Attachment M

Construction Quality Assurance Plan

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1 GENERAL

1.1 Introduction

Triassic Park Waste Disposal Facility will consist of waste receiving facilities, a RCRA-compliant hazardous waste landfill, a storm water control system including a lined storm water detention basin, and access roadways. This Construction Quality Assurance (CQA) plan is intended to be used in conjunction with the design drawings and construction specifications for the Triassic Park Waste Disposal Facility.

The CQA Plan addresses the construction quality assurance of the soils, geosynthetics, and related liner system components for the facilities listed above at the Triassic Park Facility. The CQA Plan is divided into the following sections:

Section 1: General;

Section 2: Soils CQA;

Section 3: Geosynthetic Clay Liner CQA;

Section 4: Geomembrane CQA;

Section 5: Geotextile CQA;

Section 6: Geocomposite CQA;

Section 7: Geonet CQA;

Section 8: Polyethylene Pipe and Fittings CQA;

Section 9: ADS Slotted CPT CQA;

Section 10: Corrugated Metal Pipe CQA;

Section 11: Carbon Steel and Stainless Steel Pipe CQA;

Section 12: Polyethylene Tank CQA;

Section 13: Concrete Formwork CQA;

Section 14: Reinforcement Steel CQA;

Section 15: Joints in Concrete CQA;

Section 16: Miscellaneous Metalwork CQA;

Section 17: Cast in Place Concrete CQA

Section 18: Electrical System and Pump Control CQA;

Section 19: Pumps, Piping, Meters, and Valve CQA; and

Section 20: CQA Documentation.

The facility shall not accept waste until NMED has approved the CQA certification report.

1.2 Definitions Relating to Construction Quality Assurance

1.2.1 Construction Quality Assurance and Construction Quality Control

The CQA Plan is a site-specific document which addresses the following: (i) CQA personnel responsibilities, authorities, and qualifications; (ii) inspection, monitoring, and testing activities necessary to document that the facility is constructed to meet or exceed design criteria, plans, and specifications; and (iii) CQA documentation requirements.

Construction Quality Assurance (CQA) - A planned and systematic pattern of the means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements, and will perform satisfactorily in service.

Construction Quality Control (CQC) -Those actions which provide a means to measure and control the characteristics of an item or service to meet contractual and regulatory requirements.

1.2.2 Use of the Terms in This Plan

In the context of this document:

Construction Quality Assurance (CQA) refers to means and actions employed by the CQA Engineer to assure conformity of liner system preparation, production, and installation with this CQA Plan, the General Specifications, and the Construction Drawings. CQA is provided by a party independent from the product Manufacturer and Contractor; and

Construction Quality Control (CQC) refers to those actions taken by Manufacturers, Suppliers, Contractors, or Owners, including their designated representatives, to ensure that the materials and the workmanship meet the requirements of the General Specifications, and the Construction Drawings. In the case of soils, and within this CQA Plan, CQC is typically made a part of the CQA requirements and is provided by the CQA Engineer. In the case of geosynthetic and other non-soil components, CQC is provided by the Manufacturers and installers of the various geosynthetics.

1.3 Parties to Construction Quality Assurance

1.3.1 Organization Chart

A typical project organization chart for construction of the landfill and associated facilities is provided in Figure 1-1, Typical Project Organization.

1.3.2 Description of the Parties

1.3.2.a Design Engineer

The Design Engineer is the individual, firm or corporation having direct responsibility for the design of the landfill. During construction, the Design Engineer must approve any significant deviation from the design requirements of the Contract Documents. The Design Engineer may be an employee of the Owner. An individual representing the Design Engineer directly responsible for the project must be registered as a Professional Engineer in the State of New Mexico.

1.3.2.b Contractor

The contractor is the individual, firm, or corporation, undertaking the execution of the work under the terms of the Contract Documents. The Contractor may be responsible for constructing the entire liner system (earthwork and geosynthetics), or only selected components of the liner system. The reference to Contractor refers to the General Contractor and all subcontractors which the General Contractor may employ in meeting the requirements of the Contract Documents.

1.3.2.c Drainage Gravel Supplier

The drainage gravel supplier excavates (or manufactures) and delivers drainage gravel to the Contractor at the Triassic Park Facility.

1.3.2.d Road Base Material Supplier

The road base supplier excavates (or manufactures) and delivers road base material to the Contractor at the Triassic Park Facility.

1.3.2.e Select Subbase Supplier

The select subbase supplier excavates (or manufactures) and delivers select subbase to the Contractor at the Triassic Park Facility.

1.3.2.f Resin Supplier

The resin supplier produces and delivers resin to the manufacturer of geosynthetic materials or polymer based products such as pipe.

1.3.2.g Manufacturer

The Manufacturer produces a specific component (e.g., geomembrane, geosynthetic clay liner, geotextile, geocomposite, geonet or pipe) of the proposed liner system and delivers the component to the Contractor at the site. In the General Specifications, the term Manufacturer may refer to the geomembrane Manufacturer, geotextile Manufacturer, geocomposite/geonet Manufacturer, GCL Manufacturer, or pipe Manufacturer.

1.3.2.h Construction Quality Assurance Engineer

The CQA Engineer is an individual, firm, or corporation, independent from the Owner, Contractor, and Manufacturer, that observes, tests, and documents activities related to the CQA of the earthworks at the site, and observes, tests, and documents activities related to the CQA of the installation of the geosynthetic components of the liner system. The CQA Engineer observes, tests, and documents activities related to the CQA of pipes and other liner system components. The CQA Engineer must provide an engineer which directly manages the CQA activities who is a Professional Engineer registered in the State of New Mexico. The CQA Engineer may be the same as the Design Engineer, but must be independent from the Owner.

1.3.2.i Soils Construction Quality Assurance Laboratory

The Soils CQA Laboratory is independent from the Owner, Gravel Supplier, Granular Material Supplier, and Contractor. The Soils CQA Laboratory conducts tests in the laboratory (which may be on-site or off-site) on samples of soil taken from the borrow pits, stockpiles, or the liner system.

1.3.2.j Geosynthetic CQA Laboratory

The Geosynthetics CQA Laboratory is independent from the Owner, Resin Supplier, Manufacturer, and Contractor. The Geosynthetics CQA Laboratory conducts tests on samples of geosynthetics taken from the site. The Geosynthetics CQA Laboratory may also conduct tests on pipes or other liner system components. The Geosynthetics CQA Laboratory service cannot be provided by any party involved with the manufacture or installation of any of the geosynthetic components.

1.3.2.k Owner

The Owner owns and operates the landfill. In this CQA Plan, the term "Owner" refers specifically to the Triassic Park Waste Disposal Facility.

1.3.3 Qualifications of the Parties

1.3.3.a Design Engineer

The representative of the Design Engineer, who is directly responsible for the project, will be a qualified Professional Engineer registered in the State of New Mexico. The Design Engineer must have experience and demonstrated familiarity with all liner system components, including detailed design methods and procedures.

1.3.3.b Geomembrane Installer

The Geomembrane Installer (who may be either the Contractor or a subcontractor to the Contractor) will be trained and qualified to install geosynthetics, as well as other liner system components such as pipe, if necessary.

All personnel performing seaming operations will be qualified by experience (i.e., each seamer will have installed no less than 100,000 square feet of geomembrane using the same methods of seaming that will be used on this project). At least one seamer will have experience seaming a minimum of 1,000,000 square feet of geomembrane using the same method of seaming that will be used on this project. The most experienced seamer, the "master seamer", will provide direct supervision, as required, over less experienced seamers. Field seaming may not take place without an approved master seamer being present.

The Contractor shall provide the Owner and CQA Engineer with a list of proposed seaming personnel and their professional records. Any proposed seaming personnel deemed insufficiently experienced shall not be accepted by the Owner or shall be required to pass a seaming test prior to working on the Project.

1.3.3.c Construction Quality Assurance Engineer Personnel

Personnel representing the CQA Engineer shall be properly trained and qualified to test and inspect soils, including high and low permeability soils, geosynthetics, including geomembranes, geotextiles, geocomposites, GCLs, and pipe. The CQA Engineer will predominately be represented by a Resident Engineer who has direct responsibility for management of the CQA activities. The CQA Resident Engineer shall be experienced in construction, CQA of soils; CQA of geosynthetics and pipe; and preparation of CQA documentation including CQA forms, reports, and plans.

As a minimum, CQA Monitors (CQAM) shall have a high school diploma and at least two years of construction related experience and one year of experience conducting CQA monitoring for landfill construction involving both soil and geosynthetic components, or a Bachelor of Science degree from a four year college or university and one year of experience conducting CQA monitoring for landfill construction involving both soil and geosynthetic components. In addition, the lead CQAMs shall be certified in geosynthetic by the National Institute for Certification in Engineering Technologies (NICET). The number of NICET certified monitors assigned to the work shall comply with the recommendation of the U.S. Environmental Protection Agency (EPA) as indicated in Table 1-1.

Qualification of CQA Personnel shall be documented by training records and professional résumés, and shall be reviewed by the Project Manager.

TABLE 1-1. RECOMMENDED IMPLEMENTATION PROGRAM FOR CONSTRUCTION QUALITY ASSURANCE FOR GEOSYNTHETICS

No. of Field Crews at Each Site [a]	End of 18 Months	End of 36 Months
1–2	1 - Level II	1 - Level III [b]
3–4	1 - Level II	1 - Level III [b]
	1 - Level I	1 - Level I
≥5	1 - Level II	1 - Level III [b]
	2 - Level I	1 - Level II
		1 - Level I

Source: U.S. EPA Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities. EPA/600/R-93/182, September 1993.

a Performing a critical operation; typically 4–6 people per crew.
b Or PE with applicable experience

1.3.3.d Soils Construction Quality Assurance Laboratory

The Soils CQA Laboratory shall have experience with the physical testing of soils, meet all applicable regulatory requirements, and be familiar with ASTM and other required test standards. The Soils CQA Laboratory shall be capable of providing test results in accordance with the specifications.

1.3.3.e Geosynthetics Construction Quality Assurance Laboratory

The Geosynthetics CQA Laboratory shall have experience in testing geosynthetics and other relevant liner system components and be familiar with ASTM and other applicable test standards.

1.3.4 Duties of Construction Quality Assurance Engineer

The overall responsibility of the CQA Engineer is to perform those activities specified in the CQA Plan (e.g., inspection, sampling, testing and documentation final certification). At a minimum, the CQA Engineer shall be represented by a CQA Resident Engineer and the necessary supporting CQA inspection personnel. Specific responsibilities of the CQA Resident Engineer may include:

- reviewing design criteria, plans, and specifications for clarity and completeness so that the CQA Plan can be implemented;

- educating CQA personnel on CQA requirements and procedures;
- scheduling and coordinating CQA activities;
- directing and supporting the CQA personnel in performing observations and tests by:
    - confirming that regular calibration of testing equipment is properly conducted and recorded;
    - confirming that the testing equipment, personnel, and procedures do not change adversely over time and verifying that changes do not adversely impact the inspection process;
    - confirming that the test data are accurately recorded and maintained; and
    - verifying that the raw data are properly recorded, validated, reduced, summarized, and interpreted;
- providing to the Owner reports on the observation results including:
    - review and interpretation of data sheets and reports;
    - identification of work that the CQA Resident Engineer believes should be accepted, rejected, or uncovered for observation, or that may require special testing, observation, or approval; and
    - rejection of defective work and verification that corrective measures are implemented;
- verifying that the Contractor's construction quality control plan, if required, is in accordance with the site specific CQA Plan;
- at the Owner’s request, reporting to the Contractor results of observations and tests as the work progresses and interacting with the Contractor to provide assistance in modifying the materials and work to comply with the specified design;
- providing the final report and certifications required by the CQA Plan;

For the supporting CQA personnel, specific responsibilities may include:

- performing independent on-site observation of the work in progress to verify conformance with the facility design criteria, plans and specifications;
- verifying that the equipment used in testing meets the test requirements and that the tests are conducted according to the standardized procedures defined by the CQA plan; and
- reporting to the CQA Resident Engineer results of all observation including work that is not of acceptable quality or that fails to meet the specified design.

1.4 Scope of Construction Quality Assurance

The scope of this CQA Plan includes the CQA of the subgrade, preparation and soil, pipe, concrete, and geosynthetic components of the liner and cover system. This CQA Plan does not address design guidelines, installation specifications, or selection of soils, geosynthetics, pipe or other liner system components, which are all described in the General Specifications.

The CQA Plan does not provide for Construction Quality Control which the Contractor may independently undertake to facilitate the Contractor's achieving his requirements under the General Specifications.

1.5 Units

In this CQA Plan, all properties and dimensions are expressed in customary U.S. units.

1.6 References

1.6.1 Applicable Organizations

Organizations whose standards are referenced in the CQA Plan and the General Specifications are as follows:

- NMDOT - New Mexico Department of Transportation (Standard Specifications for Road and Bridge Construction);
- ASTM - American Society for Testing and Materials;
- GRI - Geosynthetic Research Institute;
- OSHA - Occupational Safety and Health Administration; and
- U.S. EPA - United States Environmental Protection Agency.

1.6.2 Applicable Standards

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

1.6.3 Specific Standards

Specific test standards which may be cited in the CQA Plan and the General Specifications are given in Table 1-2. These standards may be modified due to technological advances since compilation of Table 1-2. All such modifications are to be approved by the Owner.

TABLE 1-2. TEST METHODS CITED IN GENERAL SPECIFICATIONS AND CQA PLAN

Method Number	Title
American Society of Testing and Materials	
1. ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
2. ASTM A 726	Standard Specification for Cold-Rolled Carbon Steel sheet, Magnetic Laminated Quality, types 1, 2, and 2S
3. ASTM C 88	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
4. ASTM C 131	Resistance to Degradation of Small-size coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
5. ASTM D 374C or D 1777	Method for Measuring Thickness of Geotextile Materials
6. ASTM D 413	Standard Test Method for Rubber Property Adhesion to Flexible Substrate
7. ASTM D 422	Standard Method for Particle-Size Analysis of Soils
8. ASTM D 570	Standard Test Method for Water Absorption of Plastics
9. ASTM D 638	Standard Test Method for Tensile Properties of Plastics
10. ASTM D 698	Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop
11. ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
12. ASTM D 751	Standard Methods of Testing Coated Fabrics
13. ASTM D 792	Standard Test Methods for Specific Gravity (Relative density) and Density of Plastics by Displacement
14. ASTM D 882	Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
15. ASTM D 1004	Standard Test Method of Initial Tear Resistance of Plastic film and Sheeting
16. ASTM D 1204	Standard Plastics Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
17. ASTM D 1238	Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

Method Number	Title
18. ASTM D 1248	Standard Specification for Polyethylene Plastic Molding and extrusion Metals
19. ASTM D 1505	Standard Test Methods for Density of Plastics by Density-Gradient Technique
20. ASTM D 1556	Standard Test Method for Density of Soil In Place by the Sand-Cone Method
21. ASTM D 1593	Standard Specification for Nonrigid Vinyl Chloride Plastic Sheeting
22. ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics
23. ASTM D 2167	Standard Test Method for Density and Unit Weight of Soils in Place by Rubber Balloon Method
24. ASTM D 2216 or D 4643	Standard Method for Laboratory Determination of water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
25. ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head)
26. ASTM D 2487	Standard Test Method for Classification of Soils for Engineering Purposes
27. ASTM D 2657	Standard Practice for Heat-Joining for Polyolefin Pipe and Fittings
28. ASTM D 2663	Carbon-Black Dispersion in Rubber
29. ASTM D 2837	Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
30. ASTM D 2922	Standard Test Method for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
31. ASTM D 3015	Recommended Practice for Microscopic Examination of Pigment Dispersion in Plastic Compounds
32. ASTM D 3017	Standard Test Method for Moisture Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)

Method Number	Title
33. ASTM D 3083	Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining
34. ASTM D 3350	Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials
35. ASTM D 3776	Mass Per Unit Area (Weight) of Woven Fabric
36. ASTM D 4253	Standard Test Method for Maximum Index Testing of Soils Using a Vibratory Table
37. ASTM D 4254	Standard test Method for Minimum Index Density of Soils and Calculations of Relative Density
38. ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
39. ASTM D 4373	Standard Test Method for Calcium Carbonate Content of Soils
40. ASTM D 4437	Standard Test Methods for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Geomembranes
41. ASTM D 4491	Standard Test Method for Water Permeability of Geotextiles by the Permittivity Method
42. ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
43. ASTM D 4632	Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Elongation Method and Peel Strength)
44. ASTM D 4643	Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
45. ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
46. ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
47. ASTM D 4833	Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
48. ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

Method Number	Title
49. ASTM D 5261	Measuring Mass Per Unit Area of Geotextile
50. ASTM D 5321	Coefficient of Soil and Geosynthetics or Geosynthetics and Geosynthetics Friction by Direct Shear
51. ASTM D 5890	Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
52. ASTM 5891	Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
53. ASTM E 11	Specification for Wire-Cloth Sieves for Testing Purposes
54. ASTM F 714	Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
55. ASTM F 904	Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials
Geosynthetic Research Institute	
1. GRI-GMI	Standard Test Method for Ductile/Brittle Transition Time for Notched Polyethylene Specimen under Constant Stress
United States Environmental Protection Agency	
1. U.S. EPA 9090	Compatibility Test for Wastes and Membrane Liners

2 SOILS CONSTRUCTION QUALITY ASSURANCE

2.1 Introduction

This section of the CQA Plan addresses the soils components of the liner and cover systems and specifies the soils CQA program to be implemented with regard to materials selection and evaluation, laboratory test requirements, field test requirements, and treatment of problems.

This section of the CQA Plan also addresses construction of the foundation subgrade, clay liners, clay covers, granular drainage layers, sump and pipe bedding gravel, the protective soil layer, and cover soil.

2.2 Excavated Subgrade

2.2.1 Verification of Subgrade Continuity

When the excavation of the landfill is completed, the CQA Engineer shall:

- inspect the subgrade on the side slopes and base of the landfill and note areas of weak or excessively weathered subgrade materials; and
- observe the proof rolling of the base of the landfill and note areas that exhibit excessive rutting, heaving, or softening.

Backfill material in the excavation shall be structural fill or clay liner material that shall be placed and compacted. The CQA Engineer will observe any excavation and backfilling operations.

The CQA Engineer shall report any problems or deviations from the above requirements to the Owner.

2.2.2 Structural Fill Placement and Compaction

The General Specifications shall be followed for the placement and compaction of structural fill. The CQA Engineer shall monitor the fill placement and compaction to verify and document the following:

- the soil being placed meets the General Specification requirements for fill as determined by the test methods and frequencies specified within this CQA Plan;
- the compacted lift thickness is in accordance with the requirements of the General Specifications;
- the previous lift is scarified as specified in the General Specifications before placing the next lift;
- fill is moisture conditioned, as required in the General Specifications; and

- the compacted moisture content and dry unit weight of the fill meets specifications as determined by the test methods and frequencies described below.

2.2.3 Construction Quality Assurance Evaluation

The minimum frequency of soils testing for CQA purposes shall conform to the minimum frequencies presented in Table 2-1.

TABLE 2-1. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF STRUCTURAL FILL

Test	Frequency	Standard Test Method
Material Properties		
Modified Proctor	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 1557
Sieve Analysis	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 422
Atterberg Limits	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 4318
IN PLACE		
Nuclear Density Meter (50 ft. Grid)		
In-Situ Moisture Content	1 per 2,500 ft2 per lift	ASTM D 6938
In-Situ Dry Unit Weight	1 per 2,500 ft2 per lift	ASTM D 6938
Calibration and Check		
Standard Count Calibration or Sandstone	1 per day of fill placement	ASTM D 1556/D6938
Oven Moisture Contents (In-Situ Moisture Content)	1 per day of fill placement	ASTM D 2216

Nuclear density meter test methods shall be used for the field testing of the in-situ dry unit weight and moisture content of the in-place, compacted fill. Standard Count Calibration, Sand Cone tests and/or Rubber Balloon tests and oven moisture content tests shall be conducted to calibrate the results of the nuclear density meter and in cases of uncertainty with the nuclear density meter test results. Any conflict over the test results shall be resolved by the CQA Engineer and the Owner. All perforations in the fill shall be backfilled in accordance with the General Specifications.

If an in-place density test result fails to meet specifications, a confirmatory test shall be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications then a second confirmatory test shall be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications then the area will be declared as meeting project specifications and the confirmatory tests shall be reported. In the event that either confirmatory test fails to meet specifications, then additional testing shall be performed to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the fill, the CQA Engineer shall determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Engineer shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Engineer deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA Engineer shall define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined, the CQA Engineer shall notify the Owner, and verify that the deficiency is corrected by the Contractor before any additional work is performed in the area of the deficiency.

2.2.4 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA survey. The CQA Surveyor shall independently survey the excavation to confirm that the grades and elevations in the field agree with those shown on the Construction Drawings. CQA Surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer. The CQA Engineer and the Owner shall review and approve the survey results before the next phase of the lining system is constructed.

2.3 Prepared Subgrade

2.3.1 Prepared Subgrade Placement and Compaction

The CQA Engineer shall verify and document that the prepared subgrade is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the prepared subgrade, the CQA Engineer shall verify and document that:

- all or an approved portion of the excavation are complete, and that a survey has been conducted to verify that the subgrade grades and elevations conform to the Construction Drawings;
- the subgrade meets specifications as determined by the test requirements of this CQA Plan;
- the surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice or frozen material; and
- if frozen subgrade material is encountered, it is removed and replaced in accordance with the General Specifications.

During placement and compaction of the prepared subgrade, the CQA Engineer shall verify and document that:

- close inspection of the placement and compaction of the prepared subgrade with earthmoving equipment is performed by the CQA Engineer;
- the prepared subgrade material meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-2;
- the prepared subgrade is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-2;
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications;
- perforations in the prepared subgrade at testing and sampling locations are backfilled in accordance with the General Specifications; and

The CQA Engineer shall document the properties of the prepared subgrade as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-2. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF PREPARED SUBGRADE

Test	Frequency	Standard Test Method
Modified Proctor	1 per 50,000 SF or a minimum of 1 per soil type	ASTM D 1557
IN PLACE		
Nuclear Density Meter (50 ft. Grid)		
In-Situ Moisture Content	1 per 2,500 ft2 per lift	ASTM D 6938
In-Situ Dry Unit Weight	1 per 2,500 ft2 per lift	ASTM D 6938
Calibration and Check		
Sand Cone (In-Situ Density)	1 per day of fill placement	ASTM D 1556
Oven Moisture Content (In-Situ Moisture Content)	1 per day of fill placement	ASTM D 2216
Material Properties		
Sieve Analysis	1 per 125,000 ft2	ASTM D 422
Atterberg Limits	1 per 125,000 ft2	ASTM D 4318

2.3.2 Construction Quality Assurance Evaluation

Construction quality assurance testing is required of the prepared subgrade, and the Contractor must take quality assurance testing into account when planning his construction schedule. Nuclear density meter test methods shall be used for testing the in-situ compacted dry unit weight and moisture content of the materials. Standard Count Calibration, Sand Cone and/or Rubber Balloon tests and oven moisture content tests shall be used to calibrate the reading of the nuclear density meter and in cases of uncertainty with the nuclear density meter readings. Any discrepancies between test results shall be resolved by the CQA Engineer and the Owner. The CQA Engineer shall conduct moisture, and density tests as specified in Table 2-2.

The testing frequency during prepared subgrade construction may be increased or modified at the discretion of the CQA Engineer when visual observations of construction performance indicate potential problems.

During construction, the frequency of testing may be increased by the CQA Engineer during adverse weather conditions, if equipment breaks down, at the start and finish of grading, if the

material fails to meet the requirements of the General Specifications, or the extent of the work area is reduced.

If an in-place density test result fails to meet specifications, a confirmatory test shall be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications then a second confirmatory test shall be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications then the area will be declared as meeting project specifications and the confirmatory tests shall be reported. In the event that either confirmatory test fails to meet specifications, then additional testing shall be performed to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the prepared subgrade, the CQA Engineer shall determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Engineer shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Engineer deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA Engineer shall define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the Contractor, the CQA Engineer shall verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the Contractor in the area of the deficiency.

Based on the requirements of the General Specifications, the Contractor shall be required to use all means necessary to protect all prior work, as well as all materials and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repaired.

2.3.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico will perform the CQA surveys. The CQA Surveyor will independently survey the elevations and grades of the clay liner surfaces, and to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and with the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The owner and the CQA Engineer shall approve the survey results before the next phase of the liner system (geomembrane installation) is constructed.

2.4 Clay Liners

2.4.1 Clay Liner Placement and Compaction

The CQA Engineer shall verify and document that the clay liner is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the clay liner, the CQA Engineer shall verify and document that:

- a test fill has been constructed with the proposed liner material and production scale equipment to confirm processing and placement procedures. In addition, field and laboratory testing shall be completed on the test fill to confirm clay placement specifications will achieve the specified permeability. A test fill plan is presented in Appendix A;
- all or an approved portion of the excavation are complete, and that a survey has been conducted to verify that the subgrade grades and elevations conform to the Construction Drawings;
- the subgrade meets specifications as determined by the test requirements of this CQA Plan;
- the surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice or frozen material; and
- if frozen subgrade material is encountered, it is removed and replaced in accordance with the General Specifications.

During placement and compaction of the clay liner, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of clay liner material with earthmoving equipment is performed by the CQA Engineer;
- the clay liner material meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-3;
- the clay liner is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-3;
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications;

- thin-walled (i.e., Shelby tube) samples of clay liner material are collected and laboratory permeability testing is performed at the frequency specified in Table 2-3;
- perforations in the clay liner at testing and sampling locations are backfilled in accordance with the General Specifications; and
- excessive wrinkles in the geosynthetic components underlying the clay have been "worked" out.

The CQA Engineer shall document the properties of the clay soil as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-3. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF CLAY LINER

Test	Frequency	Standard Test Method
Material Properties		
Recompacted Permeability (moisture content and dry density inside placement window)	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 5084
Sieve Analysis	1 per 1,053 cy placed (minimum 1 per source)	ASTM D 422
Atterberg Limits	1 per 1,053 cy placed (minimum 1 per source)	ASTM D 4318
Compaction	1 per 5,263 cy placed (minimum 1 per source)	ASTM D 1557
IN PLACE		
Lift Thickness Before Compaction	1 per 2,500 ft2 per lift	Field Measurement
Nuclear Density Meter (50 ft. Grid)		
In-Situ Moisture Content	5/acre/lift	ASTM D 3017
In-Situ Dry Unit Weight	5/acre/lift	ASTM D 6938
Calibration and Check		
Sand Cone or Rubber Balloon (In-Situ Density)	1 per 20 nuclear densities	ASTM D 1556/D 2167
Oven Moisture Contents (In-situ Moisture Content)	1 per 10 nuclear moisture	ASTM D 2216
Permeability		
Shelby tube Samples	1/acre/lift	ASTM D 5084

2.4.2 Construction Quality Assurance Evaluation

Extensive construction quality assurance testing is required of the clay liners, and the Contractor must take quality assurance testing into account when planning his construction schedule. Nuclear density meter test methods shall be used for testing the in-situ compacted dry unit weight and moisture content of the clay materials. Standard Count Calibration, Sand Cone and/or Rubber Balloon tests and oven moisture content tests shall be used to calibrate the reading of the nuclear density meter and in cases of uncertainty with the nuclear density meter readings. Any discrepancies between test results shall be resolved by the CQA Engineer and the Owner. Thin-walled (i.e., Shelby) tube samples shall be collected for hydraulic conductivity testing. At the request of the CQA Engineer, on-site construction equipment operated by the Contractor shall be used to slowly push the sample tube through the clay layer. The CQA Engineer shall conduct moisture, density, and hydraulic conductivity tests as specified in Table 2-3.

The testing frequency during clay liner construction may be increased or modified at the discretion of the CQA Engineer when visual observations of construction performance indicate potential problems or when field experience with the proposed soil liner material have been obtained.

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

All perforations in the clay liner at nuclear density test probe locations shall be backfilled by the CQA Engineer with clay liner material and compacted by hand tamping. All perforations at sand cone or rubber balloon test locations, Shelby tube sample locations, and test pit locations shall be backfilled by the Contractor with clay liner material and compacted in accordance with the specifications for the clay liner.

If an in-place density test result fails to meet specifications, a confirmatory test shall be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds specifications then a second confirmatory test shall be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds specifications then the area will be declared as meeting project specifications and the confirmatory tests will be reported. In the event that either confirmatory test fails to meet specifications, then additional testing shall be performed to identify the limits of the area that does not meet project specifications.

If a defective area is discovered in the clay liner, the CQA Engineer shall determine the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Engineer shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Engineer deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the CQA

Engineer shall define the limits and nature of the defect by testing or observation. After the extent and nature of a defect is determined and has been remedied by the Contractor, the CQA Engineer shall verify that the deficiency is corrected by retesting repaired areas before any additional work is performed by the Contractor in the area of the deficiency.

Based on the requirements of the General Specifications, the Contractor shall be required to use all means necessary to protect all prior work, as well as all materials and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repaired.

2.4.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico will perform the CQA surveys. The CQA Surveyor will independently survey the elevations and grades of the clay liner surfaces, and to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys will be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of the liner system (geomembrane installation) is constructed.

2.5 Drainage Gravel

2.5.1 Supplier

The Contractor shall require that the drainage gravel Supplier provide the CQA Engineer with quality control test results and a written certification signed by a responsible party of the Supplier that the tests required by the General Specifications have been performed on the material to be delivered to the site.

The CQA Engineer shall examine the tests results and report any deviations to the Owner. If the drainage gravel supplier cannot provide test results required by the general specifications, then the CQA Engineer may perform or arrange to perform the tests.

2.5.2 Conformance Evaluation

The test methods and frequency for CQA conformance testing of the drainage gravel are specified in Table 2-4.

If the material fails to meet the requirements of the General Specifications, the CQA Engineer shall perform sufficient sampling and testing to identify the extent of the nonconforming material at the expense of the Contractor. Nonconforming material shall be removed from the site.

TABLE 2-4. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF DRAINAGE GRAVEL

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 500 cy placed (minimum 1 per source)	ASTM D 422
Permeability	1 per source	ASTM D 5084

2.5.3 Placement and Compaction

The CQA Engineer shall verify and document that the drainage gravel is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the drainage gravel, the CQA Engineer shall verify and document that:

- the underlying geosynthetic layers are free of holes, tears, excessive wrinkles, or foreign objects; and
- all work on underlying layers is complete and accepted by the Owner.

During placement and compaction of the drainage gravel, the CQA Engineer shall verify and document that:

- drainage gravel material satisfies the requirements of the General Specifications as determined by the testing prescribed within the CQA Plan;
- drainage gravel material is spread before 12:00 noon, unless otherwise approved by the Owner;
- the equipment wheel ground pressure versus the material thickness requirements given in the General Specifications are complied with;
- the drainage gravel is placed in a manner so that the maximum material drop height is in accordance with the General Specifications;
- close observation of the placement and compaction of drainage gravel with earth moving equipment is performed; and

- the drainage gravel is compacted utilizing the equipment and number of passes specified in the General Specifications.

2.5.4 Construction Quality Assurance Evaluation

No density tests will be conducted on the drainage gravel. If the CQA Engineer suspects damage to pipes or underlying geosynthetic, the contractor shall be required to expose the potentially damaged materials and repair any observed damage.

2.5.5 Surveying

A Professional Land Surveyor registered in the State of New Mexico will perform CQA surveys. The CQA surveyor will independently survey the elevations and grades of the top of the drainage gravel, and to confirm that the grades and elevations in the field agree with those shown on the Construction Drawings. The CQA surveys will be performed in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor will be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and CQA Engineer shall approve the survey results before the next phase of the lining system is constructed.

2.6 Road Base

2.6.1 Supplier

The Contractor shall provide the CQA Engineer with quality control test results and a written certification signed by a responsible party of the road base Supplier that the tests required by the General Specifications have been performed on material representative of that which is to be delivered to the site.

The CQA Engineer shall examine the tests results and report any deviations from the General Specifications to the Owner. If the road base Supplier cannot provide test results required by the General Specifications, then the CQA Engineer may perform or arrange to perform the tests.

2.6.2 Conformance Evaluation

The test methods and frequency for CQA testing of the road base is specified in Table 2-5.

If the gravel fails to meet the requirements of the General Specifications, the CQA Engineer shall perform sufficient sampling and testing to identify the extent of the nonconforming material with the cost of such tests borne by the Contractor. Nonconforming material shall be removed from the site.

TABLE 2-5. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF ROAD BASE

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 1000 cy placed (minimum 1 per source)	ASTM D 422
Modified Proctor	1 per 1000 cy placed (minimum 1 per source)	ASTM D 1557
IN PLACE		
In-Situ Moisture Content	1 per 300 cy	ASTM D 6938
In-Situ Dry Unit Weight	1 per 300 cy	ASTM D 6938

2.6.3 Placement

The CQA Engineer shall verify and document that the road base is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the road base, the CQA Engineer shall verify and document that:

- the underlying geotextile is free of holes, tears, excessive wrinkles, or foreign objects; and
- all work on underlying layers is complete and accepted by the Owner.

During placement of the road base, the CQA Engineer shall verify and document that:

- close observation of the placement of road base with earth moving equipment is performed;
- the road base is suitable and meets the requirements of the General Specifications as determined by the test methods and frequency prescribed within this CQA Plan; and
- the road base is placed in accordance with the General Specifications.

2.6.4 Construction Quality Assurance Evaluation

Nuclear density tests shall be used for testing the in-situ dry unit weight and moisture content of the road base. If the CQA Engineer suspects damage to underlying geosynthetics, the Contractor shall be required to expose the potentially damaged materials and repair any observed damage.

2.7 Cover Soil

2.7.1 Placement and Compaction

The CQA Engineer shall verify and document that the cover soil is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the cover soil, the CQA Engineer shall verify and document that:

- All, or an approved portion, of the waste filling plan is complete, and that a survey has been conducted to verify that the waste grades and elevations conform to the Construction Drawings; and
- the surface of the subgrade is free of debris, wet and soft areas, ponded water, vegetation, mud, ice or frozen material.

During placement and compaction of the cover soil, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of cover soil with earthmoving equipment is performed by the CQA Engineer;
- the cover soil meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-6;
- the cover soil is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-6; and
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the cover soil as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-6. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF SOIL COVER

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 3000 cy placed (minimum 1 per source)	ASTM D 422
Atterberg Limits	1 per 3000 cy placed (minimum 1 per source)	ASTM D 4318
IN PLACE		
In-Situ Moisture Content	1 per 300 ft2 per lift	ASTM D 6938
In-Situ Dry Unit Weight	1 per 300 ft2 per lift	ASTM D 6938

2.7.2 Construction Quality Assurance Evaluation

Nuclear density tests shall be used for testing the in-situ unit weight and moisture content of the cover soil.

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repaired.

2.7.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the cover soil to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.8 Vegetative Cover

2.8.1 Placement and Compaction

The CQA Engineer shall verify and document that the vegetative cover is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the vegetative cover, the CQA Engineer shall verify and document that:

- all work on underlying layers is complete and accepted by the Owner; and
- the underlying geocomposite is free of holes, team, excessive wrinkles, or foreign objects.

During placement and compaction of the vegetative cover, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of vegetative cover with earthmoving equipment is performed;
- the vegetative cover meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-7;
- the vegetative cover is placed in accordance with the conditions and minimum requirements of the General Specifications; and
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the vegetative cover as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-7. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF VEGETATIVE COVER

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 3000 cy placed (minimum 1 per source)	ASTM D 422
Atterberg Limits	1 per 3000 cy placed (minimum 1 per source)	ASTM D 4318

2.8.2 Construction Quality Assurance Evaluation

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repaired.

2.8.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the vegetative cover to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.9 Pipe Bedding Sand

2.9.1 Placement and Compaction

The CQA Engineer shall verify and document that the pipe bedding is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the pipe bedding sand, the CQA Engineer shall verify and document that:

- all work on underlying layers is complete and accepted by the Owner; and
- the underlying geotextile is free of holes, tears, excessive wrinkles, or foreign objects.

During placement and compaction of the pipe bedding sand, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of pipe bedding with earthmoving equipment is performed;
- the pipe bedding sand meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-8;
- the pipe bedding sand is placed in accordance with the conditions and minimum requirements of the General Specifications; and

- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the pipe bedding sand as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-8. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF PIPE BEDDING SAND

Test	Frequency	Standard Test Material
Material Properties		
Sieve Analysis	1 per 500 cy placed	ASTM D 422
Atterberg Limits	1 per 500 cy placed	ASTM D 4318

2.9.2 Construction Quality Assurance Evaluation

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repair.

2.9.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the pipe bedding sand to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.10 Select Subbase

2.10.1 Placement and Compaction

Prior to the placement of the select subbase, the CQA Engineer shall verify and document that:

- all work on underlying layers is complete and accepted by the Owner; and
- the underlying geocomposite is free of holes, tears, excessive wrinkles, or foreign objects.

During placement and compaction of the select subbase, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of select subbase with earthmoving equipment is performed by the CQA Engineer;
- the select subbase meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-9;
- the select subbase is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-9; and
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the select subbase as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-9. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF SELECT SUBBASE

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 1,000 cy placed (minimum 1 per source)	ASTM D 422
Modified Proctor	1 per 1,000 cy placed (minimum 1 per source)	ASTM D 1557
IN PLACE		
In-Situ Moisture Content	1 per 300 cy	ASTM D 6938
In-Situ Dry Unit Weight	1 per 300 cy	ASTM D 6938

2.10.2 Construction Quality Assurance Evaluation

Nuclear density tests shall be used for testing the in-situ unit weight and moisture content of the select subbase.

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repair.

2.10.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the select subbase to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.11 Subbase

2.11.1 Placement and Compaction

The CQA Engineer shall verify and document that the subbase is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of subbase, the CQA Engineer shall verify and document that:

- all work on underlying layers is complete and accepted by the Owner.

During placement and compaction of the subbase, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of subbase with earthmoving equipment is performed by the CQA Engineer;
- the subbase meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-10;
- the subbase is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-10; and

- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the subbase as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-10. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF SUBBASE

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 1,000 cy placed (minimum 1 per source)	ASTM D 422
Modified Proctor	1 per 1,000 cy placed (minimum 1 per source)	ASTM D 1557
IN PLACE		
In-Situ Moisture Content	1 per 300 cy	ASTM D 6938
In-Situ Dry Unit Weight	1 per 300 cy	ASTM D 6938

2.11.2 Construction Quality Assurance Evaluation

Nuclear density tests shall be used for testing the in-situ unit weight and moisture content of the subbase.

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shal be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repair.

2.11.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the subbase to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.12 Foundation Sand

2.12.1 Placement and Compaction

The CQA Engineer shall verify and document that the foundation sand is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the foundation sand, the CQA Engineer shall verify and document that:

- all work on underlying layers is complete and accepted by the Owner; and
- the underlying geomembrane is free of holes, tears, excessive wrinkles, or foreign objects.

During placement and compaction of the foundation sand, the CQA Engineer shall verify and document that:

- close observation of the placement and compaction of foundation sand with earthmoving equipment is performed;
- the foundation sand meets the requirements of the General Specifications as determined by the CQA testing methods and frequency in Table 2-11;
- the foundation sand is placed in accordance with the conditions and minimum requirements of the General Specifications;
- each lift is compacted to the required thickness and minimum dry unit weight within the range of moisture contents established by the General Specifications as determined by the CQA testing methods and frequency in Table 2-11; and
- the Contractor uses the compaction equipment and the number of passes specified in the General Specifications.

The CQA Engineer shall document the properties of the foundation sand as determined by the test methods and frequency prescribed by this CQA Plan and shall report any nonconformance with the General Specifications to the Owner.

TABLE 2-11. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF FOUNDATION SAND

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 1000 cy placed (minimum 1 per source)	ASTM D 422
Modified Proctor	1 per 1000 cy placed(minimum 1 per source)	ASTM D 1557
IN PLACE		
In-Situ Moisture Content	1 per 300 cy	ASTM D 6938
In-Situ Dry Unit Weight	1 per 300 cy	ASTM D 6938

2.12.2 Construction Quality Assurance Evaluation

Nuclear density tests shall be used for testing the in-situ unit weight and moisture content of the foundation sand.

The Contractor shall be required to use all means necessary to protect all prior work, as well as all material and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repair.

2.12.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA Surveyor shall independently survey the elevations and grades of the foundation sand to confirm that the lines and elevations in the field agree with those shown on the Construction Drawings. CQA surveys shall be conducted in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the survey results before the next phase of construction.

2.13 Protective Soil Layer

2.13.1 Placement and Compaction

The CQA Engineer shall verify and document that the protective soil layer is constructed to the elevations, grades, and thicknesses shown on the Construction Drawings, with material meeting the requirements of the General Specifications as determined by the test methods and frequencies specified within this CQA Plan.

Prior to the placement of the protective soil layer, the CQA Engineer shall verify and document that:

- the underlying geocomposite is free of holes, tears, excessive wrinkles, or foreign objects; and
- all work on underlying layers is complete and accepted by the Owner.

During placement of the protective soil layer, the CQA Engineer shall verify and document that:

- the soil is suitable and satisfies the requirements of the General Specifications as determined by the test methods and frequencies prescribed in Table 2-12;
- the protective soil is placed in accordance with the General Specifications;
- the lift thicknesses and total thickness of the protective soil layer agree with the requirements of the General Specifications;
- if excessive wrinkles begin to develop in the underlying geosynthetics during material placement or spreading, the wrinkles are worked out prior to continued placement operations;
- the protective soil layer is lightly compacted as described in the General Specifications;
- the protective soil is placed on the side slopes to the limits shown on the construction drawings; and
- no protective soil layer material is placed or compacted during periods of unfavorable weather conditions.

TABLE 2-12. MINIMUM FREQUENCY OF TESTING FOR CQA EVALUATION OF PROTECTIVE SOIL

Test	Frequency	Standard Test Method
Material Properties		
Sieve Analysis	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 422
Atterberg Limits	1 per 5,000 cy placed (minimum 1 per source)	ASTM D 4318

2.13.2 Conformance Evaluation

There are no CQA testing requirements for the protective soil layer, other than thickness requirements.

If damage to underlying geosynthetics is expected, the CQA Engineer shall require that the overlying protective soil layer material be removed to expose the geosynthetics.

The Contractor shall be required to use all means necessary to protect all prior work, as well as all materials and completed work of other Sections. In the event of damage, the Contractor shall be required to immediately make all repairs and replacements necessary. The CQA Engineer shall verify and document that all damages are repaired.

2.13.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall perform the CQA surveys. The CQA surveyor shall independently survey the elevations and grades of the top of the protective soil layer on the base and side-slopes of the landfill, and to confirm that the grades and elevations in the field agree with those shown on the Construction Drawings. The CQA surveys shall be performed in accordance with the State Plane Coordinate System (NMSA 47-1-49 to 56) (Repl. Pamp. 1993) and a Facility benchmark and the requirements described in Section 2.14.

The results of the survey conducted by the CQA Surveyor shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer, and shall be reviewed by the Owner.

2.14 Surveying

The Surveyor shall be required to survey each soil layer of the liner system and cover system (except the vegetative soil cover) for the landfill in accordance with the requirements of the General Specifications. If required by the Owner, a Record Drawing will be submitted by the

Surveyor before the placement of the next liner system layer. The surveys shall be conducted at a 100 foot grid for slopes greater than 25 percent and at 50 foot grid for slopes less than 25 percent. All pipes for leachate detection, collection and/or removal shall be surveyed at start and end points and at 50 foot intervals in between. The CQA survey shall include enough information to confirm that the following features of the landfill are constructed in accordance with the Construction Drawings:

- toe of slope;
- crest of slope;
- grade breaks;
- anchor trench;
- leachate collection sump;
- leak detection sump;
- permanent landfill sump; and
- perimeter drainage ditches.

The CQA results shall be submitted to the Owner for final approval to proceed on the liner system construction.

3 GEOSYNTHETIC CLAY LINER CONSTRUCTION QUALITY ASSURANCE

3.1 Geosynthetic Clay Liner Manufacture and Delivery

3.1.1 Manufacture and Quality Control

Prior to the installation of the Geosynthetic Clay Liner (GCL), the Contractor shall be required to provide the CQA Engineer with the following information from the GCL Manufacturer:

- the certification required by the General Specifications signed by a responsible party employed by the GCL Manufacturer based on sampling interval of 1 per 50,000 square feet; and
- the manufacturing quality control certificates for each shift's production of GCL, signed by a responsible party employed by the GCL Manufacturer (such as the production manager). The quality control certificates will include:
    - roll numbers and identification; and
    - sampling procedures and results of quality control tests specified by the General Specifications including descriptions of the test methods used for GCL rolls assigned to the Triassic Park project.

The CQA Engineer shall verify and document that:

- the property values certified by the GCL Manufacturer meet all of the specified values listed in the General Specifications;
- the measurements of properties by the GCL Manufacturer are properly documented and the test methods used are in accordance with the General Specifications; and
- the quality control certificates have been provided at the specified frequency for GCL rolls, and each certificate identifies the rolls or batch number related to that certificate.

The CQA Engineer shall report deviations from the above requirements to the Owner prior to installation of the GCL.

3.1.2 Labeling

The CQA Engineer shall verify and document that the GCL Manufacturer has labeled each roll of GCL as specified in the General Specifications.

The CQA Engineer shall examine GCL rolls upon delivery and deviation from the above requirements shall be reported to the Owner prior to installation of the GCL.

3.1.3 Transportation and Handling

The CQA engineer shall observe and document the type of GCL handling equipment used by the installer is consistent with handling equipment identified in the general specifications.

Upon delivery at the site, the CQA Engineer shall conduct a visual inspection of all rolls for defects and for damage. This examination shall be conducted without unrolling rolls unless visible defects or damages are found. The CQA Engineer shall indicate to the Owner:

- any rolls that should be unrolled to allow for their inspection;
- any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- any rolls which include minor repairable flaws.

3.1.4 Storage

The CQA Engineer shall verify and document that storage of the GCL is in accordance with the General Specifications.

3.1.5 Quality Assurance Conformance Testing

Either at the Manufacture's plant or upon delivery of the rolls of GCL, the CQA Engineer shall ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the General Specifications.

Unless otherwise specified, samples shall be collected at a rate of one per lot or one per 100,000 square feet, whichever is more frequent. These samples shall be tested for:

- Bentonite Moisture Content ASTM D 4643;
- GCL Grab Strength, Elongation, Per Strength ASTM D 4632;
- GCL Permeability ASTM D 5084; and
- GCL Interface Shear Strength ASTM D 5321.

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

The CQA Engineer shall examine all results from laboratory conformance testing and shall compare the results to the specifications presented in Table 02780-1 of the Specifications. In addition, the CQA Engineer shall report any nonconformance to the Owner as soon as practical after the test results become available.

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

- the Contractor shall be required to replace the roll (or rolls) of GCL that is not in conformance with the specifications with a roll that meets the requirements of the General Specifications; and
- the CQA Engineer shall ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fails to meet the requirements, two samples per roll shall be collected from the five numerically closest untested rolls on both sides of the failed samples and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fails, a sample from every roll of GCL on site and a sample from every roll that is subsequently delivered from the same Manufacturer must be conformance tested by the Geosynthetics CQA Laboratory.

The CQA Engineer shall document actions taken in conjunction with conformance test failures and report all actions to the Owner.

3.2 Geosynthetic Clay Liner Installation

3.2.1 Earthworks

3.2.1.a Surface Preparation

The Contractor or subcontractor responsible for GCL installation shall be required to certify in writing that the surface on which the GCL will be installed is acceptable. The certificate of acceptance will be required to be given by the Contractor to the CQA Engineer, who shall then verify to the Owner that the subgrade and/or clay liner installation is accepted immediately prior to commencement of GCL installation in the area under consideration.

After the surface on which the GCL is to be installed has been accepted by the Contractor responsible for GCL installation, it will be the CQA Engineer's responsibility to indicate to the Owner any change in the underlying layer that may, in accordance with the General Specifications, require repair work. If the Owner requires repair work, then it shall be the responsibility of the Contractor to repair the underlying layer.

3.2.1.b Anchor Trenches

The CQA Engineer shall verify and document that the anchor trench backfill meets the requirements of the General Specifications and that the backfill is placed in accordance with the General Specifications.

3.2.2 Geosynthetic Clay Liner Deployment

3.2.2.a Field Panel Identification

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

The CQA Engineer shall verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the Owner, and the Contractor. This field panel identification code should be as simple and logical as possible (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the Contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The CQA Engineer shall establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code shall be used for all CQA records.

3.2.2.b Field Panel Placement

3.2.2.b.1 Installation Schedule

The CQA Engineer shall evaluate significant changes in the schedule proposed by the Contractor and advise the Owner on the acceptability of that change. The CQA Engineer shall verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer shall be repaired by the Contractor in accordance with the General Specifications.

The CQA Engineer shall record the identification code, location, and date of installation of each field panel.

3.2.2.b.2 Weather Conditions

The CQA Engineer shall verify and document that GCL is not placed during inclement weather conditions as specified within the General Specifications.

Additionally, the CQA Engineer shall verify and document that the underlying layer has not been damaged by weather conditions.

3.2.2.b.3 Damage

The CQA Engineer shall visually observe each panel, after placement, for damage. The CQA Engineer shall advise the Owner which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected by the Owner shall be marked, and their removal from the work area shall be documented by the CQA Engineer.

3.2.2.b.4 Seam Overlap and Bentonite Seal

The CQA engineer shall observe and document that the seam overlaps and bentonite material placed between panels along the seams meet specification guidelines. The CQA engineer shall verify overlap width and will observe bentonite seal placement.

3.2.3 Defects and Repairs

3.2.3.a Identification

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

3.2.3.b Repair Procedures

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

3.2.3.b.1 Rip and Tear Repair (Flat Surfaces)

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

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

3.2.3.b.2 Rip and Tear Repair (Slopes)

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

3.2.3.b.3 Displaced Panels

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

3.2.3.b.4 Premature Hydration

If the GCL is subjected to premature hydration, the GCL installer shall notify the CQA Engineer and Design Engineer for a site specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design dependent upon the degree of damage.

4 GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

4.1 Geomembrane Manufacture and Delivery

4.1.1 Resin

Prior to the installation of the HDPE geomembrane material, the Contractor shall be required to provide the CQA Engineer with the following information from the geomembrane manufacturer:

- a copy of the quality control certificates issued by the resin Supplier that includes the origin (resin Supplier's name and resin production plant), identification (brand name, number) the production date of the resin used in the manufacture of the geomembrane shipped to the site, and the results of tests conducted to verify that the quality of the resin

used to manufacture the geomembrane rolls assigned to the project meets the General Specifications; and

- certification from the geomembrane manufacturer that no reclaimed polymer is added to the resin during the manufacture of the geomembrane to be used in this project; the use of polymer recycled during the manufacturing process is permitted if the recycled polymer does not exceed 2 percent by weight of the total polymer weight.

The CQA Engineer shall review these documents and report any discrepancies with the above requirements to the Owner.

4.1.2 Geomembrane Manufacturing Quality Control

Prior to the installation of the HDPE geomembrane, the Contractor shall be required to provide the CQA Engineer with the following information from the geomembrane manufacturer:

- the certification required by the General Specifications signed by a responsible party employed by the geomembrane Manufacturer based on sampling interval of 1 per 50,000 square feet; and
- the manufacturing quality control certificates for each shift's production of geomembrane, signed by a responsible party employed by the geomembrane manufacturer (such as the production manager). The quality control certificates shall include:
    - roll numbers and identification; and
    - sampling procedures and results of quality control tests specified by the General Specifications including descriptions of the test methods used for geomembrane rolls assigned to the Triassic Park project.

The CQA Engineer shall verify and document that:

- the property values certified by the geomembrane manufacturer meet all of the specified values listed in the General Specifications;
- the measurements of properties by the geomembrane manufacturer are properly documented and the test methods used are in accordance with the General Specifications; and
- the quality control certificates have been provided at the specified frequency for geomembrane rolls, and each certificate identifies the rolls or batch number related to that certificate.

The CQA Engineer shall report deviations from the above requirements to the Owner prior to installation of the geomembrane.

4.1.3 Labeling

The CQA Engineer shall verify and document that the geomembrane manufacturer has labeled each roll of geomembrane as specified in the General Specifications.

The CQA Engineer shall examine geomembrane rolls upon delivery and deviation from the above requirements shall be reported to the Owner prior to installation of the geomembrane.

4.1.4 Transportation and Handling

Upon delivery at the site, the CQA Engineer shall conduct a visual inspection of all rolls for defects and damage. This examination will be conducted without unrolling rolls unless visible defects or damages are found. The CQA Engineer shall indicate to the Owner:

- any rolls that should be unrolled to allow for their inspection;
- any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws; and
- any rolls which include minor repairable flaws.

4.1.5 Storage

The CQA Engineer shall verify and document that storage of the geomembrane is in accordance with the General Specifications.

4.1.6 Quality Assurance Conformance Testing

Either at the manufacture's plant or upon delivery of the rolls of geomembrane, the CQA Engineer shall ensure that samples are removed at the specified frequency and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the General Specifications.

Conformance samples shall be collected by the CQA Engineer across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 1.5 feet (minimum) long by the roll width. The CQA Engineer shall mark the direction of the machine used to cut the samples with an arrow.

Unless otherwise specified, samples shall be collected at a rate of one per lot or one per 100,000 square feet, whichever is more frequent. These samples shall be tested for:

- specific gravity;
- thickness;
- yield strength and yield elongation;
- tensile strength and tensile elongation at break;
- carbon black content;

- carbon black dispersion; and
- puncture Resistance.

Test shall be conducted in accordance with the test procedure presented in the specification.

The CQA Engineer shall examine all results from laboratory conformance testing and shall report any nonconformance to the Owner as soon practical after the test results become available.

The following procedure shall apply whenever a sample fails a conformance test that is conducted by the CQA Engineer:

- the Contractor shall be required to replace the roll (or rolls) of geomembrane that is in nonconformance with the General Specifications with a roll that meets the General Specifications; and
- the CQA Engineer shall ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples will be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geomembrane on site and every roll subsequently delivered from the same Manufacturer must be conformance tested by the Geosynthetics CQA Laboratory; the cost of all such additional tests are to be borne by the Contractor.

The CQA Engineer shall document actions taken in conjunction with conformance test failures and report all actions to the Owner.

4.2 Geomembrane Installation

4.2.1 Earthwork

4.2.1.a Surface Preparation

The Contractor or subcontractor responsible for geomembrane installation shall be required to certify in writing that the surface on which the geomembrane will be installed is acceptable.

The certificate of acceptance shall be required to be given by the Contractor to the CQA Engineer, who shall then verify to the Owner that the subgrade is accepted immediately prior to commencement of geomembrane installation in the area under consideration.

After the surface on which the geomembrane is to be installed has been accepted by the Contractor responsible for geomembrane installation, it shall be the CQA Engineer's responsibility to indicate to the Owner any change in the underlying layer that may, in accordance with the General Specifications, require repair work. If the Owner requires repair work, then it will be the responsibility of the Contractor to repair the underlying layer.

4.2.1.b Anchor Trenches

The CQA Engineer shall verify and document that the anchor trench backfill meets the requirements of the General Specifications and that the backfill is placed in accordance with the General Specifications.

4.2.2 Geomembrane Deployment

4.2.2.a Layout Drawing

The Contractor is required to produce layout drawings which show the geomembrane panel configuration, dimensions, details, seam locations, etc. The layout drawings must be approved by the Owner prior to the installation of the geomembrane. The layout drawings, as modified and/or approved by the Owner shall be part of the specifications, and a copy shall be furnished to the CQA Engineer. The CQA Engineer shall become familiar with the layout drawings.

4.2.2.b Field Panel Identification

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

The CQA Engineer shall verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Owner, and the Contractor. This field panel identification code should be as simple and logical as possible (Note: manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the Contractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number shall be marked in the center of the panel in a color to allow for easy inspection.

The CQA Engineer shall establish a table or chart showing correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code shall be used for all CQA records.

4.2.2.c Field Panel Placement

4.2.2.c.1 Location

The CQA Engineer shall verify and document that field panels are installed at the locations and positions indicated in the Contractor's layout plan, as approved or modified by the Owner.

4.2.2.c.2 Installation Schedule

The CQA Engineer shall evaluate significant changes in the schedule proposed by the Contractor and advise the Owner on the acceptability of that change. The CQA Engineer shall verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer shall be repaired by the Contractor in accordance with the General Specifications.

The CQA Engineer shall record the identification code, location, and date of installation of each field panel.

4.2.2.c.3 Weather Conditions

The CQA Engineer shall verify and document that geomembrane is not placed during inclement weather conditions as specified within the General Specifications.

Additionally, the CQA Engineer shall verify and document that the underlying layer has not been damaged by weather conditions.

4.2.2.c.4 Damage

The CQA Engineer shall visually observe each panel, after placement and prior to seaming, for damage (e.g., holes, blisters, creases). The CQA Engineer shall advise the Owner which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected by the Owner shall be marked, and their removal from the work area shall be documented by the CQA Engineer.

4.2.3 Field Seaming

4.2.3.a Seam Layout

The CQA Engineer shall verify and document that the seam layout shown on the Panel Layout Drawing (Part 2.2.1) is consistent with the General Specifications. No panels may be seamed in the field without the Owner's approval. In addition, seams not specifically shown on the seam layout drawing may not be made without the Owner's prior approval.

A seam numbering system compatible with the panel numbering system shall be agreed upon by the Contractor, the Owner, and CQA Engineer.

4.2.3.b Seaming Equipment and Products

Processes approved by the General Specifications for field seaming are: (i) extrusion seaming; and (ii) fusion seaming. Proposed alternate processes shall be required to be documented and submitted to the Owner for approval. Only seaming apparatus which the Owner has specifically approved by make and model will be used. The Contractor shall be required to use a pyrometer to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

The extrusion seaming apparatus shall be equipped with gauges indicating the temperatures of the extrudate and nozzle. The Contractor shall be required to provide to the CQA Engineer the Manufacturer's certification that the extrudate is compatible with the General Specifications and is comprised of the same resin as the geomembrane.

The CQA Engineer shall log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion seaming apparatus speeds. Ambient temperatures shall be measured as specified in the General Specifications.

4.2.3.c Seam Preparation

The CQA Engineer shall verify and document that:

- prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material; and
- preparation of seams is in accordance with the General Specifications.

4.2.3.d Weather Conditions for Seaming

The CQA Engineer shall verify and document that weather conditions for seaming are within the limits specified in the General Conditions.

4.2.3.e Trial Seams

The Contractor will be required to make trial seams on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. The Contractor shall be required to make and test trial seams at the frequency and in accordance with the methods specified in the General Specifications.

The CQA Engineer shall observe all trial seam procedures. The successful trial seam sample will be assigned a number and marked accordingly by the CQA Engineer, who will log the date, hour, ambient temperature, number of seaming unit, name of seamer, and pass or fail description. The sample itself will be retained only until the construction of the liner is complete and the liner has been accepted by the Owner.

4.2.3.f Nondestructive Seam Continuity Testing

4.2.3.f.1 Introduction

Except as otherwise noted in the General Specifications, the Contractor shall nondestructively test all field seams over their full length in accordance with the General Specifications. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing shall not be permitted before sunrise or after sunset unless the Contractor demonstrates to the Owner that the Contractor has the capabilities to perform continuity testing under reduced light conditions.

The CQA Engineer shall:

- observe the continuity testing;
- record location, date, test unit number, name of tester, and outcome of all testing; and
- document and inform the Contractor of any required repairs.

The Contractor shall be required to complete any required repairs in accordance with the General Specifications.

The CQA Engineer shall:

- observe the repair and re-testing of the repair;
- mark on the geomembrane that the repair has been made; and
- document the results.

The CQA Engineer shall verify and document the procedures specified in the General Specifications where seams cannot be nondestructively tested.

The location, date of visual observation, name of tester, and outcome of the test or observation shall be recorded by the CQA Engineer and reported to the Owner.

4.2.3.g Destructive Seam Testing

4.2.3.g.1 Concept

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

4.2.3.g.2 Location and Frequency

The CQA Engineer shall select locations where seam samples will be cut out for laboratory testing. The test frequency and locations shall be established as follows:

- samples shall be collected at a minimum frequency of one test location per 500 feet of seam length (this minimum frequency is to be determined as an average taken throughout the entire landfill project); and
- test locations shall be determined during seaming at the CQA Engineer's discretion; selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any other potential cause of imperfect seaming.

The Contractor shall not be informed in advance of the locations where the seam samples will be collected.

4.2.3.g.3 Sampling Procedure

The Contractor shall be required to cut samples as directed by the CQA Engineer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The CQA Engineer shall:

- observe sample cutting;
- assign a number to each sample and mark it accordingly;
- record the sample number and location on the panel layout drawing; and
- record the reason for taking the sample at this location (e.g., routine testing, suspicious feature of the geomembrane, etc.).

All holes in the geomembrane resulting from destructive seam sampling shall be covered by the Contractor immediately after sampling and repaired in accordance with the repair procedures described in the General Specifications. The continuity of the new seams in the repaired area shall be nondestructively tested according to the General Specifications.

4.2.3.g.4 Sample Size

At a given sampling location, two types of samples shall be required to be collected by the Contractor.

First, two samples for field testing shall be collected. Each sample shall be 1 inch wide by 6 to 12 inches long, with the seam centered parallel to the width. The distance between these two samples shall be approximately 42 inches. If both samples pass the field test described in the General Specifications, a sample for laboratory testing shall be collected.

The sample for laboratory testing shall be required to be collected between the two samples for field testing. The destructive sample shall be 12 inches wide by 42 inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:

- one portion to the Contractor, 12 inches long;
- one portion to the CQA Engineer for archive storage, 12 inches long; and
- one portion to the CQA Engineer for CQA Laboratory testing, 18 inches long.

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

4.2.3.g.5 Field Testing

The two 1-inch wide samples specified above shall be required to be tested in the field, by the Contractor, by tensiometer for peel and should not fail in the seam. If any field test sample fails to pass, then the procedures outlined in the General Specifications shall be required to be followed.

The CQA Engineer shall observe field tests and mark all samples and portions with their number, date, and time.

4.2.3.g.6 Geosynthetic Construction Quality Assurance Laboratory Testing

Laboratory destructive test samples shall be packaged and shipped to the CQA Laboratory by the CQA Engineer in a manner which will not damage the test sample. The CQA Engineer shall store the archive samples until the completion of the project. Laboratory destructive test samples shall be tested by the Geosynthetics CQA Laboratory.

Testing shall include "Shear Strength", and "Peel Strength", (ASTM D 443) with 1-inch-wide strip, tested at 2 inches per minute). The minimum acceptable values to be obtained in these tests are those indicated in Table 02775-2 of Section 02775 of the General Specifications. At least five samples shall be tested for each test method. Samples shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear). At least 4 out of 5 of the samples must pass.

The Geosynthetics CQA Laboratory shall provide test results verbally to the CQA Engineer in a timely manner after they receive the samples. The CQA Engineer shall review laboratory test results as soon as they become available, and inform the Owner of the test results.

4.2.3.g.7 Procedures for Destructive Test Failure

The procedures specified within the General Specifications shall be required whenever a sample fails a destructive test, whether that test is conducted by the Geosynthetics CQA Laboratory, the Contractor's laboratory (if required), or by field tensiometer. The CQA Engineer shall verify and document that one of the options specified within the General Specifications is followed.

The CQA Engineer shall document all actions taken in conjunction with destructive test failures.

4.2.4 Defects and Repairs

4.2.4.a Identification

All seams and non-seam areas of the geomembrane shall be inspected by the CQA Engineer for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be required to be clean at the time of examination. The geomembrane surface shall be broomed or washed by the Contractor if the amount of dust or mud inhibits examination.

4.2.4.b Evaluation

Each suspect location both in seam and non-seam areas shall either be non-destructively tested using the methods described in the General Specifications, or repaired as appropriate as determined by the CQA Engineer. Each location which fails the non-destructive testing shall be marked by the CQA Engineer and shall be required to be repaired by the Contractor. Materials should not be placed over geomembrane locations that have been repaired until the CQA Engineer has approved the repair.

4.2.4.c Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and prior to placing overlying materials, the CQA Engineer shall visually inspect the geomembrane for wrinkles. The CQA Engineer shall indicate to the Contractor which wrinkles, if any, should be cut and reseamed. The seam thus produced shall be tested like any other seam.

4.2.4.d Repair Procedures

Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test shall be repaired by the Contractor in accordance with the applicable method specified within the General Specifications.

4.2.4.e Testing of Repairs

Each repair shall be located and logged by the CQA Engineer. Each repair shall be non-destructively tested using the methods described in the General Specifications as appropriate. Repairs which pass the non-destructive test will be considered as an adequate repair. Large caps may be of sufficient extent to require destructive testing, at the discretion of the CQA Engineer. Failed tests shall require the repair to be redone and retested until passing test results are obtained. The CQA Engineer shall observe the non-destructive testing of repairs and shall document the date of the repair and test outcome.

4.2.5 Appurtenances

The CQA Engineer shall verify and document that:

- installation of the geomembrane around, and connection of geomembrane to appurtenances have been made according to the General Specifications;
- extreme care is taken while seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas; and
- the geomembrane has not been visibly damaged while being connected to appurtenances.

The CQA Engineer shall inform the Owner if the above conditions are not fulfilled.

4.3 Surveying

The CQA Engineer, in conjunction with the Surveyor, shall be required to prepare an "as-built" Record Drawing for geomembrane installations. It shall include the surveyed location of field panels, seams (factory and field), repairs, and test locations.

The CQA results (Record Drawing and certification of Contractor's work) shall be submitted to the Owner for final review and approval prior to proceeding with construction of any subsequent liner system components.

5 FILTER OR CUSHION GEOTEXTILE CONSTRUCTION QUALITY ASSURANCE

5.1 Geotextiles

5.1.1 Manufacturing

The Geosynthetics Contractor shall be required to provide the CQA Engineer with the following information from the geotextile Manufacturer:

- certification required by the General Specifications signed by a responsible party employed by the geotextile Manufacturer; and
- the manufacturing quality control certificates for each shift's production of geotextile rolls, which include geotextile roll numbers and identification, sampling procedures, and descriptions and results of the quality control tests specified in the General Specifications signed by a responsible party employed by the geotextile Manufacturer.

The CQA Engineer shall examine all geotextile Manufacturer's certifications to verify and document that the property values listed on the certifications meet or exceed those specified within the General Specifications and that proper and complete documentation has been provided by the geotextile Manufacturer for all geotextile used at the site. The CQA Engineer shall report any deviations from the above requirements to the Owner prior to installation of the geotextile.

5.1.2 Labeling

The CQA Engineer shall verify and document that the geotextile Manufacturer has labeled all rolls of geotextile with the information specified in the General Specifications.

The CQA Engineer shall examine rolls upon delivery and any deviation from the above requirements shall be reported to the Owner prior to installation of the geotextile.

5.1.3 Shipment and Storage

The CQA Engineer shall observe rolls of geotextile upon delivery at the site and any deviation from the requirements specified within the General Specifications shall be reported to the Owner. Any damaged rolls shall be rejected by the CQA Engineer and required to be repaired or replaced by the Contractor.

5.1.4 Conformance Testing

Either at the Manufacturer's factory or upon delivery of the geotextile rolls, the CQA Engineer shall ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the General Specifications.

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

Samples shall be collected at a rate of one per lot or one per 100,000 square feet, whichever is more frequent. These samples will be tested for:

- mass per unit area;
- grab strength;
- tear strength;
- puncture strength; and
- permittivity;

(Note: All tests must be conducted in accordance with the test methods listed in the specification)

If the geotextile is being used as a filter, cushion or separator, the samples shall also be tested for apparent opening size.

The CQA Engineer shall examine all results of laboratory conformance testing and report any nonconformance to the Owner as soon as results become available.

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

- the Contractor shall be required to replace the roll (or rolls) of geotextile that is not in conformance with the specifications with a roll that meets the requirements of the General Specifications; and
- the CQA Engineer shall ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the roll from which the failing sample was obtained. These two samples must pass the above conformance tests. If either of these samples fails to meet the requirements, samples shall be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geotextile on site and a sample from every roll that is subsequently delivered from the same Manufacturer must be conformance tested by the Geosynthetics CQA Laboratory.

The CQA Engineer shall document actions taken in conjunction with conformance test failures and report all actions taken to the Owner.

5.1.5 Handling and Placement

The Geosynthetics Contractor shall be required to handle all geotextiles in such a manner as to ensure the geotextile is not damaged in any way. The CQA Engineer shall verify and document compliance with the following:

- just prior to geotextile placement, the layer that underlies the geotextile, if it is a geosynthetic, is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the liner system;
- in the presence of excessive wind, the geotextile is weighted with sandbags (or equivalent weight approved by the CQA Engineer);
- geotextile is kept under tension to minimize the presence of wrinkles in the geotextile. If necessary, the geotextile is positioned by hand after being unrolled to minimize wrinkles;
- geotextiles are cut using a geotextile cutter approved by the geotextile Manufacturer and the CQA Engineer. If in place, special care is taken to protect other materials (such as underlying geosynthetics) from damage which could be caused by the cutting of the geotextiles;
- the Contractor takes any necessary precautions to prevent damage to the underlying layers during placement of the geotextile;
- during placement of geotextiles, care is taken not to entrap stones, excessive dust, or moisture in the geotextile that could damage the underlying layers, generate clogging of drains or filters, or hamper subsequent seaming; and
- geotextile is not left exposed for a period in excess of 30 days after placement unless a longer exposure period is approved by the CQA Engineer and Owner.

The CQA Engineer shall document any noncompliance with the above requirements and report them to the Owner.

5.1.6 Seams and Overlaps

The CQA Engineer shall verify and document that all geotextile seams are oriented, overlapped and seamed or sewn in accordance with the General Specifications.

The Contractor shall be required to pay close attention at seams to ensure that no protective soil layer material could be inadvertently placed beneath the geotextile.

Sewing shall be required to be performed as required in the General Specifications.

5.1.7 Repair

The CQA Engineer shall verify and document that any holes or tears in the geotextile are repaired in accordance with the requirements of the General Specifications.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

6 GEOCOMPOSITE CONSTRUCTION QUALITY ASSURANCE

6.1 Geocomposites

6.1.1 Manufacturing

The Geosynthetics Contractor shall be required to provide the CQA Engineer with the following information from the geocomposite Manufacturer:

- certification required by the General Specifications signed by a responsible party employed by the geocomposite Manufacturer;
- the certification from the geocomposite Manufacturer that no reclaimed polymer was added to the resin during the manufacture of the geonet component of the geocomposite rolls assigned this project; and
- the manufacturing quality control certificates for each shift's production of geocomposite rolls which include geocomposite roll numbers and identification, sampling procedures, and descriptions and results of quality control tests for the geonet specified in the General Specifications signed by a responsible party employed by the geocomposite Manufacturer.

The CQA Engineer shall examine all of the geocomposite Manufacturer certifications to verify and document that the property values listed on the certifications meet or exceed those specified within the General Specifications and that proper and complete documentation has been provided by the geocomposite Manufacturer for all geocomposite used at the site. The CQA Engineer shall report any deviations from the above requirements to the Owner prior to installation of the geocomposite.

6.1.2 Labeling

The CQA Engineer shall verify and document that the geocomposite Manufacturer has labeled all rolls of geocomposite as specified within the General Specifications.

The CQA Engineer shall examine the rolls upon delivery and any deviation from the above requirements will be reported to the Owner prior to installation of the geocomposite.

6.1.3 Shipment and Storage

The CQA Engineer shall observe rolls of geocomposite upon delivery at the site and any deviation from the requirements of the General Specifications shall be reported to the Owner. Any damaged rolls shall be rejected by the CQA Engineer and required to be repaired or replaced by the Contractor.

6.1.4 Conformance Testing

Either at the Manufacturer's plant or upon delivery of the geocomposite rolls, the CQA Engineer shall ensure that samples are removed and forwarded to the Geosynthetics CQA Laboratory for testing to verify and document conformance with the requirements of the General Specifications.

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

Samples shall be collected at a rate of one per lot or one per 100,000 square feet, whichever is more frequent. These samples shall be tested for: peel strength (ASTM F 904); and hydraulic transmissivity, in accordance with the text methods presented in the specification.

The CQA Engineer shall examine all results from laboratory conformance testing and shall report any nonconformance to the Owner as soon as the results are become available.

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

- the Contractor shall be required to replace the roll (or rolls) of geocomposite that is not in conformance with the specifications with a roll that meets the requirements of the General Specifications; and
- the CQA Engineer shall ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples will be collected from the 5 numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geocomposite on site and a sample from every roll that is subsequently delivered from the same Manufacturer must be conformance tested by the Geosynthetics CQA Laboratory.

The CQA Engineer shall document actions taken in conjunction with conformance test failures and report all actions to the Owner.

6.1.5 Handling and Placement

The Contractor shall be required to handle all geocomposite in such a manner as to ensure it is not damaged. The CQA Engineer shall verify and document compliance with the following:

- just prior to geocomposite placement, the layer that will underlie the geocomposite is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the underlying layers or clog the drainage system;
- in the presence of excessive wind, the geocomposite is weighted with sandbags (or equivalent weight approved by the CQA Engineer);
- geocomposite is kept under tension to minimize the presence of wrinkles in the geocomposite. If necessary, the geocomposite is positioned by hand after being unrolled to minimize wrinkles;
- geocomposites are cut using a geocomposite cutter approved by the geocomposite Manufacturer and the CQA Engineer. If in place, special care is taken to protect other materials from damage which could be caused by cutting of the geocomposites;
- the Geosynthetics Contractor takes all necessary precautions to prevent damage to the underlying layers during placement of the geocomposite.;
- geocomposite is not welded to geomembranes;
- during placement of clean geocomposite, care is taken not to entrap stones, excessive dust, or moisture that could damage the underlying geomembrane, generate clogging of drains or filters, or hamper subsequent seaming;
- a visual examination of the geocomposite is carried out over the entire surface, after installation, to ensure that no potentially harmful foreign objects, such as needles, are present; and
- geocomposite is not left exposed for a period in excess of 30 days after placement unless a longer exposure period is approved by the CQA Engineer and the Owner.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

6.1.6 Seams and Overlaps

The components of the geocomposite (e.g., geotextile-geonet-geotextile) are not bonded together at the ends and edges of the rolls. The CQA Engineer shall document that the geocomposite is overlapped and secured or seamed in accordance with the General Specifications.

6.1.7 Repair

The CQA Engineer shall verify that any holes or tears in the geocomposite are repaired in accordance with the General Specifications.

The CQA Engineer shall observe any repair, document any noncompliance with the above requirements, and report the noncompliance to the Owner.

7 GEONET CONSTRUCTION QUALITY ASSURANCE

7.1 Geonet

7.1.1 Manufacturing

The Geosynthetics Contractor shall be required to provide the CQA Engineer with the following information from the geonet Manufacturer:

- certifications required by the General Specifications signed by a responsible party employed by the geonet Manufacturer;
- the certification from the geonet Manufacturer that no reclaimed polymer was added to the resin during the manufacture of the geonet rolls assigned to this project; and
- the manufacturing quality control certificates for each shift's production of geonet rolls, which include geonet roll numbers and identification, sampling procedures, and descriptions and results of quality control tests for polymer specified in the General Specifications signed by a responsible party employed by the geonet Manufacturer.

The CQA Engineer shall examine all geonet Manufacturer's certifications to verify and document that the property values listed on the certifications meet or exceed those specified within the General Specifications and that proper and complete documentation has been provided by the geonet Manufacturer for all geonet used at the site. The CQA Engineer shall report any deviations from the above requirements to the Owner.

7.1.2 Labeling

The CQA Engineer shall verify and document that the geonet Manufacturer has labeled all rolls of geonet as specified within the General Specifications.

The CQA Engineer shall examine the rolls upon delivery and any deviation from the above requirements will be reported to the Owner prior to installation of the geonet.

7.1.3 Shipment and Storage

The CQA Engineer shall observe the rolls of geonet upon delivery at the site and any deviations from the requirements specified within the General Specifications shall be reported to the Owner. Any damaged rolls shall be rejected by the CQA Engineer and shall be required to be repaired or replaced by the Contractor.

7.1.4 Conformance Testing

Either at the Manufacturer's plant or upon delivery of the geonet rolls, the CQA Engineer shall ensure that samples are removed and forwarded to the Geosynthetic CQA Laboratory for testing, to verify and document conformance with the requirements of the General Specifications.

Conformance samples shall be collected across the entire width of the roll and shall not include the first 3 feet. Unless otherwise specified, samples shall be 1.5 feet long (minimum) by the roll width. The CQA Engineer shall mark the machine direction on the samples with an arrow.

Samples shall be collected at a rate of one per lot or one per 100,000 square feet, whichever is more frequent. These samples shall be tested for:

- polymer specific gravity;
- carbon black;
- thickness;
- transmissivity; and
- polymer melt index.

Tests shall be conducted in accordance with the method indicated in the specification.

The CQA Engineer shall examine all results from laboratory conformance testing and shall report any nonconformance to the Owner as soon as the results become available.

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

- the Contractor shall be required to replace the roll (or rolls) of geonet that is not in conformance with the specifications with a roll that meets the requirements of the General Specifications; and
- the CQA Engineer shall ensure that conformance samples are removed for testing by the Geosynthetics CQA Laboratory from the closest numerical roll on both sides of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples shall be collected from the five numerically closest untested rolls on both sides of the failed sample and tested by the Geosynthetics CQA Laboratory. These ten samples must pass the above conformance tests. If any of these samples fail, a sample from every roll of geonet on site and a sample from every roll that is subsequently delivered from the same Manufacturer must be conformance tested by the Geosynthetics CQA Laboratory. The cost of such tests is to be borne by the Contractor.

The CQA Engineer shall document actions taken in conjunction with conformance test failures and report all actions taken to the Owner.

7.1.5 Handling and Placement

The Contractor shall handle all geonet in such a manner as to ensure the geonet is not damaged. The CQA Engineer shall verify and document compliance with the following:

- the geonet is free of dirt or excessive dust just before installation;
- just prior to geonet placement, the geomembrane liner that will underlie the geonet is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the geomembrane or clog the drainage system;
- on side slopes, the geonet is secured at the top of the slope then rolled down the slope in such a manner as to keep the geonet sheet in tension. If necessary, the geonet is positioned by hand after being unrolled to minimize wrinkles. Geonet can be place in the horizontal direction (i.e., across the slope) in some special locations (e.g., at the toe of a slope). If an extra layer of geonet is required, this extra layer of geonet can be placed in the horizontal direction. Such locations will be identified on the Construction Drawings;
- in the presence of excessive wind, the geonet is weighted with sandbags or the equivalent;
- unless otherwise specified, geonet is not welded to geomembrane;
- geonet shall only be cut using a cutter approved by the geonet Manufacturer and the CQA Engineer. If in place, special care is taken to protect underlying geosynthetics from damage that could be caused by cutting of the geonet;
- the geosynthetics Contractor takes any necessary precautions to prevent damage to underlying layers during placement of the geonet.
- during placement of geonets, care is taken not to entrap dirt or excessive dust in the geonet that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geonet, it is hosed clean prior to placement of the next material on top of it. In this regard, care should be taken with the handling or sandbags, to prevent rupture or damage of the sandbag; and
- geonet is not placed in direct contact with textured geomembrane liner unless specifically called for in the Construction Drawings.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

7.1.6 Stacking and Joining

Geonet shall be stacked and joined in accordance with the Construction Drawings and the General Specifications. As a minimum, the CQA Engineer shall verify and document that staking, joining and overlapping is in accordance with the General Specifications.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

7.1.7 Repair

The CQA Engineer shall verify and document that any holes or tears in the geonet are repaired in accordance with the General Specifications.

The CQA Engineer shall observe any repair, note any noncompliance with the above requirements and report them to the Owner.

8 POLYETHYLENE PIPE AND FITTINGS CONSTRUCTION QUALITY ASSURANCE

8.1 Polyethylene Pipe Manufacture and Delivery

8.1.1 Manufacturing

Prior to incorporating the polyethylene pipe and fittings into the work, the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the pipe Manufacturer.

The CQA Engineer shall verify and document that the property values certified by the pipe Manufacturer meet the requirements of the General Specifications based on a sampling interval of one sample per lot. The CQA Engineer shall report any deviations from the above requirements to the Owner.

8.1.2 Labeling

The CQA Engineer shall verify that the pipe is labeled with the information specified in the General Specification. Any deviations from the labeling requirements shall be reported to the Owner prior to pipe installation.

8.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the pipe and fittings are stored in accordance with the General Specifications.

The CQA Engineer shall visually inspect the pipe upon delivery at the site and any deviations from the requirements of the General Specifications shall be reported to the Owner.

8.1.4 Conformance Testing

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

8.2 Pipe Installation

8.2.1 Handling and Laying

The CQA Engineer shall verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the General Specifications, and in a manner intended to prevent damage to the pipe.

The pipe and fittings will be carefully examined before installation by the CQA Engineer. The CQA Engineer shall verify and document that cracks, damage or defects are not present in the pipe and fittings in excess of that allowed by the General Specifications.

The CQA Engineer shall also note the condition of the interior of pipes and fittings. Foreign material shall be removed from the pipe interior before it is moved into final position. No pipe shall be permitted to be placed until the CQA Engineer has observed the condition of the pipe. The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

8.2.2 Joints and Connections

Lengths of pipe will be required to be assembled into suitable installation lengths by the butt fusion process. Butt fusion refers to the butt joining of the pipe by softening the aligned faces of the pipe ends in a suitable apparatus and pressing them together under controlled pressure.

The CQA Engineer shall spot monitor butt fusion welding operations to ensure that the Contractor follows the General Specifications.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

8.2.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico will provide the CQA Surveys. The CQA Surveyor shall independently survey the final elevation of the invert of all polyethylene leachate collection pipe (excluding laterals).

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and will be reviewed by the Owner. The Owner and the CQA Engineer shall approve the results contained in the report before any subsequent construction that completely covers the pipe occurs.

9 ADS SLOTTED CPT AND N12 CONSTRUCTION QUALITY ASSURANCE

9.1 ADS Slotted CPT Manufacture and Delivery

9.1.1 Manufacturing

Prior to incorporating the slotted CPT into the work the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the pipe Manufacturer.

The CQA Engineer shall verify and document that the property values certified by the pipe Manufacturer meet the requirements of the General Specifications based on a sampling interval of one sample per lot. The CQA Engineer shall report any deviations from the above requirements to the Owner.

9.1.2 Labeling

The CQA Engineer shall verify that the pipe is labeled with the information specified in the General Specification. Any deviations from the labeling requirements shall be reported to the Owner prior to pipe installation.

9.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the pipe and fittings are stored in accordance with the General Specifications.

The CQA Engineer shall visually inspect the pipe upon delivery at the site and any deviations from the requirements of the General Specifications shall be reported to the Owner.

9.1.4 Conformance Testing

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

9.2 Pipe Installation

9.2.1 Handling and Laying

The CQA Engineer shall verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the General Specifications, and in a manner intended to prevent damage to the pipe.

The pipe and fittings will be carefully examined before installation by the CQA Engineer. The CQA Engineer shall verify and document that cracks, damage or defects are not present in the pipe and fittings in excess of that allowed by the General Specifications.

The CQA Engineer shall also note the condition of the interior of pipes and fittings. Foreign material shall be removed from the pipe interior before it is moved into final position. No pipe shall be permitted to be placed until the CQA Engineer has observed the condition of the pipe.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

9.2.2 Joints and Connections

Lengths of pipe shall be required to be assembled into suitable installation lengths by split couplers. The CQA Engineer shall spot monitor installation of the split couplers to ensure that the Contractor follows the General Specifications. The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

9.2.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall provide the CQA Surveys. The CQA Surveyor shall independently survey the final elevation of the invert of all slotted CPT.

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the results contained in the report before any subsequent construction that completely covers the pipe occurs.

10 CORRUGATED METAL PIPE CONSTRUCTION QUALITY ASSURANCE

10.1 Corrugated Metal Pipe Manufacture and Delivery

10.1.1 Manufacturing

Prior to incorporating the corrugated metal pipe (CMP) into the work the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the pipe Manufacturer.

The CQA Engineer shall verify and document that the property values certified by the pipe Manufacturer meet the requirements of the General Specifications based on a sampling interval of one sample per lot. The CQA Engineer shall report any deviations from the above requirements to the Owner.

10.1.2 Labeling

No labels required in specifications.

10.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the pipe and fittings are stored in accordance with the General Specifications.

The CQA Engineer shall visually inspect the pipe upon delivery at the site and any deviations from the requirements of the General Specifications shall be reported to the Owner.

10.1.4 Conformance Testing

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

10.2 CMP Installation

10.2.1 Handling and Laying

The CQA Engineer shall verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the General Specifications, and in a manner intended to prevent damage to the pipe.

The pipe and fittings shall be carefully examined before installation by the CQA Engineer. The CQA Engineer shall verify and document that cracks, damage or defects are not present in the pipe and fittings in excess of that allowed by the General Specifications.

The CQA Engineer shall also note the condition of the interior of pipes and fittings. Foreign material shall be removed from the pipe interior before it is moved into final position. No pipe shall be permitted to be placed until the CQA Engineer has observed the condition of the pipe.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

10.2.2 Joints and Connections

Lengths of pipe shall be required to be assembled into suitable installation lengths. The CMP shall be joined using the manufacturer's recommended equipment and procedures. The CQA Engineer shall spot monitor joining operations to ensure that the Contractor follows the manufacturer's specifications. The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

10.2.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall provide the CQA Surveys. The CQA Surveyor shall independently survey the final elevation of the invert of all CMP.

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve

the results contained in the report before any subsequent construction that completely covers the pipe occurs.

11 CARBON AND STAINLESS STEEL PIPE CONSTRUCTION QUALITY ASSURANCE

11.1 Steel Pipe Manufacture and Delivery

11.1.1 Manufacturing

Prior to incorporating the steel pipe into the work the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the pipe Manufacturer.

The CQA Engineer shall verify and document that the property values certified by the pipe Manufacturer meet the requirements of the General Specifications based on a sampling interval of one sample per lot. The CQA Engineer shall report any deviations from the above requirements to the Owner.

11.1.2 Labeling

The CQA Engineer shall verify that the pipe is labeled with the information specified in the General Specification. Any deviations from the labeling requirements shall be reported to the Owner prior to pipe installation.

11.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the pipe and fittings are stored in accordance with the General Specifications.

The CQA Engineer shall visually inspect the pipe upon delivery at the site and any deviations from the requirements of the General Specifications shall be reported to the Owner.

11.1.4 Conformance Testing

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

11.2 Pipe Installation

11.2.1 Handling and Laying

The CQA Engineer shall verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around the pipe is conducted in accordance with the requirements of the General Specifications, and in a manner intended to prevent damage to the pipe.

The pipe shall be carefully examined before installation by the CQA Engineer. The CQA Engineer shall verify and document that cracks, damage or defects are not present in the pipe fittings in excess of that allowed by the General Specifications.

The CQA Engineer shall also note the condition of the interior of pipes. Foreign material shall be removed from the pipe interior before it is moved into final position. No pipe shall be permitted to be placed until the CQA Engineer has observed the condition of the pipe.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

11.2.2 Joints and Connections

Lengths of pipe shall be required to be assembled into suitable installation lengths by butt welding.

The CQA Engineer shall spot monitor welding operations to ensure that the Contractor follows the General Specifications.

The CQA Engineer shall document any noncompliance with the above requirements and report it to the Owner.

11.2.3 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall provide the CQA Surveys. The CQA Surveyor shall independently survey the final elevation of the basal location of all steel pipe.

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the results contained in the report before any subsequent construction that completely covers the pipe occurs.

12 POLYETHYLENE TANK CONSTRUCTION QUALITY ASSURANCE

12.1 Polyethylene Tank Manufacture and Delivery

12.1.1 Manufacturing

Prior to incorporating the polyethylene tank into the work the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the polyethylene tank manufacturer.

The CQA Engineer shall verify and document that the property values certified by the polyethylene tank manufacturer meet the requirements of the General Specifications based on a sampling interval of one sample per lot. The CQA Engineer shall report any deviations from the above requirements to the Owner.

12.1.2 Labeling

The CQA Engineer shall verify that the polyethylene tank is labeled with the information specified in the General Specification. Any deviations from the labeling requirements shall be reported to the Owner prior to pipe installation.

12.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the polyethylene tanks are stored in accordance with the General Specifications.

The CQA Engineer shall visually inspect the polyethylene tank upon delivery at the site and any deviations from the requirements of the General Specifications shall be reported to the Owner.

12.1.4 Conformance Testing

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

12.2 Polyethylene Tank Installation

12.2.1 Handling and Laying

The CQA Engineer shall verify and document that the polyethylene tank is installed at the specified locations, and in a manner intended to prevent damage to the polyethylene tank.

The polyethylene tank shall be carefully examined before installation by the CQA Engineer. The CQA Engineer shall verify and document that cracks, damage or defects are not present in the polyethylene tank in excess of that allowed by the General Specifications.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

The owner shall obtain and keep on file at the facility written statements by the CQA engineer certifying that the design and installation of the tank system was performed in accordance with the requirements 40 CFR § 264.192 (b)through (f).

12.2.2 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall provide the CQA Surveys. The CQA Surveyor shall independently survey the final locations and elevation of the base of the polyethylene tank.

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the results contained in the report before any subsequent construction hinders surveying of the polyethylene tank.

13 CONCRETE FORMWORK CONSTRUCTION QUALITY ASSURANCE

13.1 Concrete Formwork Manufacture

Prior to incorporating the formwork into the work the Contractor shall be required to provide the CQA Engineer with the requirements of the General Specifications.

The CQA Engineer shall verify and document that the material properties meet the requirements of the General Specifications. The CQA Engineer shall report any deviations from the above requirements to the Owner.

13.2 Formwork Installation

13.2.1 Handling and Laying

The CQA Engineer shall verify and document that the formwork is installed at the specified locations, and in the manner intended by the General Specifications.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

13.2.2 Surveying

A Professional Land Surveyor registered in the State of New Mexico shall provide the CQA Surveys. The CQA Surveyor will independently survey the final locations and elevation of the formwork.

The results of the survey shall be compiled in a report signed by the CQA Surveyor and the CQA Engineer and shall be reviewed by the Owner. The Owner and the CQA Engineer shall approve the results contained in the report before any subsequent construction hinders surveying of the formwork.

14 REINFORCEMENT STEEL CONSTRUCTION QUALITY ASSURANCE

14.1 Reinforcement Steel Manufacture and Delivery

14.1.1 Manufacturing

Prior to incorporating the reinforcement steel into the work, the Contractor shall be required to provide the CQA Engineer with the material certifications required by the General Specifications signed by a responsible party employed by the reinforcement steel manufacturer.

The CQA Engineer shall verify and document that the property values certified by the reinforcement steel Manufacturer meet the requirements of the General Specifications. The CQA Engineer shall report any deviations from the above requirements to the Owner.

14.1.2 Labeling

The CQA Engineer shall verify that the reinforcement steel is labeled with the information specified in the General Specification. Any deviations from the labeling requirements shall be reported to the Owner prior to pipe installation.

14.1.3 Shipment and Storage

The CQA Engineer shall verify and document that the reinforcement steel is stored in accordance with the General Specifications.

14.1.4 Testing

If requested by the Engineer, testing outlined in the General Specifications shall be conducted.

14.2 Reinforcement Steel Installation

The CQA Engineer shall verify and document that the reinforcement steel is installed at the specified locations, and in a manner intended to prevent damage to the work.

The reinforcement steel shall be examined to ensure that the requirements of the General Specifications are followed.

The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

15 JOINTS IN CONCRETE CONSTRUCTION QUALITY ASSURANCE

15.1 Joint Material Manufacture

Prior to incorporating the joint materials into the work the Contractor shall be required to provide the CQA Engineer with the certifications required by the General Specifications signed by a responsible party employed by the Manufacturer.

The CQA Engineer shall verify and document that the property values certified by the Manufacturer meet the requirements of the General Specifications. The CQA Engineer shall report any deviations from the above requirements to the Owner.

15.2 Joint Installation

The CQA Engineer shall verify and document that the joint materials, locations and installation procedures are in accordance with the General Specifications. The CQA Engineer shall document any deviation from the above requirements and report it to the Owner.

16 MISCELLANEOUS METALWORK CONSTRUCTION QUALITY ASSURANCE

16.1 Miscellaneous Metalwork Submittals

Prior to incorporating the miscellaneous metalwork into the work, the Contractor shall be required to provide the CQA Engineer with the submittals required by the General Specifications.

16.2 Fabrication and Installation

The CQA Engineer shall verify and document that the miscellaneous metalwork is fabricated and installed at the specified locations, and in a manner intended by the General Specifications.

17 CAST IN PLACE CONCRETE CONSTRUCTION QUALITY ASSURANCE

17.1 Submittals

Prior to incorporating the cast in place concrete into the work, the Contractor shall be required to provide the CQA Engineer all submittals required by the General Specifications.

17.2 Conference

Prior to incorporating the cast in place concrete into the work, the Contractor shall be required to hold a meeting to discuss items required in the General Specifications.

17.3 Testing

The CQA Engineer shall verify and document that material sampling and testing required in the General Specifications is completed.

18 ELECTRICAL SYSTEM AND PUMP CONTROL CONSTRUCTION QUALITY ASSURANCE

18.1 Submittals

Prior to incorporating the electrical system and pump controls into the work, the Contractor shall be required to provide the CQA Engineer with the submittals required by the General Specifications.

18.2 Installation

The CQA Engineer shall systematically examine wiring and conduits before covering or backfilling to confirm proper routing, wire size, and connection methods.

18.3 Component Check

The CQA Engineer shall perform or review component checks of resistance, grounding, and load prior to complete system check.

Checking and calibration of these systems shall be performed according to manufacturer recommendations and procedures.

18.4 Testing

The CQA Engineer shall witness and document acceptance testing of the pump control system.

19 PUMPS, PIPING, METERS, AND VALVE CONSTRUCTION QUALITY ASSURANCE

19.1 Submittals

Prior to incorporating the pumps, piping, instruments (such as flow meter), and valves into the work, the Contractor shall be required to provide the CQA Engineer with the submittals required by the General Specifications.

19.2 Installation

The CQA Engineer shall observe connections and components for proper assembly, usage and construction.

19.3 Component Check

The CQA Engineer shall perform or review component checks of equipment to confirm operation in accordance with the specifications.

Checking and calibration of these systems shall be performed according to manufacturer recommendations and procedures.

19.4 Testing

The CQA Engineer shall witness and document acceptance testing of the leachate removal system.

20 CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION

20.1 Documentation

20.1.1 Introduction

An effective CQA plan depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of construction quality assurance activities. The CQA Engineer shall document that all quality assurance requirements have been addressed and satisfied.

The CQA Engineer shall provide the Owner with signed descriptive remarks, data sheets, and logs to verify and document that all monitoring activities have been carried out. The Owner

shall maintain in the Facility Operating Record a complete file of Construction Drawings, the CQA plan, the General Specifications, (test procedures, daily reports, testing logs, and other pertinent forms and documents. The forms to be used for CQA documentation shall include, at a minimum, those presented in this CQA Plan. The forms presented in this CQA Plan may be revised as necessary by the CQA Engineer.

20.1.2 Daily Record Keeping

20.1.2.a Overview

Daily records shall be completed in the field documenting CQA project administration, soils CQA, geosynthetics CQA, and other required CQA activities. The forms to be completed that pertain to each of these categories of records are discussed below.

20.1.2.b Project Administration Records

Most project administration records are completed daily by the CQA Engineer and submitted weekly to the Owner. Examples of these forms are included in Appendix B and are briefly described below.

20.1.2.b.1 Daily Field Report

The Daily Field Report shall be prepared by the CQA Engineer and submitted weekly to the Owner. At a minimum, the Daily Field Report will include the following information:

- the date, project name, location, and other identification;
- a narrative of the events and activities, including meetings and observation which occurred during a given day;
- the weather conditions;
- source and amount of water used to construct the clay liner, if any;
- the name of parties to any discussions;
- the relevant subject matter or issues;
- the activities planned and performed;
- the schedule; and
- the signature of the CQA Engineer.

20.1.2.b.2 Weekly Field Report

On a weekly basis, the CQA Engineer shall summarize in a Weekly Field Report the activities recorded on the Daily Field Reports. This report shall be submitted each week to the Owner along with the Daily Field Reports, and will include, at a minimum, the following information:

- the date, project name, location, and other information;
- a summary of work activities during reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the reporting period;
- a summary of actions taken to remedy such situations, deficiencies and or defects; and
- the signature of the CQA Resident Engineer.

Since the weekly report is presented in a report format, a form is not presented in Appendix B.

20.1.2.c Soils CQA Records

Records kept for soils related activities shall be completed by the CQA Engineer. The information shall be recorded as testing is completed in the field or as results are received from the laboratory. The records shall be available for review on site, and copies will be issued as part of the Final Report. Examples of the relevant forms are included in Appendix B and are briefly described below.

20.1.2.c.1 Field Laboratory Compaction Test Log

The results of field compaction tests, using ASTM D 698 Method A, B, C, D and ASTM D 1557 Method A, B, C (as they may be updated), shall be recorded on the Field Laboratory Compaction Test Log. Separate forms are available for each test method used.

20.1.2.c.2 Standard Count, Field Sand Cone and Rubber Balloon Density Test Log

The results of the sand cone and or rubber balloon Density Test Log. The results shall be used for comparison or calibration with nuclear density test results.

20.1.2.c.3 Summary of Sieve Analysis Test Data

This form shall provide a summary of sieve analysis test results for soils.

20.1.2.c.4 Summary of Field Density Tests

This form shall provide a summary of field nuclear density test results and sand cone test results for soils.

20.1.2.c.5 Summary of Index Laboratory Test Data

This form shall provide a summary of index test results performed as required for soils.

20.1.2.c.6 Summary of Permeability Laboratory Data

This form shall provide a summary of laboratory permeability test data required for clay liners.

20.1.2.d Geosynthetics CQA Records

Records for the installation of geosynthetics shall be completed by the CQA Engineer. The information shall be recorded as the work progresses. The records shall be available for review on site and copies shall be issued as part of the final CQA report. Examples of the CQA forms to be completed for geosynthetics are included in Appendix D and briefly described below.

20.1.2.d.1 Material Inventory

The identifying roll number and pertinent information of each roll of geosynthetic received at the site shall be recorded on this form as the materials arrive at the site. This information shall be used to track manufacturer's quality control information, conformance test samples, and other CQA documentation.

20.1.2.d.2 Nondestructive Test Log

This form shall be used to record the time, date, equipment operator, and results of vacuum box or air pressure testing of production geomembrane seaming operations.

20.1.2.d.3 Panel Placement Monitoring Log

This form shall be used to record geomembrane panel numbers as they are placed in the field and to cross-reference the assigned panel numbers with roll numbers. The weather conditions, time, and temperature at placement shall be recorded on the log. Measured dimensions used to calculate the area of the geomembrane shall be recorded on the log.

20.1.2.d.4 Repair Summary Log

Information on repairs to geomembrane panels and seams shall be recorded on this form. The information recorded shall include a code to describe the type of repair, the name of the operator making the repair, the location (i.e. seam or panel location) of the repair, nondestructive testing results of the repair, and initials of the CQA Engineer observing the repair.

20.1.2.d.5 Seam and Panel Location Log

The relative location of repairs to geomembrane panels and seams described in the Repair Summary Log shall be recorded on this form. The results of destructive tests and nondestructive shall be indicated in this log, as well as, location and results of thickness measurements taken for each panel.

20.1.2.d.6 Destructive Test Log

This form shall be used to record the results from testing performed on geomembrane seams at the Geosynthetics CQA Laboratory (an independent testing laboratory). The results for both peel and shear shall be recorded. The form shall be completed as data becomes available.

20.1.2.d.7 Trail Seam and Seaming Log

This form shall be used to record results of trial geomembrane seam testing and to track production seaming activities. The time, temperature, type of seaming equipment used, name of seamer, and length of seam shall be recorded.

20.1.2.d.8 Certificate of Acceptance Subgrade Surface

The Certificate of Acceptance is required to be signed by the Contractor prior to the installation of the geomembrane. The area being accepted must be described on the certificate.

20.1.2.e Survey Records

Record Drawings resulting from the surveying performed by the CQA Surveyor shall be reviewed by the CQA Engineer and the Owner. The Record Drawings shall be available for review onsite, and copies shall be issued as part of the final CQA Report issued by the CQA Engineer. At a minimum, these Records Drawings shall include as-built survey data for the following liner system components:

- prepared subgrade;
- structural fill
- clay liner;
- polyethylene pipe and fittings;
- geomembrane liners;
- drainage gravel;
- protective soil layer;
- road base;
- cover soil;
- vegetative cover;
- pipe bedding;
- select Subbase;
- subbase;
- foundation sand;
- geocomposite;
- geonet;
- geotextile;
- polyvinyl chloride pipe;

- geosynthetic clay liner;
- steel Pipe; and
- polyethylene tank.

20.1.3 Photographic Documentation

Photographic documentation shall serve as a pictorial record of work progress, problems, and mitigation activities. The basic file shall contain color prints; negatives and electronic files and shall be stored in in chronological order in the Final Report. These photographs shall be available for review by the Owner, the CQA Engineer, and other interested parties. Selected photographs will be reproduced as part of the Final Report. The remaining photographs shall be transmitted to the Owner and archived by the Owner as part of the operating records.

20.1.4 Design and/or Specification Changes

Design and/or specification changes may be required during construction. In such cases, the CQA Engineer shall notify the Owner. The Owner shall submit these changes to NMED for review and approval according to permit modifications requirements of 40 CFR §§ 270.41 and 42.

Major design and/or specifications changes shall be made only with the written agreement of the Design Engineer and the Owner and shall take the form of an addendum to the General Specifications.

20.1.5 Signatures and Final Reports

At the completion of the work, the CQA Engineer shall submit a final CQA report to the Owner.

At a minimum, this report shall include: (a) summaries of all construction activities; (b) sources and amounts of water used to construct the clay liners; (c) results of chemical quality analyses of construction water from each source; (d) observation logs and testing data sheets including sample location plans; (e) a discussion of all changes from design and material specifications; (f) CQA Record Drawings; (g) the photographic documentation and (h) a summary statement sealed and signed by a Professional Engineer registered in the State of New Mexico that construction quality assurance was conducted as provided in the CQA Plan and, based on visual observations and data generated in accordance with the CQA Plan, the landfill was constructed in accordance with 40 CFR § 264.19, the Construction Drawings, the CQA Plan, and the General Specifications, except as properly authorized and documented in the CQA final report. The CQA Record Drawings shall include the following: primary and secondary geomembrane panel layout drawings; all drawings (including cross-sections) depicting any deviations from the Construction Drawings; and all survey conformance data.

A separate Final Report shall be issued for Phase 1A and each subsequent phase of the landfill. The final CQA Report shall present the results of CQC tests conducted by the installation constructors as well as the CQA tests.

Appendix A

Test Fill Plan

1.0 PURPOSE AND SCOPE

The purpose of the test fill is to establish a sequential and logical approach for the development of placement and compaction procedures to be used during construction of cohesive soil liners as an indicator that the soil liners are constructed in a way that meets design performance specifications. The test fill program will allow the Contractor, the Design Engineer, and the Construction Quality Assurance (CQA) engineer to identify appropriate placement and compaction procedures by establishing relationships between various compaction parameters, density, water content, Atterberg limits, particle size distribution, and permeability of the fill.

Once the construction procedures have been established by the test fill program, the Contractor and the CQA Engineer will monitor the cohesive soil liner construction procedures as an indicator that the design performance specifications are being achieved, Test fill construction procedures will include measuring lift thickness, counting the number of compactor coverages, and performing in-place density and moisture content tests to verify that the specified degree of compaction is achieved.

The test fill will be constructed in uniform horizontal lifts of uniform thicknesses.

This test fill program documents the requirements for constructing the test fill. The test fill program will include:

- subgrade preparation
- construction of a 3-foot-thick test fill
- inspection and testing of the test fill
- sampling of portions of the test fill

The test fill program described in this appendix may be modified based on site specific design and construction considerations.

Feasibility testing of clay sources will have been performed before the start of the test fill. These tests should provide the basic relationship of permeability with varying density and moisture content.

2.0 CONSTRUCTION EQUIPMENT

The equipment to be used for the test fill shall be proposed by the Contractor, and approved by the CQA Engineer and Project Manager.

3.0 TEST FILL MATERIAL

Test fill material shall be approved by the CQA Engineer. The material shall meet the requirements of the Specification Section 02221. The Material shall be an inorganic cohesive soil with a plasticity index (PI) ranging between 10 and 40; at least 50 percent of the soil shall pass the No. 200 sieve. As approved by the CQA Engineer, small quantities of fill with PI greater than 40 may be allowed if such materials are thoroughly mixed with other less plastic soils. Other materials may be considered based upon laboratory testing and upon approval of the Project Manager. The maximum particle size shall be 2 inches before processing. No frozen material shall be used, and in-place material that becomes frozen prior to completion of operations shall be removed.

4.0 TEST FILL CONSTRUCTION

4.1 SUBGRADE PREPARATION

The area within the limits of the test fill shall be cleared and grubbed of all trees, debris, brushes, stumps, roots, trash, and any other vegetation or objectionable material. Following clearing and grubbing, the area shall be stripped of topsoil. Topsoil shall be stockpiled in an area designated by the Project Manager.

The surface of the subgrade shall be proof-rolled so as to be free of soft zones, irregularities, loose earth, and abrupt changes in grade. The subgrade and test fill shall be sloped at a 2 percent grade. No standing water or excessive moisture shall be allowed on the surface of the subgrade. The surface shall be inspected by the CQA Engineer prior to beginning construction of the test fill.

If placement and compaction of soil materials on slope areas is to be accomplished by the downslope compaction method rather than by horizontal benching, the test fill shall have a sloped area of similar grade to the intended liner installation where the downslope compaction method can be evaluated.

4.2 CONFIGURATION

The test fill shall be a rectangle approximately 60 feet long by 20 feet wide. The test fill shall be constructed to a thickness of 3 feet in uniform horizontal lifts. Lines and grades shall be controlled by survey.

4.3 FILL PLACEMENT

The test fill shall be constructed in uniform horizontal lifts to a total thickness of 3 feet after compaction in accordance with the procedures specified below. The procedures, which vary with the lift considered, are intended to allow determination of a relationship between soil compaction criteria, which include density and moisture content, permeability, and compaction method parameters. Compaction method parameters include: (1) compactor characteristics; (2) thickness of compacted/uncompacted layers; (3) number of compactor coverages; and, soils moisture content.

4.3.1 First Lift

1. The first lift of test fill material shall be placed to a thickness resulting in 6 inches after compaction.

2. Soils moisture content shall be maintained when the placement window defined in the Specifications (Section 02221). The contractor shall adjust the moisture content as necessary to obtain the specified density criteria.

3. The test fill material shall be compacted with two one-way coverages using the Contractor's proposed compaction equipment.

4. The Contractor shall permit the CQA Engineer to perform in-place density tests and collect soil samples as specified in 5-3..

5. QA Engineer to perform in-place density tests and collect soil samples as specified in Section 5.3.

6. Holes left in the lift shall be repaired in accordance with methods outlined in the CQA plan. The repairs shall be compacted using procedures which have been shown to meet the required moisture and density criteria.

7. The test fill material shall be compacted a second time by applying two more one-way coverages with the selected compactor.

8. Steps 4 and 5 shall be repeated. Second tests shall be taken near the original tests.

9. The test fill material shall be compacted a third time by applying two more one-way coverages with the selected compactor.

10. Steps 4 and 5 shall be repeated. Third tests shall be taken near the first and second tests.

11. Steps 8 and 9, respectively, shall be repeated and continued until specified compaction criteria are obtained as identified by the CQA Engineer.

4.3.2 Second Lift

1. The loose thickness of the second lift shall be such that the thickness of the lift will be 6 inches after compaction.

2. A competent bond with the first lift shall be achieved by the Contractor and approved by the CQA Engineer.

3. Steps 2 through 10 of Section 4.3.1 shall be repeated.

4.3.3 Remaining Lifts

1. The loose thickness of the remaining lifts shall be such that the thickness of the lifts will be 6 inches after compaction.

2. The procedures for compacting and testing the remaining lifts shall be those that have been tested and proven effective during the compaction of the second lift.

4.3.4 Final Surface Preparation

The surface of the test fill shall be rolled with a smooth steel drum or pneumatic rolled so as to be free of irregularities, loose earth, and abrupt changes in grade. All stones larger than 1 inch shall be removed. Stones which are smaller than 1 inch and are judged to be detrimental to a geomembrane liner will be removed. One-half of the prepared soil surface shall be protected against drying with temporary plastic sheets. The sheets shall be placed immediately after the completion of surface preparation. Observations and documentation of desiccation cracking versus time shall be made on the uncovered section of the test fill.

5.0 INSPECTION AND TESTING

5.1 TEST FILL MATERIAL

The CQA Engineer shall perform testing on the cohesive soil material prior to its use in the test fill. Testing, using the most recent ASTM method, will include at least the following:

- soil density/moisture content relationship using the Modified and Standard Proctor Compaction Method (ASTM D 698 and ASTM D 1557)
- natural water content (ASTM D 2216)
- particle size distribution (ASTM D 422)
- Atterberg limits (ASTM D 4318)
- soil classification (ASTM D 2487)

5.2 SUBGRADE PREPARATION

The CQA Engineer shall observe the prepared subgrade for firmness, smoothness, and absence of abrupt changes in grade.

5.3 TEST FILL CONSTRUCTION

5.3.1 Lift Compaction

For the first and second lifts, the CQA Engineer shall perform the following activities:

- estimate the thickness of the loose lifts
- count the number of compactor coverages and observe compactor coverage of the test fill (Figure 1)
- at every two (2) coverages, perform a minimum of eight nuclear gauge in-place density and moisture reading (ASTM D 2292); compute degree of compaction (i.e., in-place dry density divided by the Standard Proctor or Modified maximum dry density; collect four additional soil samples for moisture content determination (ASTM D 2216)
- observe the repair of holes left in the lift as a result of density testing and soil sample collection
- continue in-place density testing and moisture content determination to enable development of a curve giving in-lace dry density versus number of compactor coverages for each lift thickness

For each of the remaining lifts, the CQA engineer shall perform the following activities:

- verify that the thickness of the loose lift does not exceed the loose thickness determined from testing of the second lift
- count the number of compactor coverages, determined from testing of the second lift, which are necessary to achieve the specified density and observe compactor coverage of the test fill
- perform a minimum of eight nuclear density tests per lift to verify the adequacy of the construction procedures previously established

The CQA Engineer shall collect a minimum of six (6) undisturbed samples from varying depths of the completed test fill. The samples shall be waxed or otherwise protected to retain natural moisture and tested in the laboratory for the following:

- hydraulic conductivity (permeability) using water as the permeant (ASTM D 5084)
- dry density
- particle size distribution (ASTM D 422)
- Atterberg limits (ASTM D 4318)
- soil classification (ASTM D 2487)
- soil moisture content (ASTM D 2216)

The CQA Engineer shall observe the test fill to verify the adequacy of the bonding between adjacent lifts. Such observation shall be exercised on the portion of the test fill which has been excavated to permit removal of undisturbed soil block samples.

5.3.2 Final Surface Preparation

The CQA Engineer shall observe the prepared surface for firmness, smoothness, and absence of abrupt changes in grade.

5.3.3 Permeability Testing

The permeability of the test fill shall be assessed by performance of a minimum of six (6) laboratory tests on 12-inch diameter undisturbed specimens obtained at a location selected by the CQA Engineer.

5.4 TEST RESULTS

The test results which will be used to verify that the specified construction procedures meet the design performance criteria shall be:

- compaction testing (i.e., degree of compaction, in-place dry density, and moisture content)
- results of laboratory permeability testing performed on undisturbed soils samples
- soil index testing to evaluate material suitability

5.5 LINES AND GRADES

The following surfaces shall be surveyed to verify that proper thicknesses have been constructed:

- prepared surface of the subgrade
- final surface of the test fill

6.0 DOCUMENTATION

The CQA Engineer shall document activities associated with the construction, monitoring, and testing of the test fill. Such documentation shall include daily reports of construction activities and oral communications with the contractor. In addition, the following shall be documented for each of the section listed below:

6.1 TEST FILL MATERIAL

The CQA Engineer shall provide a moisture-density relationship for the test fill liner material and other and other test results as specified in Section 5.1.

6.2 TEST FILL CONSTRUCTION

6.2.1 Subgrade preparation

The CQA Engineer shall document observations on subgrade preparation, as specified in Section 5.2.

6.2.2 Test Fill Construction

The CQA Engineer shall document activities of the test fill construction, monitoring, and testing in a test fill summary report, which shall include but not be limited to:

- record of the compactor type, configuration, and weight; for sheepsfoot compactors, record the drum diameter and length, empty and ballasted weight, length and face area of feet, and yoking arrangement, if any
- record thicknesses of lifts prior to and after compaction
- record density versus number of compactor coverages for each lift thickness, as specified in Section 5.3.1
- record the number of compactor coverage which will provide the specified degree of compaction and permeability
- record the procedure to bond lifts
- results of moisture, in-place density and degree of compaction, as specified in Section 5.3.1
- repair of holes left in the lift as a result of density testing and soil sample collection, as specified in Section 5.3.1
- results of laboratory permeability testing and other soil properties tests performed on undisturbed soil samples
- as-built drawing of the test fill and locations of all test samples for each lift
- cross-section of the test fill showing number of lifts and lift thickness
- description of actual construction procedures
- observations of test fill excavation for removal of undisturbed soils samples and observations of layer bonding, as specified in Section 5.3.1

Appendix B

Project Administration Records

Attachment M

TerraMatrix

Engineering & Environmental Services
1475 Pine Grove Road, P.O. Box 774018
Steamboat Springs, Colorado 80477

FIELD ENGINEER'S DAILY REPORT

PROJECT NAME: TRIASSIC PARK WASTE DISPOSAL FACILITY
PROJECT NUMBER: 602
PAGE ___ of ___
FIELD ENGINEER:_____

DATE:_____ S M T W T F S
AREA:_____
_____
WEATHER:_____

CONTRACTOR WORK PERFORMED.....

TESTING OR SURVEYING PERFORMED.....

DISCUSSIONS WITH CONTRACTOR OR CLIENT.....

COMMENTS.....

VISITORS:

Field Book Number ___ Pages ___ to ___
SIGNATURE:_____

MONTGOMERY WATSON WEEKLY FIELD SUMMARY REPORT
TRIASSIC PARK WASTE DISPOSAL FACILITY
CONSTRUCTION QUALITY ASSURANCE
WEEK #1

Introduction

In accordance with the CQA Implementation Plan for cover construction at the Triassic Park Waste Disposal project, Montgomery Watson is providing a weekly summary of construction and CQA activities for the construction related to the earthworks geosynthetics. Copies of Daily Reports and associated field book notes have been submitted previously. The following table presents a summary of construction conditions and activities for the week.

	Date Su	Date M	Date T	Date W	Date Th	Date F	Date Sa	Week Total	Cumulative Total to Date
1. Staff On-site:									
Name									
Name									
Name									
Name									
Name									
Name									
Name									
Name									
Total On-site Hours									
2. Weather Conditions									
Temperature									
Precipitation									
Site Closure									
3. Contractor Activity									
Earth Works									
Type D subgrade preparation									
Sand placement									
Type B placement over geonet									
Type E placement over geotextile									
Other									
Geosynthetics									
Geosynthetics deployment									
Geosynthetics detail work									

MONTGOMERY WATSON WEEKLY FIELD SUMMARY REPORT
TRIASSIC PARK WASTE DISPOSAL FACILITY
CONSTRUCTION QUALITY ASSURANCE
WEEK #1 (Continued)

	6/13 Su	6/14 M	6/15 T	6/16 W	6/17 Th	6/18 F	6/19 Sa	Week Total	
4. Geosynthetics Activity									
Material Inventory (see attached material quantities summary)									
Geomembrane									
Geonet									
Geotextile									
Material Deployment (based on total deployed lengths of panels, including overlaps and prior to trimming)									
Geomembrane (square feet)									
Geonet (square feet)									
Geotextile (square feet)									
Geomembrane Field Seaming									
Fusion welding footage									
Fusion destructive tests									
Extrusion welding footage									
Extrusion destructive tests									
5. QA Soil Testing									
Field Testing									
Laboratory Testing									

MONTGOMERY WATSON DAILY FIELD REPORT
TRIASSIC PARK WASTE DISPOSAL FACILITY

Daily Report Number
Date Work Performed

MONDAY

Staff On-site

☐ Name	☐ Name	☐ Name
☐ Name	☐ Name	☐ Name
☐ Name	☐ Name	☐ Name

Weather Conditions

Temperature (F)_____
Skies_____
Wind_____
Precipitation? ☐
Site Closure? ☐

Contractor Activity

Earthworks

☐ Type D subgrade preparation
☐ Sand placement
☐ Type B placement over geonet
☐ Type E placement over geotextile
☐ Other

Geosynthetics

☐ Geosynthetics deployment
☐ Geosynthetics detail work

Geosynthetic Activity Summary (Geosynthetic Installation Monitoring Summary attached)

Material Inventory (see Weekly Summary Report for material quantities)

☐ Geomembrane
☐ Geonet
☐ Geotextile

Material Deployment	today (sf)	total to date (sf)
Geomembrane		
Geonet		
Geotextile		

Issues List Updated ☐ (attached)
Area Approved for Sand Placement (see attached drawing)

Other:

QA Soil Testing

☐ Field Testing
☐ Laboratory Testing

Meeting Attendance (meeting notes attached)
Daily Construction Meeting

☐ Name
☐ Name
☐ Name
☐ Name
☐ Name

Miscellaneous

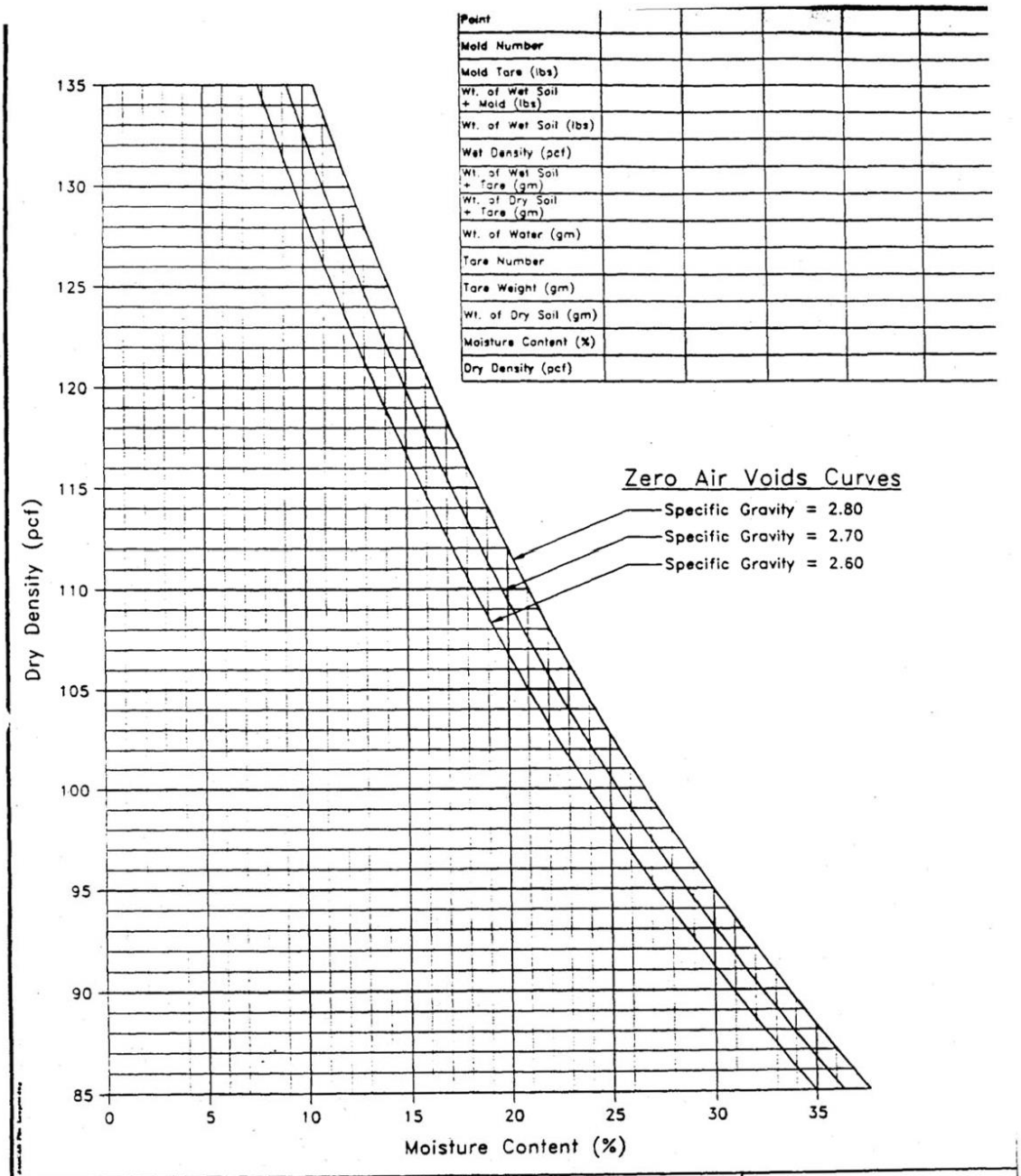
Report prepared by:

W:\WP\602\ResOct2000Permit\Vol IV\Daily Field Rpt
10/2/00 sha

Appendix C

Soils CQA Records

Attachment M


Point
Mold Number
Mold Tare (lbs)
Wt. of Wet Soil + Mold (lbs)
Wt. of Wet Soil (lbs)
Wet Density (pcf)
Wt. of Wet Soil + Tare (gm)
Wt. of Dry Soil + Tare (gm)
Wt. of Water (gm)
Tare Number
Tare Weight (gm)
Wt. of Dry Soil (gm)
Moisture Content (%)
Dry Density (pcf)
Zero Air Voids Curves
Specific Gravity = 2.80
Specific Gravity = 2.70
Specific Gravity = 2.60
Dry Density (pcf)
135
130
125
120
115
110
105
100
95
90
85
0
5
10
15
20
25
30
35
Moisture Content (%)
Project Name:
Sample Location:
Sample No.:
Sample Source:
Technician:
Sample Description:
Max. Dry Density (pcf):
Opt. Moisture (%):
Procedure:
Liquid Limit (%):
Plasticity Index (%):
Natural Moisture (%):
% - 3/4 in.:
% - No. 4:
% - No. 200:
TerraMatrix
MOISTURE-DENSITY RELATIONSHIP OF SOIL
Project No.:
Date:

NUCLEAR GUAGE (ASTM D2922)
STANDARD COUNT LOG (ASTM D3017)

PROJECT NAME: TRIASSIC PARK WASTE DISPOSAL FACILITY **PROJECT NO. 602**

NUCLEAR GUAGE MODEL_____ **SERIAL NO.:**_____

DATE ARRIVED ON SITE:_____ **DATE DEPART SITE:**_____

DATE (day/mo)	QA ID	MOISTURE COUNT	DENSITY COUNT	PASS/ FAIL	PECENT CHANGE		DATE (day/mo)	QA ID	MOISTURE COUNT	DENSITY COUNT	PASS/ FAIL	PECENT CHANGE

IN-SITU DENSITY TESTS - RUBBER LOON METHOD (ASTM D 2167)
TRIASSIC PARK WAS. SPOSAL FACILITY

)WNER: GANDY MARLEY INC. PROJECT NUMBER: 602

)ATE:_____ MATERIAL TESTED:_____ OPTIMUM WATER CONTENT:____ MAX DRY DENSITY (pcf):___

TESTED BY:_____ REVIEWED BY:_____ WEATHER:_____ PAGE___ OF ___

TEST NUMBER	RUBBER BALLOON	NUCLEAR DENSITY	RUBBER BALLOON	NUCLEAR DENSTIY	RUBBER BALLOON	NUCLEAR DENSITY
ELEVATION						
LOCATION						
FINAL READINGS (ft³)						
AVERAGE FINAL READING (ft³)						
INITIAL READING (ft³)						
CORRECTED VOLUME (ft³)						
SOIL WEIGHT + TARE (gm)						
TARE (gm)						
WEIGHT WET SOIL (gm)						
WET DENSITY (pcf)						
TIN NUMBER						
WEIGHT WET SOIL + TARE (gm)						
WEIGHT DRY SOIL + TARE (gm)						
WEIGHT OF WATER (gm)						
TARE (gm)						
WEIGHT DRY SOIL (gm)						
MOISTURE CONTENT						
DRY DENSITY (pcf)						
MAXIMUM DRY DENSITY (pcf)						
PERCENT COMPACTION						
CORRELATION TO TROXLER						

SAMPLE:_____

Sieve	Cumulative Weight Retained	Cumulative % Retained	Cumulative % Passing	Specification % Passing
3"				
2"				
1"				
3/4"				
3/8"				
#4				
#10				
#20				
#40				
#60				
#100				
#200				
PAN				

SAMPLE AND TARE WT: _____

TARE WT: _____ CONTAINER NO.:_____

WEIGHT BEFORE SIEVING:_____

UNIFORMITY COEFFICIENT, (D_{60}/D_{10}):_____
COEFFICIENT OF CURVATURE, $(D_{30})/(D_{10} \times D_{60})$:_____

SIEVE ANALYSIS FORM (ASTM D 422)

PROJECT: TRIASSIC PARK WASTE DISPOSAL FACILITY CQA

PROJECT NO. 602 DATE:_____ TESTED BY:_____

TERRAMATRIX
1475 Pine Grove Road
Steamboat Springs, Colorado 80477

NUCLEAR FIEL[illegible]EN[illegible]/MOISTURE TEST DATA
TRIASSIC PARK WA[illegible] DISPOSAL FACILITY
(ASTM 2922, D3017)

PROJECT NUMBER: 602
OWNER: GANDY MARLEY INC.
LOCATION:

CONTRACTOR:_____
SHEET NUMBER_____

TROXLER MODEL _____ SERIAL NO.:_____STANDARD COUNT: DENSITY: _____ MOISTURE:_____ REQUIRED COMPACTION (%): __

WEATHER: _____FIELD MONITOR: _____

TEST NUMBER													
GENERAL TEST LOCATION													
REFERENCE STAKE	I.D. NUMBER												
	NORTH COORDINATE												
	EAST COORDINATE												
	ELEVATION												
	BEARING (TO TEST)												
	DISTANCE												
MODE & DEPTH													
WET DENSITY (pcf)													
DRY DENSITY (pcf)		TROXLER	LAB	TROXLER	LAB	TROXLER	LAB	TROXLER	LAB	TROXLER	LAB	TROXLER	LAB
% MOISTURE													
% COMPACTION													
OPTIMUM MOISTURE (%)													
MAXIMUM DRY DENSITY (pcf)													
PASS/FAIL													

SOILS TEST REQUEST SHEET

PROJECT NAME: TRIASSIC PARK WASTE DISPOSAL FACILITY PROJECT NO. 602 LAB NO._____

REQUESTED BY_____ PROJECT MANAGER APPROVAL_____ PAGE____ OF ____

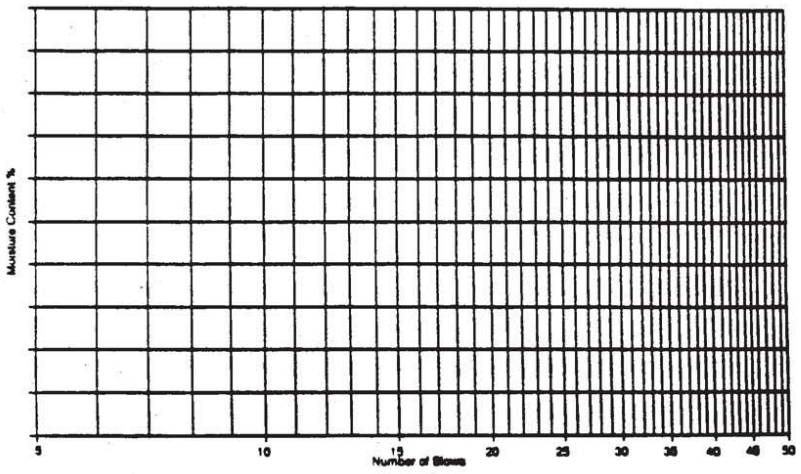
SAMPLE NUMBER	SAMPLE DEPTH LOCATION AND/OR STATION	VISUAL USCS SYMBOL	MOISTURE CONTENT	DRY DENSITY	ATTERBERG LIMITS	SIEVE ANALYSIS	#200 WASH	HYDROMETER ANALYSIS	COMPACTION TEST	UNDISTURBED PERMEABILITY	DIRECT SHEAR	UNCONFINED COMPRESSION	REMOLDED PERMEABILITY	DATE REQUESTED	RESULTS DUE BY	DATE COMPLETED	DATE SAMPLE STORED	DATE SAMPLE DISPOSED OF

COMMENTS:

SPECIAL INSTRUCTIONS:

SAMPLES DELIVERED BY:_____
SAMPLES RECEIVED BY:_____

Type of Test	LL	LL	LL	LL	Nat. M.C.
Container #					
Tare Wt. (g)					
Number of Blows					
Wt. Sample Wet + Tare (g)					
Wt. Sample Dry + Tare (g)					
Weight of Water (g)					
Weight of Dry Soil (g)					
Moisture Content (%)					
Type of Test	PL	PL	Borehole #		
Container #			Sample #		
Tare (g)			Depth		
Wt. Sample Wet + Tare (g)			Liquid Limit		
Wt. Sample Dry + Tare (g)			Plastic Limit		
Weight of Water (g)			Plasticity Index		
Weight of Dry Soil (g)			Moisture Content		
Moisture Content (%)			Liquidity Index		



Sample Description: _____

_____

ATTERBERG LIMITS

Project: TRIASSIC PARK WASTE DISPOSAL FACILITY CQA
Project No.: DATE: TESTED BY: TERRAMATRIX

CONSTANT HEAD PERMEABILITY ON GRANULAR SOIL
GANDY MARLEY INC.
CHAVES COUNTY, NEW MEXICO

DATE:_____ SHEET____ OF ___

OWNER:_____ PROJECT NUMBER:_____

PROJECT NAME:_____LOCATION:_____

SAMPLE NO.:_____ TECH._____

DESCRIPTION:_____

HEIGHT BEFORE (H1):		HEIGHT AFTER (H2):	
(1)	_____	(1)	_____
(2)	_____	(2)	_____
(3)	_____	(3)	_____
(4)	_____	(4)	_____

AVERAGE (H1) _____ AVERAGE (H2) _____

SAMPLE DIMENSIONS

HEIGHT, L=(H1-H2), cm: _____ HEAD, h, cm: _____

DIAMETER, cm:_____

AREA, A, sq. cm:_____

	QUANTITY OF WATER, Q (cubic cm)	TIME, t (sec)
TRIAL 1:	_____	_____
TRIAL 2:	_____	_____
TRIAL 3:	_____	_____
AVERAGE:	_____	_____

K= QL/Ath= _____ cm/sec

1 inch = 2.45 cm
1 gal = 3785.41 cubic cm

*TerraMatrix Inc. * P.O. Box 774018 * Steamboat Springs, Colorado 80477 * (303) 879-6260*

Appendix D

Geosynthetics CQA Records

Attachment M

GEOSYNTHETICS INVENTORY, QUALITY .NTROL AND CONFORMANCE TESTING LOG

PROJECT NUMBE
PROJECT NAME:
OWNER:
INSTALLER:

DATE OF INVENTORY:_____
DATE OF DELIVERY: _____
TRUCK TYPE:_____
BILL OF LADING NUMBER:_____

QAM:_____
UNLOADING EQUIPMENT:_____
WEATHER CONDITIONS:_____
MANUFACTURER: _____

MATERIAL TYPE: GEOMEMBRANE GCL GEONET (COMPOSITE) GEOTEXTILE(CU) OTHER:_____

	INVENTORY LOG						QUALITY CONTROL CERTIFICATES AND CONFORMANCE TESTING VERIFICATION				
	ROLL NUMBER	LOT #	MON ID	ROLL LXW (ft x ft)	AREA (ft2)	DAMAGE REMARKS	QC CERT RECD Y/N	DATE CONF. SAMPLE CUT/ SENT OUT	DATE CONF. RESULTS REC'D.	CONF. RESULTS REVIEWED BY/DATE	P/F
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											
13.											
14.											
15.											
16.											
17.											
18.											
19.											
20.											

NCR#_____

TOTAL AREA THIS PAGE

REVIEWED BY: DATE:

GEOSYNTHETICS PANEL DEPLOYMENT LOG

PROJECT NUMBER:
OWNER:
INSTALLER:

DATE :_____
SHEET NUMBER___**of**___

GEOSYNTHETIC TYPE: **PRIMARY/SECONDARY/TERTIARY/CLOSURE**
GEOMEMBRANE **GCL** **GEONET(COMPOSITE)** **GEOTEXTILE(CU)**

OTHER/COMMENTS: _____
SUBGRADE CONDITION (Surface Compaction, Protrusions, Desiccation, Excessive Moisture): _____

PANEL NUMBER															
ROLL NUMBER															
DEPLOYED LENGTH (FT)															
*AMBIENT AIR TEMP (F)															
VISUAL OBSERVATION															
**OBSERVED OVERLAP															
MONITOR															
REMARKS															
SHEET THICKNESS (MILS)	LEAD	TRAIL	SPEC	P F		LEAD	TRAIL	SPEC	P F		LEAD	TRAIL	SPEC	P F	
			36					36					36		
			36					36					36		
			36					36					36		
			36					36					36		
			36					36					36		
AVERAGE			60					60					60		

PANEL NUMBER															
ROLL NUMBER															
DEPLOYED LENGTH (FT)															
*AMBIENT AIR TEMP (F)															
VISUAL OBSERVATION															
**OBSERVED OVERLAP															
MONITOR															
REMARKS															
SHEET THICKNESS MILS	LEAD	TRAIL	SPEC	P F		LEAD	TRAIL	SPEC	P F		LEAD	TRAIL	SPEC	P F	
			36					36					36		
			36					36					36		
			36					36					36		
			36					36					36		
			36					36					36		
AVERAGE			60					60					60		

NCR REFERENCE NUMBER (IF REQUIRED)_____

INSTRUMENT ID#
THERMOMETER _____
MICROMETER _____
WIND GAUGE _____

REVIEWED BY_____ **DATE**_____

* Ambient air temperature must be between 40° and 100° F for HDPE deployment
** Observed overlap must conform to construction specifications for relevant material type

File: Paneldep log
Printed: December 9, 1997 (10:01am)

TerraMatrix Inc. • P.O. Box 774018 • Steamboat Springs, Colorado 80477 • (970) 879-6260 • (970) 879-9048 (fax)

GEOMEMBRANE DEFECT LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

SHEET NUMBER: _____

DEFECT CODE	DEFECT LOCATION		DEFECT TYPE (SEE BELOW)	LOG DATE	CQA MON	REMARKS	REPAIR DATE*	TEST DATE *
	SEAM, PANEL OR REPAIR NO.	DEFECT LOCATION DESCRIPTION						
A								
B								
C								
D								
E								
F								
G								
H								
I								
J								
K								
M								
N								
P								
Q								
R								
S								
T								
W								
X								

AD ANIMAL RELATED DAMAGE
B UNDISPERSED RESIN BEAD
BO FUSION WELDER BURN
BS BOOT, SKIRT FOR FML PENETRATION
CO CHANGE OF OVERLAP
CR CREASE
D INSTALLATION DAMAGE
DF-# FUSION DESTRUCTIVE TEST NUMBER
DX-# EXTRUSION DESTRUCTIVE TEST NUMBER
EE EARTHWORKS DAMAGE
EXT EXTENSION
FM FISHMOUTH
FS FAILED SEAM LENGTH
FTS FIELD TEST STRIP
HT HEAT TRACK BURN
IO INSUFFICIENT OVERLAP (UNDER SPEC)
MO MANUFACTURER/DELIVERY DAMAGE
PT PRESSURE TEST CUT
SI SOIL IRREGULARITY
SL SLAG ON TEXTURED SHEET
T THREE PANEL INTERSECTION
VL VACUUM TEST LEAK
WR WRINKLE
WS WELDER RESTART
OTHER

NOTE: * COLUMNS TO BE USED BY THE DATA REVIEWER ONLY

REVIEWED BY:_____ DATE_____

NCR REFERENCE NUMBER (IF REQUIRED)_____

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File:P:\SHELLY\FIELDFRM\DEFECTLO.FRM 12/9/97

GEOMEMBRANE S. . PRESSURE TEST LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

DATE: ___________

MACHINE NUMBER: _______ CQA MONITOR: _________ SHEET NUMBER: ____of____

SEAM NUMBER*	SEAM SECTION** FROM - TO	TECH ID	START TIME	FINISH TIME	INITIAL PRESSURE	FINAL PRESSURE	PRESSURE DIFFERENCE	PASS/FAIL	OBS TEST Y/N	ENTIRE SEAM COMPLETE NO	ENTIRE SEAM COMPLETE YES	REMARKS
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											
/	-											

* Indicate seam number by two adjacent panel numbers, with the lowest panel number indicated first.
** Reference seam endpoints from an End of Seam (EOS), a defect repair number or a point location on the seam (reference point, distance from reference point).

REVIEWED BY______ DATE______

NCR REFERENCE NUMBER (IF REQUIRED)____________________________

GEOMEMBRANE S I VACUUM TEST LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

CQA MONITOR: _____
VACUUM BOX NUMBER_____

SHEET ____ **OF** __

SEAMS								REPAIRS					
SEAM NUMBER*	SEAM SECTION ** FROM TO	TEST DATE	TECH ID	DEFECTS***	SEAM COMPLETE NO YES	OBS TEST	REMARKS	DEFECT CODE	TEST DATE	TECH ID	DEFECTS***	OBS TEST	REMARKS
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-				/								
/	-												
/	-				/								
/	-				/								
/	-				/								

* Indicate seam number by two adjacent panel numbers, with the lowest panel number indicated first and proper layer (i.e., Tertiary, Secondary Primary).
** Reference seam endpoints from an End of Seam (EOS), a repair number or a point location on the seam (i.e., Reference point, distance from reference point).
*** Record quantity of leaks detected and reference new defect code in remarks column.

REVIEWED BY_____ **DATE**_____

NCR REFERENCE NUMBER (IF REQUIRED)_____

GEOMEMBRANE EX[illegible]SION TRIAL SEAM LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

DATE: __________

SHEET NUMBER: _____of_____

TRIAL SEAM NUMBER (TSX-#)	TIME WELDED	AMBIENT TEMPERATURE (F)	TECH ID	MACHINE NUMBER (MX-#)	CQA MON ID	TEMPERATURE SETTINGS		PEEL TEST RESULTS			SHEAR TEST RESULTS			PASS/FAIL	REMARKS
						PRE-HEAT SETTING	BARREL TEMP. (F)	SAMPLE	STRENGTH (lbs/in)	BREAK TYPE	SAMPLE	STRENGTH (lbs/in)	BREAK TYPE		
								A			D				
								B			E				
								C							
								A			D				
								B			E				
								C							
								A			D				
								B			E				
								C							
								A			D				
								B			E				
								C							
								A			D				
								B			E				
								C							
								A			D				
								B			E				
								C							
SPECIFICATION REQUIREMENTS : 60 mil GEOMEMBRANE								PEEL		FTB	SHEAR		FTB		

(CIRCLE MACHINE USED)

TMI TENSIOMETER CALIBRATION: SERIAL #: 124 CALIBRATION DATE: 4/1/96 RECALIBRATION DATE: 4/1/97
NSC TENSIOMETER CALIBRATION: SERIAL #'S:93021/91001 CALIBRATION DATE: 10/14/96 RECALIBRATION DATE: 10/14/97

NCR REFERENCE NUMBER (IF REQUIRED)____________________

REVIEWED BY_______ DATE_______

GEOMEMBRANE FUSION DESTRUCTIVE LOG

ROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

DESTRUCTIVE MONITOR: _____

DATE TESTED:_____

DESTRUCTIVE SAMPLE NUMBER: _____(ASSIGNED BY QAM)

DESTRUCTIVE INFORMATION:

DEFECT NO.	SEAM NO.	LOCATION	TECH ID	MACHINE NUMBER	DATE	CQA MON ID

DESTRUCTIVE TEST DATA:

PEEL TEST RESULTS					
SAMPLE (INSIDE TRACK)	STRENGTH (lbs/in)	BREAK TYPE	SAMPLE (OUT. TRACK)	STRENGTH (lbs/in)	BREAK TYPE
A1			A2		
B1			B2		
C1			C2		
D1			D2		
E1			E2		
SPECIFICATION REQUIREMENTS	90	FTB		90	FTB

SHEAR TEST RESULTS						
SAMPLE	PEAK STRENGTH (lbs/in)	BREAK TYPE	WELD TO GRIP LENGTH (a)	WELD TO GRIP FAILING SIDE AT YIELD (b)	WELD TO GRIP FAILING SIDE AT BREAK (c)	SHEAR STRAIN (%) AT YIELD((b-a)/a)/ AT BREAK ((c-a)/a)
F						
G						
H						
I						
J						
SPECIFICATION REQUIREMENTS	119	FTB				AT YIELD - 10 % MIN AT BREAK - 50 % MIN

PASS/FAIL: _____

REMARKS:_____

REVIEWED BY_____ DATE_____

(CIRCLE MACHINE USED)

TMI TENSIOMETER CALIBRATION: SERIAL #: 124 CALIBRATION DATE: 4/1/96 RECALIBRATION DATE: 4/1/97
NSC TENSIOMETER CALIBRATION: SERIAL #'S: 93021/91001 CALIBRATION DATE: 10/14/96 RECALIBRATION DATE:10/14/97

NCR REFERENCE NUMBER (IF REQUIRED)_____

GEOMEMBRANE EXT[illegible]SION SEAM/REPAIR LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

MACHINE NUMBER: MX_____ CARRYOVER: _____ CQA MONITOR: _____ DATE: _____

PASSING TRIAL SEAM INFORMATION EXTRUDER PURGED OF HEAT DEGRADED EXTRUDATE (1)_____ SHEET NUMBER: ____of____

NO	TIME	TECH ID	PRE-HEAT	BARREL

SEAM NUMBER (2)	SEAM SECTION (3) FROM	TO	DEFECT CODE	START TIME	TECH ID	TEMPERATURE VERIFICATION PRE-HEAT SETTING	TEMPERATURE VERIFICATION BARREL TEMP. (F)	REPAIR SIZE (L x W)	APPROX. LENGTH WELDED (ft)	DISTANCE FROM LAST DESTRUCTIVE (ft)	DESTRUCTIVE NUMBER	ENTIRE SEAM COMPLETE No	ENTIRE SEAM COMPLETE Yes	REMARKS	NON-DEST TEST DATE (minimum wedge)
/															
/															
/															
/															
/															
/															
/															
/															
/															
/															
/															
/															

(1) Extruder must be purged when starting a seam and when welding stops for more than 1 minute.
(2) Indicate seam number by two adjacent panel numbers, with the lowest panel number indicated first.
(3) Reference seam endpoints from an End of Seam (EOS), a defect repair number or a point location on the seam (reference point, distance from reference point).

REVIEWED BY_____ DATE_____

(CIRCLE MACHINE USED)
TMI TENSIOMETER CALIBRATION: SERIAL NUMBER: 124 CALIBRATION DATE: 4/1/96 RE-CALIBRATION DATE: 4/1/97
NSC TENSIOMETER CALIBRATION: SERIAL NUMBER: 93021/91001 CALIBRATION DATE: 10/14/96 RE-CALIBRATION DATE: 10/14/97

NCR REFERENCE NUMBER (IF REQUIRED) _____

TerraMatrix Inc. * P.O. Box 774018 * Steamboat Springs, Colorado 80477 * (970) 879-6260 * (970) 879-9048 (fax) File: P:\SHELLY\FIELDFRM\EXTRUSI LOG 4/8/9[illegible]
Printed: December 9, 1997

GEOMEMBRA USION SEAM LOG

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:
DATE: _____

MACHINE NUMBER: M#_____ CARRYOVER: _____ CQA MONITOR: ____ SHEET NUMBER: ____of____

PASSING TRIAL SEAM INFORMATION

NO.	TIME	TECH ID	WEDGE TEMP.	SPEED

SEAM NUMBER[1]	SEAM SECTION[2] FROM	TO	START TIME	TECH ID	TEMPERATURE/SPEED VERIFICATION WEDGE TEMP.(F)	SPEED	APPROX. LENGTH WELDED (ft)	DISTANCE FROM LAST DESTRUCTIVE (ft)	DESTRUCTIVE NUMBER	ENTIRE SEAM COMPLETE NO	YES	REMARKS	NON-DESTRUCT TEST DATE (pressure only)
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												
/	-												

(1) Indicate seam number by two adjacent panel numbers, with the lowest panel number indicated first.
(2)Reference seam endpoints from an End of Seam (EOS), a defect repair number or a point location on the seam (reference point, distance from reference point).

REVIEWED BY_____ DATE_____

(CIRCLE MACHINE USED)

TMI TENSIOMETER CALIBRATION: SERIAL NUMBER: 124 CALIBRATION DATE: 4/1/96 RECALIBRATION DATE: 4/1/97
NSC TENSIOMETER CALIBRATION: SERIAL NUMBER: 93021/91001 CALIBRATION DATE: 10/14/96 RECALIBRATION DATE: 10/14/97

NCR REFERENCE NUMBER (IF REQUIRED)_____

LETTER OF ACCEPTANCE
OF SOIL SUBGRADE SURFACE

PROJECT NUMBER:
OWNER:
LOCATION:
INSTALLER:

	Check Applicable
Pond 4	_____
Repository	_____

I, the Undersigned, the duly authorized representative of TerraMatrix Inc. (TMI), have visually observed the soil subgrade surface within the area described below, and found that: 1.) all stones, rocks, debris, trash, roots, branches, and foreign matter, as well as pockets of soft or loose soil, and stones and rocks larger than ½ inch, have been removed from the surface; 2.) the surface is smooth and free of irregularities, sharp objects and abrupt changes in grade; and, 3.) the surface has been smooth-drum rolled.

This is a general acceptance for the area described below. The area of deployment for any given day will be reinspected by TerraMatrix to ensure that the subgrade surface continues to meet the above described criteria. The final inspection will be recorded in the TerraMatrix daily logs.

Area that has been observed is outlined on the attached drawing and is identified by:

_____
_____
_____

TMI REPRESENTATIVE

_____	_____	_____	_____
NAME	SIGNATURE	TITLE	DATE

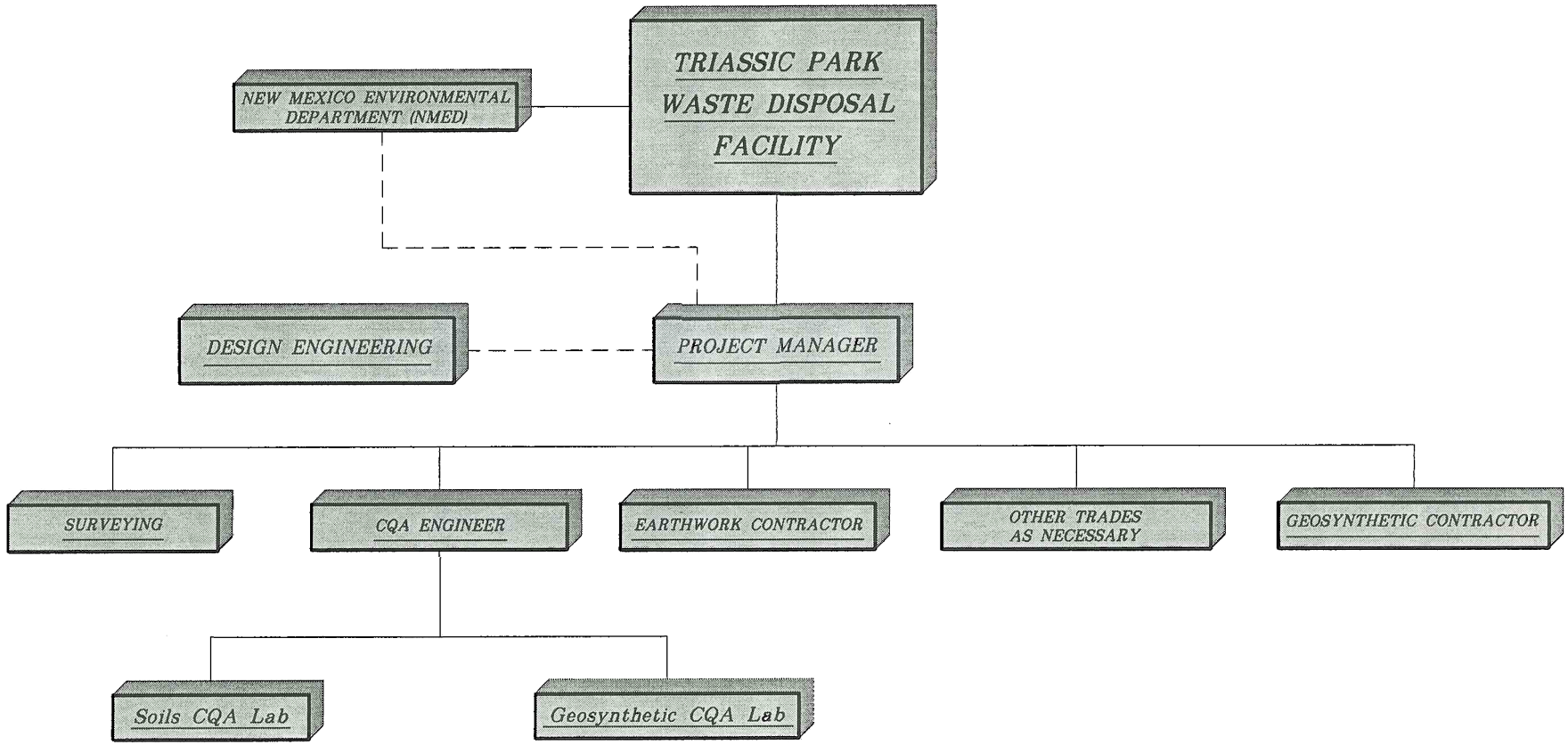
LETTER RECEIVED BY

_____	_____	_____	_____
NAME	SIGNATURE	TITLE	DATE

NCR REFERENCE NUMBER (IF REQUIRED)_____

File: P:\SHELLY\FIELDFRM\SURFACCP.FRM
Printed: December 9, 1997 (10:07am)

*TerraMatrix Inc. * P.O. Box 774018 * Steamboat Springs, Colorado 80477 * (303) 879-6260 * (303) 879-9048 (fax)*



REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	TECH LAW REVIEW COPY	4/24/00	J.Pellicer	J.Bever	J.Pellicer

TerraMatrix
MONTGOMERY WATSON
Mining Group

PROJECT No: 602-0200
AutoCAD FILE: TPORG-TECHLAW-1
SCALE: Not to Scale
FIGURE No: I-1

Triassic Park Waste Disposal Facility

TYPICAL PROJECT ORGANIZATION