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**CONSTRUCTION QUALITY ASSURANCE PLAN
LANDFILL CAP REMEDIAL ACTION**

**ONALASKA MUNICIPAL LANDFILL SITE
Onalaska, Wisconsin**

WA 38-5NL5 / Contract No. 68-W8-0040

April 1992

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Section 1 Introduction

Purpose

This Construction Quality Assurance Plan (CQAP) for the landfill cap remedial action at the Onalaska Municipal Landfill Site provides a manual for:

- Observing construction activities
- Documenting that construction has been completed in general accordance with the plans and specifications

Scope and Limitations

The scope of this CQAP includes:

- Identifying the project participants and organizational structure
- Defining participants' responsibilities and authorities
- Outlining project communication
- Establishing quality levels and requirements
- Establishing project closeout guidelines

The plan consists of text and several appendixes. The text identifies the project participants and their responsibilities and authorities, the documentation format, and general quality assurance (QA) requirements for various elements of the project. The appendixes present QA requirements which relate to specific elements of the landfill cap remedial action.

This plan does not include:

- A subcontractor's or sub-subcontractor's quality control (QC) plan
- A manual of observation and test procedures
- QA procedures associated with operating or monitoring the closed landfill

Project Description

The Onalaska Municipal Landfill site is located in the Township of Onalaska, La Crosse County, Wisconsin. The site consists of Onalaska's former municipal landfill, about 8 acres in size, and adjacent property under which a groundwater plume of naphtha contaminants has migrated. The site is bordered by the Black River to the north and west, and Sportsmans Club Road to the south and east.

The site was a sand and gravel quarry before it was used as a municipal landfill from the 1960s to the mid-1970s. Industrial wastes, including naphtha-based solvents, were also disposed of at the site.

The U.S. Environmental Protection Agency (U.S. EPA) conducted a remedial investigation and feasibility study (RI/FS) at the site from April 1988 to December 1989. The RI determined that, as a result of waste disposal at the landfill, various chemical contaminants had been leaching into the groundwater and flowing toward the Black River. The Record of Decision (ROD), signed in August of 1990, calls for the following remedial action to protect human health and the environment:

- Design, construction, operation, and maintenance of a groundwater extraction, treatment, and discharge system to meet cleanup standards and discharge requirements to be designated
- In situ bioremediation of soil contaminated by naphtha floating on the groundwater table and emanating from the landfill
- Design, construction, and maintenance of a landfill cap under applicable or relevant and appropriate laws
- Monitoring of groundwater, surface water, and sediments

Applicable Regulations and Guidance

This CQAP has been prepared to meet construction and QA requirements of the following:

- Wisconsin Solid Waste Management Regulations, Wisconsin Administrative Code, Department of Natural Resources, NR 500, 504, 506, 514, and 516.
- Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act (RCRA).

- Technical Guidance Document: *Construction Quality Assurance for Hazardous Waste Land Disposal Facilities*, EPA/530-SW-86-031, October 1986.
- CH2M HILL, *Construction Inspection Manual (CIM)*, revised January 1991.

Key Concepts

Quality Assurance

Quality assurance refers to all activities designed to provide adequate documentation and confidence that materials and workmanship substantially meet the requirements of the project objectives.

Quality Control

Quality control refers to those actions taken by the manufacturer, fabricator, or subcontractor to confirm that materials and workmanship meet the requirements of the contract or purchase order and the applicable drawings and specifications. QC requirements are not specifically addressed in this document but are presented in Section 01400 of the General Requirements (see Subcontract Documents).

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Section 2 Responsibilities and Authority

Organizational Structure

The conceptual organizational structure of the construction team is shown in Figure 2-1. Key parties of the organization include the U.S. EPA, Wisconsin Department of Natural Resources (DNR), the Prime Contractor (CH2M HILL), and the Construction Subcontractor.

Responsibilities

EPA

The EPA is responsible for the overall construction of the facility. The EPA must comply with the requirements of the DNR and demonstrate, by submission of construction QA documentation, that the facility was constructed as specified in the design. The EPA will retain independent design, QA, and construction organizations to accomplish the work and will have the authority to hire and fire these organizations. The EPA also has the authority to accept or reject design plans and specifications, QA plans, reports, and recommendations of the Quality Assurance Manager, and the materials and workmanship of the Construction Subcontractor.

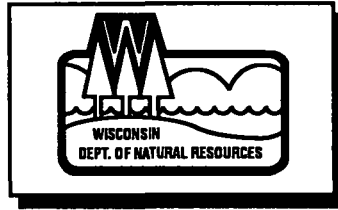
DNR

The DNR is authorized by law to issue permits for construction of hazardous waste disposal facilities. It is the responsibility of the DNR to review the EPA's design and site-specific QA program for compliance with the DNR's regulations.

The DNR has the responsibility and authority to review and accept, or reject, any design revisions submitted by the EPA. The DNR also has the authority to review all construction QA documentation during or after facility construction to confirm that the approved COAP was followed, and that the facility was constructed as specified in the design. These activities may involve onsite inspections or testing independent of the QA program.

CH2M HILL Site Manager

The CH2M HILL Site Manager is responsible for CH2M HILL activities as stated in the ARCS V contract (EPA Contract No. 68-W8-0040) between CH2M HILL and the EPA. The Site Manager provides and maintains qualified project staff, monitors and controls the budget, and is the primary contact with EPA on contractual matters.



LEGEND

- Responsibility
- Communication

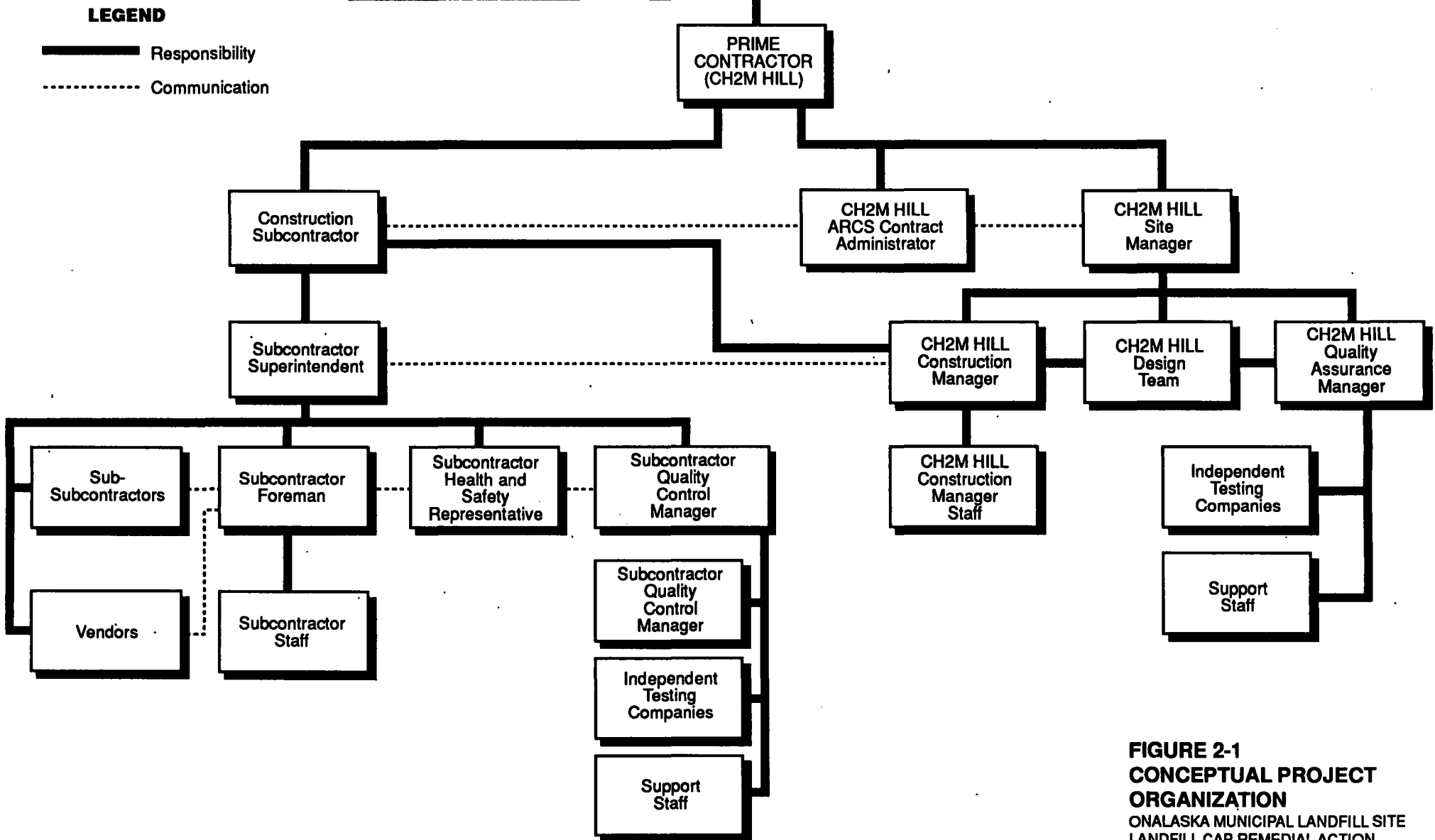


FIGURE 2-1
CONCEPTUAL PROJECT ORGANIZATION
 ONALASKA MUNICIPAL LANDFILL SITE
 LANDFILL CAP REMEDIAL ACTION

The Site Manager supervises the CH2M HILL design staff and assists them in resolving project related issues which cannot be adequately resolved at a lower level.

CH2M HILL Design Staff

The CH2M HILL Design Staff's primary responsibility is to design the facility so that it will fulfill the operational requirements of the EPA and the performance requirements of the DNR. Design activities may not end until construction is complete. The design staff will:

- Clarify or interpret requirements of the plans and specifications
- Review submittals for conformance to the construction documents
- Review requests for design changes during construction
- Prepare design changes to account for unexpected site conditions or changes in construction or operation methodology

CH2M HILL Quality Assurance Manager

The CH2M HILL Quality Assurance Manager is the task manager responsible for implementing the CQAP and for advising the CH2M HILL Site Manager and Construction Manager on QA and construction-related issues. The Quality Assurance Manager coordinates and supervises the activities of CH2M HILL personnel and other personnel and organizations, as required, and provides QA, review, and advisory services during construction. The Quality Assurance Manager is also responsible for monitoring the QA and construction management activities and for seeing that they are coordinated, yet independent, paths. He or she advises the CH2M HILL Site Manager and the EPA of conditions which may affect the proper execution or quality of the work. Specific responsibilities include:

- Reviewing and critiquing the QC plan submitted by the Subcontractor
- Ensuring adequate indoctrination and training of QA and support personnel
- Managing the QA budget

Resident Staff

The CH2M HILL Construction Manager is directly responsible to the CH2M HILL Site Manager for the field administration of the construction contract requirements during construction. He or she may have specific design review assignments during construction. In addition, the Construction Manager performs field observation duties

and directs a field technical staff. The Construction Manager acts as a liaison, and is in direct communication with, the Construction Subcontractor and the CH2M HILL Design Team.

The Construction Manager and field technical staff observe the Construction Subcontractors' materials and workmanship for compliance with the plans and specifications and can issue and enforce nonconformance reports for subcontractor workmanship and materials that do not meet the requirements of the contract documents. The field staff has the authority to direct the subcontractor. The Quality Assurance Manager will review nonconformance reports submitted by the Construction Manager. The Construction Manager will be available onsite on a full-time basis during construction and will be present to observe construction of critical design features.

Construction Manager

The Construction Manager performs the following duties:

Prebid

- Performs a constructibility review of the design
- Attends prebid meeting; assists design staff in preparation of addenda resulting from prebid meeting
- Conducts subcontractor prequalification
- Opens and evaluates construction contract bids

During Construction

- Establishes site field office including communication and filing systems and other necessary office equipment
- Supervises and directs Construction Inspectors and Independent Testing Companies' daily activities to coordinate with the Subcontractors' daily activities
- Submits nonconformance reports and other QA documents to the EPA as an authorized representative of the Quality Assurance Manager
- Reviews Subcontractor change order cost estimates, time extension requests, and claims
- Reviews subcontractor schedules

- **Reviews subcontractor bid breakdown and schedule of payment**
- **Documents the resolution of inadequacies noted in nonconformance reports**
- **Establishes location and time and frequency sampling criteria for verification testing to be performed by Construction Inspectors or Independent Testing Companies**
- **Reviews results of subcontractor-submitted QC tests for compliance with contract requirements**
- **Reviews daily inspection reports and test data for completeness before submitting them to the Quality Assurance Manager**
- **Conducts weekly progress meetings and prepares and distributes meeting notes discussing progress, problem areas, and status of long-lead items**
- **Updates own record drawings to compare against Subcontractors' record drawings**
- **Attends record drawing review meetings**
- **Advises the Quality Assurance Manager and the EPA of conditions that may affect satisfactory completion and/or quality of work**

Construction Inspectors

Construction Inspectors perform the following duties:

- **Observes the fabrication, manufacture, and testing of materials in the Subcontractors' or Vendors' offsite or onsite work areas, as required**
- **Observes and samples purchased materials upon delivery to verify that correct type, quantity, and size of material has been furnished**
- **Observes performance of Subcontractor's work and identifies any areas of noncompliance with contract standards**
- **Performs field QA verification testing according to the program outlined by the Quality Assurance Manager**
- **Prepares daily diaries of construction activities, observations, and verification tests performed**

- Advises Construction Manager of site conditions or construction conditions which may affect the accomplishment or quality of work
- Maintains a visual account of construction progress by taking photographs on a regular basis

Independent Testing Companies

Independent Testing Companies may be retained by the Quality Assurance Manager to perform geotechnical laboratory or field testing and/or inspection duties on materials and construction. Responsibilities of the Independent Testing Companies will include:

- Controlling and supervising independent testing company personnel assigned to the project
- Ensuring that all personnel assigned to the project are properly qualified and trained for the assigned tasks
- Maintaining the proper equipment and supplies for performing the assigned task in accordance with specified test procedures
- Advising the Quality Assurance Manager and staff in selecting geotechnical samples for QA
- Obtaining test specimens and performing QA tests as requested
- Documenting and submitting test results and observation records as established by the Quality Assurance Manager and the CQAP
- Advising the Quality Assurance Manager and staff concerning the interpretation of observations and test results
- Reporting any noncompliance to the Quality Assurance Manager and Construction Manager immediately
- Maintaining project files for review, upon request, by the Quality Assurance Manager and staff

Construction Subcontractor

The Construction Subcontractor, by way of a specific contract with the Contractor, is charged with performing and controlling the construction work in accordance with the contract documents.

Vendors, Independent Test Companies, and Sub-subcontractors to the Construction Subcontractor

These organization are agents of the Construction Subcontractor by way of contracts, subcontracts, or similar arrangements. As such, they are responsible, through the Subcontractor, for maintaining QC procedures in accordance with their contractual arrangements and the Subcontractor's QC plans. These agents should also provide the Subcontractor with QC data and reports necessary for the agents' submittals to the EPA.

Authority

The key parties have specific authorities dictated by the various binding contracts and regulatory documents which govern the construction of the Landfill Cap Remedial Action. The authority assigned to each party is outlined in general terms as follows:

- **DNR**—authority to enforce applicable regulatory documents. The DNR is authorized to visit the site and perform observations, audits, verification testing, etc., at any time.
- **EPA**—contractual authority with respect to the contract with CH2M HILL. The EPA is authorized to visit the site and perform observations, audits, verification testing, etc., at any time.
- **Construction Subcontractor**—authority to perform construction activities within the limits of the contractual documents between CH2M HILL and the Construction Subcontractor.
- **CH2M HILL Project Staff**—authority to interpret the project design stated in the construction documents as authorized by the EPA and to carry out activities required to properly document the materials and workmanship of the Construction Subcontractor and the Subcontractor's QC group, in accordance with the requirements of the contract documents and the CQAP. The project staff has contractual authority with respect to the individual contract with the Construction Subcontractor.

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Section 3 Project Communications

Lines of Communication

Accurate and timely communication is required to avoid construction related conflicts and potential errors and omissions. The EPA, CH2M HILL, the Construction Subcontractor, and their respective employees and staff must have an established communication network as shown in Figure 2-1. Establishing open lines of communication is essential for maintaining strong working relationships and producing quality work.

The primary lines of communication between key project parties are shown in the general organization chart (Figure 2-1). Lines of communication will be discussed and established by all parties at the preconstruction meeting. The discussion will include:

- Communication procedures between supervisory and field staff
- Direct communication procedures between key parties for specific issues and situations
- Procedures and restrictions for secondary lines of communication within the project organization
- Procedures for information transfer and confirmation between the various parties
- Procedures for documentation of all communications
- Format for meetings, reports, submittals, etc.

Communications will be documented with each party receiving a copy of such documentation (e.g. telephone memorandums, meeting notes, etc.). Copies will be routed to other parties if they should be aware of the situation (i.e., problem, change, agreement, etc.).

Strict document control procedures will be established for items such as subcontractor submittals, test results, and plan or specification revisions. These controls will include distribution and confirmation procedures to verify that documents are appropriately dispatched and incorporated into the project. Whenever possible, documents indicating revisions in plans, specifications, or procedures will be distributed immediately and explained to all parties at routine or special project meetings.

Project Meetings

Project meetings will be scheduled to define and maintain responsibility and authority by promoting communication between various personnel responsible for designing, constructing, managing, and observing the construction. Conduct of these meetings is the primary responsibility of the Construction Manager or an authorized representative. The purpose of the routine project meetings is to keep all parties informed and provide a forum for solving design, construction, and QA problems. Meeting minutes will be taken and distributed by the Construction Manager.

Prebid Meeting

A meeting will be held before the bid submittal date to provide a forum for interested Subcontractors to discuss the contract documents. At a minimum, the Construction Manager, Quality Assurance Manager, Site Manager, EPA representative, and DNR representative should be present to meet with interested Subcontractors. Any specific questions that are brought up will be answered in the form of an addendum to the contract documents.

Preconstruction Meeting

A meeting will be held to review the project and schedule and to clarify or resolve issues before construction startup. At a minimum, the Construction Manager, Quality Assurance Manager, Construction Subcontractor, EPA and DNR representatives, and selected sub-subcontractors should be present. During this meeting the Construction Manager should:

- Provide each party with relevant construction QA documents and supporting information. Supporting information may include construction drawings, specifications, site health and safety plans, and other applicable documents. This information transfer is not limited to documents distributed by the Construction Manager. All parties should use the opportunity to distribute relevant documents.
- Review the General Conditions. Identify project site limits emphasizing coordination with other contracts.
- Familiarize each party with their specific responsibilities within the CQAP relative to the design criteria, construction drawings, schedules, and specifications. Discuss specific milestone dates, liquidated damages, etc.

- Discuss the purpose of the CQAP and the documentation structure provided by the CQAP to verify that the facility will be constructed efficiently and within the specified design criteria and schedule.
- Review the responsibilities of each party.
- Review lines of authority and communication for each party.
- Discuss the established procedures and protocol for observations and tests, including sampling strategies.
- Discuss the established procedures and protocol for handling construction deficiencies, repairs, and retesting.
- Review methods for documenting and reporting inspections and testing data.
- Review work area security and safety protocol.
- Discuss procedures for locating and protecting construction materials and preventing damage to the materials from inclement weather or other events.
- Discuss submittal and approval procedures for O&M manuals and payment withholding if O&M Manuals are not approved at 75 percent construction.
- Conduct a site walk to review construction material and equipment storage locations.
- Discuss payment for work in place including method of payment and unit cost work.

The preconstruction meeting will be documented by the Construction Manager and minutes will be provided to all parties.

Progress Meetings

Progress meetings will be held at least weekly at the Contractor's field office according to a schedule agreed to by the Construction Manager and the Construction Subcontractor. At a minimum, the meeting will be attended by the Construction Subcontractor and the Construction Manager. The Quality Assurance Manager should attend the meeting during periods of critical construction or problems which require his or her presence. The purpose of the progress meeting is to:

- Review the previous week's activities and accomplishments

- Review the Construction Subcontractor's work plan for construction for the upcoming week
- Determine whether offsite personnel should be onsite to witness specified testing
- Discuss existing or potential construction or schedule problems including delivery of any long-lead items

The progress meeting will be documented by the Construction Manager or a designated representative. Copies of the meeting minutes will be sent to all personnel attending the meeting and the Site Manager, the Quality Assurance Manager, and the EPA, if not present.

Problem or Work Deficiency Meetings

A special meeting may be held if a problem or deficiency is present or likely to occur. At a minimum, the meeting should be attended by the Construction Subcontractor and the Construction Manager. If the problem relates to QA issues, the Quality Assurance Manager and applicable Construction Inspectors should attend. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

- Define and discuss the problem or deficiency
- Review alternative solutions
- Implement a plan to resolve the problem or deficiency

These meetings will be documented by the Construction Manager or a designated representative. Copies of the meeting minutes will be sent to all personnel attending the meeting and the Site Manager, the Quality Assurance Manager, and the EPA, if not present.

Document Transmittals

Document transmittals between the project parties provide a record of communications and are necessary for keeping appropriate construction and QA personnel informed of project requirements, progress, changes, and quality of the work. To prevent misunderstandings and omissions, transmittals should be formally communicated with proper documentation and confirmation of submittal and receipt.

Contract Clarification / Interpretation Requests

Contract Clarification/Interpretation Requests (Form 270) are submitted when an explanation of the intent of specific construction requirements, as presented in the

contract documents, is required. These are generally submitted by the Construction Subcontractor to the Construction Manager.

Contract Clarification/Interpretation Requests shall be submitted to the CH2M HILL Design Team through the Construction Manager who will coordinate the request with the CH2M HILL Quality Assurance Manager. All interpretations of design or specifications by the Design Team will be issued in writing. In special cases, a Design Engineer may communicate a design interpretation or clarification verbally, followed by written confirmation. The Construction Manager is responsible for informing all parties of the Design Team's interpretations and will control the distribution of documents to construction, QA, and regulatory personnel.

Contract Modification Requests

A Contract Modification Request is made if a change in plans and specifications is deemed necessary for the following reasons:

- Changed site conditions
- Changed materials conditions
- Alternative design procedures proposed
- Alternative materials proposed
- Unit cost item adjustment

Contract Modification Requests are generally written by a Design Engineer, possibly in response to a Contract Clarification/Interpretation Request submitted by the Construction Subcontractor or the Construction Manager, and implemented through the construction management chain rather than QA personnel. However, Contract Modification Requests involve other groups such as regulators, and estimators. As a result, all Contract Modification Requests should be submitted to the Construction Manager for coordination with the Design Engineer and other appropriate groups. The Construction Manager will review, negotiate, and finalize all Contract Modification Requests and issue Contract Modifications (Change Orders) as necessary. The Construction Manager is responsible for transmitting all Contract Modifications to the appropriate organizations, including the QA team, before the change becomes part of the project record.

Likewise, the Construction Manager may issue a Field Order (Form 275) for clarification and interpretation of drawings in cases where a contract modification is not suitable. For example, a Field Order may be issued in response to a Subcontractor-initiated Contract Clarification/Interpretation Request when the clarification does not affect the schedule or cost of the work.

Construction Subcontractor Submittals

The contract documents require that the Subcontractor submit a Quality Control Plan, materials certifications, inspection and test data, etc., for review by the Construction Manager and the Quality Assurance Manager and staff. Documents shall be submitted to the Contractor according to the frequency and number specified in the contract documents and the CQAP. Sub-subcontractor and vendor submittals shall be made through the Subcontractor. All test data and similar submittals shall be submitted with a transmittal form outlining the contents of the submittal and the date submitted.

The Subcontractor shall make submittals to the Site Manager, who will forward copies to the Submittal Coordinator. A flow chart of the submittal process is shown in Figure 3-1.

As submittals are received, the receipt will be documented on a submittal log form by the Submittal Coordinator. The Submittal Coordinator will assign the submittal to appropriate project team member(s) for detailed review. The reviewer(s) will check the submittal for general compliance with the contract documents and will note missing information or deviations. The Construction Manager will oversee the review process and help resolve questions regarding compliance with subcontract documents.

Review comments on submittals will clearly state what (if any) information the reviewer considers to be missing. Notes will be written legibly with red ink on the front sheet of a submittal so that deficiencies can be clearly identified by the Subcontractor. Notes will not be in the form of questions, rather, they will state what has been omitted or what is not acceptable.

Following the detailed review, the Submittal Coordinator will send a marked-up copy of the submittal and a submittal reply form to the Subcontractor. The Submittal Coordinator will indicate on the submittal reply form whether deviations from the subcontract documents were noted, and whether additional submittals or resubmittals by the Contractor are required. The Submittal Coordinator will keep the Site Manager and the Construction Manager informed of the submittal process. Copies of the original submittal, review copies, and submittal log and reply forms will be kept in a project submittal file.

Before construction, the Subcontractor should submit requests for approval of substitutions, clarifications of design, and other review items to the Construction Manager, who will forward copies to the Quality Assurance Manager.

QC documentation generated by sub-subcontractors or suppliers will be submitted through the Subcontractor to the Construction Manager, who will forward copies to the Quality Assurance Manager for conformance evaluation and incorporation into the records. The appendixes refer to specific forms that are to be used for QC data submittals. Sample copies of forms are supplied in Appendix D.

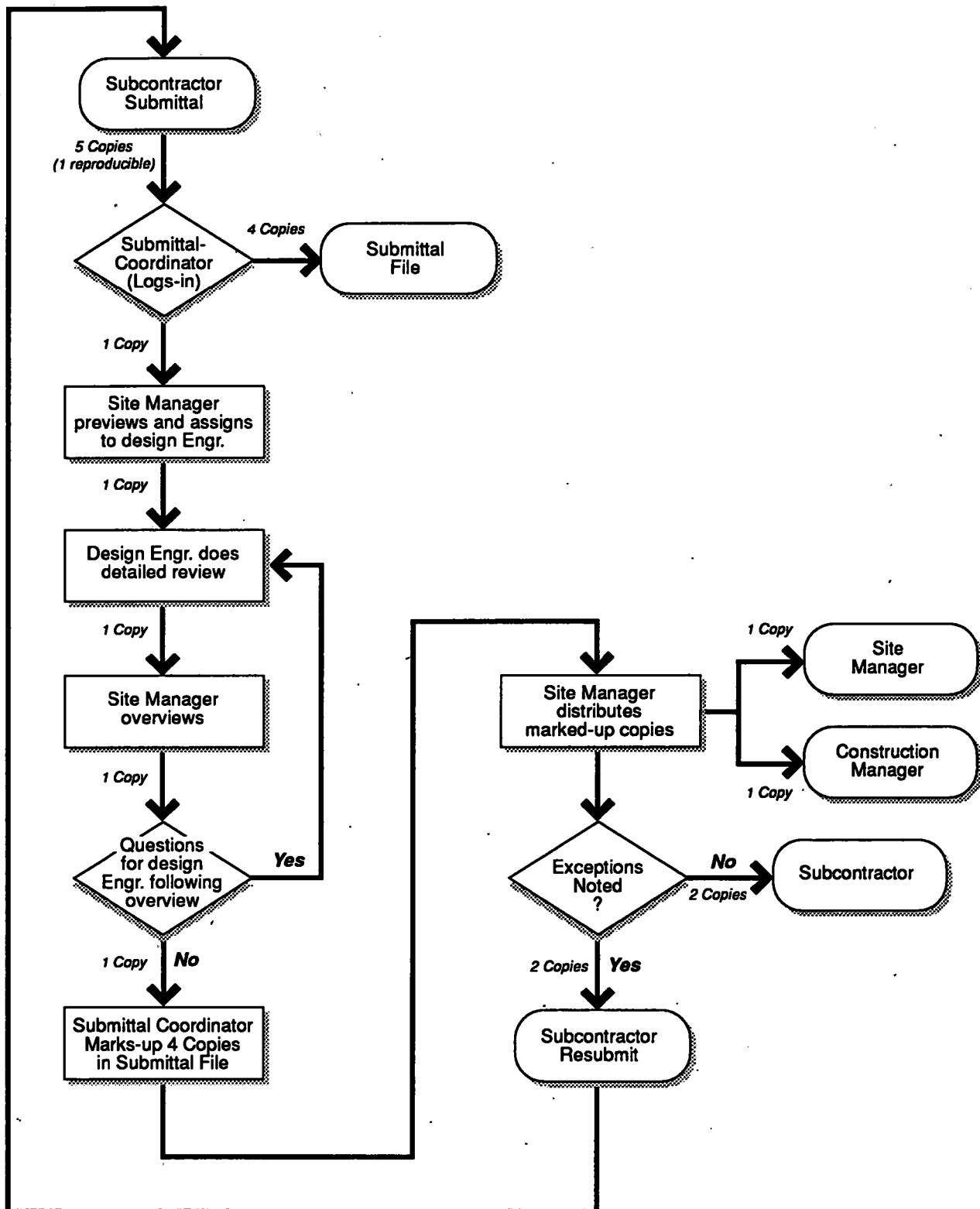


FIGURE 3-1
SUBMITTAL PROCESS FLOW
CHART
 ONALASKA MUNICIPAL LANDFILL SITE
 LANDFILL CAP REMEDIAL ACTION

Nonconformance Reports

Initiation of Reports

When materials, methods, or elements of work are not in accordance with subcontract documents and immediate resolution cannot be achieved, a nonconformance report (form 316) will be prepared. Nonconformance reports initiated by the Construction Inspectors shall be submitted to the Construction Manager. He or she will issue the nonconformance report to the Construction Subcontractor and see that a corrective action plan is developed by the Subcontractor.

The written nonconformance report should be issued as soon as possible after the nonconformance is detected. Nonconformance report forms are included in Appendix D. Each nonconformance report shall be assigned a unique file number and recorded on a nonconformance report log. This log will allow its status to be easily tracked.

The sole exception to this policy will be verbal notices made by the Construction Manager or Construction Inspectors to the Subcontractor for procedures which can be, and are, corrected immediately upon notice. All verbal notices will be recorded on the field observation form with an explanation of corrective measures taken, and the time required to bring the work into conformance.

Resolution of Nonconformances

No payment will be issued for work until the nonconformance is resolved. Each nonconformance report will remain in effect until corrective actions have been taken that meet the intent of the subcontract documents and the satisfaction of the QA representatives onsite. When corrective actions are acceptable, the Construction Manager shall document the corrective actions taken, results of any retests, and complete the acceptance portion of the nonconformance report. Likewise, Construction Inspectors shall observe and document the corrective actions and acceptability of the results on field observation forms. Whenever possible, retests should be performed by the same Construction Inspector(s) that initially detected the nonconformance.

Full documentation is required for resolution of each nonconformance report. When a nonconformance is resolved, the following documentation procedures will be followed:

- A copy of the observer's explanation of corrective action and acceptance will be attached to the nonconformance report for review and filing.

- **Observation reports, data summaries, etc., will be updated to reflect the resolved status of the original deficiency (e.g., notes of corrective action in observation reports, resubmittals, retest results). At a minimum, the nonconformance report file number, date, test number, etc., which identify the initial deficiency, will be included.**
- **The corrected nonconformances will be checked off the record book, initialed, and dated by the Quality Assurance Manager, Construction Manager, or designated representative.**

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Section 4
Quality Level and Requirements

General

The quality of materials and workmanship shall be controlled by the subcontractor or supplier who furnishes the work or material involved. However, the Subcontractor has the ultimate responsibility for QA for his sub-subcontractors and vendors.

Quality assurance personnel (i.e., Construction Inspectors and outside laboratories or consultants designated by the Quality Assurance Manager) will observe QC testing and perform verification testing of the construction materials, workmanship, and the Subcontractor's QC activities. Typically, the QA verification testing is performed at a fraction of the frequency of the QC testing requirements (see Section 1400 of the General Requirements). Actual test frequency is a function of specific construction activities, as outlined in the Construction Subcontractor's Quality Control Plan and the CQAP. Specific QA requirements for observation and verification testing are detailed in the attached appendixes. A summary of the QA testing required is presented in Table 4-1. The Supplement to the QAP contains copies of forms to be used to document QA activities.

All QC testing, sampling, and inspection shall be conducted by the Construction Subcontractor, the Subcontractor's supplier, or subcontracted Independent Testing Companies. The Subcontractor shall provide to the Construction Manager, in a timely fashion or as specified, copies of QC inspection and testing reports if specified in the subcontract. These reports shall include documentation of failed tests and corrective actions taken.

Observation and Verification Testing

The appendixes outline the required QA observations and verification tests. The field personnel should obtain, review, and familiarize themselves with the applicable procedures, codes, standards, specifications, drawings, observation and verification testing requirements, and accept/reject criteria.

The Quality Assurance Manager oversees the proper performance of the required QA observation and verification testing. To accomplish this random, but planned, observation and verification testing will be conducted.

Construction Inspectors or other field QA personnel shall document observations on the Daily Diary Inspection Report and shall document verification tests on the appropriate testing forms. All documentation must be recorded in ink. To correct an error on an inspection report, a single line will be drawn through the error, and

Table 4-1
SCHEDULE OF QUALITY ASSURANCE TESTING
Onalaska Municipal Landfill Site
Onalaska Township, Wisconsin
Landfill Cap Remedial Action
Page 1 of 2

Material	Test	Reference^a	Minimum Frequency
Grading Layer Material	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 5,000 cy (In-place Volume)
Working Surface Material and Granular Fill	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 5,000 tons (In-place Volume)
	Moisture-Density	ASTM D1557	1 per 5,000 tons
Pipe Backfill Material^b	Grain Size Thru No. 200 Sieve	ASTM D422	1 test each material
	Moisture-Density	ASTM D1557	1 test each material
Clay Barrier Material Source	Moisture-Density	ASTM D1557	1 per source (5 point curve)
	Grain Size Thru 0.002 mm	ASTM D422	1 per source
	Atterberg Limits	ASTM D4318	1 per source
	Moisture Content	ASTM D2216	1 per source
	Remolded Hydraulic Conductivity	ASTM D5084	2 per source^c
Clay Barrier Test Pads	Thin-wall Tube Samples	ASTM D1587	1 per test pad
	Atterberg Limits	ASTM D4318	1 per tube
	Moisture Content	ASTM D2216	1 per tube
	Dry Density	None	1 per tube
	Grain Size Thru 0.002 mm	ASTM D422	1 per tube
	Hydraulic Conductivity	ASTM D5084	1 per tube
Clay Barrier Layer - During Placement	Moisture-Density	ASTM D1557	1 per 10,000 tons (5 point curve)
	Grain Size Thru 0.002 mm	ASTM D422	1 per 10,000 tons
	Atterberg Limits	ASTM D4318	1 per 10,000 tons
	Moisture Content	ASTM D2216	1 per 10,000 tons

Table 4-1
SCHEDULE OF QUALITY ASSURANCE TESTING
Onalaska Municipal Landfill Site
Onalaska Township, Wisconsin
Landfill Cap Remedial Action
Page 2 of 2

Material	Test	Reference ^a	Minimum Frequency
Clay Barrier Layer - As-Placed	Thin-wall Tube Samples	ASTM D1587	1 per acre per 1-foot thickness
	Atterberg Limits	ASTM D4318	Every 2nd tube
	Moisture Content	ASTM D2216	Every 2nd tube
	Dry Density	None	Every 2nd tube
	Grain Size Thru 0.002 mm	ASTM D422	Every 2nd tube
Sand Drainage Material	Hydraulic Conductivity	ASTM D5084	Every fourth tube
	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 5,000 tons
	Remolded Hydraulic Conductivity	ASTM D2434	1 per 5,000 tons
	Moisture-Density	ASTM D1557	1 per 5,000 tons
Coarse Aggregate	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 10,000 tons
	Moisture-Density	ASTM D1557	1 per 10,000 tons
Base Course	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 5,000 tons
	Moisture-Density	ASTM D1557	1 per 5,000 tons
Cover Soil	Grain Size Thru No. 200 Sieve	ASTM D422	1 per 15,000 tons
Trench Clay	Grain Size Thru 0.002 mm	ASTM D422	1 per 5,000 tons
	Atterberg Limits	ASTM D4318	1 per 5,000 tons
	Moisture-Density	ASTM D1557	1 per 5,000 tons
Topsoil	pH, Nitrogen, Phosphorus, Potassium and USDA Classification	Varies	1 every two acres

^a ASTM Standards referenced to 1991 Annual Book of ASTM Standards.

^b Pipe Backfill Material includes Select Backfill Material for Pipe Zone and Backfill above the Pipe Zone for culverts.

^c Remold sample to 90% Relative Compaction with a moisture content at both optimum moisture and 3 percent above optimum moisture.

the correct information should be entered next to the error. All corrections should be initialed and dated.

Daily diary observation records and verification testing forms must, as a minimum, contain the following information:

- Item, condition, or activity observed or verification testing performed.
- Location of observation or test.
- Date of the observation or verification test.
- Inspector's name and signature.
- Type of verification test or observation.
- Observation or verification test source criteria (drawing, specification, etc.).
- Results or acceptability.
- Reference to corrective action taken in connection with nonconformance. Record the relevant nonconformance report number.

QA Subcontracts and Procurement

The anticipated QA subcontracts include contracts for independent geotechnical laboratory testing companies.

Items or services procured for QA purposes that may affect the measurement of quality of the construction project should meet the requirements of the subcontract specifications and this CQAP, as applicable.

GLT301/006.51

Section 5 Documentation

General

All project QC and QA activities pertaining to the subcontract specifications and the CQAP are to be documented.

Test Results

Results from all field tests, geotechnical laboratory tests, and material design evaluations should be submitted to the Construction Manager, who will forward copies to the Quality Assurance Manager. The tests and evaluations include, but are not limited to, the following:

- Laboratory moisture-density relationships
- Field moisture and density
- Atterberg limits
- Grain size
- Laboratory remolded permeability
- Field hydraulic conductivity

Photographic Record

A project photographic record will be made and kept as part of the QA record. In addition to recording construction progress and general installation details, the photographic record will be used to document deviations from design and nonconformance items or work. Each photograph will be marked with a sequence number, date, and location. Color or black and white film will be used, as appropriate. Any of the observers may photograph work for record purposes. The Quality Assurance Manager will maintain the photographic record file.

Daily Inspection Diaries

Daily inspection diaries shall be maintained by the Construction Inspectors. At the end of each shift, copies of the daily diary will be submitted to the Construction Manager and Quality Assurance Engineer. Each inspector will maintain a daily diary completed in ink with each work day consecutively numbered. The standard CH2M HILL Construction Inspection Diary (Form 21C) will be used (Appendix D).

The content of the diary shall include as a minimum (where applicable):

- Weather conditions

- Subcontractor personnel onsite
- List of major equipment onsite (idle versus operating)
- Substantive conversations held with the subcontractor
- Identification of separate attachments such as an Investigation of Differing Site Conditions form
- Unforeseen conditions that may cause a slowdown of the Subcontractor
- Progress photographs and photographs taken to document differing site conditions
- A log of work in progress and new work started
- Location and description of work and subcontractor or sub-subcontractor who is performing it
- Summary of verification testing performed for QA
- Signature of the inspector with full name, title, and date

Monthly Progress Report

A monthly progress report will be prepared by the Construction Manager. The report will be transmitted to all QA team members and the EPA. The monthly progress report shall include as a minimum the following items:

- Work accomplished the past month
- Work scheduled for the next month
- Project schedule: total work days, and total days remaining to completion
- Construction budget: basic contract and approved change orders

Record Keeping

Maintaining complete, accurate records of all work is crucial to verifying conformance to the specifications and drawings. Oral communications during meetings, discussions with the QA team, and telephone conversations must be summarized in writing. Copies will be sent to the Quality Assurance Manager for further distribution. Appendix D includes the required documentation forms.

Document Posting and Review

Document Log-In

When QA documents and related documents are received, the Quality Assurance Manager will date the documents and assign an entry number to each. The entry number, document title, date received, and unique document control number will be recorded.

Document Status Sheet

The Quality Assurance Manager should use a document status sheet to track document transmittals, especially nonconformance reports and submittals. The document status sheet is used by the Quality Assurance Manager to maintain the construction-reporting schedule according to both the planned and the actual construction schedule.

Review and Sign-off

The Quality Assurance Manager will review all QA documents for technical adequacy and completeness. Documents found to be technically adequate and complete will be signed (signature and printed name) and dated by the Quality Assurance Manager and filed in the Project Quality Assurance Record. Should any deficiencies be noted, the document will be returned unsigned to the originator for explanation and revision. When revisions are made, the revision and explanation will be signed and dated by the document originator. QA documents, once reviewed and filed, will not be amended without specific approval by the Quality Assurance Manager.

GLT301/007.51

APPENDIX A
QUALITY ASSURANCE REQUIREMENTS
EARTHWORK

Appendix A

Quality Assurance Requirements—Earthwork

The Construction Inspectors will perform the following observations and verification tests at random intervals as appropriate to the construction activity for all earthwork. CH2M HILL and the U.S. EPA recognize that the Construction Inspectors cannot be everywhere while the construction takes place. The Construction Inspectors will try to observe the major construction activities, but will not be responsible for deficiencies in the work performed by the Subcontractor and Sub-subcontractors or for their means, methods, techniques, or health and safety precautions.

- Observe that construction sequence described in the project specifications is being followed.
- Observe and report changed conditions from expected geological characteristics.
- Observe that all excavated and imported material for use on the project is free of roots, organic matter, trash, debris, and other deleterious materials. Observe that the material is free from segregation, lenses, pockets, streaks, or layers of material differing substantially in texture or gradation. Observations of the borrow area excavation and processing operation shall be performed as judged appropriate.
- Observe compactive effort, apparent effectiveness, and uniformity of compaction.
- Test and record compacted density and moisture content as stated for the specific materials or as directed by the Quality Assurance Manager. Tests shall be performed using the nuclear gauge method (ASTM D2922 and D3017) or the sand cone method (ASTM D1556) and laboratory determination of water content (ASTM D2216). Testing may be performed by an Independent Testing Company.
- Verify that the compacted material meets or exceeds the relative compaction specified in the subcontract documents and described in the following sections.
- Observe that layers of material which are too wet to properly compact are removed, or aerated by a disc, harrow, or blade to hasten reduction of the moisture content so that the specified moisture content range is achieved.

- Observe that layers of material which are too dry are brought to proper moisture content by adding water and mixing uniformly throughout the layer.
- Report the laboratory testing and field density test results on the appropriate verification test form. Submit all test results not meeting construction standards to the Construction Manager for nonconformance review.

GLT301/010.51

Grading Layer Material

Material Requirement

Grading Layer Material (Section 02200)

Imported material free from roots, organic matter, trash, debris, rocks larger than 3 inches, and other deleterious materials. Excavated onsite material containing refuse may be used providing the placement and compaction requirements specified herein are followed.

Submittals

If imported material is used, the Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3). No submittals are required if onsite material is used.

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 5,000 cy (in-place volume)
------------	-----------	----------------------------------

Applications

- (1) Rough Grading of landfill cap (Section 02200)

Compaction per the requirements of Section 207.3.6.2 of the Standard Specifications, Standard Compaction:

Loose lift thickness = 8 inches

Compact *...to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment...*

GLT301/010.51

Working Surface Material and Granular Fill

Material Requirement

Working Surface Material (Section 02200)

One-inch minus sand and gravel or crushed rock, free from dirt, clay balls, and organic matter, well graded from coarse to fine, containing sufficient finer material for proper compaction and less than 8 percent by weight passing the No. 200 sieve.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 5,000 tons
Moisture Density*	ASTM D1557	1 per 5,000 tons

*In the event that a representative compaction curve cannot be developed following the requirements of ASTM D1557, use ASTM D4253 and ASTM D254 (relative density (RD)).

Applications

(1) Working Surface Layer (Section 02200)

Loose lift thickness = 6 inches

Compact each lift to 90 percent Relative Compaction (RC; ASTM D1557)
65 percent RD (ASTM D4253 and D4254)

(2) Granular Fill (Section 02200)

Loose lift thickness = 6 inches

Compact each lift to 95 percent RC or 75 percent RD

(3) Decontamination Pad (Section 02601)

Place material over final geotextile layer in two equal lifts (minimum total thickness 12-inches)

Compact each lift to 90 percent RC or 65 percent RD

GLT301/010.51

Pipe Backfill Material

Material Requirement

Select Backfill Material (Section 02200)

Excavated material, free from stones, roots, and organic material, of suitable gradation for satisfactory compaction. If excavated material at a particular location is not satisfactory, use suitable material from other portions of the trench excavation. The maximum size of particles shall be $\frac{3}{4}$ inch in their greatest dimension.

Backfill Above the Pipe Zone (Section 02200)

Materials from the excavation containing no particles larger than 3-inch diameter, free from roots, debris, and organic matter.

Submittals

If material is imported, the Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3). No submittals are required for onsite material.

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 test each material
Moisture-Density*	ASTM D1557	1 test each material

*In the event that a representative compaction curve cannot be developed following the requirements of ASTM D1557, use ASTM D4253 and ASTM D4254 (RD).

Applications

- (1) Pipe Base and Pipe Zone for culverts (Section 02205)

Loose lift thickness = 6 inches

Compaction of the backfill shall provide a dry density equal to, or greater than, the original adjacent undisturbed earth

(2) Above Pipe Zone for culverts (Section 02205)

Loose lift thickness = 6 inches

Compact each lift to 90 percent RC or 65 percent RD

GLT301/010.51

Clay Barrier Material

Material Requirement

Clay Barrier Material (Section 02200)

Natural CL or CH clay soil, as defined by the Unified Soil Classification System (USCS), free from organic or other deleterious material. The clay shall have a gradation such that 100 percent by weight passes the 1-inch sieve, at least 80 percent by weight passes the No. 4 sieve, and at least 50 percent by weight passes the No. 200 sieve. At least 25 percent by weight of the material shall be clay (<0.005 mm). The clay shall have a liquid limit ranging from 20 to 50 percent and a plasticity index of between 10 and 30 percent. The clay shall have an in-place compacted permeability of 1×10^{-7} cm/sec or less.

Submittals

The Contractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Source

The following testing shall be made on samples taken at each source area identified.

Moisture-Density	ASTM D1557	1 per source
Grain Size	ASTM D422	1 per source
Atterberg Limits	ASTM D4318	1 per source
Moisture Content	ASTM D2216	1 per source
Remolded Hydraulic Conductivity*	ASTM D5084	2 per source

*Perform two remolded hydraulic conductivity tests:

- One at 90 percent RC and optimum moisture content and
- One at 90 percent RC and moisture content 3 percent above optimum

Clay Barrier Test Pads

The following testing shall be made during the construction of each test pad.

Thin-wall Tube Sample (ASTM 1587):		1 per test pad
Atterberg Limits	ASTM D4318	1 per tube
Moisture Content	ASTM D2216	1 per tube
Dry Density	None	1 per tube
Grain Size	ASTM D422	1 per tube
Hydraulic Conductivity	ASTM D5084	1 per tube
Moisture-Density Curve	ASTM D1557	1 per test pad

Clay Barrier Layer

The following testing shall be made on samples taken during placement.

Moisture-Density Curve	ASTM D1557	1 per 10,000 tons (5-point curve)
Grain Size	ASTM D422	1 per 10,000 tons
Atterberg Limits	ASTM D4318	1 per 10,000 tons
Moisture Content	ASTM D2216	1 per 10,000 tons

The following testing shall be made on the placed material.

Thin-wall Tube Sample (ASTM 1587):		1 per acre per 1-foot thickness
Atterberg Limits	ASTM D4318	Every 2nd tube
Moisture Content	ASTM D2216	Every 2nd tube
Dry Density	None	Every 2nd tube
Grain Size	ASTM D422	Every 2nd tube
Hydraulic Conductivity	ASTM D5084	Every 4th tube

The unused tubes will be retained until the clay barrier layer is completed and requirements verified.

Applications

(1) Clay Barrier Test Pads

Loose lift thickness = 6 inches

The purpose of the test pad is to determine the equipment and methods necessary to produce a barrier layer with a permeability not greater than 1×10^{-7} cm/sec. The

source testing includes remolded hydraulic conductivity designed to indicate what density and moisture content will satisfy that criteria. Two test pads are specified to provide information on a range of moisture conditions. The parameters assigned in the specifications (90 percent RC with 0 and +3 percent greater than optimum) may be altered based on the results of the laboratory testing.

For the first (possibly only) source tested

For the first test pad:

Compact each lift to minimum of 90 percent RC with a moisture content at optimum

For the second test pad:

Compact each lift to minimum of 90 percent RC with a moisture content at 3 percent above optimum

Additional testing as necessary for additional moisture-density conditions or for additional sources.

(2) Clay Barrier Layer

Loose lift thickness = 6 inches

Compact each lift to density and moisture content determined necessary to achieve a permeability equal to or less than 1×10^{-7} cm/sec during construction of the test pad

Observations

The Clay Barrier Layer is critical to the operation of the cap. QA observation of the Clay Barrier Test Pad and Clay Barrier Layer shall include the following:

- Observe that the equipment and methods used on the Clay Barrier Layer are the same as those used successfully during construction of the final Clay Barrier Test Pad.
- Observe Subcontractor's field density check and undisturbed hydraulic conductivity sampling progress to check for adequate quantity and spatial distribution of tests and sampling as specified in the Subcontractor's Quality Control Plan and the construction specifications.
- Test and record compacted density and moisture content at a frequency of one test per acre per lift or as directed by the Quality Assurance Manager. Tests shall be performed by the Contractor or an independent geotechnical laboratory using the Nuclear Gauge Method (ASTM D2922 and D3017) or the Sand Cone Method (ASTM D1556) and Laboratory Determination of Water Content (ASTM D2216). If

the Nuclear Gauge Method is used, verify the moisture content using Laboratory Determination of Water Content and correct nuclear gauge moisture readings if appropriate.

- Verify that the compacted material meets or exceeds the relative compaction necessary to meet the permeability requirement (as determined during the construction of the Clay Barrier Test Pad).
- Observe proper conditioning of material to achieve the moisture content necessary to meet the permeability requirement (as determined during the construction of the Clay Barrier Test Pad).
- If the clay layer is not to be worked for a period of 48 hours or if rain is expected, observe that the surfaces are graded and seal-rolled with a steel smooth drum roller to minimize infiltration and promote runoff of precipitation. The surface shall be scarified and moisture conditioned, if necessary, before placing additional material to achieve a good bond between the lifts of fill.
- Obtain thin-walled tube samples of the installed clay from the Subcontractor and perform index tests to compare with the hydraulic conductivity/index test correlations established by the test pad data evaluation. Index testing may include water content, Atterberg Limits, grain size, and in-place density, etc. Obtain samples at a frequency of one tube per acre per one-foot layer or as necessary to adequately document conditions.

In addition, test for hydraulic conductivity at a minimum frequency of one test per four tubes sampled. Quality Assurance testing shall be performed as specified in this CQAP.

- Observe that thin-walled tube sampling of placed clay is performed in general accordance with ASTM D1587, however, a drill rig is not required if the Subcontractor can satisfactorily push the tubes by other means. Tubes shall be first-quality and not reused. Unusual sampling conditions, especially those which may contribute to sample disturbance, will be recorded. Samples are to be appropriately sealed to protect against moisture loss. The tubes should be labeled, using an indelible marker, with the job number and elevation, sample location, sample number, amount of recovery, date, and an arrow indicating the top of the sample. Samples should be protected with suitable resilient packing material to reduce shock, vibration, and disturbance, and protected from extreme heat or cold during shipment.

- Observe that all sampling locations in the Clay Barrier Layer are backfilled using the materials and methods specified in Section 01400, Quality Control.
- Check that the Quality Control independent laboratory is qualified to perform hydraulic conductivity tests. Verify that the testing is performed in general conformance with ASTM D5084.
- Verify that the in-place material provides a hydraulic conductivity equal to or less than 1×10^{-7} cm/sec based on the results of the undisturbed hydraulic conductivity tests and the correlation of the index property tests performed by the Quality Control and Quality Assurance groups.
- Verify that the Subcontractor uses appropriate methods to prevent significant water loss and desiccation cracking before and after compaction.
- Verify that the grade survey complies with the tolerances provided in the specifications.

GLT301/010.51

Sand Drainage Material

Material Requirement

Sand Drainage Material (Section 02200)

Natural sand, manufactured sand, or a combination thereof conforming to requirements of ASTM C33 for fine aggregate and having less than 2 percent by weight passing the No. 200 sieve. The sand shall have an in-place permeability of 1×10^{-2} cm/sec or greater when compacted to 85 percent relative compaction.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement.

Grain Size	ASTM D422	1 per 5,000 tons
Remolded Hydraulic Conductivity	ASTM D2434	1 per 5,000 tons
Moisture Density*	ASTM D1557	1 per 5,000 tons

*In the event that a representative compaction curve cannot be developed following the requirements of ASTM D1557, use ASTM D4253 and ASTM D4254 (RD).

Application

- (1) Sand Drainage Layer (Section 02200)

Loose lift thickness = 8 inches

Compact each lift to 85 percent RC or 50 percent RD

GLT301/010.51

Coarse Aggregate

Material Requirement

Coarse Aggregate (Section 02200)

Natural gravel or crushed rock free from dirt, clay balls, roots, and organic material. Coarse aggregate shall conform to Section 501.3.6.4.5 of the Standard Specifications, Size No. 1.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 10,000 tons
Moisture-Density*	ASTM D1557	1 per 10,000 tons

*In the event that a representative compaction curve cannot be developed following the requirements of ASTM D1557, use ASTM D4253 and ASTM D4254 (RD).

Applications

- (1) Geotextile Envelope around Sand Drainage Layer Piping (Section 02200)

Loose lift thickness = 8 inches
Compact each lift to 85 percent RC or 50 percent RD

- (2) Landfill Gas Collector and Interceptor Trench Backfill (Section 02200)

Loose lift thickness = 8 inches
Compact each lift to 85 percent RC or 50 percent RD

- (3) Mow Strip Gravel (Section 02930)

Place mow strip gravel around monitoring wells and gas vents as shown on Drawings

GLT301/010.51

Base Course

Material Requirement

Base Course (Section 02200)

Conform to Section 304.2.6 of the Standard Specifications, Gradation No. 1 for crushed-gravel or crushed stone.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 5,000 tons
Moisture-Density*	ASTM D1557	1 per 5,000 tons

*In the event that a representative compaction curve cannot be developed following the requirements of ASTM D1557, use ASTM D4253 and ASTM D4254 (RD).

Applications

- (1) Sportsman Club Road Improvements (Section 02205)

Loose lift thickness = 6 inches

Compact each lift to 95 percent RC or 75 percent RD

- (2) Access Road

Loose lift thickness = 6 inches

Compact each lift to 95 percent RC or 75 percent RD

GLT301/010.51

Cover Soil

Material Requirements

Cover Soil (Section 02200)

Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soil capable of sustaining grass and retaining sufficient moisture for grass growth. Free from roots, sticks, hard clay, and stones which will not pass through a 1½-inch square opening.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 15,000 tons
------------	-----------	-------------------

Application

- (1) Cover Soil (Section 02200)

Compaction per the requirements of Section 207.3.6.2 of the Standard Specifications, Standard Compaction:

Loose lift thickness = 8 inches

Compact . . . *to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment . . .*

Subcontractor share provide adequate cover and equipment such that no damage occurs to the sand drainage layer piping.

GLT301/010.51

Trench Clay

Material Requirements

Trench Clay (Section 02200)

Natural or processed CL, SC, or MH soil, as defined by the Unified Soil Classification System (USCS), free from organic or other deleterious material. The clay shall have a gradation such that 100 percent by weight passes the 1-inch sieve, at least 50 percent by weight passes the No. 4 sieve, and at least 30 percent by weight passes the No. 200 sieve. At least 10 percent by weight of the material shall be clay (<0.005 mm). The clay shall have a minimum liquid limit of 20 percent and a minimum plasticity index of 10 percent.

Submittals

The Subcontractor shall provide certification, test results, source, and samples (see Section 02200, Paragraph 1.3).

Testing

The following testing shall be made on samples taken during placement:

Grain Size	ASTM D422	1 per 5,000 tons
Atterberg Limits	ASTM D4318	1 per 5,000 tons
Moisture-Density	ASTM D1557	1 per 5,000 tons

Application

- (1) Trench Clay (Section 02200)

Loose lift thickness = 6 inches
Compact to 85 percent RC

GLT301/010.51

Topsoil

Material Requirements

Topsoil (Section 02930)

Topsoil may be available from stockpiles on the site from the Subcontractor's stripping. If more topsoil is needed, supply imported topsoil.

Imported topsoil shall be a natural, friable soil, representative of productive soils in the vicinity. It shall be obtained from well-drained areas, free from admixture of subsoil and foreign matter, and objects larger than 2 inches in diameter, toxic substances, and other deleterious material which may be harmful to plant growth and be a hindrance to grading, planting, and maintenance operations.

Topsoil, both stockpiled and imported, shall meet, or shall be improved to meet, the following mechanical requirements by adding sand and/or peat or manure and incorporating into the topsoil:

Sand	Maximum 65 percent
Silt	Maximum 50 percent
Clay	Maximum 25 percent

Submittals

As specified in Section 02930, Item 2.13.

Testing

The following testing shall be made on samples taken during placement:

pH, Nitrogen, Phosphorus, Potassium 1 every two acres

Application

- (1) Topsoil (Section 02930)

Spread topsoil in areas shown on the Drawings.

GLT301/010.51

APPENDIX B
QUALITY ASSURANCE REQUIREMENTS
GEOSYNTHETICS

- Observe the placement of the geonet strips between two layers of Type II geotextiles. Verify that the geonet strips are fastened on both sides with securing pins.
- Verify that geonet strips are placed with the long dimension in the direction of flow (parallel to the direction of the slope).

Placement of Geotextiles and Geomembrane for Decontamination Pad

- Observe that subgrade is smooth and cleared of all sharp objects and debris.
- Observe that geotextile is laid both below and above the geomembrane loosely with a minimum overlap of 12 inches.
- Verify that the geomembrane covers the decontamination area without field seams.

GLT301/011.51

APPENDIX C
QUALITY ASSURANCE REQUIREMENTS
POLYETHYLENE PIPING

Appendix C
Quality Assurance Requirements—Polyethylene Piping

Delivery, Handling, and Storage

- Verify that the pipe is delivered to the site undamaged.
- Verify that the pipe is stored on level ground and that pipe is not stacked to the extent that excessive deformation could occur.
- Observe that the pipe is carefully handled so it will not be damaged by contact with sharp objects.

Material

- Verify that the pipe delivered is manufactured specifically for this project and conforms to the specifications.
- Verify that the pipe is of the sizes and types specified. Observe that the perforations are of the size and pattern specified.
- Verify that the polyethylene pipe lengths and fittings are of the same type, grade, and class of polyethylene compound, and supplied from the same raw material supplier.

Joints

- Observe that mechanical connections conform to the specifications.

Placement

- Observe that the pipe is handled with care to prevent damage or twisting when being lowered into the trench.
- Observe that the trench excavation and backfill conforms to the requirements of the Earthwork section.

GLT301/012.51

APPENDIX D
QA DATA SUBMITTAL FORMS

**CONSTRUCTION CONTRACT
MODIFICATION FORMS**



WORK CHANGE DIRECTIVE

WCD No.: _____

Project No.: _____

Project: _____

Owner: _____

Contractor: _____

Engineer: _____

The following additions, deletions or revisions to the Work have been ordered and authorized:

DESCRIPTION OF WORK: (LIST DOCUMENTS ATTACHED) _____

REASON FOR CHANGE: _____

METHOD OF PAYMENT (Check one)

- Contract Unit Price
- Lump Sum
- Cost of the Work (Time and Materials)

REMARKS: _____

ORDERED BY _____

OWNER

DATE

RECOMMENDED BY: _____

ENGINEER

DATE



FIELD ORDER

Field Order No. _____

To: _____
Contractor

Date: _____

Project: _____

Project No. _____

Engineer: _____

Description of Alteration: _____

Reason for Alteration: _____

Refer to Drawing Sheets _____ Section or Detail _____

Refer to Specification Paragraphs _____

Will Additional Drawings be Necessary Yes No Assigned No. of Drawings _____

It is understood and mutually agreed that this form is to be used only to record minor alterations which do not increase or decrease the Contract price; Contract times, or change the intent of a specific provision of the Contract. Any alterations involving change to the Contract price, Contract times, or Contract requirements must be covered by a formal Contract modification executed by the Owner and the Contractor. A summation of these field orders will be incorporated into a modification(s) prior to Contract completion.

ENGINEER
By: _____
Date: _____
Copy: Owner

CONTRACTOR: (RECEIPT ACKNOWLEDGEMENT)
By: _____
Title: _____
Date: _____



REQUEST FOR QUOTATION

QUOTATION NO. _____

DATE: _____

TO: _____

FROM: _____

PROJECT: _____

PROJECT NO. _____

KEYWORD DESCRIPTION: _____

DATE QUOTATION REQUIRED _____

THE FOLLOWING MODIFICATION TO THE CONTRACT HAS BEEN IDENTIFIED. PURSUANT TO THE GENERAL CONDITIONS, PLEASE PROVIDE A QUOTATION FOR THE ALTERATION AS DESCRIBED IN ITEM 1. THE QUOTATION SHOULD INCLUDE AN ITEMIZED BREAKDOWN OF CONTRACTOR AND SUBCONTRACTOR COSTS, INCLUDING LABOR, MATERIALS, RENTALS, APPROVED SERVICES, OVERHEAD, AND PROFIT. THIS REQUEST SHALL NOT BE CONSIDERED AUTHORIZATION TO PROCEED WITH THE WORK HEREIN DESCRIBED.

TO BE COMPLETED BY INITIATOR OF REQUEST:

1. SCOPE OF WORK: (INCLUDE LIST OF ATTACHMENTS)

2. REASON(S) FOR MODIFICATION:

3. APPROVAL OF REQUEST:

OWNER _____ DATE _____

ENGINEER _____ DATE _____

TO BE COMPLETED BY CONTRACTOR:

4. TOTAL COST OF MODIFICATION (ATTACH DETAILED BREAKDOWN) \$ _____

5. WILL A MODIFICATION TO THE CONTRACT TIME BE REQUIRED?

YES NO

IF SO, TRADE(S) _____

NO. OF PERSONNEL _____

DURATION _____ (CALENDAR DAYS)

6. ATTACHMENT IDENTIFICATION: (LIST) _____

7. QUOTATION IS IN EFFECT UNTIL (DATE) _____

8. APPROVAL OF QUOTATION

CONTRACTOR _____ DATE _____

SUBMITTAL FORMS

**SAMPLE-ENGINEER'S
SUBMITTAL REVIEW STAMP**

<input type="checkbox"/> NO EXCEPTION TAKEN	<input type="checkbox"/> MAKE CORRECTIONS NOTED
<input type="checkbox"/> REJECTED	<input type="checkbox"/> REVISE AND RESUBMIT
<input type="checkbox"/> SUBMIT SPECIFIED ITEM	
<p>Checking is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.</p>	
<p>CH2M HILL</p>	
<p>Date _____ By _____</p>	

EACH OFFICES' ADDRESS WILL BE AFFIXED

**NONCONFORMANCE REPORT
FORM**



NONCONFORMANCE REPORT

To _____

Date
Time A.M./P.M.
Inspector

Project Title: _____ Project No. _____

Contractor: _____ Contract No. _____

You are hereby notified that tests inspection indicates that the _____

does not conform to the specifications requirements. The specification violated is

Section _____ Article/Paragraph _____ Under the provisions

of the contract specifications, the requirements are _____

Nonconforming work, materials, or equipment shall be required, under the Articles of the General Conditions of the Contract, to be removed and replaced at the Contractor's own expense.

Nonconformance report was received by Contractor

By _____

Title _____

Date _____

CORRECTIVE MEASURES ARE ACCEPTABLE
BY: _____ DATE: _____

- DISTRIBUTION:**
1. FIELD OFFICE
 2. CONTRACTOR
 3. ENGINEER
 4. OWNER

GENERAL OFFICE FORMS

SAFETY FORMS



ACCIDENT REPORT

DATE: _____

NOTE: TO BE COMPLETED ONLY FOR REPRESENTATIVES OF CH2M HILL, INC.

PROJECT: _____ PROJECT NO. _____

INJURED EMPLOYEE: _____ EMPLOYEE NO. _____

DATE INJURED: _____ TIME _____ A.M. P.M.

DATE REPORTED: _____ LAST DAY WORKED: _____

DID EMPLOYEE RETURN TO WORK: _____ DATE RETURNED: _____

WHERE ACCIDENT OCCURRED: _____

WITNESSES: _____

WORK PERFORMING WHEN INJURED: _____

KIND AND EXTENT OF INJURY: _____

NAME - ADDRESS OF DOCTOR - HOSPITAL: _____

DESCRIPTION OF ACCIDENT: _____

WAS THERE EQUIPMENT MALFUNCTION? YES NO

DESCRIBE DAMAGE TO EQUIPMENT OR PROPERTY: _____

UNSAFE CONDITION OR ACT CAUSING ACCIDENT: _____

ACTION TAKEN TO PREVENT SIMILAR ACCIDENT: _____

ADDITIONAL RECOMMENDATIONS OR ACTION: _____

SUPERVISOR: _____

PHOTO(S) TAKEN

CHM HILL EMERGENCY PHONE NUMBERS

	PHONE	ADDRESS	CONTACT	FIRST AID TRAINED
POLICE DEPARTMENT			ATTN:	
FIRE DEPARTMENT			ATTN:	
PARAMEDIC			ATTN:	
FIRE REPORT			ATTN:	
AMBULANCE SERVICE			ATTN:	
WATER DEPARTMENT			ATTN:	
GAS UTILITY			ATTN:	
ELECTRIC UTILITY			ATTN:	
TELEPHONE UTILITY			ATTN:	
LOCAL SANITARIAN			ATTN:	
HOSPITAL			ATTN:	
OWNER			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	
			ATTN:	

THIS NOTICE IS LOCATED AT: _____

CONSTRUCTION REPORTING FORMS

VERIFICATION TESTING FORMS

MATERIAL TESTED _____ TEST GAUGE SERIALNO. _____

TEST REFERENCE AASHTO T-99 METHOD _____ AASHTO T-180 METHOD _____ OTHER _____

ASTM D-698 METHOD _____ ASTM D-1557 METHOD _____

STANDARD COUNT: MOISTURE _____ DENSITY _____

LOCATION					
TEST ELEVATION					
MATERIAL TYPE					

MOISTURE CONTENT ASTM D3017

TEST NUMBER					
MOISTURE COUNTS	TRENCH STD.				
	TEST				
COUNT TOTAL					
COUNT AVERAGE					
COUNT RATIO					
WATER LBS/FT. ³					

DENSITY ASTM D2922

TEST MODE - DEPTH					
REFERENCE UNIT WEIGHT	MAXIMUM				
	MINIMUM				
DENSITY COUNTS	TRENCH STD.				
	TEST				
COUNT TOTAL					
COUNT AVERAGE					
COUNT RATIO					
WET DENSITY LBS/FT. ³					
WATER LBS/FT. ³					
DRY DENSITY LBS/FT. ³					
% COMPACTION					
MOISTURE CONT. - % DRY DENSITY					
TESTED BY					
CHECKED BY					

REMARKS: _____

PROJECT NUMBER



MOISTURE CONTENT

ASTM D2216

PROJECT DESCRIPTION: _____
 MATERIALS LABORATORY: _____
 SAMPLE LOCATION: _____ SAMPLE NO. _____
 TYPE OF SAMPLE: _____

SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							
SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							
SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							
SAMPLE LOCATION							
SAMPLE NO.							
CAN NO.							
GROSS WET MASS							
GROSS DRY MASS							
MOISTURE MASS							
TARE MASS							
DRY SOIL MASS							
MOISTURE CONTENT, %							

TESTED BY: _____ DATE: _____ COMPUTED BY: _____ DATE: _____ CHECKED BY: _____ DATE: _____



	PROJECT NUMBER
SAND CONE FIELD DENSITY	
ASTM D1556	

PROJECT DESCRIPTION: _____
 MATERIALS LABORATORY: _____

SAND CONE SERIAL NO. _____ BASE PLATE SERIAL NO. _____

ITEM	UNITS	TEST DATA				
TEST NUMBER						
TEST LOCATION						
TEST ELEVATION						
MATERIAL TYPE						
WET DENSITY						
BULK DENSITY OF SAND						
ORIGINAL SAND						
REMAINING SAND						
SAND USED						
GROSS VOLUME						
TARE VOLUME						
NET VOLUME OF TEST HOLE						
GROSS WET MASS						
TARE NUMBER						
TARE MASS						
WET SOIL MASS						
WET DENSITY						
MOISTURE CONTENT						
TARE NUMBER						
GROSS WET MASS						
GROSS DRY MASS						
MOISTURE MASS						
TARE MASS						
DRY SOIL MASS						
MOISTURE CONTENT	%					
TEST RESULTS						
IN-PLACE DRY DENSITY						
COMPACTION						
RELATIVE DENSITY						
SPECIFICATION						
_____ % ASTM D698	METHOD _____	= _____	LB/FT ³	RELATIVE DENSITY (%) $= \frac{D_{FLD} - D_{MIN}}{D_{MAX} - D_{MIN}} \times \frac{D_{MAX}}{D_{FLD}} \times 100$		
_____ % ASTM D1557	METHOD _____	= _____	LB/FT ³			
_____ % ASTM D2049	METHOD _____	= _____	LB/FT ³			
REMARKS _____						

TESTED BY: _____	DATE: _____	COMPUTED BY: _____	DATE: _____	CHECKED BY: _____	DATE: _____
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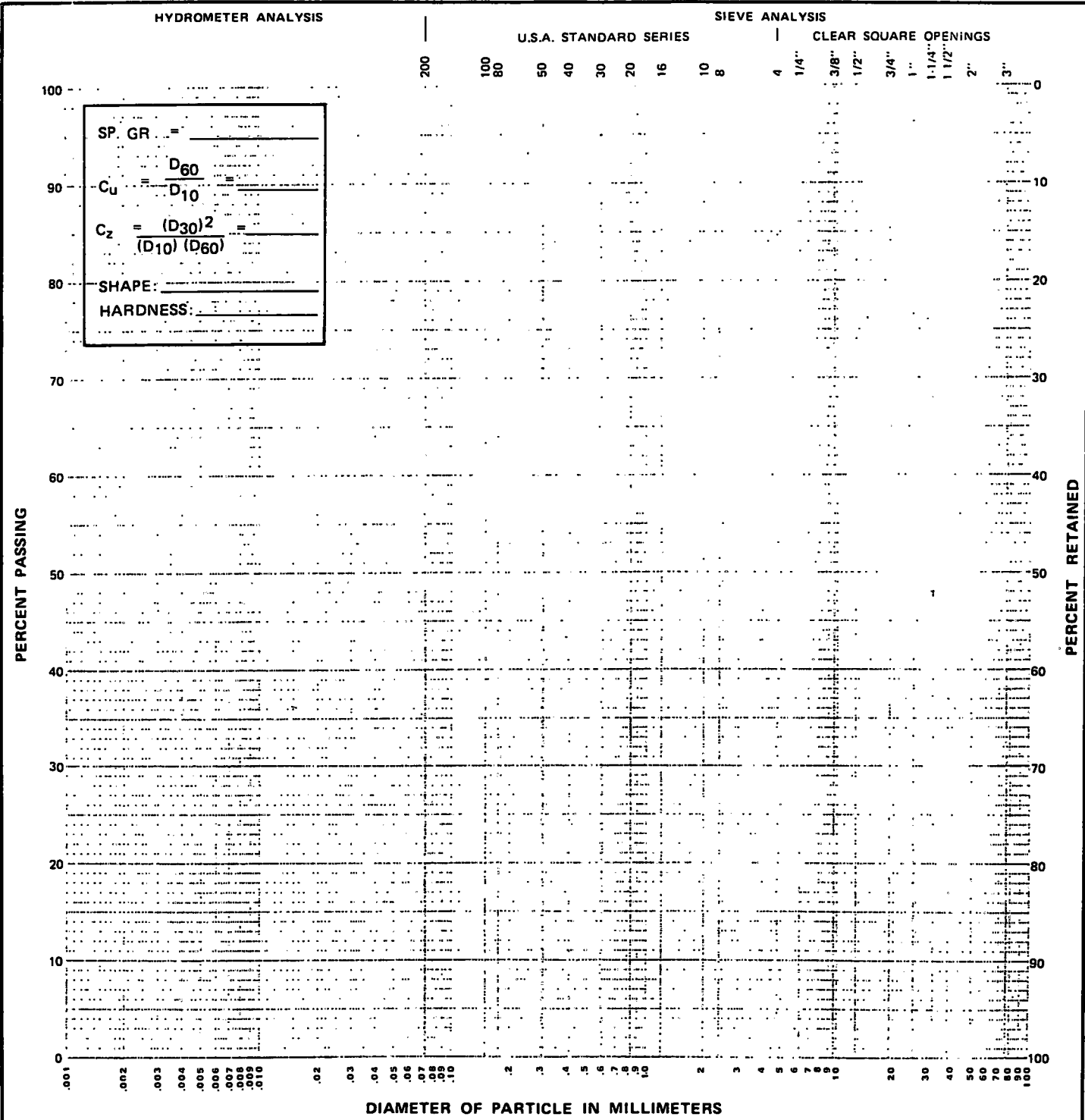


PROJECT NUMBER

PARTICLE-SIZE ANALYSIS

ASTM D422

PROJECT DESCRIPTION: _____
 MATERIALS LABORATORY: _____
 SAMPLE LOCATION: _____ SAMPLE NO. _____
 TYPE OF SAMPLE: _____



COL- LOIDS	CLAY SIZE	SILT SIZE	SAND			GRAVEL	COBBLES
			FINE	MEDIUM	COARSE		

SAMPLE CLASSIFICATION _____

TESTED BY: _____	DATE: _____	COMPUTED BY: _____	DATE: _____	CHECKED BY: _____	DATE: _____
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