

PART III UNIT-SPECIFIC CONDITIONS FOR FINAL STATUS OPERATIONS

OPERATING UNIT 11

Integrated Disposal Facility

Appendix 4B Detailed Design Cell 1 Construction Quality Assurance Plan

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1 **Acronyms**

ASTM	American Society for Testing and Materials
CDN	Composite drainage net
CM	Construction Manager
CQA	Construction Quality Assurance
CQC	Construction Quality Control
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
GCL	Geosynthetic clay liner
GRI	Geosynthetic Research Institute
IDF	Integrated Disposal Facility
LCRS	Leachate collection and removal system
LDS	Leak detection system
NCR	Non-Conformance Report
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
PM	Project Manager
QA	Quality assurance
QC	Quality control
RFI	Request for Information
SBL	Soil bentonite admix liner
SLDS	Secondary leak detection system
UCL	Upper control limit
WAC	Washington Administrative Code

2

3

1 SECTION I—GENERAL

2 1.1 INTRODUCTION

3 This Construction Quality Assurance (CQA) Plan describes the quality assurance (QA) activities for
4 constructing Phase I of the Integrated Disposal Facility (IDF) at the Hanford facility in Richland,
5 Washington.

6 1.1.1 Applicable Units

7 QA activities will be required during construction of Cell 1 of Phase I to certify that the following
8 construction activities are performed in accordance with the construction documents:

- 9 • Construction/preparation of foundation systems for liners
- 10 • Construction of dikes or embankments
- 11 • Construction of low-permeability soil liners
- 12 • Construction of geomembranes
- 13 • Construction of leachate collection and removal systems and leak detection systems

14 This CQA Plan has been prepared to describe the activities that will be performed during construction of
15 the lining system, leachate collection and leak detection systems, and operation layer of Cell 1. This CQA
16 Plan is intended to satisfy the regulatory requirements and guidance established in 40 CFR 264.19, the
17 U.S. Environmental Protection Agency's (EPA) technical guidance document, *Quality Assurance and*
18 *Quality Control for Waste Containment Facilities* (EPA 1993), and Washington Administrative Code
19 (WAC) 173-303-335.

20 This CQA Plan will be implemented by a CQA Officer (herein referred to as the CQA certifying
21 engineer), a person familiar with EPA's technical guidance document, *Quality Assurance and Quality*
22 *Control for Waste Containment Facilities* and this CQA Plan. The CQA certifying engineer will be
23 supported by the number of CQA representatives necessary to implement the requirements in this CQA
24 Plan and to document the work.

25 1.1.2 Scope

26 This CQA Plan establishes general administrative and documentation procedures that will be applicable for
27 selected activities of construction. With respect to responsibilities, personnel qualifications, and specific
28 inspection and testing activities, this CQA Plan addresses only those activities associated with the soils,
29 geosynthetics, and related liner and leachate collection system piping components for the IDF.

30 The CQA requirements are divided into the following sections to provide quick access to CQA requirements
31 for individual liner components:

- Soils CQA
- Geosynthetic Clay Liner CQA
- Geomembrane CQA
- Geotextile CQA
- Composite Drainage Net CQA
- Polyethylene Pipe and Fittings CQA
- CQA Documentation and Certification
- CQA Documentation and Certification

32 1.2 PROJECT ORGANIZATION

33 This section describes the anticipated project organization for the IDF construction activities. The
34 following subsections address the organizations involved in the construction, their respective roles in
35 construction activities, and the methods of interactions between organizations.

36 1.2.1 Responsibility and Authority

37 The organization chart for the IDF construction is shown in Figure 1-1. These personnel will be
38 associated with two main entities that include the Tank Farm operating contractor and his agents and the

1 construction general contractor and his personnel and/or subcontractors. The project team consists of both
2 full-time field personnel and part-time management personnel. The part-time management personnel will
3 be onsite during the IDF construction periodically to monitor progress, attend meetings, resolve disputes,
4 and ensure that the work is implemented in accordance with the construction drawings, technical
5 specifications, CQA Plan, and the RCRA permit. The field personnel will consist of the key personnel
6 onsite during construction. The solid lines on the organization chart represent project responsibilities such
7 as scope, cost, and schedule. The dashed lines represent the functional responsibilities of staff for QA,
8 design, and management. The responsibilities and reporting requirements for each project team member
9 are described in the following sections.

10 **1.2.1.1 Project Team**

11 When the individuals identified below are designated to perform specific functions described in this CQA
12 Plan, the reference to these individuals includes their designee or an alternate who can function on their
13 behalf. The Department of Energy – Office of River Protection (DOE-ORP) Manager is the owner’s
14 representative and is responsible for project funding and overall project scope. The DOE-ORP manager
15 and IDF project manager keep the regulatory agencies informed of IDF construction activities and
16 progress.

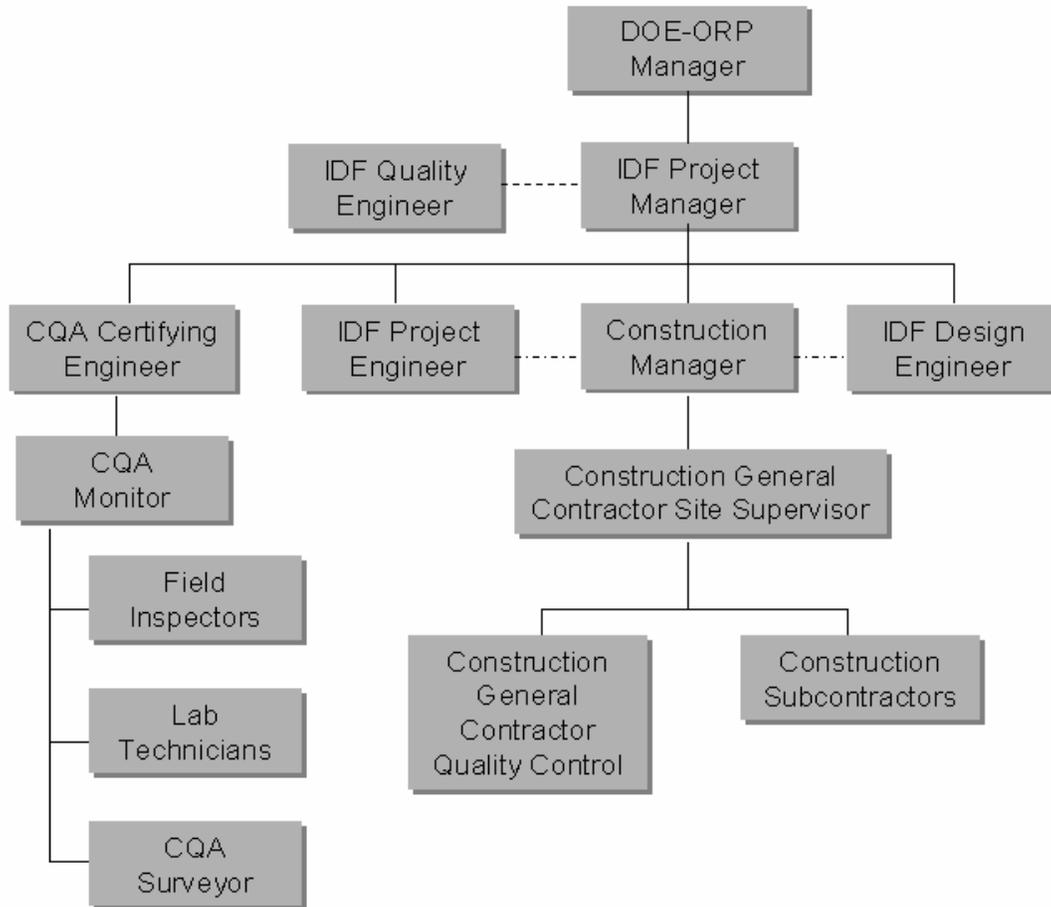
17 **IDF Project Manager (PM)**

18 The IDF PM is an employee or agent of the Tank Farm operating contractor, has overall responsibility for
19 the IDF construction, and interfaces with the DOE-ORP manager. The IDF PM directs the activities of the
20 IDF project and field team staff, including the CM, design engineer, and the project engineer.
21 Additionally, the IDF PM has overall responsibility for the achievement of quality. Functionally, the IDF
22 PM reviews and approves quality assurance reports submitted by the IDF CQA certifying engineer.

23 **IDF Project Engineer**

24 The IDF project engineer is an employee or agent of the Tank Farm operating contractor and is
25 responsible for providing technical support to the IDF project team. The IDF project engineer is supported
26 by the design engineer for reviewing and/or preparing technical documents related to engineering design
27 and analyses.

1 **Figure 1-1. QA Organization Chart**



2

3 **IDF Quality Engineer**

4 The IDF quality engineer is an employee or agent of the Tank Farm operating contractor and is
5 independent from line management on the project. The IDF quality engineer provides overview and

1 assessment of QA on the project. The IDF quality engineer provides feedback and assessment results to
2 the IDF PM.

3 **IDF Design Engineer**

4 The IDF design engineer is an employee or agent of the Tank Farm operating contractor is responsible for
5 reviewing and/or preparing technical documents related to the IDF design and construction. The design
6 engineer prepares the construction drawings, technical specifications, and the CQA Plan. The IDF design
7 engineer reports to the IDF PM and supports the IDF project engineer.

8 **1.2.1.2 Field Team**

9 **IDF Construction Manager**

10 The IDF CM is an employee or agent of the Tank Farm operating contractor and serves as the point of
11 contact between the IDF construction general contractor and the IDF project team. All construction
12 general contractor correspondence and direction flows through the CM. The CM oversees the daily
13 construction field activities and is the onsite representative for the IDF PM.

14 **CQA Certifying Engineer**

15 The CQA certifying engineer is an employee or agent of the Tank Farm operating contractor who has the
16 overall responsibility of implementing this CQA Plan and directly supervises the CQA monitor, field
17 inspection team, and laboratory technicians. The CQA certifying engineer is responsible for preparation
18 of an implementation plan that addresses how the CQA Plan is to be implemented, and how CQA work is
19 to be performed, tracked, and coordinated, as well as how procedures outlined in this CQA Plan are to be
20 followed. The implementation plan will be submitted to IDF project manager and CM for approval.

21 Functionally, the CQA certifying engineer submits certified CQA reports to the IDF CM for review and
22 approval by the IDF PM. The CQA certifying engineer is a registered professional engineer in
23 Washington and has the authority to provide a certification letter that the IDF is constructed in accordance
24 with the approved CQA Plan, the approved plans and specifications, and any approved changes. The
25 CQA certifying engineer also has the authority and responsibility to stop work and recommend remedial
26 actions to the IDF PM.

27 **Field Inspector**

28 Field inspectors are employees or agents of the Tank Farm operating contractor and report to the CQA
29 certifying engineer. The field inspector's function is to perform testing and observations, in accordance with
30 this CQA Plan and under the direction of the CQA monitor and CQA certifying engineer.

31 **Soils Laboratory Technicians**

32 Laboratory technicians are employees or agents of the Tank Farm operating contractor and report to the
33 CQA certifying engineer and provide the QA laboratory testing, required by this CQA Plan and as
34 requested by the CQA monitor and CQA certifying engineer.

35 **CQA Surveyor**

36 The CQA surveyor will be an employee or agent of the Tank Farm operating contractor and will be a
37 registered land surveyor in the State of Washington.

38 **CQA Monitor**

39 The CQA monitor is an employee or agent of the Tank Farm operating contractor, reports directly to the
40 CQA certifying engineer, and is a CQA representative, supported by the field inspection team and
41 laboratory technician. The CQA monitor ensures that all CQA tests are performed in accordance with this
42 CQA Plan and accepted procedures.

1 **Construction General Contractor**

2 The IDF construction general contractor is responsible for implementing the approved design by
3 providing the necessary labor, equipment, materials, and all other resources necessary to construct the
4 IDF.

5 **Construction General Contractor Site Supervisor**

6 The site supervisor is an employee or agent of the construction general contractor and is responsible for
7 implementing the IDF construction activities. The site supervisor has overall responsibility for all
8 construction activities related to the IDF, controls day-to-day construction tasks, and is the point of
9 contact for construction general contractor field personnel. The site supervisor ensures the work is
10 progressing in accordance with approved construction contract documents and the approved schedule.

11 **Construction Subcontractors**

12 Construction subcontractors include specialty companies, retained by the IDF construction general
13 contractor, to perform specific work activities at the IDF such as earth moving, geosynthetic lining
14 installation, piping, and building/tank installation. The construction subcontractors report directly to the
15 construction general contractor site supervisor.

16 **Construction General Contractor Quality Control**

17 The construction general contractor provides a construction QC engineer who supports the site supervisor.
18 The primary responsibility of the construction QC engineer is to ensure that the work is performed in
19 accordance with the technical specifications and construction drawings. Specific duties of the construction
20 QC engineer include activities such as preparing construction submittals, field documentation, and
21 interfacing with the CQA certifying engineer.

1 **1.2.2 Project Meetings**

2 The various progress and status meetings that are anticipated to be held throughout the IDF construction
3 are described below. The purpose of the meetings is to discuss work progress, planning, and other issues
4 related to construction. A portion of these meetings can be dedicated to CQA issues, as necessary, to
5 provide an opportunity for the CQA team to express concerns regarding quality, relay test results, and
6 ensure good communication between all organizations involved in the construction of the IDF.

7 **1.2.2.1 Pre-Construction Meeting**

8 A pre-construction meeting will be scheduled prior to beginning construction activities for the IDF. At a
9 minimum, the meeting will be attended by IDF staff including the PM, CM, project engineer, design
10 engineer, as well as the construction general contractor site supervisor, and the CQA certifying engineer.
11 A portion of the meeting will be dedicated to the discussion of QA issues. Suggested CQA topics will
12 include, but not be limited to:

- 13 • Reviewing the responsibilities of each organization
- 14 • Discussing the authority of agencies and project and field team members to order work stoppages
- 15 • Reviewing lines of authority and communication for each organization
- 16 • Providing each organization with all relevant CQA documents and supporting information
- 17 • Familiarizing each organization with the CQA Plan and its role, relative to the design criteria, plans,
18 and specifications
- 19 • Discussing the established procedures or protocol for observations and tests, including sampling
20 strategies
- 21 • Discussing the established procedures or protocol for handling construction deficiencies, repairs, and
22 re-testing, including “stop work” conditions
- 23 • Reviewing methods for documenting and reporting inspection data
- 24 • Reviewing methods for distributing and storing documents and reports
- 25 • Reviewing work area security and safety protocol
- 26 • Reviewing the proposed project schedule
- 27 • Discussing procedures for the location and protection of construction materials and for the prevention
28 of damage of the materials from inclement weather or other adverse events
- 29 • Determining action items, assigning actionees, and recording minutes to be transmitted to meeting
30 attendees
- 31 • Discussing document control requirements and control of CQA records
- 32 • Discussing control and protection of samples

33 **1.2.2.2 Daily Pre-Job Briefing**

34 The construction general contractor will conduct daily pre-job briefings at the work area. The participants
35 will include the construction field personnel, including lower tiered subcontractors and CQA
36 representatives. The primary purpose of these meetings will be to address the day’s planned activities.
37 The CQA monitor will discuss CQA activities planned for that day and interface needs with the
38 construction personnel. Suggested CQA topics are:

- 39 • Review the work location and activities for the day
- 40 • Discuss the construction general contractor’s personnel and equipment assignments for the day
- 41 • Address scheduling of resources for upcoming work
- 42 • Review any new test data
- 43 • Discuss any potential construction problems, including unexpected subsurface conditions

- 1 • Discuss CQA-planned activities and interface needs

2 This meeting will be documented and the documentation will be retained on file by the CQA monitor.

3 **1.2.2.3 Construction Progress Meetings**

4 Weekly progress meetings will be held at the site to discuss construction progress. At a minimum, the
5 weekly progress meetings will be attended by the IDF PM, CM, the site supervisor, and the CQA
6 certifying engineer or CQA monitor. The purposes of the meeting are to:

- 7 • Review previous activities and accomplishments
8 • Review claims, change orders, delays, and similar items
9 • Review planned activities for the upcoming 2-week period
10 • Finalize resolution of problems from previous meetings
11 • Discuss potential problems with the work planned for the upcoming 2-week period

12 Minutes will be recorded and transmitted to meeting attendees and other interested parties.

13 **1.2.2.4 Non-Conformance Meetings**

14 Meetings will be convened as necessary to address non-conformances discovered during inspection.
15 Deficiencies observed during construction by the CQA representatives will be brought to the attention of
16 the IDF CM and CQA certifying engineer and documented using the non-conformance reporting (NCR)
17 procedures outlined in Section 8.1.4. These deficiencies also will be tracked in the CQA representative's
18 field log book until resolution and included in the daily summary report. These documents will include
19 the description of the deficiency and actions taken or to be taken to resolve.

1 **1.2.3 Hold Points**

2 Mandatory hold points will be established for certain key activities. At these points, the IDF construction
3 general contractor will notify the CQA monitor or CQA certifying engineer that the layer or portion of a
4 layer is ready for review. The hold points anticipated for the IDF would be at completion or partial
5 completion of each of the following components:

- 6 • Prepared subgrade
- 7 • SLDS geomembrane and composite drainage net (CDN)
- 8 • SLDS riser pipe
- 9 • Soil bentonite admix soil liner
- 10 • Secondary GCL
- 11 • Secondary geomembrane
- 12 • LDS CDN
- 13 • LDS piping
- 14 • Primary geosynthetic clay liner (GCL)
- 15 • Primary geomembrane
- 16 • Cushion geotextile
- 17 • LCRS piping
- 18 • Drain gravel
- 19 • Separation geotextile
- 20 • Operations layer

21 On side slopes, a LCRS CDN would substitute for the cushion geotextile, drain gravel, and separation
22 geotextile.

23 **1.3 PERSONNEL QUALIFICATIONS AND TRAINING**

24 This section describes the qualifications and training required for CQA personnel. All documentation
25 relating to qualifications will be maintained with the project CQA records.

26 **1.3.1 CQA Certifying Engineer**

27 The CQA certifying engineer will have landfill construction certification experience. The CQA certifying
28 engineer will, at a minimum, be a registered civil professional engineer in good standing in the State of
29 Washington, possess a bachelor's degree in civil or construction engineering, geotechnical engineering,
30 engineering geology, or a closely related discipline, and have sufficient practical, technical, and
31 managerial experience to successfully direct the CQA activities discussed in this CQA Plan. The CQA
32 certifying engineer's qualifications will be documented by training records and a professional resume
33 showing significant field experience in landfill construction and low permeability soil-bentonite admix
34 liner construction, having directed CQA activities at a minimum of three landfill construction projects or
35 a minimum of 100 acres of combined landfill area certifying experience. The CQA certifying engineer
36 will be familiar with the EPA technical guidance document, *Quality Assurance and Quality Control for*
37 *Waste Containment Facilities* (EPA 1993). Qualification documentation will be reviewed by the IDF PM
38 and IDF project engineer.

39 **1.3.2 CQA Monitor**

40 At a minimum, the CQA monitor will have a high school diploma and at least five years of construction-
41 related experience, including at least three years of experience conducting CQA monitoring for earthwork
42 construction (including a minimum of three landfill construction projects or a minimum of 50 acres of
43 combined landfill area experience), or a bachelor of science degree from a four-year college or university
44 and at least two years of experience conducting CQA monitoring for earthworks construction (including a
45 minimum of three landfill construction projects). The CQA monitor must be capable of performing work
46 with little or no daily supervision. The CQA monitor will be familiar with the EPA technical guidance
47 document, *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA 1993).

1 Qualifications of the CQA monitor will be documented by training records and a professional resume,
2 reviewed by the IDF PM and CQA certifying engineer.

3 **1.3.3 Field Inspector**

4 At a minimum, the field inspector will have a high school diploma and at least two years of construction-
5 related experience, including at least one year of experience conducting CQA monitoring for earthwork
6 construction, or will have a bachelor of science degree from a four-year college or university and at least
7 six months of experience conducting field inspection for earthworks construction. The field inspector
8 must be capable of routine engineering technician work, under general daily supervision. The field
9 inspector will be familiar with the EPA technical guidance document, *Quality Assurance and Quality*
10 *Control for Waste Containment Facilities* (EPA 1993). Qualifications of the field inspector will be
11 documented by training records and a professional resume, reviewed by the IDF PM and CQA certifying
12 engineer.

13 **1.3.4 Soils Laboratory Technicians**

14 Laboratory technicians will have at a minimum a high school diploma and at least five years of
15 construction materials laboratory testing related experience, including at least three years of experience
16 performing geotechnical laboratory tests for earthwork construction, including compacted low
17 permeability soil-bentonite admix, or will have a bachelor of science degree from a four-year college or
18 university and at least two years of experience performing geotechnical laboratory tests for earthwork
19 construction, including low permeability soil-bentonite admix. The laboratory technician must be capable
20 of routine laboratory tech work, under general daily supervision. Qualifications of laboratory technicians,
21 including training records and professional resumes, will be reviewed by the IDF PM and CQA certifying
22 engineer.

23 **1.3.5 Geosynthetic Laboratory**

24 The geosynthetic laboratory will be selected by the CQA certifying engineer and will provide the
25 geosynthetic QA conformance testing required by this CQA Plan, as requested by the CQA monitor and/or
26 CQA certifying engineer. The geosynthetics CQA laboratory will be unaffiliated with the materials supplier
27 or manufacturer, or construction general contractor. The geosynthetics CQA laboratory will have at least
28 five years of experience in testing geosynthetics and other relevant liner system components, and will be
29 familiar with American Society for Testing and Materials (ASTM) and other applicable test standards.

30 **1.4 DEFINITIONS RELATING TO CONSTRUCTION QUALITY ASSURANCE**

31 **1.4.1 Construction Quality Assurance and Construction Quality Control**

32 **Construction Quality Assurance**—A planned and systematic pattern of the means and actions designed
33 to provide adequate confidence that items or services meet contractual and regulatory requirements, and
34 will perform satisfactorily in service.

35 **Construction Quality Control (CQC)**—Those actions that provide a means to measure and control the
36 characteristics of an item or service to meet contractual and regulatory requirements.

37 **1.4.2 Use of the Terms in This Plan**

38 The definitions used in the context of this CQA Plan are as follows:

- 39 • CQA refers to means and actions employed by the CQA representatives to assure conformity of liner
40 system, LCRS, LDS, SLDS, and pipe preparation, production, and installation with this CQA Plan,
41 the technical specifications, and the construction drawings. CQA will be provided by a third party,
42 acting independently from the product manufacturer and construction general contractor.
- 43 • CQC refers to those actions taken by manufacturers, suppliers, or construction general contractor,
44 including their designated representatives, to ensure that the materials and the workmanship meet the
45 requirements of the technical specifications and the construction drawings.

1 **1.5 REFERENCES**

2 **1.5.1 Applicable Organizations**

3 Organizations whose standards are referenced in the CQA Plan include:

- 4 • ASTM—American Society for Testing and Materials
5 • DOE—Department of Energy
6 • GRI—Geosynthetic Research Institute
7 • OSHA—Occupational Safety and Health Administration
8 • EPA—U.S. Environmental Protection Agency

9 **1.5.2 Applicable Standards**

10 Any reference to standards of any society, institute, association, or governmental agency will pertain to
11 the edition in effect as of the date of this CQA Plan, unless stated otherwise.

12 Specific test standards for tests cited in the CQA Plan are provided in the technical specifications. These
13 standards may be modified due to technological advances since compilation of the technical
14 specifications. All such modifications are to be approved in accordance with change order procedures
15 described in Section 8.1.5.

1 **1.6 CONSTRUCTION ACTIVITIES AND SUBMITTAL REQUIREMENTS**

2 **1.6.1 Construction Activities**

3 This section describes the construction activities and submittal requirements that will be performed by the
4 construction general contractor during the IDF construction. This CQA Plan only addresses selected
5 activities of the Phase I construction.

6 In general, construction activities will consist of preparing the subgrade, installing the liner system, the
7 leak detection systems (LDS and SLDS), the leachate collection and removal system (LCRS), and
8 operations layer and necessary equipment to complete the landfill for waste acceptance. Construction will
9 consist of these activities:

- 10 • Mobilizing construction equipment and personnel
- 11 • Vendor data submittals
- 12 • Installing sediment and erosion control
- 13 • Preparing soil bentonite material
- 14 • Excavation, embankment, fine grading of landfill subgrade, and sump construction
- 15 • Constructing the secondary leak detection system (SLDS) sump
- 16 • Constructing the soil bentonite admix liner (SBL)
- 17 • Dust control activities during construction
- 18 • Placing the geosynthetics for the secondary liner
- 19 • Constructing the leak detection system (LDS)
- 20 • Placing the geosynthetics for the primary liner
- 21 • Constructing the leachate collection and removal system
- 22 • Constructing the operations layer
- 23 • Site restoration
- 24 • Demobilization

25 Prior to the start of construction activities, the CQA representatives will review and become familiar with
26 all construction drawings, technical specifications, the CQA Plan, and RCRA permit. The CQA certifying
27 engineer also will be familiar with the most recent construction schedule, so that adequate resources (i.e.,
28 laboratory, field testing equipment, staff, and CQA forms), including contingencies (e.g., backup
29 equipment, alternate laboratory, and alternate CQA staff) for CQA activities, will be commensurate with
30 the anticipated construction productivity and work schedule.

31 **1.6.2 Submittal Requirements**

32 The construction general contractor will provide the submittals required (listed in Table 1-1 in this
33 section) to the IDF PM. Submittals will be provided far enough in advance of scheduled installation dates
34 to allow time for reviews, possible revisions and resubmittals, placing orders, and securing delivery. The
35 construction general contractor will identify, track, and disposition all required vendor data. The IDF PM
36 will respond to each required submittal as stated in the technical specifications.

37 The submittals presented in Table 1-1 will be required as a minimum. A master submittal list will be
38 provided as part of the contract documents.

39 **1.6.3 Receipt Inspection Procedures**

40 Inventory of manufactured materials used in lining system construction is detailed in Sections 3.1.4
41 (GCL), 4.1.4 (geomembrane), 5.1.4 (geotextiles), 6.1.4 (CDN) and 7.1.4 (polyethylene piping). The
42 purpose of this section is to provide a general summary of the minimum requirements and procedures for
43 receiving and controlling purchased materials, equipment, or services as required by the contract
44 documents.

45 Procurement, receipt, and inspection of construction materials and equipment are the responsibilities of
46 the construction general contractor, with verification by the CQA certifying engineer and IDF CM.

- 1 Procedures specific to the IDF Phase I construction project will be prepared as part of the construction
2 quality control (QC) plan, to be submitted by the construction general contractor.
- 3 Procedures to control receipt inspection will include the following, at a minimum:
- 4 • The contract documents will provide a master submittal list that identifies the materials, equipment,
5 or services requiring receipt inspection. Upon delivery to the project site, the general construction
6 contractor will attach secure and visible “Quality Hold for Inspection” tags to each item.
 - 7 • All items, materials, and equipment that have been tagged will be stored in segregated areas, as
8 identified in the contract documents. Items will be restricted from further use until all construction
9 general contractor and CQA certifying engineer inspections are completed.
 - 10 • Upon inspection if items, materials, or equipment held for inspection, the “Quality Hold for Inspection”
11 tag will be removed and replaced with one of the following, as appropriate:
 - 12 a) Acceptance tag
 - 13 b) Non-conformance (red) tag
 - 14 c) Conditional use tag
 - 15 • The construction general contractor may utilize only those items tagged as “Accepted” or
16 “Conditional Use.”
 - 17 • Red tagged materials will not be used in construction and will be moved to a segregated area or
18 removed from the site.
 - 19 • Conditional use tagged materials are restricted to use for specific conditions identified on the tag.
 - 20 • Documentation of receipt inspection will be completed, maintained, and stored in a single location, in
21 a secure and protected environment for the full performance period of the construction contract.

1 **Table 1-1. Required Submittals**

Submittal	Description	Requirement
Source Quality Control for Imported Materials (structural fill, drain gravel and crushed surfacing)	Gradation tests performed in accordance with ASTM D422 by a qualified independent test laboratory for imported materials on samples taken at place of production prior to shipment. Samples will be taken for gradation testing from every 2,000 tons of prepared materials, in accordance with ASTM D75.	Submitted by the construction general contractor and approved by the IDF PM prior to the shipment of material to the project site.
Geomembrane Installation Plan	Proposed layout drawings for each layer of geomembrane material. Geomembrane layout will show panel configuration, general dimensions, and seam locations.	Submitted by the construction general contractor and approved by the IDF PM prior to the installation of the respective geomembrane liner.
Subgrade surface acceptance	Certification in writing that the surface on which the geomembrane will be installed is acceptable to the installer. A certificate of acceptance will be provided by the construction general contractor to the CQA representative, who will then verify to the CQA certifying engineer that the deployment surface has been accepted immediately prior to commencement of geomembrane installation in the area under consideration.	Certificate signed by the installer and construction general contractor prior to installation of geomembrane over the subgrade.
GCL quality control certifications, test data and properties guarantee	<p>Provide manufacturer's quality control (QC) test data for GCL material to be installed, including:</p> <p>Bentonite – suppliers' name and location, brand name, lot number, dated quality control information from supplier, manufacturer's test data verifying that bentonite meets manufacturer's specifications.</p> <p>GCL – written guarantee that GCL conforms to the technical specification requirements and test certificates for each production lot or 50,000 square feet of GCL material including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for GCL.</p>	Submitted by the construction general contractor prior to installation of the GCL material and approved by the IDF PM.

Submittal	Description	Requirement
Geomembrane quality control certifications, test data and properties guarantee	<p>QC Testing shall be performed by manufacturer to demonstrate the geomembrane conforms to technical specification requirements. Prior to delivery of any geomembrane material, the manufacturer shall submit all required information listed in the technical specifications (Section 02661).</p> <p><u>QC Certification:</u> Prior to shipment, the geomembrane manufacturer shall provide a quality control certificate for each roll of geomembrane. The quality control certificate shall be signed by a responsible party employed by the geomembrane manufacturer, such as the production manager. The quality control certificate shall include:</p> <ol style="list-style-type: none"> 1. Roll numbers and identification, resin lot, and batch numbers. 2. Sampling procedures and results of quality control tests. As a minimum, results shall be given for thickness, asperity, tensile strength, and tear resistance in accordance with methods indicated in the technical specifications. Tests shall be conducted on each production lot of geomembrane or every 50,000 square feet, whichever results in the greater number of tests. 	Submitted by the construction general contractor prior to installation of the geomembrane material and approved by the IDF PM.
Geotextile material certifications and test data	<p>Provide manufacturer's QC test data for geotextile material to be installed, including:</p> <p>Geotextile – written guarantee that geotextile conforms to specification requirements, certification that manufacturer continuously inspected geotextile for presence of needles and found it to be needle-free, and test certificates for geotextile material including roll numbers, test methods, and test results verifying compliance with the technical specifications physical properties for geotextile. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications.</p>	Submitted by the construction general contractor prior to installation of the geotextile material and approved by the IDF PM.
Composite drainage net material certifications and test data	<p>Provide manufacturer's QC test data for composite drainage net material to be installed, including:</p> <p>Composite drainage net – manufacturer's specification measured using appropriate test methods, written guarantee that composite drainage net conforms to specification requirements, manufacturer's QC test data for the geotextile component as specified above for geotextile, and test certificates for composite drainage net material and geonet component including roll numbers, test methods, and test results verifying compliance with the technical specification requirements for composite drainage net and geonet. Frequency of manufacturer's QC testing shall be at the standard rate stated in the manufacturer's QC plan for each required property in the technical specifications</p>	Submitted by the construction general contractor prior to installation of the composite drainage net material and approved by the IDF PM.

Submittal	Description	Requirement
Interface Shear Strength test data	<p>Provide data prior to material shipment for the interface friction angle between the textured geomembrane and other materials (including CDN, GCL, and Admix Liner) directly in contact with the geomembrane as specified in Section 02661; and between the CDN and the operations layer as specified in Section 02373 of the technical specifications.</p> <p>Friction angle shall be determined by direct shear testing under fully saturated conditions (ASTM D5321 or D6243 for GCL interface) at low nominal normal loads of both 100, 250, and 500 pounds per square foot (psf), and high nominal normal loads of 2,000, 8,000, and 15,000 psf, except for the CDN/Operations Layer interface which shall be reported at low normal load only. Report results for both peak and large displacement (minimum 2 inches) strength. Perform two interface shear strength tests on each interface under each set of normal loads.</p>	<p>Submitted by the construction general contractor prior to geosynthetic material shipment and reviewed and approved by the IDF PM for conformance with project strength requirements. Allow IDF PM a minimum 20 working days for this evaluation upon receipt of data.</p>
Admix Liner Preparation and Placement Plan	<p>Provide a detailed plan for preparation of the admix material, including a description of the equipment and procedures to be used, personnel qualifications, equipment calibration certificates and methods for monitoring bentonite additions and moisture conditioning.</p> <p>Also provide an admix liner placement plan to specify lift thickness control and to allow for required testing, described in the CQA Plan and technical specifications on the admix liner during placement operations.</p>	<p>Submitted by the construction general contractor prior to start of admix production for approval by IDF PM.</p>
Bentonite QC certificates and test data	<p>Provide bentonite supplier's descriptive data, specification sheets, literature, and other data as necessary to fully demonstrate that the bentonite proposed for use in the admix complies with the requirements of the technical specifications. The manufacturer shall certify that the bentonite furnished complies with these Specifications. A certificate shall be submitted to the CQA Engineer for each railcar or every three truckloads of bentonite delivered.</p>	<p>Submitted by the construction general contractor prior to start of admix production for approval by IDF PM.</p>
Polyethylene Pipe and Fittings	<p>Provide manufacturer's QC test data for piping and fittings that will be installed on the landfill floors and slopes.</p>	<p>Submitted by the construction general contractor prior to installation of the pipe for approval by the IDF PM.</p>

1 **SECTION II—SOILS CONSTRUCTION QUALITY ASSURANCE**

2 This section discusses the CQA requirements for soil layers including fill placement, subgrade
3 preparation, admix liner, drain gravel, and operations layer.

4 **2.1 FILL PLACEMENT AND SUBGRADE PREPARATION**

5 This section of the CQA Plan addresses the soils components necessary to provide a prepared subgrade
6 for the liner systems and specifies the soils CQA program to be implemented with regard to materials
7 selection and evaluation, laboratory test requirements, field test requirements, and corrective action
8 requirements.

9 **2.1.1 Fill Placement and Compaction**

10 The technical specifications will be followed for the stockpiling, placement, and compaction of earthfill
11 and structural fill. The CQA monitor will monitor the fill placement and compaction to verify and
12 document the following:

- 13 • The soil being placed meets the technical specifications requirements for earthfill and structural fill as
14 determined by the test methods and frequencies specified within this CQA Plan and the source quality
15 control submittals.
- 16 • The placement surface has been prepared as specified in the technical specifications.
- 17 • The compacted lift thickness is in accordance with the requirements of the technical specifications.
- 18 • The dry unit weight of the earthfill and structural fill meets specifications as determined by the test
19 methods and frequencies described in Table 2-1 for earthfill and Table 2-2 for structural fill.
- 20 • Material placed in permanent stockpiles meets the appropriate specifications for earthfill or structural
21 fill.

22 **2.1.2 Construction Quality Assurance Evaluation**

23 The frequency of soils testing for CQA purposes will conform to the minimum frequencies presented in
24 Table 2-1 for earthfill and Table 2-2 for structural fill. Material properties will be determined from
25 samples collected either immediately after placement or from stockpiles.

26 Nuclear density meter test methods will be used for the field testing of the in situ dry unit weight of the
27 in-place, compacted fill. Any settlement or other defects in the fill will be backfilled and compacted in
28 accordance with the technical specifications.

29 Standard count calibrations will be conducted to monitor the aging of the nuclear density gauge sources in
30 accordance with ASTM standards. Sand cone or drive sleeve tests will be conducted periodically to verify
31 densities using the nuclear density gauge. Oven moisture content tests will be conducted and compared to
32 field moisture content results to determine a field correction factor for moisture. Sand cone or drive sleeve
33 tests and in situ moisture content tests will be performed at the frequencies specified in Tables 2-1 and 2-
34 2.

35 If an in-place density test result fails to meet specifications, a confirmatory test will be performed
36 immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications, a second
37 confirmatory test will be performed at a second location immediately next to the failed test. If the second
38 confirmatory test also meets or exceeds specifications, the area will be declared as meeting project
39 specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to
40 meet specifications, a CQA representative will determine the extent and nature of the defect by
41 observations and/or additional testing, as necessary, to identify the limits of the area that does not meet
42 project specifications.

1 If a defective area is discovered in the fill, a CQA representative will determine the extent and nature of the
2 defect. If the defect is indicated by an unsatisfactory test result, the CQA representative will determine the
3 extent of the defective area by additional tests, observations, a review of records, or other means that the
4 CQA representative deems appropriate. If the defect is related to adverse site conditions, such as
5 excessively wet soils or surface desiccation, the CQA representative will define the limits and nature of the
6 defect by testing or observation. After the extent and nature of a defect is determined and remedied by the
7 construction general contractor, the CQA representative will verify that the deficiency has been corrected
8 by re-testing repaired areas before any additional work is performed by the construction general contractor
9 in the area of the deficiency. All confirmatory tests, failing tests, and re-tests will be recorded in the CQA
10 representative's field book or compaction testing form. The approximate location and elevation of each test
11 will be recorded.

12 The CQA representative will document fill placement and compaction as determined by the test methods
13 and frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the
14 non-conformance reporting procedures outlined in Section 8.1.4.

15 **2.2 PREPARED SUBGRADE**

16 The CQA representative will verify and document that the prepared subgrade is constructed to the
17 elevations and grades shown in the construction drawings, with subgrade meeting the requirements of the
18 technical specifications as determined by the test methods and frequencies specified within this CQA
19 Plan.

20 Upon completion of the excavation of the landfill, the CQA monitor will perform the following tasks:

- 21 • Inspect the subgrade on the side slopes and base of the landfill and note areas of weak or excessively
22 weathered subgrade materials
- 23 • Observe completion of excavation and subgrade compaction prior to foundation, fill, or liner
24 placement
- 25 • Observe the proof rolling of the base of the landfill and note areas that exhibit excessive rutting,
26 heaving, or softening
- 27 • Observe that the surface of the subgrade is free of debris, wet and soft areas, standing water,
28 vegetation, mud, ice, or frozen material
- 29 • Observe any excavation and backfilling operations associated with unsuitable material found in the
30 prepared subgrade
- 31 • Verify that a survey has been conducted to further verify that the subgrade grades and elevations
32 conform to the construction drawings
- 33 • Verify that the prepared subgrade material meets the requirements of the technical specifications as
34 determined by the CQA testing methods and frequency in Table 2-3
- 35 • Verify that sampling points in the prepared subgrade are plugged or backfilled so that the prepared
36 subgrade meets the technical specifications
- 37 • Document the location and volume of any unsuitable material removed from the prepared subgrade
38 and report any non-conformance with the technical specifications in accordance with the non-
39 conformance reporting procedures in Section 8.1.4

40 **2.2.1 Layer Completion Certification**

41 The construction general contractor will be required to notify the CQA representative when an area of
42 prepared subgrade is complete prior to constructing the overlying layer. The construction general
43 contractor can proceed with the overlying layer upon acceptance of the area of prepared subgrade by the

1 CQA representative. The CQA certifying engineer will provide a certificate of layer completion to the
2 construction general contractor and the IDF project engineer, certifying that the area is complete.

3 **2.3 SOIL BENTONITE ADMIX LINER AND TEST PADS**

4 The soil bentonite admix liner (SBL) is composed of a mixture of base soil and bentonite material. Two
5 SBL test pads will include both a horizontal and a sloped test pad. The horizontal test pad will be
6 constructed by using the same compaction methods as that used for the production SBL, to ensure the
7 SBL is constructed to meet the minimum hydraulic conductivity requirements. The sloped test pad will be
8 constructed on a sloping surface to verify that compaction methods (determined during the horizontal test
9 pad) will be adequate for the side slopes of the landfill. If necessary, the technical specifications and/or
10 CQA Plan may be modified, based on the results of the test pads.

11 **2.3.1 Test Pads**

12 Test pads will be constructed by the construction general contractor to determine acceptable placement
13 and compaction methods to produce a low permeable SBL on a horizontal surface and on a 3H:1V side
14 slope that satisfies the performance requirements of the technical specifications.

15 In addition, the mixing of the base soil and bentonite admixture using the pugmill will be tested to ensure
16 adequate control of the ratio of admixture components as well as the homogeneity of the completed SBL
17 mixture.

18 **2.3.1.1 Construction Quality Assurance Evaluation**

19 During test pad construction, the CQA representative will continuously observe and document the
20 construction of the test pad. These guidelines will be followed to ensure that the test pad accurately
21 represents the performance of the full-scale facility:

- 22 • Construction of the test pad will use the same soil material, design specifications, equipment, and
23 procedures as proposed for the full-scale facility.
- 24 • The test pad length, width, and depth will be as required by the technical specifications and for the in-
25 situ hydraulic conductivity test spacing.
- 26 • The number of lifts used to construct the test pad will be as required by the technical specifications.

27 The test pad will be constructed to allow determination of the relationship among density, moisture
28 content, and method of compaction. Field variables can affect this relationship and must be carefully
29 measured and controlled, both in the test pad and during construction of the full-scale liner. At a
30 minimum, the following will be observed and documented:

- 31 • Track weight of base soil and bentonite during mixing operations
- 32 • Mixing operation homogeneity
- 33 • Test pad configuration and dimensions
- 34 • Compaction equipment type, configuration, and weight
- 35 • Number of passes and speed of the compaction equipment
- 36 • Uncompacted and compacted lift thickness
- 37 • Weather conditions, including ambient temperature, humidity, wind speed and direction, and
38 precipitation

39 The CQA representative will provide the necessary surveying and/or reference grid points for adequately
40 and expeditiously determining the elevation and dimensions of the test pad, including each lift.

41 The CQA representative will be responsible for all testing, surveying, and documentation necessary to
42 verify that the test pad performs in accordance with the technical specifications, and that the methods,
43 equipment, and materials used can achieve the same results or better during full-scale construction.

1 Testing methods and frequencies will be as indicated in Table 2-4. Additional tests may be conducted at
2 the direction of the CQA certifying engineer. All tests will be conducted in accordance with the methods
3 and procedures specified in Table 2-4. Tests are separately identified in Table 2-4 which are intended to
4 provide the following:

- 5 • Information Only, for use in evaluating overall methods , materials, or equipment
- 6 • Pass/Fail, that have criteria established in the technical specifications which must be met
- 7 • Calibration and Check, for use in calibrating instruments

8 The CQA certifying engineer will compare the results of the test pad constructed on the level surface with
9 the results of the test pad on the side slopes. The CQA certifying engineer will recommend changes to
10 compaction methods, if necessary, to the IDF project engineer. The CQA certifying engineer will prepare
11 an interim report which summarizes the construction and testing of the test pads.

12 It is important to note that an acceptable zone has been established in the technical specifications for the
13 allowable moisture content and density ranges that are applicable for the SBL admix to meet minimum
14 permeability requirements. This zone may be adjusted as a result of the test pad data obtained during
15 construction to reflect specific conditions observed based on the construction general contractor's
16 proposed blending, placement, and compaction methods. With the range of placement moisture content
17 and density allowed with this approach, minimum compaction effort (i.e., the number of passes a piece of
18 compaction equipment needs to bring the admix into the allowable moisture/density zone) will vary based
19 on material conditions and placement location. Minimum compaction effort recommendations will be
20 developed by the CQA certifying engineer for application to both bottom slope and side-slope admix
21 construction based on test pad results. However, these minimums should be considered as guidelines only
22 and may need to be adjusted based on changes to admix properties (primarily moisture content), site
23 conditions, and compaction location as needed to bring the admix into the required acceptable zone for
24 compaction.

25 **2.3.2 Soil Bentonite Admix Liner**

26 The CQA team will verify and document that the SBL is placed to the elevations, grades, and thicknesses
27 shown in the construction drawings, with bentonite-amended material meeting the requirements of the
28 technical specifications as determined by the test methods and frequencies specified within this CQA
29 Plan.

30 **2.3.2.1 Construction Quality Assurance Evaluation**

31 CQA testing will be performed during processing and placement of the SBL. The CQA team will conduct
32 the processing and placement tests for the SBL as specified in Table 2-5. The maximum allowable
33 percentage of failing tests is specified in Table 2-6.

34 ***Processing***

35 The construction general contractor shall process and condition admix material using a central type
36 pugmill plant as described in the technical specifications. Prior to amending the base soil with bentonite, a
37 CQA representative will verify and document the following:

- 38 • Equipment and methods are the same or equivalent as determined from the test pad studies.
- 39 • All submittals have been reviewed and approved.
- 40 • The base soil source area (either onsite excavation or borrow area) has been approved by the design
41 engineer, IDF PM, or IDF project engineer.
- 42 • The mixing equipment is suitable for amending base soils with bentonite.
- 43 • The base soil does not contain rocks with dimensions in excess of those required by the technical
44 specifications.

1 During processing, the CQA representative will verify and document the following:

- 2 • The bentonite is in conformance with the technical specifications.
- 3 • Close observation of the base soil excavation and processing is performed by the field inspector.
- 4 • The processed SBL material meets the requirements of the technical specifications as determined by
5 the CQA testing methods and frequency in Table 2-5.
- 6 • The moisture content and consistency of base soil allow bentonite to be mixed uniformly.
- 7 • Bentonite amendments are mixed uniformly with the base soil.
- 8 • The processed SBL material is stored, protected, and allowed to cure in accordance with the
9 conditions and minimum requirements of the technical specifications.
- 10 • Calibration of the pugmill operation feed rate controls for bentonite, base soil and water.
- 11 • The bentonite is mixed at the required application rate, established by the technical specifications as
12 determined by the CQA testing methods and frequency in Table 2-5.

13 The CQA representative will document the properties of the processed soil bentonite material, as
14 determined by the test methods and frequency prescribed by this CQA Plan, and will report any non-
15 conformance with the technical specifications, following procedures outlined in Section 8.1.4.

16 The CQA representative will observe processing activities including base soil excavation, bentonite
17 blending, and moisture conditioning.

18 The CQA representative will monitor the excavation of base soil from the approved borrow source or
19 onsite excavations. Deleterious base soil or base soil not meeting the technical specifications will be
20 identified and reported to the CQA certifying engineer and not allowed in the processing area.

21 CQA tests will be performed on the raw bentonite used in the SBL to verify conformance to the technical
22 specifications. The CQA representative will collect samples of raw bentonite delivered to the site for
23 testing. The CQA laboratory technician will conduct free swell, and grain size tests of the bentonite in
24 accordance with Table 2-5. If the test results of a sample fail to meet specifications, a confirmatory test
25 will be performed immediately subsequent to the failed test. If the confirmatory test meets or exceeds
26 specifications, a second confirmatory test will be performed. If the second confirmatory test also meets or
27 exceeds specifications, the bentonite will be declared as meeting project specifications and the
28 confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications,
29 the bentonite will be rejected and removed from the site.

30 The CQA representative will observe mixing and test the bentonite-amended soil, prior to placing it in the
31 landfill.

32 ***Placement***

33 Prior to the placement of the SBL, the CQA representative will verify and document the following:

- 34 • The test pads have been constructed with the approved liner material and production scale equipment
35 to confirm placement and compaction procedures produce the required low-permeability admix for
36 both on a horizontal surface and on a 3H:1V side slope.
- 37 • All or an approved portion of the prepared subgrade meets specifications as determined by the test
38 requirements of this CQA Plan and the CQA certifying engineer has issued the completion certificate.
- 39 • The SBL material is free of roots, stumps, vegetation, or any other type of deleterious material that
40 may impact the performance of the placed SBL.

- 1 • The SBL material does not contain stones with dimensions in excess of those required by the
2 technical specifications.
 - 3 • The SBL material meets or exceeds the requirements of the technical specifications as determined by
4 the CQA testing methods and frequency in Table 2-5.
 - 5 • The moisture content of the SBL material is uniform.
- 6 During placement and compaction of the SBL, the CQA Team will verify and document the following:
- 7 • Close observation of the placement and compaction of SBL material with earthmoving equipment is
8 performed by the field inspectors. Inspectors to verify that means and methods are the same as those
9 approved in the test pad process.
 - 10 • The SBL material meets the requirements of the technical specifications as determined by the CQA
11 testing methods and frequency in Table 2-5 and is within the maximum allowable failure rates in
12 Table 2-6.
 - 13 • The SBL is placed in accordance with the conditions and minimum requirements of the technical
14 specifications.
 - 15 • Each lift is compacted to the required thickness and minimum dry unit weight within the range of
16 moisture contents established by the technical specifications as determined by the CQA testing
17 methods and frequency in Table 2-5.
 - 18 • Shelby tube samples are collected for laboratory permeability testing at the frequency specified in
19 Table 2-5.
 - 20 • Penetrations in the SBL at testing and sampling locations are repaired in accordance with the
21 technical specifications.
 - 22 • The SBL is maintained until it is covered by the geomembrane liner in accordance with the technical
23 specifications.
 - 24 • In areas of inaccessibility by the compactor, in areas of nonstandard SBL placement, and/or in areas
25 of different compaction methods, more frequent testing will be performed due to thinner lift
26 thicknesses to achieve equivalent compactive effort. Each lift, no matter how thin, will be tested for
27 density and moisture in accordance with Table 2-5.
- 28 The CQA representative will document the properties of the SBL as determined by the test methods and
29 frequency prescribed by this CQA Plan and will report any non-conformance in accordance with the non-
30 conformance reporting, as outlined in Section 8.1.4.
- 31 The CQA representatives will collect samples immediately after a loose lift of SBL materials has been
32 placed for property tests, prior to compaction. Once compacted, nuclear density gauge test methods will
33 be used for testing the in situ compacted dry unit weight and moisture content of the SBL. Standard count
34 calibration and moisture content tests will be used to calibrate the reading of the nuclear density gauge.
35 Standard count calibration and in situ moisture content tests, using the oven dry method, will be
36 performed at the frequencies specified in Table 2-5. The results of the oven dry moisture content tests will
37 be compared with the field moisture content results to determine a field moisture correction factor. The
38 CQA representative will adjust the field moisture correction factor as test data is collected (i.e., moving
39 average). The CQA representative will collect Shelby tube samples of the SBL for laboratory
40 permeability tests as specified in Table 2-5.
- 41 If in-place density test results fail to meet specifications, a confirmatory test will be performed
42 immediately adjacent to (within 3 ft of) the failed test. If the confirmatory test meets or exceeds
43 specifications, a second confirmatory test will be performed at a second location immediately next to

1 (within 3 ft of) the failed test. If the second confirmatory test also meets or exceeds specifications, the
2 area will be declared as meeting project specifications and the confirmatory tests will be reported. In the
3 event that either confirmatory test fails to meet specifications, additional testing will be performed to
4 identify the limits of the area that does not meet project specifications. All confirmatory tests, failing
5 tests, and re-tests will be recorded in the CQA representative's field book or compaction testing form. The
6 approximate location and elevation of each test will be recorded.

7 Rapid laboratory permeability tests, such as the constant volume tests, will be used when possible to
8 determine permeability. Once the sample has achieved the specified permeability, the test result will be
9 reported immediately to the CQA certifying engineer. The number of failing tests will be less than the
10 maximum percentage of failing tests specified in Table 2-6. The maximum percentage of failing tests are
11 anticipated to cover laboratory or field recording mistakes, math errors, or other unknown circumstances
12 that are not discovered until after the layer is covered with the succeeding layer(s). Otherwise, all failed
13 tests will be corrected in the field as they are observed.

14 If a defective area is discovered in the SBL other than a failed in-place density test, the CQA
15 representative will determine the extent and nature of the defect. If the defect is indicated by an
16 unsatisfactory test result, the CQA representative will determine the extent of the defective area by
17 additional tests, observations, a review of records, or other means that the CQA representative deems
18 appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface
19 desiccation, the CQA representative will define the limits and nature of the defect by testing or
20 observation. After the extent and nature of a defect is determined and remedied by the construction
21 general contractor, the CQA representative will verify that the deficiency has been corrected by re-testing
22 repaired areas before any additional work is performed by the construction general contractor in the area
23 of the deficiency.

24 The testing frequency during the SBL construction may be increased or modified at the discretion of the
25 CQA certifying engineer, when visual observations of construction performance indicate potential
26 problems or when field experience with the proposed SBL material have been obtained.

27 During construction, the frequency of testing may be increased by the CQA representative during adverse
28 weather conditions, if equipment breaks down, at the start and finish of grading, if the material fails to
29 meet the requirements of the technical specifications, or if the extent of the work area is reduced.

30 The construction general contractor will repair all penetrations in the SBL resulting from sampling and
31 other CQA activities, in accordance with the technical specifications. These perforations will be identified
32 to the construction general contractor by the CQA representative. All repairs will be inspected by the
33 CQA representative.

34 The construction general contractor will be required to use all means necessary to protect all prior work as
35 well as all materials and completed work of other sections. In the event of damage, the construction
36 general contractor will be required to immediately make all repairs and replacements necessary. The CQA
37 representative will verify and document that all damages are repaired.

38 **2.3.2.2 Layer Completion Certification**

39 The construction general contractor will be required to notify the CQA representative when an area of
40 SBL is complete, prior to constructing the overlying layer. The construction general contractor may begin
41 placement of the overlying layer after acceptance of the SBL by the CQA certifying engineer. The CQA
42 certifying engineer will provide a certificate of layer completion to the construction general contractor
43 and the IDF project engineer, certifying that the area is complete.

44 The CQA certifying engineer will ensure all CQA tests are complete and that all defective areas have
45 been repaired and re-tested in accordance with this CQA Plan and the technical specifications. The
46 certificate of layer completion will indicate that the SBL meets the low permeability requirement, based

1 on laboratory tests and the thickness of the SBL meeting the minimum requirement specified in the
2 technical specifications.

3 **2.4 DRAIN GRAVEL**

4 **2.4.1 Conformance Evaluation**

5 No CQA conformance material testing is planned for the drain gravel. Construction general contractor is
6 required to submit gradation test results demonstrating conformance with required material properties as
7 part of source quality control, in accordance with the technical specifications.

8 **2.4.2 Placement and Compaction**

9 The CQA representative will verify and document that the drain gravel is constructed to the elevations,
10 grades, and thicknesses shown in the construction drawings, with material meeting the requirements of
11 the technical specifications as determined by the test methods and frequencies specified within this CQA
12 Plan.

1 Prior to the placement of the drain gravel, the CQA representative will verify and document that:

- 2 • The underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects.
- 3 • All work on underlying layers is complete and accepted by the CQA certifying engineer.

4 During placement and compaction of the drain gravel, the CQA representative will verify and document
5 the following:

- 6 • Drain gravel material satisfies the requirements of the technical specifications as determined by the
7 source quality control submittals.
- 8 • Drain gravel material is non-angular and free of material that could damage the underlying liner
9 materials.
- 10 • Drain gravel material is spread during cooler portions of the day, unless otherwise approved by the
11 CQA certifying engineer.
- 12 • Spreading and hauling equipment and operations are in compliance with material thickness and
13 operations requirements, given in the technical specifications.
- 14 • If excessive wrinkles begin to develop in the underlying geosynthetics during gravel or sand
15 placement or spreading, the wrinkles are worked out prior to continued placement operations.
- 16 • The drain gravel is placed in a manner that will not damage underlying geosynthetics, will minimize
17 slippage of geosynthetic layers, and will not provide excess tensile stress on the geosynthetics, in
18 accordance with the technical specifications.
- 19 • Close observation of the placement and compaction of drain gravel with earth moving equipment is
20 performed.

21 **2.4.3 Construction Quality Assurance Evaluation**

22 No density tests will be conducted on the drain gravel. If the CQA representative suspects damage to
23 pipes or underlying geosynthetic, the construction general contractor will be required to expose the
24 potentially damaged materials and repair any observed damage.

25 **2.4.4 Layer Completion Certification**

26 The construction general contractor will be required to notify the CQA representative when an area of the
27 LCRS or LDS drain gravel is complete, prior to constructing the overlying layer. The construction general
28 contractor may begin placing the overlying layer when the drain gravel is accepted by the CQA certifying
29 engineer. The CQA certifying engineer will provide a certificate of layer completion to the construction
30 general contractor and the IDF project engineer, certifying that the area is complete.

31 **2.5 OPERATIONS LAYER**

32 The CQA representative will verify and document that the operations layer, including the operations layer
33 material placed in the SLDS sump area, is constructed to the elevations, grades, and thicknesses shown in
34 the construction drawings, with material meeting the requirements of the technical specifications as
35 determined by the test methods and frequencies specified within this CQA Plan.

36 Prior to the placement of the operations layer, the CQA representative will verify and document the
37 following:

- 38 • The underlying geosynthetic layer is free of holes, tears, excessive wrinkles, or foreign objects.
- 39 • All work on underlying layers is complete and accepted by the CQA certifying engineer.

40 During placement of the operations layer, the CQA representative will verify and document that:

- 1 • The soil is suitable and satisfies the requirements of the technical specifications as determined by the
2 test methods and frequencies prescribed in Table 2-7.
- 3 • The operations soil is placed in accordance with the technical specifications and construction
4 drawings.
- 5 • The lift thicknesses and total thickness of the operations layer agree with the requirements of the
6 construction drawings.
- 7 • If excessive wrinkles begin to develop in the underlying geosynthetics during material placement or
8 spreading, the wrinkles are worked out prior to continued placement operations.
- 9 • The operations layer is placed in a manner that will not damage underlying geosynthetics, will
10 minimize slippage of geosynthetic layers, and will not provide excess tensile stress on the
11 geosynthetics, in accordance with the technical specifications.
- 12 • Spreading and hauling equipment and operations are in compliance with material thickness and
13 operations requirements given in the technical specifications.
- 14 • The operations layer is placed on the side slopes to the limits shown in the construction drawings.
- 15 • No operations layer material is placed or compacted during periods of unfavorable weather
16 conditions, such as after heavy rains or snow, in accordance with requirements given in the technical
17 specifications.

1 **2.5.1 Conformance Evaluation**

2 The test methods and frequencies for CQA conformance testing for the operations layer are specified in
3 Table 2-7.

4 If damage to underlying geosynthetics is suspected, the CQA representative will require that the overlying
5 operations layer material be removed to expose the geosynthetics.

6 The construction general contractor will be required to use all means necessary to protect all prior work,
7 as well as all materials and completed work of other sections. In the event of damage, the construction
8 general contractor will be required to immediately make all repairs and replacements necessary. The CQA
9 representative will verify and document that all damages are repaired.

10 **2.5.2 Layer Completion Certification**

11 The construction general contractor will be required to notify the CQA representative when an area of the
12 operations layer is complete. The CQA certifying engineer will provide a certificate of layer completion
13 to the construction general contractor and the IDF project engineer, certifying that the area is complete.

14 **2.6 SOIL SURVEYING**

15 A survey will be performed by or under the direction of a professional land surveyor registered in the
16 State of Washington. The surveyor will independently survey the elevations and grades of the soil layers
17 including, but not limited to:

- 18 • Top of prepared subgrade
19 • Top of SBL
20 • Top of LCRS drain gravel
21 • Top of operations layer

22 Surveys will be performed on the base and side slopes of the landfill, to confirm that the grades and
23 elevations in the field agree with those shown in the construction drawings and with the minimum
24 acceptable tolerances required in the technical specifications. The results of the survey, conducted by the
25 surveyor, will be compiled in a report signed by the surveyor and the CQA certifying engineer.

26 The surveyor will be required to survey each soil layer of the liner system for the IDF landfill, in
27 accordance with the requirements of this CQA Plan. A record drawing or tabular listing of surveyed
28 points will be submitted to the CQA certifying engineer by the surveyor before the placement of the next
29 liner system layer. The surveys will be conducted at a 50-ft grid across the entire area of the survey. The
30 survey will include, but not be limited to, the following features of the landfill:

- 31 • Toe of slope
32 • Crest of slope
33 • Grade breaks
34 • Anchor trench
35 • SLDS, LDS and LCRS sumps

1 **Table 2-1. Minimum Frequency of Testing for CQA Evaluation of Earthfill**

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor or maximum index density for free-draining soil	1 per 20,000 yd ³ (minimum 1 per source or soil type)	ASTM D698 or ASTM D4253
Placement		
In-place wet unit weight	1 per 5,000 ft ² per lift	ASTM D2922, D1556
In-place moisture content	1 per 5,000 ft ² per lift	ASTM D3017, D2216
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

2

3 **Table 2-2. Minimum Frequency of Testing for CQA Evaluation of Structural Fill**

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor or maximum index density for free-draining soil	1 per 2,000 tons (minimum 1 per source or soil type)	ASTM 698 or ASTM 4253
Placement		
In place moisture content	1 per 2,500 ft ² per lift	ASTM D3017, D2216
In place dry unit weight	1 per 2,500 ft ² per lift	ASTM D2922, D1556
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per day of fill placement	ASTM D2216

4

1 **Table 2-3. Minimum Frequency of Testing for CQA Evaluation of Prepared Subgrade**

Test	Frequency	Standard Test Method
Material Properties^a		
Standard proctor or maximum index density for free-draining soil	1 per 250,000 ft ² (minimum 1 per source or soil type)	ASTM 698 or ASTM 4253
In Place^b		
In-place wet unit weight	4 per acre (approx. 1 per 10,000 ft ²)	ASTM D2922, D1556
In-place moisture content	4 per acre (approx. 1 per 10,000 ft ²)	ASTM D3017, D2216
Standard count calibration	1 per day when in place tests are performed	ASTM D3017/D2922
Concrete block calibration	1 per day when in place tests are performed	ASTM D3017/D2922
Over moisture content (in situ moisture content)	1 per day when in place tests are performed	ASTM D2216

a. Prior to subgrade excavation.

b. After reaching subgrade elevation.

1 **Table 2-4. Test Pad Testing Methods and Minimum Frequency**

Test	Frequency	Standard Test Method
Material Property		
Natural moisture content ^a	4 per each Base Soil type per test pad	ASTM D2216
Particle size distribution ^b	4 per each Base Soil type per test pad	ASTM D422
Standard proctor ^a	4 per each Base Soil type per test pad	ASTM D698
Bentonite dry fineness ^b	1 per test pad	Technical specification
Bentonite high swelling ^b	1 per test pad	Technical specification
Processing ^b		
Bentonite/Base Soil application rate	1 per working day of admix processing during test pad construction	Measure weight of base soil and bentonite entering pugmill during a given period of time
Maximum clod size	Periodic monitoring	Observation
Curing	1 per 12 hours	Observation
Pre Compaction ^a		
Lift thickness	1 per lift	Field measurement
Percent fines	1 per lift	ASTM D1140
Percent gravel	1 per lift	ASTM D422
Atterberg limits	1 per lift	ASTM D4318
Placement	Periodic monitoring	Observation
Post Compaction		
Lift thickness ^b	4 per lift	Field measurement
In-place moisture content ^b	4 per lift	ASTM D3017
In-place dry unit weight ^b	4 per lift	ASTM D2922
Shelby tube samples ^b (laboratory permeability)	1 per lift	ASTM D1587/ASTM D5084 ^{c,d}
Number of passes ^a	Monitor each lift	Observation
Boutwell permeameter test ^b	5 for the horizontal test pad only	ASTM D6391, first stage only
Calibration and Check ^e		
Standard count calibration	1 per day of fill placement	ASTM D3017/D2922
Oven moisture contents (in situ moisture content)	1 per lift	ASTM D2216
In-place dry unit weight	1 per lift	ASTM D1556, D2167, or D2937

Notes:

- a. Tests for information only
- b. Pass/fail tests
- c. The average effective confining stress will be 5 psi.
- d. Rapid turnaround tests (Method F–Constant Volume) will be used when possible.
- e. Calibration check tests

1 **Table 2-5. Minimum Frequency of Testing for CQA Evaluation of SBL**

Test	Frequency	Standard Test Method
Bentonite		
Dry fineness	1 per lot	Technical specification ^a
High swelling	1 per lot	Technical specification
Processing		
Base soil excavation	Periodic monitoring	Observation
Base soil natural moisture content	1 per working day of hauling base material or per material color/consistency change	ASTM D2216
Base soil grain size	1 per working day of hauling base material or per material color/consistency change	ASTM D422
Bentonite/Base Soil application rate	1 per working day of admix processing	Measure weight of base soil and bentonite entering pugmill during a given period of time
Maximum clod size	Periodic monitoring	Observation
Curing ^c	1 per 12 hours	Observation
Pre-Compaction		
Lift thickness ^d	1 per 2,500 ft ² per lift	Field measurement
Percent fines	1 per 1,000 yd ³ (minimum of 1 per day of placement)	ASTM D1140
Percent gravel	1 per 1,000 yd ³ (minimum of 1 per day of placement)	ASTM D422
Atterberg limits	1 per 1,000 yd ³ (minimum of 1 per day of placement)	ASTM D4318
Placement	Periodic monitoring	Observation
Post Compaction		
Lift thickness	5 per acre per lift	Full measurement
In place moisture content	5 per acre per lift	ASTM D3017
In place dry unit weight	5 per acre per lift	ASTM D2922
Shelby tube samples (laboratory permeability)	1 per acre per lift	ASTM D1587/ ASTM D5084 ^{e, f}
Number of passes ^g	Observe 1 per acre per lift	Observation
Construction oversight	Periodic monitoring	Observation
Calibration and Check		
Oven moisture content (per each nuclear gauge)	1 per 10 nuclear gauge moisture contents	ASTM D2216

Test	Frequency	Standard Test Method
Standard count calibration (per each nuclear gauge)	1 per day of placement	ASTM D2922/ASTM D3017
a. The test method is described in the technical specification.	6 inches or less.	
b. Not used.	e. The average effective confining stress will be 5 psi.	
c. Curing is stockpiling the SBL material for 12 hours to allow the bentonite to hydrate.	f. Rapid turnaround tests (Method F – Constant Volume) will be used when possible.	
d. A loose lift thickness is such that the compacted thickness is	g. A single pass is defined as forward and back.	

1

2

Table 2-6. Maximum Allowable Percentage of Failed Tests for CQA Evaluation of SBL

Test	Maximum percentage
Percent gravel	5 percent not concentrated in one lift or one area
Clod size	10 percent not concentrated in one lift or one area
In place moisture content	3 percent not concentrated in one lift or one area, and no water content less than 2 percent or more than 3 percent of the specified value
In place dry unit weight	3 percent not concentrated in one lift or one area, and no dry unit weight less than 5 pounds per cubic foot (pcf) below the specified value
Shelby tube samples (laboratory permeability)	5 percent not concentrated in one lift or one area

3

4

Table 2-7. Minimum Frequency of Testing for CQA Evaluation of Operations Layer

Test	Frequency	Standard Test Method
Material Properties		
Standard proctor or maximum index density for free-draining soil	1 per 20,000 yd ³ (minimum 1 per source or soil type)	ASTM D698 or ASTM D4253
Sieve analysis	1 per 10,000 yd ³ placed (minimum 1 per source)	ASTM D422
In-Place (Outside edge of liner only)		
In-place wet unit weight	1 per 5,000 ft ² per lift	ASTM D2922, D1556
In-place moisture content	1 per 5,000 ft ² per lift	ASTM D3017, D2216
In-Place (SLDS sump)		
In-place wet unit weight	2 per lift	ASTM D2922, D1556
In-place moisture content	2 per lift	ASTM D3017, D2216

5

1 **SECTION III—GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE**

2 **3.1 GEOSYNTHETIC CLAY LINER MANUFACTURE AND DELIVERY**

3 **3.1.1 Labeling**

4 The CQA representative will verify and document that the GCL manufacturer has labeled each roll of GCL
5 and includes the information required by the technical specifications. The CQA representative will examine
6 GCL rolls upon delivery and deviation from the above requirements will be reported to the CQA certifying
7 engineer prior to installation of the GCL.

8 **3.1.2 Transportation and Handling**

9 The CQA representative will observe and document that the type of GCL handling equipment used by the
10 installer minimizes damage to the material. Upon delivery at the site, the CQA representative will conduct
11 a visual inspection of all rolls for defects and for damage. This examination will be conducted without
12 unrolling rolls unless visible defects or damages are found. The CQA representative will indicate to the
13 CQA certifying engineer:

- 14 • Any rolls that need to be unrolled to allow for their inspection
15 • Any rolls, or portions thereof, that need to be rejected and removed from the site because they have
16 severe flaws
17 • Any rolls that include minor repairable flaws

18 **3.1.3 Storage**

19 The CQA representative will verify and document that storage of the GCL is in accordance with the
20 technical specifications.

21 **3.1.4 Inventory**

22 All geosynthetic materials that arrive onsite will be inventoried. The inventory will include the specific
23 roll numbers delivered with each shipment. The inventory will be compared to the QC testing
24 information, supplied by the manufacturer to ensure that the material tested is the same material that was
25 delivered to the site. Material for which QC testing data has been supplied will be sampled for
26 conformance testing. Conformance samples may be obtained by the CQA representative at the
27 manufacturing plant or taken upon delivery of the material to the site by a CQA representative. As
28 shipments arrive at the site, a CQA representative will monitor the unloading operations and will
29 inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as
30 possible.

- 1 The CQA representative will record the following information, at a minimum, for each roll:
- 2 • **Manufacturer**—Indicate the manufacturer of the material that is being inventoried, that may not be
3 the same as the installer
 - 4 • **Date of Inventory**—Date that the material was inventoried
 - 5 • **Date of Delivery**—Enter date when the truck arrived onsite, if known
 - 6 • **Truck Type**—Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed,
7 box trailer)
 - 8 • **Bill of Lading Number**—If the bill-of-lading is available, indicate number and date (also attach copy
9 to inventory form)
 - 10 • **CQA Representative**—Indicate name of CQA representative performing inventory
 - 11 • **Unloading Equipment**—Indicate the type and model number of the equipment unloading the
12 geosynthetic material; also note any special attachments that are used to unload the material (stinger,
13 straps, forks)
 - 14 • **Weather Conditions**—Describe the weather conditions, including temperature, wind, cloud cover,
15 and precipitation during unloading and conformance sampling operation
 - 16 • **Material Type**—Indicate type of geosynthetic material
 - 17 • **Roll Number**—Indicate each roll number that is written on the roll (The roll numbers contain a variety
18 of information regarding the material and the manufacturing process.)
 - 19 • **Lot Number**—Lot number
 - 20 • **Roll (L × W)**—Indicate the roll width as written on the roll label; if two materials are bonded together
21 (i.e., geonet/geotextile), obtain measurements for both materials
 - 22 • **Area (square feet)**—Indicate the total square footage of the roll
 - 23 • **Damage Remarks**—Document any visible damage to the roll; if possible, indicate if damage was
24 present prior to unloading or if it occurred during unloading

25 The CQA representative will immediately notify the IDF CM if a nonconforming or conditional use tag is
26 attached to any of the inventoried items.

27 Items that are restricted from further use until the inspections have been completed will be clearly
28 delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from
29 inventoried and approved items, to the extent possible. The CQA representative will be responsible for
30 coordinating with the construction general contractor during material delivery, so that the material is not
31 moved more than necessary after it is unloaded and damage due to handling is minimized.

32 The CQA representative will perform the inventory immediately after the material arrives on the site to
33 avoid delaying construction. The CQA representative will be responsible for verifying that only accepted
34 material is installed at the IDF landfill and that all inventories and inspections are documented and
35 maintained.

36 **3.1.5 Quality Assurance Conformance Testing**

37 Either at the manufacturer's plant or upon delivery of the rolls of GCL, the CQA representative will
38 ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA
39 Laboratory for testing, to verify and document conformance with the technical specifications.

1 Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet
2 along the length of the roll. Unless otherwise specified, samples will be 1.5 feet (minimum) long by the
3 roll width. The CQA representative will mark the machine direction on the samples with an arrow.

4 Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet,
5 whichever is greater. These samples will be tested for:

- 6 • Index Flux (ASTM D5887)
- 7 • Bentonite Mass per Unit Area (ASTM D5993)
- 8 • Bentonite Swell Index Test (ASTM D5890)

9 The test will be conducted in accordance with the test procedure presented in the technical specifications.

10 The CQA representative will examine all results from laboratory conformance testing and compare the
11 results to the specifications presented in the technical specifications. In addition, the CQA representative
12 will report any non-conformance to the CQA certifying engineer as soon as practical after the test results
13 become available.

14 The following procedure will apply whenever a sample fails a conformance test that is conducted by the
15 Geosynthetics CQA Laboratory:

- 16 • The construction general contractor will be required to replace the roll (or rolls) of GCL not in
17 conformance with the specifications with a roll that meets the requirements of the technical
18 specifications.
- 19 • The CQA representative will ensure that conformance samples are removed for testing by the
20 Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which
21 the failing sample was obtained. These two samples must pass the above conformance tests. If either
22 of these samples fails to meet the requirements, samples will be collected from the five numerically
23 closest untested rolls on both sides of the failed samples and tested by the Geosynthetics CQA
24 Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a
25 sample from every roll of GCL onsite and a sample from every roll that is subsequently delivered
26 from the same manufacturer must be conformance tested by the Geosynthetics CQA Laboratory until
27 the manufacturer has thoroughly demonstrated compliance with the above requirements to the sole
28 satisfaction of the CQA certifying engineer. The costs of all such tests are to be borne by the
29 construction general contractor.
- 30 • The CQA representative will document actions taken in conjunction with conformance test failures as
31 outlined in Section 8.1.4 and report all actions to the CQA certifying officer.

32 **3.2 GEOSYNTHETIC CLAY LINER INSTALLATION**

33 **3.2.1 Surface Preparation**

34 For fill surfaces that will underlay a GCL layer, the CQA representative will verify and document the
35 following:

- 36 • The surface of the fill does not contain holes, ruts, protrusions, or other surface irregularities in excess
37 of those dimensions specified by the technical specifications.
- 38 • The surface of the fill has been compacted to form a firm, stable base.
- 39 • The surface of the fill is free of any type of deleterious material that may cause damage to GCL,
40 including debris, organic material, frozen soil, ice, and rocks.
- 41 • The surface of the fill is free of standing water or excessive moisture.

- 1 • The construction general contractor has certified in writing that the surface on which the GCL will be
2 installed is acceptable.

3 The subgrade surface will be inspected immediately prior to commencement of GCL installation. If any
4 change in the surface requires repair work, in accordance with the technical specifications, the
5 construction general contractor will be responsible for repairing the fill surface.

6 A certificate of subgrade surface acceptance will be required from the construction general contractor.
7 The CQA representative will verify that the subgrade is accepted by the GCL installer, immediately prior
8 to commencement of GCL installation.

9 After the surface on which the GCL is to be installed has been accepted by the construction general
10 contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying engineer
11 any change in the underlying layer that may, in accordance with the technical specifications, require
12 repair work. If the CQA certifying engineer requires that repair work be done, it will be the responsibility
13 of the construction general contractor to repair the underlying layer.

14 **3.2.2 Anchor Trenches and Sumps**

15 Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify
16 and document the following:

- 17 • The sumps and anchor trenches are excavated to the grades and dimensions shown in the construction
18 drawings. Any anomalies in the soil encountered during excavation will be brought to the attention of
19 the IDF project engineer and removed as directed.
- 20 • The anchor trench excavation surface is prepared for installation of geosynthetics, with rounded
21 corners, and free of loose soil or deleterious material.

22 After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify
23 and document that the backfill for the geosynthetic anchor trenches is placed and compacted in
24 accordance with the technical specifications.

25 **3.2.3 Geosynthetic Clay Liner Deployment**

26 **3.2.3.1 Field Panel Identification**

27 A field panel is the unit area of GCL that is to be placed in the field (i.e., a field panel is a roll or a portion
28 of roll cut in the field).

29 The CQA representative will track the placement location of each GCL panel by assigning an
30 identification code (number or letter-number) or by an equivalent tracking method. The identification
31 method will be agreed upon by the CQA certifying engineer and the construction general contractor. This
32 field panel identification scheme will be as simple and logical as possible. (Note: manufacturing plant roll
33 numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility
34 of the construction general contractor to ensure that each field panel placed is marked with the
35 manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to
36 allow for easy inspection.

37 The CQA representative will establish a table or chart showing correspondence between manufacturing
38 plant roll numbers and field panel identification codes. The field panel identification code will be used for
39 all CQA records.

40 **3.2.3.2 Field Panel Placement**

41 ***Installation Schedule***

42 The CQA representative will evaluate significant changes in the schedule, proposed by the construction
43 general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The
44 CQA representative will verify and document that the condition of the underlying layer has not changed

1 detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by
2 the construction general contractor, in accordance with the technical specifications.

3 ***Weather Conditions***

4 The CQA representative will verify and document that GCL is not placed during inclement weather
5 conditions, as specified in the technical specifications. Additionally, the CQA monitor will verify and
6 document that the existing underlying layer has not been damaged by weather conditions.

7 ***Damage***

8 The CQA representative will visually observe each panel, after placement, for damage. The CQA
9 representative will inform the construction general contractor which panels, or portions of panels, are
10 rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by
11 the CQA representative will be marked, and their removal from the work area will be documented by the
12 CQA representative.

13 ***Seam Overlap and Bentonite Seal***

14 The construction general contractor will observe and document that the seam overlaps and bentonite
15 material placed between panels, if required, along the seams meets specification guidelines. The CQA
16 representative will verify overlap width and will observe bentonite seal placement.

17 **3.2.3.3 Field Panel Protection**

18 The CQA representative will observe and document that the GCL is completely covered with
19 geomembrane or protective plastic cover at the end of each workday and protected from damage and
20 hydration due to weather. The CQA representative will verify and document that equipment does not
21 operate directly on the GCL and that a smooth rub sheet is used to maneuver textured geomembrane over
22 the GCL to prevent damage to the GCL.

23 **3.2.4 Defects and Repairs**

24 Any defects and subsequent repairs will be documented, using NCR procedures outlined in Section 8.1.4.

25 **3.2.4.1 Identification**

26 All seams and non-seam areas of the GCL will be inspected by the CQA representative for evidence of
27 defects, holes, contamination of geotextiles, displaced panels, premature hydration, and any sign of
28 contamination by foreign matter. The CQA representative will observe and document repair procedures
29 described below.

30 **3.2.4.2 Repair Procedures**

31 Prior to cover material placement, damage to the GCL will be identified and repaired by the installer.

32 ***Rip and Tear Repair (Flat Surfaces)***

33 Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or
34 soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in
35 place), with a minimum overlap of 12 inches on all edges.

36 Accessory bentonite will be placed between the patch edges and the repaired material at a rate of a quarter
37 pound per lineal foot of edge, spread in a continuous 6 inch fillet.

38 ***Rip and Tear Repair (Slopes)***

39 Damaged GCL material on slopes will be repaired by the same procedures as described above, however,
40 the overlapped edges of the patch need to be wide enough to ensure the patch will keep its position during
41 backfill or cover operations.

42 ***Displaced Panels***

1 Displaced panels will be adjusted to the correct position and orientation. The adjusted panel will then be
2 inspected for any geotextile damage or bentonite loss. Damage will be repaired by the above described
3 procedure.

4 ***Premature Hydration***

5 If the GCL is subjected to premature hydration, the construction general contractor will notify the CQA
6 certifying engineer for a site-specific determination as to whether the material is acceptable or if
7 alternative measures must be taken to ensure the quality of the design dependent upon the degree of
8 damage.

1 **SECTION IV–GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE**

2 **4.1 GEOMEMBRANE MATERIAL**

3 **4.1.1 Labeling**

4 The CQA representative will verify and document that the geomembrane manufacturer has labeled each
5 roll of geomembrane and includes the information required by the technical specifications. The CQA
6 representative will examine geomembrane rolls upon delivery and deviation from the requirements will
7 be reported to the CQA certifying engineer, prior to installation of the geomembrane.

8 **4.1.2 Transportation and Handling**

9 Upon delivery at the site, the CQA representative will conduct a visual inspection of all rolls for defects
10 and damage. This examination will be conducted without unrolling rolls unless visible defects or damage
11 are found. The CQA representative will indicate the following to the CQA certifying engineer:

- 12 • Any rolls that need to be unrolled to allow for their inspection
- 13 • Any rolls, or portions thereof, that need to be rejected and removed from the site because they have
14 severe flaws
- 15 • Any rolls that include minor repairable flaws

16 **4.1.3 Storage**

17 The CQA representative will verify and document that storage of the geomembrane is in accordance with
18 the technical specifications.

19 **4.1.4 Inventory**

20 All geosynthetic materials that arrive onsite will be inventoried in accordance with the technical
21 specifications. The inventory will include the specific roll numbers delivered with each shipment. The
22 inventory will be compared to the QC testing information supplied by the manufacturer to ensure that the
23 material tested is the same material that was delivered to the site. Material for which QC testing data has
24 been supplied will be sampled for conformance testing. Conformance samples may be obtained by the
25 CQA representative at the manufacturing plant or taken upon delivery of the material to the site by a CQA
26 representative. As shipments arrive at the site, a CQA representative will monitor the unloading
27 operations and will inventory the material. Rolls selected for conformance testing will be set aside for
28 sampling as soon as possible.

29 The CQA representative will record the following information, at a minimum, for each roll:

- 30 • **Manufacturer**–indicate the manufacturer of the material that is being inventoried, that may not be
31 the same as the installer
- 32 • **Date of Inventory**–Date that the material was inventoried
- 33 • **Date of Delivery**–Enter date when the truck arrived onsite, if known
- 34 • **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed,
35 box trailer)
- 36 • **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy
37 to inventory form)
- 38 • **CQA Representative**–Indicate name of CQA representative performing inventory

- 1 • **Unloading Equipment**—Indicate the type and model number of the equipment unloading the
2 geosynthetic material; also note any special attachments that are used to unload the material (stinger,
3 straps, forks)
- 4 • **Weather Conditions**—Describe the weather conditions, including temperature, wind, cloud cover,
5 and precipitation during unloading and conformance sampling operation
- 6 • **Material Type**—Indicate type of geosynthetic material (HDPE, geotextile, or geonet)
- 7 • **Roll Number**—Indicate each roll number that is indicated on the roll (The roll numbers contain a
8 variety of information regarding the material and the manufacture process.)
- 9 • **Lot Number**—Lot number as indicated
- 10 • **Roll (L × W)**—Indicate the roll width as indicated on the roll label; if two materials are bonded
11 together (i.e., geonet/geotextile), obtain measurements for both materials
- 12 • **Area (square feet)**—Indicate the total square footage of the roll
- 13 • **Damage Remarks**—Document any visible damage to the roll; if possible, indicate if damage was
14 present prior to unloading or if it occurred during unloading

15 Items that are restricted from further use until the inspections have been completed will be clearly
16 delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from
17 inventoried and approved items to the extent possible. The CQA representative will be responsible for
18 coordinating with the construction general contractor during material delivery, so that the material is not
19 moved more than necessary after it is unloaded and damage due to handling is minimized.

20 The CQA representative will perform the inventory immediately after the material arrives onsite to avoid
21 delaying construction. The CQA representative will be responsible for verifying that only accepted
22 material is installed at the IDF landfill, and that all inventories and inspections are documented and
23 maintained.

24 **4.1.5 Quality Assurance Conformance Testing**

25 Either at the manufacturer's plant or upon delivery of the rolls of geomembrane, the CQA representative
26 will ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA
27 Laboratory for testing to verify and document conformance with the technical specifications.

28 Conformance samples will be taken by the CQA representative across the entire width of the roll and will
29 not include the first 3 feet. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll
30 width. The CQA representative will mark the direction of the machine used to cut the samples with an
31 arrow.

32 Unless otherwise specified, samples will be taken at a rate of one per lot or one per 50,000 square feet,
33 whichever is greater. These samples will be tested for:

- 34 • Thickness (ASTM D5199 or D5994)
- 35 • Tensile characteristics (yield strength and elongation at yield, ASTM D638)
- 36 • Asperity (GRI GM-12)
- 37 • Puncture resistance (ASTM D4833)

38 Test will be conducted in accordance with the test procedure presented in the technical specifications. The
39 CQA representative will examine all results from laboratory conformance testing and will report any non-
40 conformance after the test results become available. The following procedure will apply whenever a
41 sample fails a conformance test that is conducted by the CQA representative:

- 1 • The construction general contractor will be required to replace the roll (or rolls) of geomembrane in
2 non-conformance with the technical specifications with a roll that meets the technical specifications.
- 3 • The CQA certifying engineer will ensure that conformance samples are removed for testing by the
4 Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These
5 two samples must pass the above conformance tests. If either of these samples fail, samples will be
6 collected from the five numerically closest untested rolls on both sides of the failed sample and tested
7 by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If
8 any of these samples fail, a sample from every roll of geomembrane onsite and every roll
9 subsequently delivered from the same manufacturer must be conformance tested by the Geosynthetics
10 CQA Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above
11 requirements to the sole satisfaction of the CQA certifying engineer. The costs of all such tests are to
12 be borne by the construction general contractor.

13 **4.1.6 Manufacturing Plant Site Visit**

14 The manufacturer shall allow the CQA certifying engineer or his designated representative to visit the
15 manufacturing plant, if the CQA certifying engineer so chooses. If possible, the visit shall be prior to or
16 during the manufacturing of the geomembrane rolls for the specific project. The CQA Engineer or his
17 designated representative shall review the manufacturing process, quality control, laboratory facilities,
18 and testing procedures as described in the technical specifications (see Section 02661).

19 **4.2 GEOMEMBRANE INSTALLATION**

20 **4.2.1 Surface Preparation**

21 For SBL surfaces that will underlay a geomembrane layer, the CQA representative will verify and
22 document the following:

- 23 • The surface of the subgrade or SBL does not contain holes, depressions, or protrusions in excess of
24 those dimensions specified by the technical specifications.
- 25 • The surface of the subgrade or SBL has been rolled with a smooth-drum roller to form a firm stable
26 base without ridges, wheel ruts, and surface irregularities.
- 27 • The surface of the subgrade or SBL is free of any type of deleterious material that may cause damage
28 to geomembrane.
- 29 • The construction general contractor has certified in writing that the surface on which the
30 geomembrane will be installed is acceptable.

31 The subgrade and SBL surface will be inspected immediately prior to commencement of geomembrane
32 installation. If any change in the surface requires repair work, in accordance with the technical
33 specifications, the construction general contractor will be responsible for repairing the surface. A
34 certificate of subgrade surface acceptance will be required from the construction general contractor. The
35 CQA representative will verify that the subgrade is accepted by the geomembrane installer immediately
36 prior to commencement of geomembrane installation.

37 After the surface on which the geomembrane is to be installed has been accepted by the construction
38 general contractor, it will be the CQA representative's responsibility to indicate to the CQA certifying
39 engineer any change in the underlying layer that may, in accordance with the technical specifications,
40 require repair work. If the CQA certifying engineer requires that repair work be done, it will be the
41 responsibility of the construction general contractor to repair the underlying layer.

42 **4.2.2 Anchor Trenches and Sumps**

43 Prior to placement of geosynthetics in the anchor trenches or sumps, the CQA representative will verify
44 and document the following:

- 1 • The excavation of the sumps and anchor trenches is performed in accordance with the technical
2 specifications. Any anomalies in the soil encountered during excavation will be brought to the
3 attention of the IDF project engineer and removed as directed.
- 4 • The anchor trench excavation surface is prepared for installation of geosynthetics with rounded
5 corners and is free of loose soil or deleterious material.

6 After geosynthetics deployment into the anchor trench is complete, the CQA representative will verify
7 and document that the backfill for the geosynthetic anchor trenches is placed and compacted in
8 accordance with the technical specifications and construction drawings.

9 **4.2.3 Geomembrane Deployment**

10 **4.2.3.1 Layout Drawing**

11 The construction general contractor will be required to produce layout drawings that show the
12 geomembrane panel configuration, dimensions, details, and seam locations. The layout drawings must be
13 approved by the CQA certifying engineer, prior to the installation of the geomembrane.

14 **4.2.3.2 Field Panel Identification**

15 A field panel is the unit area of geomembrane that is to be seamed in the field (i.e., a field panel is a roll
16 or a portion of roll cut in the field).

17 The CQA representative will verify that each field panel is given an identification code (number or letter-
18 number) consistent with the layout plan. This identification code will be agreed upon by the CQA
19 representative and the construction general contractor. This field panel identification code will be as
20 simple and logical as possible. (Note: manufacturing plant roll numbers are usually cumbersome and are
21 not related to location in the field.) It will be the responsibility of the construction general contractor to
22 ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number
23 will be marked in the center of the panel in a color to allow for easy inspection.

24 The CQA representative will establish a table or chart showing correspondence between manufacturing
25 plant roll numbers and field panel identification codes. The field panel identification code will be used for
26 all CQA records.

27 **4.2.3.3 Field Panel Placement**

28 ***Location***

29 The CQA representative will verify and document that field panels are installed at the locations and
30 positions indicated in the construction general contractor's layout plan, as approved or modified by the
31 CQA certifying engineer.

32 ***Installation Schedule***

33 The CQA representative will evaluate significant changes in the schedule, proposed by the construction
34 general contractor, and will advise the CQA certifying engineer on the acceptability of that change. The
35 CQA representative will verify and document that the condition of the underlying layer has not changed
36 detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by
37 the construction general contractor in accordance with the technical specifications.

38 The CQA representative will record the identification code, location, and date of installation of each field
39 panel.

40 ***Weather Conditions***

41 The CQA representative will verify and document that geomembrane is not placed during inclement
42 weather conditions, as specified in the technical specifications. Additionally, the CQA representative will
43 verify and document that the underlying layer has not been damaged by weather conditions.

1 **Damage**

2 The CQA representatives will visually observe each panel, after placement and prior to seaming, for
3 damage (e.g., holes, blisters, and creases). The CQA representative will inform the construction general
4 contractor which panels, or portions of panels, need to be rejected, repaired, or accepted. Damaged panels
5 or portions of damaged panels that have been rejected by the CQA certifying engineer will be marked,
6 and their removal from the work area will be documented by the CQA representative, using the NCR
7 procedures outlined in Section 8.1.4.

8 **4.2.4 Field Seaming**

9 **4.2.4.1 Seam Layout**

10 The CQA certifying engineer will verify and document that the seam layout shown in the panel layout
11 drawing is consistent with the technical specifications. A seam numbering system compatible with the
12 panel numbering system will be agreed upon by the construction general contractor and CQA certifying
13 engineer.

14 **4.2.4.2 Seaming Equipment and Products**

15 Processes approved by the technical specifications for field seaming are extrusion seaming; and fusion
16 seaming. Proposed alternate processes will be required to be documented and submitted to the CQA
17 certifying engineer for approval. The construction general contractor will be required to use a pyrometer
18 to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

19 The extrusion seaming apparatus will be equipped with gauges, indicating the temperatures of the
20 extrudate and nozzle. The construction general contractor will be required to provide to the CQA
21 certifying engineer the manufacturer's certification that the extrudate is compatible with the
22 geomembrane material and is comprised of the same resin as the geomembrane.

23 The CQA representative will log ambient temperatures, seaming apparatus temperatures, and extrudate
24 temperatures or fusion seaming apparatus speeds. Ambient temperatures will be measured to verify
25 compliance with the technical specifications.

26 **4.2.4.3 Seam Preparation**

27 The CQA certifying engineer will verify and document the following:

- 28 • Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material.
29 • Preparation of seams is in accordance with the technical specifications.

30 **4.2.4.4 Weather Conditions for Seaming**

31 The CQA representative will verify and document that weather conditions for seaming are within the
32 limits specified in the technical specifications.

33 **4.2.4.5 Trial Seams**

34 The construction general contractor will be required to make trial seams on fragment pieces of
35 geomembrane liner to verify that seaming conditions are adequate. The construction general contractor
36 will be required to make and test trial seams at the frequency and in accordance with the methods
37 specified in the technical specifications.

38 The CQA representative will observe all trial seam procedures. The trial seam samples will be assigned a
39 number and marked accordingly by the CQA representative, along with the date, hour, ambient
40 temperature, number of seaming unit, name of seamer, and pass or fail description. A sample of the trial
41 seam will be retained by the CQA team until the construction of the liner is complete and the liner has
42 been accepted by the CQA certifying engineer.

1 **4.2.4.6 Nondestructive Seam Continuity Testing**

2 Except as otherwise noted in the technical specifications, the construction general contractor will
3 nondestructively test all field seams over their full length, in accordance with the technical specifications.
4 The purpose of nondestructive tests is to check the continuity of seams. Continuity testing will be carried
5 out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing will
6 not be permitted before sunrise or after sunset unless the construction general contractor demonstrates to
7 the CQA certifying engineer that the construction general contractor has the capabilities to perform
8 continuity testing under reduced light conditions. The CQA representative will perform the following
9 tasks:

- 10 • Observe the continuity testing
11 • Record location, date, test unit number, name of tester, and outcome of all testing
12 • Document and inform the construction general contractor of any required repairs

13 The construction general contractor will be required to complete any required repairs, in accordance with
14 the technical specifications. The CQA representative will perform the following tasks:

- 15 • Observe the repair and re-testing of the repair
16 • Mark on the geomembrane that the repair has been made
17 • Document the results

18 The CQA representative will verify and document the procedures specified in the technical specifications
19 where seams cannot be nondestructively tested. The location, date of visual observation, name of tester,
20 and outcome of the test or observation will be recorded by the CQA representative and reported to the
21 CQA certifying engineer.

22 **4.2.4.7 Destructive Seam Testing**

23 ***Concept***

24 Destructive seam tests will be performed at selected locations. The purpose of these tests is to evaluate
25 seam strength and integrity. Seam strength testing will be done as the seaming work progresses, not at the
26 completion of all field seaming.

27 ***Location and Frequency***

28 The CQA representative will select locations where seam samples will be cut out for laboratory testing at
29 the frequency specified in the technical specifications (see Section 02661). In general, destructive tests
30 will be located in non-critical areas, such as seam run-out areas or near three-panel intersections or other
31 areas that will require a patch anyway. In addition, because extrusion welding may be limited on a daily
32 basis, extrusion destructive samples may be welded after passing a trial seam on scrap material not used
33 for construction. However, when significant lengths (greater than 100 feet) of seams or caps are extrusion
34 welded, a destructive test of the weld will be taken.

35 Control charts will be used to track the performance of each welding machine and technician to allow for
36 biased sampling, according to performance. An upper control limit (UCL) will be established to
37 statistically identify the sources of test failures. Machines and technicians whose failure rates exceed the
38 UCL will then be identified and destructively tested at twice the original frequency (one per 250 feet of
39 seam length) to better monitor their performance. Once the failure rate drops back into compliance with
40 the UCL, the original testing frequency will be reinstated. Machines and technicians whose failure notes
41 are below the UCL will be identified to decrease the original frequency, as approved by the CQA
42 certifying engineer.

43 The UCL is established based on the failure rate for all destructive tests plus three standard deviations
44 with a ceiling of 3.5 percent. The ceiling is the maximum failure rate determined to be acceptable, as
45 agreed upon jointly by the construction general contractor and CQA certifying engineer. The initial UCL
46 will be calculated once a single machine or technician fails two destructive tests and will typically be

1 updated daily with the most recent destructive testing results. Destructive tests tracking a failed
2 destructive will not be included in the calculation of the failure rates.

3 Additional destructive test locations may be required during seaming operations. The necessity for such
4 additional sampling and testing will be determined by CQA representatives and will be implemented
5 when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any
6 other reason to suspect potentially defective seams. The location selection of the additional testing will be
7 based on the CQA representative's judgment and observation of a suspected problem.

8 The construction general contractor will not be informed in advance of the locations where the seam
9 samples will be taken.

10 ***Sampling Procedure***

11 The construction general contractor will be required to cut samples, as directed by the CQA representative
12 as the seaming progresses, in order to have laboratory test results before the geomembrane is covered by
13 another material. The CQA representative will perform the following tasks:

- 14 • Observe sample cutting
- 15 • Assign a number to each sample and mark it accordingly
- 16 • Record the sample number and location on the panel layout drawing
- 17 • Record the reason for taking the sample at this location (e.g., routine testing, suspicious feature of the
18 geomembrane)

19 All holes in the geomembrane resulting from destructive seam sampling will be covered by the
20 construction general contractor immediately after sampling and will be repaired in accordance with the
21 repair procedures described in the technical specifications. The continuity of the new seams in the
22 repaired area will be nondestructively tested, according to the technical specifications.

23 ***Size of Samples***

24 At a given sampling location, two types of samples will be taken by the construction general contractor.
25 First, two specimens for field testing will be taken. Each of these specimens will be 1 inch wide by 6 to
26 12 inches long, with the seam centered parallel to the width. The distance between these two specimens
27 will be approximately 42 inches. If both specimens pass the field test described in the technical
28 specifications, a sample for laboratory testing will be taken.

29 The sample for laboratory testing will be required to be taken between the two specimens for field testing.
30 The destructive sample will be 12 inches wide by 42 inches long, with the seam centered lengthwise. The
31 sample will be cut into three parts and distributed as follows:

- 32 • One portion to the construction general contractor, 12 inches long
- 33 • One portion to the IDF CM for archive storage, 12 inches long
- 34 • One portion to the CQA certifying engineer for CQA Laboratory testing, 18 inches long

35 Final determination of the sample sizes will be made at the preconstruction meeting.

36 ***Field Testing***

37 The two 1-inch-wide specimens, as specified above, will be required to be tested in the field by the CQA
38 representative by tensiometer for peel and shear and need to not fail in the seam. If any field test sample
39 fails to pass, the procedures outlined in the technical specifications will be followed.

40 The CQA representative will mark all samples and portions with their number, date, and time.

41 ***Geosynthetic Construction Quality Assurance Laboratory Testing***

42 Laboratory destructive test samples will be packaged and shipped to the Geosynthetics CQA Laboratory by
43 the CQA representative in a manner that will not damage the test sample. The CQA representative will store
44 the archive samples until the completion of the project.

1 Testing will include “Shear Strength” and “Peel Strength” (ASTM D6392) with 1-inch-wide strip, tested
2 at 2 inches per minute. The minimum acceptable values to be obtained in these tests are those indicated in
3 the technical specifications. At least five specimens will be tested for each test method. Specimens will be
4 selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least four out of five of the
5 specimens for each test must pass.

6 The laboratory will provide test results verbally to the CQA certifying engineer in a timely manner after
7 they receive and test the samples. The CQA certifying engineer will review laboratory test results as soon
8 as they become available and will inform the CQA certifying engineer of the test results.

9 ***Procedures for Destructive Test Failure***

10 The procedures specified in the technical specifications will be required whenever a sample fails a
11 destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory or by field
12 tensiometer. The CQA certifying engineer will verify and document that one of the options specified in
13 the technical specifications is followed. The CQA representative will document all actions taken in
14 conjunction with destructive test failures, including preparation of NCRs, as outlined in Section 8.1.4.

15 **4.2.5 Defects and Repairs**

16 **4.2.5.1 Identification**

17 All seams and non-seam areas of the geomembrane will be inspected by the CQA representative for
18 evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign
19 matter. Because light reflected by the geomembrane helps to detect defects, the surface of the
20 geomembrane will be required to be clean at the time of examination. The geomembrane surface will be
21 required to be swept or washed by the construction general contractor if the amount of dust or mud
22 inhibits examination.

23 **4.2.5.2 Evaluation**

24 Each suspect location both in seam and non-seam areas will be required to be either non-destructively tested
25 using the methods described in the technical specifications, or repaired as appropriate as determined by the
26 CQA certifying engineer. Each location that fails the non-destructive testing will be marked by the CQA
27 representative and will be required to be repaired by the construction general contractor. Materials will not be
28 placed over geomembrane locations that have been repaired until the CQA representative has approved the
29 repair.

30 **4.2.5.3 Large Wrinkles**

31 When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is
32 completed) and prior to placing overlying materials, the CQA representative will visually inspect the
33 geomembrane for wrinkles. Based on the requirements of the technical specifications, the CQA
34 representative will indicate to the construction general contractor which wrinkles, if any, are to be cut,
35 overlapped, and seamed to remove the wrinkle. The seam thus produced will be tested like any other
36 seam.

37 **4.2.5.4 Repair Procedures**

38 Any portion of the geomembrane either exhibiting a flaw or failing a destructive or nondestructive test
39 will be repaired by the construction general contractor in accordance with the applicable method specified
40 in the technical specifications. An NCR will be prepared to document all flaws and failed tests, as
41 outlined in Section 8.1.4. Each repair will be located and logged by the CQA representative.

42 **4.2.5.5 Testing of Repairs**

43 Each repair will be non-destructively tested, using the methods described in the technical specifications as
44 appropriate. Repairs that pass the non-destructive test will be considered adequate. Large caps may be of
45 sufficient extent to require destructive testing, at the discretion of the CQA certifying engineer. Failed
46 tests will require the repair to be redone and re-tested until passing test results are obtained. The CQA

1 representative will observe the non-destructive testing of repairs and will document the date of the repair
2 and test outcome.

3 **4.2.6 Appurtenances**

4 The CQA representative will verify and document the following:

- 5 • Installation of the geomembrane around, and connection of geomembrane to, appurtenances have
6 been made according to the technical specifications or manufacturer's recommendations.
- 7 • Extreme care is taken while seaming around appurtenances, since neither non-destructive nor
8 destructive testing may be feasible in these areas.
- 9 • The geomembrane has not been visibly damaged while being connected to appurtenances.

10 The CQA representative will inform the CQA certifying engineer if the above conditions are not fulfilled.

11 **4.3 GEOMEMBRANE PANEL LAYOUT SURVEY**

12 A survey will be performed by or under the direction of a professional land surveyor registered in the
13 State of Washington. The surveyor will independently survey the elevations and location of each panel
14 intersection and destructive sample. The results of the survey conducted by the surveyor will be compiled
15 in a report signed by the surveyor and the CQA certifying engineer.

16 The surveyor will be required to survey each geomembrane panel intersection and destructive sample
17 location for the IDF landfill, in accordance with the requirements of this CQA Plan. A record drawing
18 will be submitted to the CQA certifying engineer by the surveyor. The survey will include enough
19 information to confirm that the geomembrane layout is in accordance with the panel layout and include,
20 but not be limited to, the following information:

21 Geomembrane panel intersections

- 22 • Destructive sample location and identification
- 23 • Edge of geomembrane liner
- 24 • Panel identification numbers

25 Each geomembrane layer will be surveyed including, but not be limited to:

- 26 • Secondary leak detection system geomembrane
- 27 • Secondary geomembrane
- 28 • Primary geomembrane

29 **4.4 LAYER COMPLETION CERTIFICATION**

30 The construction general contractor will be required to notify the CQA representative when an area of
31 geomembrane is complete, prior to constructing the overlying layer. The construction general contractor
32 may place overlying layer after acceptance of geomembrane layer by the CQA Certifying Engineer. The
33 CQA certifying engineer will provide a certificate of layer completion to the construction general
34 contractor and the IDF project engineer, certifying that all CQA tests are complete and all defects have
35 been repaired and tested.

1 **SECTION V–GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE**

2 **5.1 GEOTEXTILE MATERIAL AND INSTALLATION**

3 **5.1.1 Labeling**

4 The CQA representative will verify and document that the geotextile manufacturer has labeled all rolls of
5 geotextile with the information specified in the technical specifications. The CQA representative will
6 examine rolls upon delivery, and any deviation from the requirements will be reported to the CQA
7 certifying engineer. Geotextile rolls that are not labeled or that have illegible labels will be removed and
8 disposed by the construction general contractor.

9 **5.1.2 Transportation and Handling**

10 The CQA representative will observe rolls of geotextile upon delivery at the site, and any deviation from
11 the transportation and handling requirements specified in the technical specifications will be reported to
12 the CQA certifying engineer. Any damaged rolls will be rejected by the CQA certifying engineer and
13 required to be repaired or replaced by the construction general contractor.

14 **5.1.3 Storage**

15 The CQA representative will verify and document that storage of the geotextile is in accordance with the
16 technical specifications.

17 **5.1.4 Inventory**

18 All geotextile materials that arrive onsite will be inventoried. The inventory will include the specific roll
19 numbers delivered with each shipment. The inventory will be compared to the QC testing information,
20 supplied by the manufacturer to ensure that the material tested is the same material that was delivered to
21 the site. Material for which QC testing data has been supplied will be sampled for conformance testing.
22 Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken
23 upon delivery of the material to the site by a CQA representative.

24 As shipments arrive at the site, a CQA representative will monitor the unloading operations and will
25 inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as
26 possible.

27 The CQA representative will record the following information, at a minimum, for each roll:

- 28 • **Manufacturer**–Indicate the manufacturer of the material that is being inventoried, that may not be
29 the same as the installer
- 30 • **Date of Inventory**–Date that the material was inventoried
- 31 • **Date of Delivery**–Enter date when the truck arrived onsite, if known
- 32 • **Truck Type**–Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed,
33 box trailer)
- 34 • **Bill-of-Lading Number**–If the bill-of-lading is available, indicate number and date (also attach copy
35 to inventory form)
- 36 • **CQA Representative**–Indicate name of CQA representative performing inventory
- 37 • **Unloading Equipment**–Indicate the type and model number of the equipment unloading the
38 geosynthetic material; also note any special attachments that are used to unload the material (stinger,
39 straps, forks)
- 40 • **Weather Conditions**–Describe the weather conditions, including temperature, wind, cloud cover,
41 and precipitation during unloading and conformance sampling operation

- 1 • **Material Type**—Indicate type of geosynthetic material
- 2 • **Roll Number**—Indicate each roll number that is indicated on the roll
- 3 • **Lot Number**—Lot number
- 4 • **Roll (L × W)**—Indicate the roll width as indicated on the roll label; if two materials are bonded
5 together (i.e., geonet/geotextile), obtain measurements for both materials
- 6 • **Area (square feet)**—Indicate the total square footage of the roll
- 7 • **Damage Remarks**—Document any visible damage to the roll; if possible, indicate if damage was
8 present prior to unloading or if it occurred during unloading

9 Items that are restricted from further use until the inspections have been completed will be clearly
10 delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from
11 inventoried and approved items to the extent possible. The CQA representative will coordinate with the
12 construction general contractor during material delivery so that the material is not moved more than
13 necessary after it is unloaded and damage due to handling is minimized.

14 The CQA representative will perform the inventory immediately after the material arrives onsite to avoid
15 delaying construction. The CQA representative will be responsible for verifying that only accepted
16 material is installed at the IDF landfill and that all inventories and inspections are documented and
17 maintained.

18 **5.1.5 Conformance Testing**

19 Either at the manufacturer's factory or upon delivery of the geotextile rolls, the CQA representative will
20 ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to
21 verify and document conformance with the requirements of the technical specifications. Conformance
22 samples will be taken across the entire width of the roll and will not include the first 3 feet along the edge
23 of the roll. Unless otherwise specified, samples will be 3 feet (minimum) long by the roll width. The CQA
24 representative will mark the machine direction on the samples with an arrow.

25 Samples will be taken at a rate of one per material lot or one per 50,000 square foot, whichever is greater.
26 These samples will be tested for the following:

- 27 • Permittivity (ASTM D4491, Type 1 only)
- 28 • Grab strength (ASTM D4632)
- 29 • Tear strength (ASTM D4533)
- 30 • Puncture strength (ASTM D4833)

31 The CQA representative will examine all results of laboratory conformance testing and report any non-
32 conformance to the CQA certifying engineer as soon as results become available. The following
33 procedure will apply whenever a sample fails a conformance test that is conducted by the Geosynthetics
34 CQA Laboratory:

- 35 • The construction general contractor will replace the roll (or rolls) of geotextile not in conformance
36 with the specifications with a roll that meets the requirements of the technical specifications.
- 37 • The CQA representative will ensure that conformance samples are removed for testing by the
38 Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which
39 the failing sample was obtained. These two samples must pass the above conformance tests. If either
40 of these samples fail to meet the requirements, samples will be collected from the five numerically
41 closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA
42 Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a
43 sample from every roll of geotextile onsite and a sample from every roll that is subsequently

1 delivered from the same manufacturer must be conformance tested by the Geosynthetics CQA
2 Laboratory, until the manufacturer has thoroughly demonstrated compliance with the above
3 requirements to the sole satisfaction of the CQA certifying engineer. The cost of all such tests are to
4 be borne by the construction general contractor.

5 The CQA representative will document actions taken in conjunction with conformance test failures and
6 report all actions taken to the CQA certifying engineer. Failed tests will be documented using NCR
7 procedures, outlined in Section 8.1.4.

8 **5.1.6 Deployment**

9 The construction general contractor will be required to handle all geotextile material in such a manner as
10 to ensure that it is not damaged in any way.

11 It will be the CQA representative's responsibility to indicate to the CQA certifying engineer any change
12 in the underlying layer that may, in accordance with the technical specifications, require repair work. If
13 the CQA certifying engineer requires that repair work be done, it will be the responsibility of the
14 construction general contractor to repair the underlying layer.

15 The CQA representative will verify and document compliance with the following:

- 16 • Just prior to geotextile placement, the layer that underlies the geotextile, if it is a geosynthetic, is
17 clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could
18 potentially damage the liner system.
- 19 • In the presence of excessive wind, the geotextile is weighted with sandbags (or equivalent weight
20 approved by the CQA representative).
- 21 • Geotextile is kept under tension to minimize the presence of wrinkles in the geotextile. If necessary, the
22 geotextile is positioned by hand after being unrolled to minimize wrinkles.
- 23 • Geotextile is cut using a geotextile cutter approved by the geotextile manufacturer and the CQA
24 representative. If in place, special care is taken to protect other materials (such as underlying
25 geosynthetics) from damage that could be caused by the cutting of the geotextiles.
- 26 • The construction general contractor takes any necessary precautions to prevent damage to the
27 underlying layers during placement of the geotextile.
- 28 • During placement of geotextile, care is taken not to entrap stones, excessive dust, or moisture that
29 could damage the underlying layers, generate clogging of drains or filters, or hamper subsequent
30 seaming.
- 31 • Geotextile is not left exposed for an excess of 14 days after placement, to prevent damage from
32 exposure to ultraviolet radiation (sunlight). If the geotextile is exposed for more than 14 days, a
33 temporary cover may be deployed for the duration of the delay or samples may be submitted to an
34 independent testing laboratory to ensure that detrimental levels of UV degradation have not occurred.
35 Test results shall be submitted to CQA certifying engineer for review and approval. Detrimental level
36 of UV degradation is defined in the technical specifications (see Section 02371).

37 The CQA representative will document any non compliance with the above requirements and report them
38 to the CQA certifying engineer.

39 **5.1.7 Seams and Overlaps**

40 The CQA representative will verify and document that all geotextile seams are oriented and overlapped,
41 in accordance with the technical specifications. The construction general contractor will be required to
42 pay close attention at seams to ensure that no protective soil layer material could be inadvertently placed
43 beneath the geotextile.

1 **5.1.8 Repair**

- 2 The CQA representative will verify and document that any holes or tears in the geotextile are repaired, in
3 accordance with the requirements of the technical specifications. The CQA representative will document
4 any noncompliance with the above requirements and report it to the CQA certifying engineer.

1 **SECTION VI—COMPOSITE DRAINAGE NET CONSTRUCTION QUALITY ASSURANCE**

2 **6.1 COMPOSITE DRAINAGE NET MATERIAL AND INSTALLATION**

3 **6.1.1 Labeling**

4 The CQA representative will verify and document that the composite drainage net manufacturer has
5 labeled all rolls of composite drainage net as specified in the technical specifications. The CQA
6 representative will examine rolls upon delivery, and any deviation from the above requirements will be
7 reported to the CQA certifying engineer prior to installation of the composite drainage net.

8 **6.1.2 Transportation and Handling**

9 The CQA representative will observe rolls of composite drainage net upon delivery at the site, and any
10 deviation from the requirements of the technical specifications will be reported to the CQA certifying
11 engineer. Any damaged rolls will be rejected by the CQA representative and be required to be repaired or
12 replaced by the construction general contractor.

13 **6.1.3 Storage**

14 The CQA representative will verify and document that the storage of the composite drainage net is in
15 accordance with the technical specifications.

16 **6.1.4 Inventory**

17 All CDN that arrive onsite will be inventoried. The inventory will record the specific roll numbers
18 delivered with each shipment. The inventory will be compared to the QC testing information supplied by
19 the manufacturer, to ensure that the material tested is the same material that was delivered to the site.
20 Material for which QC testing data has been supplied will be sampled for conformance testing.
21 Conformance samples may be obtained by the CQA representative at the manufacturing plant or taken
22 upon delivery of the material to the site by a CQA representative.

23 As shipments arrive at the site, a CQA representative will monitor the unloading operations and will
24 inventory the material. Rolls selected for conformance testing will be set aside for sampling as soon as
25 possible.

26 The CQA representative will record the following information, at a minimum, for each roll:

- 27 • **Manufacturer**—Indicate the manufacturer of the material that is being inventoried, that may not be
28 the same as the installer
- 29 • **Date of Inventory**—Date that the material was inventoried
- 30 • **Date of Delivery**—Enter date when the truck arrived onsite, if known
- 31 • **Truck Type**—Indicate type of truck used for shipping geosynthetics (covered or uncovered flatbed,
32 box trailer)
- 33 • **Bill-of-Lading Number**—If the bill-of-lading is available, indicate number and date (also attach copy
34 to inventory form)
- 35 • **CQA Representative**—Indicate name of CQA representative performing inventory
- 36 • **Unloading Equipment**—Indicate the type and model number of the equipment unloading the
37 geosynthetic material; also note any special attachments that are used to unload the material (stinger,
38 straps, forks)
- 39 • **Weather Conditions**—Describe the weather conditions, including temperature, wind, cloud cover,
40 and precipitation during unloading and conformance sampling operation

- 1 • **Material Type**—Indicate type of geosynthetic material (high-density polyethylene, geotextile, or
2 geonet)
- 3 • **Roll Number**—Indicate each roll number that is written on the roll
- 4 • **Lot Number**—Lot number as indicated
- 5 • **Roll (L × W)**—Indicate the roll width as indicated on the roll label; if two materials are bonded
6 together (i.e., geonet/geotextile), obtain measurements for both materials
- 7 • **Area (square feet)**—Indicate the total square footage of the roll
- 8 • **Damage Remarks**—Document any visible damage to the roll; if possible, indicate if damage was
9 present prior to unloading or if it occurred during unloading

10 Items that are restricted from further use until the inspections have been completed will be clearly
11 delineated by the CQA representative. Accepted materials will be kept separate or clearly delineated from
12 inventoried and approved items to the extent possible. The CQA representative will coordinate with the
13 construction general contractor during material delivery so that the material is not moved more than
14 necessary after it is unloaded and damage due to handling is minimized.

15 The CQA representative will perform the inventory immediately after the material arrives onsite to avoid
16 delaying construction. The CQA representative will be responsible for verifying that only accepted
17 material is installed at the IDF landfill and that all inventories and inspections are documented and
18 maintained.

19 **6.1.5 Conformance Testing**

20 Either at the manufacturer's plant or upon delivery of the composite drainage net rolls, the CQA
21 representative will ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory
22 for testing, to verify and document conformance with the requirements of the technical specifications.

23 Conformance samples will be taken across the entire width of the roll and will not include the first 3 feet.
24 Unless otherwise specified, samples will be 3 feet long (minimum) by the roll width. The CQA
25 representative will mark the machine direction on the samples with an arrow.

26 Samples will be taken at a rate of one per lot or one per 50,000 square feet, except as noted otherwise
27 below, whichever is greater. The geonets will be tested for the following:

- 28 • Polymer specific gravity (ASTM D1505)
- 29 • Thickness (ASTM D5199)
- 30 • Nominal transmissivity (ASTM D4716 – one per production lot)

31 The composite drainage nets will be tested for the following:

- 32 • Adhesion (GRI-GC7 or ASTM D413)
- 33 • Transmissivity (ASTM D4716 – one per production lot)

34 The CQA representative will examine all results from laboratory conformance testing and will report any
35 non-conformance to the CQA certifying engineer as soon as the results become available.

36 The following procedure will apply whenever a sample fails a conformance test that is conducted by the
37 Geosynthetics CQA Laboratory:

- 38 • The construction general contractor will be required to replace the roll (or rolls) of composite
39 drainage net not in conformance with the specifications with a roll that meets the requirements of the
40 technical specifications.

- 1 • The CQA representative will ensure that conformance samples are removed for testing by the
2 Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These
3 two samples must pass the above conformance tests. If either of these samples fail, samples will be
4 collected from the five numerically closest untested rolls on both sides of the failed sample and tested
5 by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If
6 any of these samples fail, a sample from every roll of composite drainage net onsite and a sample
7 from every roll that is subsequently delivered from the same manufacturer must be conformance
8 tested by the Geosynthetics CQA Laboratory, until the manufacturer has thoroughly demonstrated
9 compliance with the above requirements to the sole satisfaction of the CQA certifying engineer. The
10 cost of such tests is to be borne by the construction general contractor.

11 The CQA representative will document actions taken in conjunction with conformance test failures and
12 report all actions to the CQA certifying engineer. Failed tests will be documented using NCR procedures,
13 outlined in Section 8.1.4.

14 **6.1.6 Deployment**

15 The construction general contractor will be required to handle all composite drainage net in such a
16 manner as to ensure that it is not damaged.

17 The construction general contractor (responsible for composite drainage net installation) will be required
18 to certify in writing that the surface on which the composite drainage net will be installed is complete and
19 acceptable. A certificate of partial completion will be given by the construction general contractor to the
20 CQA representative, who will then verify to the CQA certifying engineer that the deployment surface is
21 complete, prior to commencement of composite drainage net installation.

22 After the surface on which the composite drainage net is to be installed has been accepted by the
23 construction general contractor, the CQA representative will have responsibility to indicate to the CQA
24 certifying engineer any change in the underlying layer that may, in accordance with the technical
25 specifications, require repair work. If the CQA certifying engineer requires that repair work be done, it
26 will be the responsibility of the construction general contractor to repair the underlying layer.

27 The CQA representative will verify and document compliance with the following:

- 28 • Just prior to composite drainage net placement, the layer that will underlie the composite drainage net
29 is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could
30 potentially damage the underlying layers or clog the drainage system.
- 31 • In the presence of excessive wind, the composite drainage net is weighted with sandbags (or
32 equivalent weight approved by the CQA certifying engineer).
- 33 • Composite drainage net is kept under tension to minimize the presence of wrinkles in the composite
34 drainage net. If necessary, the composite drainage net is positioned by hand after being unrolled, to
35 minimize wrinkles.
- 36 • Composite drainage net is cut using a composite drainage net cutter, approved by the composite
37 drainage net manufacturer and the CQA representative. If in place, special care is taken to protect
38 other materials from damage that could be caused by the cutting of the composite drainage net.
- 39 • The construction general contractor takes all necessary precautions to prevent damage to the
40 underlying layers during placement of the composite drainage net.
- 41 • Composite drainage net is not welded to geomembranes.
- 42 • During placement of clean composite drainage net, care is taken not to entrap stones, excessive dust,
43 or moisture that could damage the underlying geomembrane, generate clogging of drains or filters, or
44 hamper subsequent seaming.

- 1 • A visual examination of the composite drainage net is carried out over the entire surface, after
2 installation, to ensure that no potentially harmful foreign objects, such as needles, are present.
- 3 • Composite drainage net is not left exposed for an excess of 14 days after placement, to prevent
4 damage from exposure to ultraviolet radiation (sunlight).

5 The CQA representative will document any noncompliance with the above requirements and report it to
6 the CQA certifying engineer.

7 **6.1.7 Seams and Overlaps**

8 The components of the composite drainage net (e.g., geotextile-geonet-geotextile) are not bonded together
9 at the ends and edges of the rolls. The CQA representative will document that the composite drainage net
10 is overlapped and secured in accordance with the technical specifications.

11 **6.1.8 Repair**

12 The CQA representative will verify that any holes or tears in the composite drainage net are repaired, in
13 accordance with the technical specifications. The CQA representative will observe any repair, document
14 any noncompliance with the above requirements, and report the noncompliance to the CQA certifying
15 engineer. Repair areas will be documented using NCR procedures, outlined in Section 8.1.4.

1 **SECTION VII-POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY**
2 **ASSURANCE**

3 **7.1 PIPE AND FITTINGS**

4 The CQA representative will monitor the placement of the LCRS, LDS and SLDS pipe, located on the
5 IDF landfill floor and on the landfill slopes.

6 **7.1.1 Labeling**

7 The CQA representative will verify that the pipe is labeled with the information specified in the technical
8 specifications. Any deviations from the labeling requirements will be reported to the CQA certifying
9 engineer prior to pipe installation.

10 **7.1.2 Transportation and Handling**

11 The CQA representative will verify and document that the pipe and fittings are handled in accordance
12 with the technical specifications. The CQA representative will visually inspect the pipe upon delivery at
13 the site, and any deviations from the requirements of the technical specifications will be reported to the
14 CQA certifying engineer.

15 **7.1.3 Storage**

16 The CQA representative will verify and document that storage of the pipe and fittings is in accordance
17 with the technical specifications.

18 **7.1.4 Inventory**

19 The CQA representative will inventory the polyethylene piping and fitting, delivered to the site that will
20 be installed at the bottom and on the slopes of the landfill. The CQA representative will perform the
21 following tasks:

- 22 • Verify the material for conformance with the technical specifications and construction drawings
23 • Verify slot dimensions for conformance with the technical specifications
24 • Check the material for damage, mishandling, and adverse exposure

25 Items that are restricted from further use until the inspections have been completed will be clearly
26 delineated by the CQA representative. Accepted materials will be kept separate from inventoried and
27 approved items, to the extent possible. The CQA representative will be responsible for coordinating with
28 the construction general contractor during material delivery, to limit the material being moved more than
29 necessary after it is unloaded and thereby minimizing damage due to handling.

30 The CQA representative will perform the inventory immediately after the material arrives onsite to avoid
31 delaying construction. The CQA representative will be responsible for verifying that only accepted
32 material is installed at the IDF landfill, and that all inventories and inspections are documented and
33 maintained.

34 **7.1.5 Conformance Testing**

35 No conformance testing will be conducted on the materials delivered to the site.

36 **7.1.6 Handling and Laying**

37 The CQA representative will verify and document that the pipe is installed at the specified locations,
38 grades, and angles, and that placement of backfill around and over the pipe is conducted in accordance
39 with the requirements of the technical specifications and in a manner intended to prevent damage to the
40 pipe.

1 The pipe and fittings will be carefully examined before installation by the CQA representative. The CQA
2 representative will verify and document that cracks, damage, or defects are not present in the pipe and
3 fittings in excess of that allowed by the technical specifications.

4 The CQA representative will also note the condition of the interior of pipes and fittings. Foreign material
5 will be removed from the pipe interior before it is moved into final position. No pipe will be permitted to
6 be placed until the CQA representative has observed the condition of the pipe. The CQA representative
7 will document any deviation from the requirements and report it to the CQA certifying engineer.

8 **7.1.7 Joints and Connections**

9 Lengths of pipe will be required to be assembled into suitable installation lengths by the butt-fusion
10 process. Butt-fusion refers to the butt-joining of the pipe by softening the aligned faces of the pipe ends in
11 a suitable apparatus and pressing them together under controlled pressure. The CQA representative will
12 spot-monitor butt-fusion welding operations to ensure that the construction general contractor follows the
13 technical specifications for both slotted and solid pipes. The CQA representative will verify that internal
14 weld beads have been removed from the horizontal and side slope sections of the LCRS, LDS, and SLDS
15 riser pipes. The CQA representative will document any noncompliance with the requirements and report
16 it to the CQA certifying engineer.

17 **7.1.8 Surveying**

18 A survey will be performed by or under the direction of a professional land surveyor registered in the
19 State of Washington. The surveyor will independently survey the final elevation and alignment of the top
20 of the pipe and fittings. Surveys will be performed on all pipe locations within the footprint of the landfill
21 to confirm that the alignment and elevations in the field agree with those shown in the construction
22 drawings. The results of the survey will be compiled in a report signed by the surveyor and the CQA
23 certifying engineer.

24 The surveyor will be required to survey each pipe location within the IDF landfill, in accordance with the
25 requirements of this CQA Plan. A record drawing will be submitted to the CQA certifying engineer by
26 the surveyor before placement of the next liner system layer. The surveys will be conducted every 50 feet
27 along the pipe alignment and appurtenances. The survey will include enough information to confirm that
28 the following features of the landfill piping are constructed in accordance with the construction drawings:

- 29 • Beginning and end top of pipe elevations
- 30 • Connection location
- 31 • Grade breaks
- 32 • Riser pipes
- 33 • Sump extensions

34 The piping that will be surveyed will include, but not be limited to, the following:

- 35 • SLDS piping
- 36 • LDS piping
- 37 • LCRS piping

38 The CQA certifying engineer will approve the survey results for each layer before the subsequent
39 component of the lining system is constructed.

1 **SECTION VIII—CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION AND**
2 **CERTIFICATION**

3 **8.1 DOCUMENTATION AND CERTIFICATION**

4 A major function of CQA is to properly and adequately document and certify the work. This section
5 describes the minimum required documentation. The CQA certifying engineer may recommend to the
6 IDF CM additional documentation for performing CQA tasks that are for certification. In addition, the
7 CQA certifying engineer will prepare forms, field data sheets, sample labeling schemes, and chain-of-
8 custody procedures and submit them to the IDF CM and IDF PM for approval, prior to construction.

9 **8.1.1 Daily Reports**

10 Daily reports will be completed by the CQA representatives when they are onsite. All CQA personnel
11 will be assigned field books by the CQA certifying engineer that will be labeled with a unique number.
12 The CQA representatives, including the CQA certifying engineer, will record all field observations and
13 the results of field tests in their assigned field book. When not in use, all field books will be left in the
14 field records file. After each book is filled (or at the end of the project), the field book will be returned to
15 the CQA certifying engineer and routed to the project files.

16 Each page of the field book will be numbered, dated, and initialed by CQA personnel. At the start of a
17 new work shift, CQA personnel will list the following information at the top of the page:

- 18 • Job name
- 19 • Job number
- 20 • Date
- 21 • Name
- 22 • Weather conditions
- 23 • Page number (if pages are not pre-numbered)

24 The remaining individual entries will be prefaced by an indication of the time at which they occurred. If
25 the results of test data are being recorded on separate sheets, it will be noted in the field book. Entries in
26 the field book will include, but not be limited to, the following information:

- 27 • Reports on any meetings held and their results
- 28 • Equipment and personnel being used in each location, including construction general contractors
- 29 • Descriptions of areas being observed and documented
- 30 • Descriptions of materials delivered to the site, including any quality verification (vendor certification)
- 31 documentation
- 32 • Descriptions of materials incorporated into construction
- 33 • Calibrations, or recalibrations, of test equipment, including actions taken as a result of recalibration
- 34 • Decisions made regarding use of material and/or corrective actions to be taken in instances of
- 35 substandard quality
- 36 • Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective
- 37 measures reports used to substantiate the decisions described in the preceding item

38 At the end of each day, the field CQA monitor will summarize the day's activities on a daily field
39 monitoring report form. The field report will include a brief summary of the day's activities and highlight
40 any unresolved issues that must be addressed by the CQA certifying engineer or by CQA representatives
41 the following day.

1 The daily field monitoring report will be filled out in triplicate. The CQA monitor will attach three copies
2 of the field book notes for that day. The three copies will be distributed as follows:

- 3 • Original will be filed in field office
- 4 • One copy will be transmitted to the CQA certifying engineer
- 5 • One copy will be transmitted to the IDF CM

6 The CQA certifying engineer will review and initial each summary field report before distributing to the
7 project quality records and the IDF CM.

8 **8.1.2 Inspection Data Sheets**

9 All observed field and laboratory test data will be recorded on an inspection data sheet. At a minimum,
10 each inspection data sheet will include the following information:

- 11 • Unique identifying sheet number for cross-referencing and document control
- 12 • Description of the inspection activity
- 13 • If appropriate, location of inspection activity or location from which the sample was obtained
- 14 • Type of inspection activity and/or procedure used (reference to standard method when appropriate)
- 15 • Any recorded observation or test data, with all necessary calculations
- 16 • Results of the inspection activity and comparison with specification requirements
- 17 • Identification of any personnel involved in the inspection activity
- 18 • Signature of the individual(s) performing the CQA representative activity and concurrence by the
19 CQA certifying engineer
- 20 • Identification of deficiencies and any required reinspections

21 Forms used for the data sheets will be prepared and submitted to the IDF CM and IDF PM in accordance
22 with this section. The data sheets will include, but are not limited to, the forms listed below:

- 23 • Sample log
- 24 • Compaction test result log
- 25 • Soil test result summary form
- 26 • Equipment calibration log

27 **8.1.3 Record Drawing Maintenance**

28 The construction general contractor will maintain a complete set of construction drawings labeled “Red-Line”
29 as-built drawings. At the completion of the project, the as-built drawings pertaining to the work certified
30 under this CQA Plan will be produced in electronic format and submitted to the CQA certifying engineer. The
31 CQA certifying engineer will review the completed set of as-built drawings and certify the drawing set as the
32 record drawings for the IDF.

33 **8.1.4 Non-Conformance Reporting**

34 Deficiencies/defects identified by in-process testing may be reworked in accordance with the technical
35 specifications or CQA Plan to correct the deficiency without initiating the NCR process (i.e., failed
36 compaction test or failed geomembrane destructive test), and in-process tests will be tracked by the CQA
37 representative until it is corrected. A non-conformance is considered to be a deficiency in characteristics,
38 documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate.
39 All deficiencies, defects, damage, or test failures that are not corrected by in-process rework will be
40 considered a non-conformance and will be documented on a Non-Conformance Report (NCR) form. The

1 non-conformance will be referred to the IDF CM, for disposition and initiation of corrective action
2 processes.

3 All NCR situations will be brought to the attention of the IDF CM for concurrence, prior to initiating the
4 NCR. Upon issuance of the non-conformance report, the IDF CM will notify the IDF design engineer,
5 IDF quality engineer, and IDF PM that the report has issued. Other individuals, as directed by the IDF
6 PM, will participate in NCR disposition, resolution, and corrective action processes as needed. All
7 documentation relating to NCR situations will be retained in the project quality records.

8 **8.1.5 Resolution of Contract Document Questions and Clarifications**

9 Request for Information (RFI) forms will be provided to the CQA certifying engineer for the purpose of
10 submitting written requests to the IDF CM, for assistance in understanding the design intent of the
11 contract documents. The CM will determine whether the IDF design engineer's technical support staff
12 will address the RFI.

13 RFIs initiated by the construction general contractor will be addressed by the IDF project engineer and
14 CM, not by the CQA certifying engineer, and are not in the scope of the CQA Plan.

15 Any RFIs that result in contract document changes will be incorporated by the IDF CM and PM,
16 following the procedures outlined in Section 8.1.6.

17 **8.1.6 Construction Change Order and Contract Document Changes**

18 Requests for changes to the technical specifications or construction drawings will be referred to the IDF
19 CM and initiated as a change order. All change orders and resulting design changes will be approved by
20 the appropriate project team member prior to implementation, as outlined in procedure HNF-IP-0842,
21 Volume 4., Section 4.29 (Engineering Document Change Control Requirements). Requests for
22 modifications to the CQA Plan will also be made by completing a change order to the IDF CM and
23 procurement agent, with copies to the IDF quality engineer and IDF project engineer.

24 If, during the course of construction, questions arise regarding interpretation of the plans and/or
25 specifications, the IDF CM will be contacted by the CQA certifying engineer. Any clarification of the
26 construction drawings will be documented by a change order, if necessary, or by telephone conversation
27 records or meeting minutes, and routed to the IDF design engineer, IDF CM, and IDF PM. The change
28 order will also be routed to the project files.

29 **8.1.7 Progress Reports**

30 The CQA certifying engineer will prepare a summary progress report each week, or at time intervals
31 established at the pre-construction meeting. At a minimum, this report will include the following
32 information:

- 33 • A unique identifying sheet number for cross-referencing and document control
- 34 • The date, project name, location, and other information
- 35 • A summary of work activities accomplished during the progress reporting period
- 36 • Identification of areas or items inspected and/or tested during the reporting period that are addressed
37 by the report
- 38 • A summary of the quality characteristics being evaluated, with appropriate cross-references to
39 technical specifications and/or construction drawings
- 40 • References to the technical specifications or construction drawings defining the acceptance criteria
41 for each inspected characteristic
- 42 • A summary of inspection and test results, failures, and re-tests

- 1 • A summary of construction situations, deficiencies, and/or defects occurring during the progress
- 2 reporting period
- 3 • A summary of other problem resolutions and dispositions
- 4 • The signature of the CQA certifying engineer

5 The progress report will be submitted to the IDF PM no more than two days after the last reporting day in
6 the progress report. Copies will also be submitted to the IDF PM, IDF quality engineer, and construction
7 general contractor.

8 **8.1.8 Final Documentation and Certification**

9 All daily inspection summary reports, inspection sheets, problem identification and corrective measures
10 reports, acceptance reports, change orders, NCRs, photographic records, progress reports, construction
11 drawings, construction drawing revisions, and other pertinent documentation will be retained as
12 permanent project quality records. At the completion of the project, a final CQA report that incorporates
13 all such information, along with as-built drawings, will be prepared by the CQA certifying engineer and
14 submitted to the IDF PM. The CQA certifying engineer will prepare an interim report for construction
15 and testing of the test pads. A final CQA report and certification letter will be completed at the end of the
16 construction that will fulfill the CQA certification requirements specified in WAC 173-303-335(4).

17 The CQA certifying engineer will coordinate the completion of the as-built record drawings that will be
18 generated by a land surveyor licensed in the State of Washington. The as-built records will include scale
19 drawings depicting depths, plan dimensions, elevations, fill thicknesses, and geosynthetic panel layouts.
20 The report will include documentation of each construction component monitored by CQA personnel and
21 will be signed, stamped, and certified by the CQA certifying engineer.

22 **8.1.9 Storage of Records**

23 During the construction of the IDF, the CQA certifying engineer will be responsible for all CQA
24 documents. This includes the CQA certifying engineer's copy of the design criteria, plans, procedures,
25 and specifications; the CQA Plan; and the originals of all the data sheets and reports. The field records
26 will be kept in lockable, metal cabinets or on metal shelving within a facility, protected by a fire alarm
27 and/or a communication system that provides fire department response and/or fire suppression systems;
28 or, in an Underwriters Laboratory-listed, one-hour fire-rated cabinet. At the completion of the project, all
29 completed documents will be routed to the project quality records.

30 **8.1.10 Storage of Archive Construction Material Samples**

31 The CQA certifying engineer will be responsible for storing construction material samples collected
32 during the duration of the project.

33 The CQA certifying engineer will coordinate with the IDF PM and IDF CM on which samples will be
34 archived at the completion of the project. All samples will be kept in small containers (i.e., 5-gallon
35 plastic buckets). Each container will be labeled with the following information:

- 36 • Project name
- 37 • Date
- 38 • Sample I.D.
- 39 • Material type
- 40 • Point of contact

41 Control and protection of samples will be accomplished through the use of an index listing of samples.
42 This index will identify each sample gathered and include the same information required for the sample
43 containers. It will also identify where the sample is stored and person responsible for the sample storage,
44 thus providing a documented record of each sample and methodology for verifying that all samples are
45 available in storage and that no samples have been misplaced.

- 1 All samples will be stored neatly in a cool, dry location, approved by the CQA certifying engineer. The
- 2 CQA certifying engineer will coordinate with the IDF PM and IDF CM to determine which sample will
- 3 be archived at the project completion.

4

1 **SECTION IX—REFERENCES**

- 2 40 CFR 264.19. *Code of Federal Regulations*, Standards for Owners and Operators of Hazardous Waste
3 Treatment, Storage, and Disposal Facilities, Section 19, “Construction Quality Assurance Program.”
4 Office of the Federal Register. July 9, 1999.
- 5 ASTM. *1997 Annual Book of ASTM Standards*, Volume 4.08: Soil and Rock (I). American Society for
6 Testing and Materials, Philadelphia, Pennsylvania. 1997.
- 7 CH2M HILL. *Drawings for the Integrated Disposal Facility (IDF) Detailed Design*. RPP-19941, Rev. 0.
8 Prepared for CH2M HILL Hanford Group. February 2004.
- 9 CH2M HILL. *Specifications for the Integrated Disposal Facility (IDF) Detailed Design*.
10 RPP-18489, Rev. 0. Prepared for CH2M HILL Hanford Group. February 2004.
- 11 Geosynthetic Research Institute (GRI). “Standard Test Method for Asperity Measurement of Textured
12 Geomembranes Using a Depth Gage,” Test Method GM12. Philadelphia, Pennsylvania. 2000.
- 13 U.S. Department of Energy. “Radioactive Waste Management,” DOE O 435.1. August 28, 2001.
- 14 U.S. Environmental Protection Agency, Office of Research and Development. *Technical Guidance*
15 *Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93-
16 182. Cincinnati, Ohio. 1993.
- 17 Washington Administrative Code (WAC) 173-303-335, *Construction Quality Assurance Program*.