended use of the material in construction of the cap soil barrier layer. Pre-construction testing shall determine the maximum dry density and optimum moisture content, grain size distribution, and recompacted laboratory permeability.	
		• Be constructed in lifts to achieve uniform compaction, in accordance with the substantive requirements of *OAC* 3745-27-08(D)(21)(g)(i)(a) through (e), (ii), and (iii).	
		• Be adequately protected from damage due to desiccation, freeze/thaw cycles, wet/dry cycles, and the intrusion of objects during construction of the cap system	
		• Have QC control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (nuclear methods), ASTM D1556-00 (sand cone), ASTM D2167-94 (rubber balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.	
11	Ohio Administrative Code – Sanitary	If a geosynthetic clay liner is used in the composite cap system, it shall be placed above an engineered subbase. Design and	Section 4.6 and Technical

	Landfill Facility Construction OAC 3745-27-08(D)(22)(e)	construction of the engineered subbase shall comply with the following:	Specification Section 02225
		• The thickness of the subbase shall be sufficient to achieve an evenly graded surface and shall be a minimum of twelve inches thick	
		• Be free of debris, foreign material, and deleterious material	
		• Not be comprised of solid waste	
		• Not have any abrupt changes in grade that may result in damage to the geosynthetics	
		• Not have any sharp edged protrusions or any particles protruding more than one quarter of one inch	
		• Have pre-construction testing of the borrow soils performed on representative samples to determine the maximum dry density and optimum moisture content according to ASTM D698-00A (standard proctor), or ASTM D1557-00 (modified proctor) at a frequency of no less than once for every ten thousand cubic yards	
		• Be constructed in lifts to achieve uniform compaction. Each lift shall include the following: o Be constructed of soil as follows: ▪ Be constructed in loose lifts of twelve inches or less ▪ Be constructed of a soil with a maximum clod size that does not exceed the lift thickness o Be compacted to at least ninety five percent of the maximum dry density as determined by ASTM D698-00A (standard proctor) or at least ninety percent of the maximum dry density as determined by ASTM D1557-00 (modified proctor)	
		• Have QC control testing of the constructed lifts performed to determine the density and moisture content according to ASTM D2922-01 and ASTM D3017-01 (nuclear methods), ASTM D1556-00 (sand cone), ASTM D2167-94 (rubber balloon) or other methods acceptable to the director or his authorized representative at a frequency of no less than five tests per acre per lift. The locations of the individual tests shall be adequately spaced to represent the constructed area. Any penetrations shall be repaired using bentonite.	
12	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(23)	A geosynthetic clay liner meeting the requirements of paragraph (d)(9) of this rule shall be placed above the engineered subgrade in the composite cap system	Section 6 and Technical Specification Section 02772
13	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(D)(24)	A flexible membrane liner meeting the requirements of paragraph (d)(10) of this rule shall be placed above the recompacted soil barrier layer or the geosynthetic clay liner in the composite cap system	Section 5 and Technical Specification Section 02770
14	Ohio Administrative Code – Sanitary	The drainage layer of the cap shall be comprised of granular materials that meet the following requirements:	Section 4.7 and Technical
		• Have a minimum thickness of one foot	

	Landfill Facility Construction OAC 3745-27-08(D)(25)	• Not clog or freeze	Specification Section 02710
		• Not damage the underlying flexible membrane liner	
		• Have no more than five percent of the particles, by weight, passing through the 200-mesh sieve	
		• Have no greater than ten percent carbonate content by weight	
		• Have a minimum permeability of one times ten to the negative three centimeters per second (1 x 10-3 cm/sec)	
		• Granular materials shall have QC testing in accordance with the following at a frequency of no less than once for every three thousand cubic yards of material: o Permeability using ASTM D2434-68 (constant head); o Grain size distribution using ASTM D422-63 (sieve); and o Carbonate content using ASTM D3042-97 at a pH of 4.0	
		• An alternative material and/or thickness may be used provided it is demonstrated to the satisfaction of the director or his authorized representative that the material meets the requirements of this paragraph. The appropriate QC testing and frequency of testing needs to be approved by Ohio EPA prior to use.	
15	Ohio Administrative Code – Sanitary Landfill Facility Construction OAC 3745-27-08(G)	The specific soils and representative samples of the geosynthetic materials that will be used at the site shall be tested for interface shear strength over the entire range of normal stresses that will develop at the facility. Prior to the initial use of each specific geosynthetic material(s) in the construction of engineered components at a facility, the appropriate shear strengths for all soil to geosynthetic and geosynthetic to geosynthetic interfaces that include the material(s) shall be determined at least twice using ASTM D5321-92 (direct shear test) or ASTM D6243-98 (direct shear test for gcl) and at least once for each subsequent construction event using samples of the materials identified by the initial two tests to be at the highest risk for slope failure. Tests involving the flexible membrane liner interface shall be conducted with a recompacted soil that has the highest moisture content and the lowest density specified for construction of the recompacted soil liner. Tests involving Geosynthetic clay liner material shall be conducted with hydrated samples. The results of pre-construction testing required by this rule must meet all applicable specifications in this rule and the set of approved parameters in the permit to install application that were established by the slope stability analysis and shall be evaluated and signed and sealed by a professional engineer registered in the state of Ohio and submitted to the appropriate Ohio EPA district office no later than seven days prior to the intended use of the materials.	OSWDF Soil/Geosynthetic Direct Shear Testing Program Final Report (DOE 2016)
		CHEMICAL WASTE	
16	Code of Federal Regulations – Chemical Waste Landfills 40 CFR 761.75(b)(2)	The geomembrane component of the liner system shall comply with the requirements of 40 *CFR* 761.75(b)(2), listed as follows:	Section 5, Technical Specification Section 02770, and Geomembrane-Leachate Compatibility
		• have a minimum thickness of 30 mils	
		• have precautions taken to ensure that the integrity is maintained	
		• be chemically compatible with PCBs	

		• be designed with adequate soil underlining and soil cover to prevent excessive stress and prevent rupture of the liner	Study (DOE 2016)

APPENDIX B: CQC FORMS

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Note: Examples of CQC forms will be provided with the final design documents.

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