# CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

# FINAL CLEANUP ACTION

# BSB DIVERSIFIED COMPANY, INC. PROPERTY,
# KENT, WASHINGTON

**AUGUST 2009**

**(REVISED JUNE 2011)**

**PREPARED FOR:**


**B.S.B. DIVERSIFIED COMPANY, INC.**

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**PREPARED BY:**


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## CERTIFICATION PAGE

The engineering material and data contained in this manual were prepared under the supervision and direction of the undersigned, whose seal as a registered professional engineer in the State of Washington is affixed below.

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Roger B. North, P.E.
Design Engineer of Record

# Table of Contents

Table of Contents (continued)

# 1 INTRODUCTION

## 1.1 PROJECT UNDERSTANDING

B.S.B. Diversified Company, Inc. (BSB) has responsibility for the project site (Site) located at 8202 South 200th Street, in Kent, Washington. The site was used for metal finishing and electroplating from the mid-1950s until 1985. PES Environmental, Inc. (PES) has prepared a Final Cleanup Action (FCA) to address soil and groundwater contamination, particularly chlorinated solvents, at the Site.

The objective of the FCA is to mitigate environmental risk by preventing untreated groundwater from flowing from the Site to adjacent properties. Groundwater will be treated on-site and reintroduced to the groundwater unit outside the site.

The FCA includes the following activities:

- Construction of a soil-bentonite cut-off wall (SBCW) around the perimeter of the Site.
- Construction of a final cover system over the site and associated site grading (cut and fill).
- Construction of zero valent iron (ZVI) reactor vault within the limits of the SBCW, to treat contaminated groundwater from within the site. This activity was started in 2009, and subsequently suspended by the Owner to further define existing conditions and cleanup action options.
- Installation of piping to transfer treated water from the ZVI reactor vessels to an infiltration gallery located outside the SBCW.
- Miscellaneous other site work items, such as drainage ditches, providing entrance facilities, and abandonment and installation of site monitoring wells and/or piezometers.

BSB has prepared a two phase construction approach to implement the FCA.

- Phase I comprises the construction of the ZVI reactor vault and the associated site clearing activities. The construction of the ZVI reactor vault will include the installation of temporary works (shoring and dewatering systems), excavation of soils from the footprint of the ZVI reactor vault, which will be stockpiled on site for possible reuse during Phase II of the FCA, and construction in-place of the ZVI reactor vault itself. PES, Vista Consultants, LLC (VISTA) and Livermore Associates, Inc. (Livermore) have prepared the Construction Drawings and Technical Specifications for the Phase I remedial activities.
- Phase II will include all other activities required to complete the FCA including the construction of the SBCW and the final cover.

## 1.2 CONSTRUCTION QUALITY ASSURANCE OBJECTIVES

Construction quality assurance (CQA) represents a planned and systematic pattern of procedures and documentation designed to provide confidence that items of work or services meet the requirements of the contract documents. A third-party consultant independent of the Owner and Contractor must perform CQA. This CQA Manual has been prepared to outline specific monitoring, testing, construction and documentation procedures to ensure that the remedial action objectives of the project are met.

The CQA activities are separate from the construction quality control (CQC) activities identified in the Construction Drawings and Technical Specifications that the Contractor must perform. CQC activities

provide a means to measure and regulate the characteristics of an item or service to comply with the requirements of the contract documents.

## 1.3 DOCUMENT CONTENTS

This CQA Manual is presented in the following seven sections:

- **Section 1** is the introduction. It presents a description of the document format, definitions, and terms used throughout the document.
- **Section 2** presents general organization structure of the participants in the construction program and definitions relevant to the CQA program. .
- **Section 3** presents general requirements of the CQA program.
- **Section 4** presents special requirements for specific work items associated with the construction elements, including procedures such as materials verification, test standards, testing frequencies, conformance and construction testing, and construction monitoring.
- **Section 5** presents documentation and record keeping.

## 1.4 REFERENCE DOCUMENTS

- The following reference documents provide background information and detailed information regarding the project.
- PES Environmental, Inc., "Focused Remedial Investigation Summary/Feasibility Study Report, BSB Property, Kent, Washington" (December 5, 2005);
- PES Environmental, Inc., Vista Consultants, LLC., and Livermore Associates, Inc, "Construction Drawings, Final Cleanup Action Phase I" for BSB Diversified, Inc. Property, Kent, Washington" (August 2009); and
- Vista Consultants, LLC, "Technical Specifications, Final Cleanup Action Phase I", for BSB Diversified, Inc. Property, Kent, Washington" (July 2009).

## 1.5 CONTACTS AND ADDRESSES -

The following addresses, phone numbers, facsimile numbers, and contacts of organizations involved with the project are provided for informational purposes only.

| | |
|---|---|
| **Site:** | BSB Diversified, Inc. Property<br>8202 South 200th Street<br>Kent, Washington |
| **Owner's Representative:** | B.S.B. Diversified Company, Inc. |
| ***Contact:*** | Mr. Ron Burt |
| ***Mailing Address:*** | Burt Geology & Environmental Applications, PLLC<br>902 Grapevine Lane<br>Nashville, Tennessee 37221 |
| ***Phone:*** | (615) 828-6126 |
| **Environmental Engineer:** | PES Environmental, Inc. |

| | |
|---|---|
| ***Contact:*** | Mr. Brian O'Neal, P.E. (Engineer of Record) |
| ***Mailing Address:*** | PES Environmental, Inc.<br>1215 4th Avenue, Suite 1350<br>Seattle, Washington 98161 |
| ***Phone:*** | (206) 529-3980 |
| ***Fax:*** | (206) 529-3985 |
| **Civil Engineer:** | Vista Consultants, LLC |
| ***Contact:*** | Mr. Roger B. North P.E. (Engineer of Record) |
| ***Mailing Address:*** | Vista Consultants, LLC<br>4132 SW Barbur Blvd.<br>Portland, Oregon 97239 |
| ***Phone:*** | (503) 922.2522 |
| **Structural Engineer:** | Livermore Associates, Inc. |
| ***Contact:*** | Mr. Gary Livermore, P.E. (Engineer of Record) |
| ***Mailing Address:*** | Livermore Associates, Inc.<br>140 SW Arthur Street<br>Portland, OR 97201 |
| ***Phone:*** | (503) 892.3002 |

# 2 ORGANIZATIONAL STRUCTURE AND DEFINITIONS

## 2.1 INTRODUCTION

This section describes duties and responsibilities of key project organizations and personnel and the definition of key terms that are critical to maintaining the overall quality of the project.

## 2.2 RESPONSIBILITIES

### 2.2.1 Owner's Project Manager

The project Technical Specifications and the CQA Manual use terms such as "Owner's Project Manager", "CQA Monitors", and "CQA Consultant" to refer to responsibilities that may be fulfilled by one or more organizations, and either one or more individuals. The person(s) involved will be authorized to make judgments and decisions on behalf of the Owner, but also responsible for ensuring that the CQA plan is implemented. Therefore the duties of the responsible organizations(s) and individuals(s) may vary depending on the stage of construction and the activities on any given day. This role will generally be referred to in the remainder of this document as the Owner's Project Manager; however, definitions are provided below for the other terms, so that the typical functions of each CQA related role are defined.

The Owner's Project Manager will not be on-site full time, but will vary his time depending on the activities being performed and any associated administrative, inspection, and observational requirements. However, it is anticipated that the Owner's Project Manager will routinely visit the site every day during construction.

### 2.2.2 Responsibilities of the Contractor

The Contractor is responsible for coordinating the activities of its own forces and subcontractors, scheduling and performing the work within the timeframe and budget agreed to in the contract, performing the work in accordance with the Construction Drawings and Technical Specifications and implementing quality control (QC) procedures to document construction complies with the Technical Specifications. The Contractor is expected to cooperate with the Owner's Project Manager in performing CQA activities to achieve a quality product.

### 2.2.3 Responsibilities of the Surveyor

The Surveyor must be licensed in the State of Washington. The Surveyor will work at the direction of the Contractor to assist in constructing the project in substantial accordance with the Construction Drawings and Technical Specifications and performing surveys to document as-built conditions.

## 2.3 DEFINITIONS

Whenever the terms listed below are used, the intent and meaning will be interpreted as indicated.

**ASTM -** ASTM International.

**CQA Engineer of Record -** The authorized representative of the CQA Consultant (CQAC) responsible for certifying that construction was completed in substantial accordance with the construction documents and approved modifications made during construction. The CQA Engineer of Record must be an engineer registered in the state of Washington.

**CQA Monitors -** Authorized representatives of the CQAC, responsible for implementing this CQA program and for observing and documenting the activities of the Contractor in sufficient detail and continuity to provide a high level of confidence that construction was completed in substantial accordance with the Contract Documents and approved modifications. The CQA Monitors also monitor Contractor-performed tests, and perform tests when appropriate, to provide a high level of confidence that the characteristics of the work meet the requirements of the contract documents.

CQA Monitors are responsible for timely preparation and processing of all required documentation and reports associated with construction observations and testing. Accurate and concise reports must be prepared for all monitoring activities and for each test performed.

**CQA Consultant (CQAC)** – The firm having the primary responsibility of implementing and managing the CQA program. Upon completion of construction, the CQA Organization must prepare a Final Construction Report (FCR).

**CQA Team** – In addition to representatives of the CQAC, the CQA Team may include representatives of the Owner and the Design Engineer(s). Through observation and record keeping the CQA will be provided by the CQA Team for all components.

**Contract Documents -** The official set of documents issued by the Owner, which includes bidding requirements, contract forms, contract conditions, Technical Specifications, Construction Drawings, addenda, and contract modifications.

**Construction Drawings -** The official Construction Drawings, profiles, typical cross-sections, elevations, details, and amendments and supplemental drawings, which show the locations, character, dimensions, and details of the work to be performed. Construction Drawings are also referred to as the "Plans", "Drawings", or "Contract Drawings."

**Contractor -** The person, persons, firm, partnership, corporation, or any combination, private, municipal, or public, who, as an independent Contractor, has entered into a contract with the Owner, and who is referred to throughout the contract documents by singular number and masculine gender. The term Contractor means the Contractor and its authorized representative.

The Contractor is responsible for coordinating the activities of subcontractors, scheduling and performing the work within the timeframe and budget agreed to in the contract, performing the work in accordance with the Construction Drawings and Technical Specifications and implementing quality control (QC) procedures to document construction complies with the Technical Specifications. The Contractor is expected to cooperate with the CQA Monitors to achieve a quality product.

**Design Engineer(s) -** The individuals or firms responsible for the design and preparation of the project Construction Drawings and Technical Specifications. They are also referred to as "Designer(s)", or "Engineer(s)".

**Design Engineer(s) of Record -** The authorized representative of the Design Engineer(s) who is the individual responsible for design of the project, and for approving any changes to the design during construction.

**Final Construction Report (FCR)** - The FCR will include information generated through the CQA program and must document the extent to which construction was performed in substantial accordance with the Construction Drawings, Technical Specifications and the design intent.

**Geomembrane -** A geosynthetic lining material also referred to as flexible membrane liner, membrane, liner, or sheet.

**Geotextile -** A fabric manufactured from synthetic fiber that is designed to achieve specific engineering objectives, including seepage control, media separation (e.g., between drainage gravel and soil), and filtration.

**Geosynthetics Contractor -** The individual or organization responsible for the installation of geosynthetic materials. Also referred to as the "Contractor" or "Installer".

**Manufacturing Quality Control (MQC) -** A planned system of inspections that is used to directly monitor and control the manufacture of a material, which is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements of materials and workmanship as stated in certification documents and the Technical Specifications (ref. EPA/600/R-93/182).

**Manufacturing Quality Assurance (MQA) -** A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and Technical Specifications. MQA includes manufacturing facility inspections, verifications, audits and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization to determine if the manufacturer is in compliance with the product certification and Technical Specifications for the project (ref. EPA/600/R-93-182).

**Non-Conformance -** A deficiency in character, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. Examples of non-conformances include, but are not limited to, physical defects, test failures, and inadequate documentation.

**Owner -** B.S.B. Diversified Company, Inc.

**Owner's Project Manager –** Owner's authorized representative responsible for scheduling CQA activities, and contract administration. The Owner's Project Manager will request assistance from the Owner, Design Engineer(s) of Record, and CQA Engineer of Record to resolve construction or regulatory issues.

**Panel -** A unit area of the geosynthetics that is seamed in the field or in the fabricator's plant.

**Procedure -** A document that specifies or describes how an activity is to be performed.

**Project Documents -** The project documents comprise the Contractor submittals; Construction Drawings; record drawings; Technical Specifications; shop drawings; CQC and CQA plans; safety plan; and project schedule.

**Quality Assurance Laboratory –** An independent third party laboratory, capable of performing tests according to the various standards contained in the Contract Documents, and responsible for materials testing to assure various materials used to construct components of the project meet specified requirements.

**Record Drawings -** Drawings recording the constructed dimensions, details, and coordinates of the project (also referenced to as "as-builts" or "as-built drawings"). The record drawings shall be stamped by an engineer registered in the State of Washington.

**Technical Specifications -** The qualitative and quantitative description for manufacturing and installing products, materials, and workmanship upon which the contract is based.

**Testing -** Verification that an item meets specified requirements by subjecting that item to a set of physical, chemical, environmental, or operating conditions.CQA Manager.

**Third Party –** The party or organization independent of the Owner and Contractor, where the Owner is the first party and the Contractor is the second party.

# 3 GENERAL REQUIREMENTS

This section of the CQA Manual describes general requirements of the CQA Organization. It includes general requirements for notifications, meetings, control of project records and documentation and control of nonconforming work.

## 3.1 NOTIFICATIONS

As stated in the Technical Specifications, the Contractor is required to notify the Owner's Project Manager in advance of performing any work requiring sampling, testing and monitoring as described on the Construction Drawings, in the Technical Specifications, and/or this CQA Manual. The Contractor must also notify the Owner's Project Manager in advance of any sampling, testing and monitoring activities conducted by the Contractor, so the Owner's Project Manager can observe these activities. It is the CQAC's responsibility to remind the Contractor of its notification requirements.

## 3.2 COORDINATION

Coordination includes, but is not limited to, the proper selection of equipment, materials and labor to perform the intended task and the coordination of work activities within the Site such that work, traffic, staging and support areas are utilized effectively and not compromised.

As stated in the Technical Specifications, the Contractor shall be aware that CQA monitoring is required as a component of many of the Contractor's work activities and these monitoring events need to be considered in developing the schedule. Failure to perform the CQA monitoring may require additional work to be performed or the removal and replacement of completed work.

## 3.3 SUBMITTALS

As defined on the Construction Drawings and in the Technical Specifications, the Contractor is required to make submittals prior to executing certain work activities. The Owner's Representative and the Design Engineer(s) of record are responsible for timely review of these submittals and distribution of their review comments to the Contractor, Owner and CQAC. It is the CQAC's responsibility to review all approved submittals and where those submittals involve approval of certain materials to assure that materials delivered to the project site comply with the approved submittals.

## 3.4 MEETINGS

In order to facilitate construction, and to clearly define construction goals and activities, close coordination between the design engineers, Owner's Project Manager, and Contractor is essential. To meet this objective, pre-construction and progress meetings will be held for each of the major work elements.

### 3.4.1 Pre-Construction Meeting

A pre-construction meeting will be held at the site and be attended at a minimum by the Owner's Project Manager and Contractor. The purpose of this meeting will be to cover the following items, as appropriate:

- Discuss and review general, site-specific and activity-specific health and safety issues;
- Present a proposed construction progress schedule and submittals as required by the Contract Documents;

- Discuss liquidated damages (if applicable);
- Discuss procedures for handling submittals;
- Discuss the direction of correspondence, and coordinate responsibility between Contractor and Owner;
- Schedule periodic progress meetings;
- Summarize required laboratory materials testing;
- Discuss payment requests, and progress payment procedures;
- Discuss change order procedures;
- Discuss Owner's site regulations;
- Review the Construction Drawings, Technical Specifications, CQA plan, work area security, safety procedures, and related issues;
- Provide all parties with relevant documents;
- Review responsibilities for each party;
- Define lines of communication and authority;
- Establish reporting and documenting procedures;
- Review testing equipment and procedures;
- Establish testing protocols and procedures for correcting and documenting construction or nonconformance;
- Identify subcontractors that may be working on the project site; and
- Conduct a site inspection to discuss work area, stockpile areas, lay-down areas, access roads, haul roads, and related items.

The Owner's Project Manager must take minutes of the meeting and distribute copies to all parties within one week of the meeting

### 3.4.2 Progress Meetings

Informal progress meeting will generally be required daily. In addition to the Contractor, attendees will depend on the stage of construction; however, the Owner's Project Manager will generally be present. The purpose of these meetings is to:

- Discuss problems and resolutions;
- Review the condition of the project;
- Review test data;
- Discuss the Contractor's planned activities, personnel and equipment assignments for the day;
- Review the previous day's activities and accomplishments; and
- Resolve any outstanding problems or disputes.

### 3.4.3 Periodic Progress Meetings

Periodic scheduled progress meetings will be held during the execution of the project. At a minimum, the Contractor and the Owner's Project Manager will be present. The meetings will be held to document progress, problems, construction schedule, design changes, test data, and any other necessary issues. The Owner's Project Manager will prepare the agenda for each meeting and prepare meeting minutes for distribution to all parties.

### 3.4.4 Other Meetings

As required, special meetings will be held to discuss problems or non-conformances. At a minimum, the Owner's Project Manager, Contractor, and CQA Monitor will attend this meeting. If the problem requires a design modification and subsequent change order, the Design Engineer of Record should also be present. The Owner's Project Manager will document the meeting.

## 3.5 CONTROL OF CONSTRUCTION DOCUMENTS, AS-BUILT RECORDS, AND FORMS

### 3.5.1 Project Control of Construction Documents

The Owner's Project Manager will control construction documents, including Technical Specifications, Construction Drawings, and change orders. Upon issuance of new copies or revisions, it is the responsibility of the Owner's Project Manager to notify the Contractor and CQA staff of the revisions, to provide revised contract documents and then order the recall of all copies of the contract documents that do not include the latest revisions.

### 3.5.2 Project Control of As-Built Information

The Owner's Project Manager, the Contractor, and project surveyor collect as-built information. During the work, the Contractor working with the Owner's Project Manager is responsible for compiling this information onto one set of Construction Drawings and Technical Specifications, which will be maintained at the project site. These Construction Drawings and Technical Specifications will be clearly marked as "Project Record Drawings and Project Record Technical Specifications." At the completion of the project, all as-built information will be used in preparing the FCR.

### 3.5.3 Project Control of Forms

The Owner's Project Manager will maintain a master of each CQA form used on the project. Upon issuance of a new or modified form, the Owner's Project Manager will recall and remove all superseded copies along with the master, and provide new copies for use.

## 3.6 PROCESSING REPORTS

### 3.6.1 Processing Daily Reports

The Owner's Project Manager will prepare a daily report for those days that he or she is present on site. Copies of all daily reports must be maintained at the site.

### 3.6.2 Processing Test Reports

The Owner's Project Manager or CQA laboratory must complete a test report whenever testing is performed. Copies of all test reports must be transmitted weekly to the CQA Engineer of Record, with originals maintained at the site.

### 3.6.3 Processing Project Records

Project records will be completed as needed. Use of the project records is limited to the scope for which they are intended. All project records must be maintained at the site.

## 3.7 CORRECTING NON-CONFORMING WORK

### 3.7.1 Observation of Non-Conformance

Whenever non-conforming work is discovered, the Owner's Project Manager must notify the Contractor as soon as possible.

### 3.7.2 Determining Extent of Non-Conformance

Whenever nonconformance is discovered the Owner's Project Manager must determine the extent of the nonconforming work. Additional sampling, testing, and observations may be necessary to determine the extent of the deficiency.

### 3.7.3 Documenting Non-Conformance

All non-conformances must be documented in writing in a non-conformance log, on daily progress reports, test reports and elsewhere, as appropriate. The documentation must occur immediately upon determining the extent of the nonconformance. For a nonconformance, which is considered serious or complex in nature, or which requires an engineering evaluation, the Design Engineer of Record must be notified.

### 3.7.4 Corrective Measures

For a simple or routine nonconformance, corrective measures must be determined by specification direction, or if none exists, the Owner's Project Manager, and Contractor will discuss standard construction methods to correct the deficiency. For more complex issues the Design Engineer of Record must determine corrective measures.

### 3.7.5 Verification of Corrective Measures

Upon notification to the Owner's Project Manager by the Contractor that corrective measures are complete, the Owner's Project Manager must verify its completion. The verification must be accomplished by observations or re-testing and photographs. The Owner's Project Manager must prepare written documentation of the corrective measures on daily reports, logs and forms, and the Nonconformance Report. The report must then become part of the project documentation and be maintained on site.

## 3.8 MATERIALS QUALITY VERIFICATION

### 3.8.1 Samples

The Contractors will identify sources and samples of various materials. Samples may need to be tested by the CQA Organization to determine if each material meets quality requirements defined in the Technical Specifications. A representative example of each sample, with corresponding test results, must be maintained on site to visually compare it with actual materials delivered to the project.

### 3.8.2 Materials Submittals

Material submittals may be used by the CQA Organization to establish the acceptability of materials. When submittals are required, the Technical Specifications define the Contractor's responsibilities for submitting material samples to the Owner's Project Manager for review.

### 3.8.3 Certificates of Compliance

Where allowed in the Technical Specifications, certificates of compliance may be used by the CQA Organization to establish the acceptability of materials in lieu of testing. These certificates generally state the material is in compliance with a particular code, standard, or specification.

## 3.9 CALIBRATION OF EQUIPMENT AND MATERIALS

Before placing a piece of testing equipment into service, its accuracy must be verified by calibration and a copy of the calibration certificate must be submitted to the Owner's Project Manager. The calibration must be performed within one month of use on the project, unless otherwise approved by the Owner's Project Manager as customary and usual for the equipment. Types of equipment requiring calibration include nuclear gauges and scales. The calibration procedures and frequencies must be per the manufacturer's instructions, API and/or ASTM standards. Whenever the equipment is suspect or is producing questionable results, it must be removed from service immediately and re-calibrated.

# 4 WORK ELEMENTS

Tables 4.1 to 4.6 outline specific CQA requirements for this project. Each table represents an overall work element and may involve several tasks or items.

**TABLE 4-1**

**SITE CLEARING AND PREPARATION**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Utility Location | Specification 01510. Contractor to locate utilities in project area. | Review results of utility locating service's work. If necessary work with parties to mitigate utilities that conflict with project area. | Prior to beginning field work. | N/A |
| Erosion and Sediment Control Measures – Performance Checks | Drawing 4. | Visually inspect to ensure erosion and sediment control (ESC) measures are installed as shown on Drawing 4 – including features at soil stockpile area, and ditches. | Prior to breaking ground. | N/A |
| | | Visually inspect to document performance of ESC measures. Document any maintenance, repair or cleaning to maintain proper function. | Daily. | |
| Establish Site Survey Control | Specifications 01052 and 01700. | Confirm benchmark and datum used. | Before start of work. | N/A |
| Protect Existing Groundwater Treatment Facilities and Equipment | Drawings 2 and 3. Specification 01510 | Visually inspect to document protection. | Daily. | N/A |

**TABLE 4-1**

**SITE CLEARING AND PREPARATION**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Clear and grub | Drawing 2. | Visually inspect and document to assure all clearing and grubbing from work area is performed and materials are removed from site. | Prior to starting construction activities. | N/A |
| Prepare soil stockpile area | Drawings 2 and 4 | Visually inspect to assure that asphalt has been removed, and that stockpiled soils will be in contact with exposed soil. | Prior to starting soil excavation. | N/A |
| | | Assure that asphalt is removed from site and properly disposed. | | |
| ZVI Reactor Vault Layout | Drawings 5, 6, and 7. | Visually inspect to document layout per Drawings. | Prior to excavating or shoring. | N/A |

**TABLE 4-2**

**SHORING**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Steel Sheet Piles – Materials | Specification 02221. Approved Work Plan prepared by the Contractor. | For material specified in work plan, visually inspect or confirm that the following properties meet design intent, per Contractors Work Plan:<br>Mass;<br>Length; | Upon delivery to site. | ASTM A572 |

**TABLE 4-2**

**SHORING**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Thickness;<br>Width; and<br>Straightness. | | |
| Steel Sheet Piles - Driven Position | At or outside the design limits of ZVI reactor vault location. | Visually inspect relative to layout location. | Daily observation while driving in progress | N/A |
| Steel Sheet Piles - Driving Record with Driven Length | Approved Work Plan prepared by the Contractor. | Prepare pile log documenting length of each pile, blows per foot to drive each pile, and final top and tip elevations for each pile. | For each pile; submit within 24 hours of driving. | N/A |
| Steel Sheet Piles – Waler Materials | Approved Work Plan prepared by the Contractor. | For material specified in work plan, visually inspect to assure that the following properties meet design intent, per Contractors Work Plan:<br>Section;<br>Length; and<br>Straightness. | Upon delivery to site. | N/A |
| Steel Sheet Piles – Waler Installation | Approved Work Plan prepared by the Contractor. | Visually inspect to ensure walers are installed at design elevations, with connections between walers and bracing per | Upon installation. | N/A |

**TABLE 4-2**

**SHORING**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Contractors Work Plan. | | |
| Sheet pile removal | Approved Work Plan prepared by the Contractor. | Visually inspect removal to assure installed components are not damaged. | During sheet pile removal. | N/A |

**TABLE 4-3**

**WATER MANAGEMENT, EXCAVATION, AND TREMIE CONCRETE**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Prior to starting work. | Specification 01025. and approved Excavation, Shoring, Water Management and Tremie Concrete Placement Plan prepared by the Contractor. | Submittal and approval of Excavation, Shoring, Water Management and Tremie Concrete Placement Plan prepared by the Contractor | N/A | N/A |
| Maintain water level in in excavation within 6 ft of ground surface during excavation and placement of tremie concrete. | Section 02221. Contractor's approved Excavation, Shoring, Water Management and Tremie Concrete Placement Plan. | Observe level of water within the excavation. | Continuously during excavation and tremie concrete placement activities | Observation and direct measurement. |

**TABLE 4-3**

**WATER MANAGEMENT, EXCAVATION, AND TREMIE CONCRETE**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Removal of water from within excavation following construction of tremie concrete slab and clean surface of tremie concrete. | Contractor's approved Excavation, Shoring, Water Management and Tremie Concrete Placement Plan. | Observe water removal from within excavation | After tremie concrete slab constructed | Observation. |
| | | Observe surface of concrete to document surface is clean enough for construction of Reactor Vault base slab. | | |
| | | | | |
| Discharge of groundwater to Sanitary | Specification 01025, Technical Memorandum dated 7/27/09, and King County discharge requirements. | Record discharge volume and document discharge rate does not exceed 100 gpm. | Daily | Observation |
| | | Measure Turbidity at discharge location.. | | Turbidity meter. |
| Excavation to Elevation 3 ft | Specification 02221. | Observe and document excavation to design lines and grades. | As required. | Observation and survey. |
| | | Document base of excavation is stable and not subject to base heave. | Periodically during excavation and prior to constructing tremie concrete slab. | Sounding with weighted measuring device. |

**TABLE 4-3**

**WATER MANAGEMENT, EXCAVATION, AND TREMIE CONCRETE**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Management of excavated soils | Specification 02221, Drawing 4, and City of Kent erosion and sediment control requirements. | Observe to assure compliance. | Daily during earthwork activities. | Observation. |
| Manage water emanating from stockpile. | Specification 02221, Drawing 4, and Contractor's approved Excavation, Shoring, Water Management and Tremie Concrete Placement Plan. | Observe to assure water from stockpile soils is being managed and is not discharging directly from site. | Daily during earthwork activities. | Observation. |
| Tremie Concrete | Specification 03111, Drawings 6, 7 and 8, and Contractor's approved Excavation, Shoring, Water Management and Tremie Concrete Placement Plan. | Review Contractor approved submittal, and request certification from supplier for each load delivered. | One submittal for each mix design and certification for each load delivered. | N/A |
| | | Slump and spread | At least 1 test every 50 cy. | ASTM C143 |
| | | Air Content | | ASTM C231 |
| | | Temperature | | ASTM C1064 |
| | | Strength | Every 150 cy | ASTM C31 |

**TABLE 4-3**

**WATER MANAGEMENT, EXCAVATION, AND TREMIE CONCRETE**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Visually inspect tremie pipe to be straight, vertical pipe of sufficient length to reach bottom of excavation, is at least 6-in. ID and equipped with a funnel to accept concrete. | Prior to pouring concrete. | Observation. |
| | | Visually inspect tremie pipe to ensure bottom is closed with a plug or plastic cap before admitting concrete at beginning of any pour. | | |
| | | Ensure bottom of tremie pipe is kept continuously under surface of concrete throughout pour. | During concrete pour. | Use sounding lead to determine level of concrete as work proceeds. |

**TABLE 4-4**

**CAST IN PLACE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Reinforcement | Drawings S0.1, S1.1, and S1.2. | Visually inspect to assure deformed bars are Grade 60, ASTM A615. Visually inspect bar size. | Upon Delivery. | ASTM A615 |
| | | Visually inspect to assure bar sizes and to assure lap splice lengths. | After fixing and before placing concrete. | N/A |
| | | Visually inspect to assure correct cover to wall forms or top and bottom of base slab. | | |
| | | Visually inspect to assure bars are tied in place correctly. | | |
| Embedded Items | Specification 051200 and Drawings S0.1, S1.1 and S1.2. | Visually inspect to assure embedded items are fixed securely in correct positions. | Before placing concrete. | N/A |
| Waterstops | Specification 031513 and Drawing S1.1. | Review Contractor's approved submittal, and verify delivered product matches submittal. | Upon delivery and before installation. | See table in Specification. |
| | | Visually inspect to assure waterstop centered and secured in correct | Prior to pouring concrete. | N/A |

**TABLE 4-4**

**CAST IN PLACE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | positions. | | |
| | | Visually inspect to assure waterstop butt splices are welded correctly. | Prior to pouring concrete. | Manufacturer recommendations. |
| Formwork | Specification 033000. | Visually inspect to assure formwork erected, secured and braced to support concrete loads. | Prior to installing steel and/or pouring concrete. | ACI 301. |
| Concrete | Specification 033000 and Drawing S0.1. | Review Contractor approved submittal, and request certification from supplier for each load delivered. | One submittal for each mix design and certification for each load delivered. | N/A |
| | | Slump | At least 1 test every 50 cy. and 1 test per shift. | ASTM C143 |
| | | Air Content | | ASTM C231 |
| | | Temperature | | ASTM C1064 |
| | | Strength | | ASTM C31 |
| | | Visually inspect to assure that concrete is placed continuously in such a way that no concrete placed on previously placed concrete that has hardened enough to create a seam or plane of weakness. | Continuous during concrete placement. | N/A |

**TABLE 4-4**

**CAST IN PLACE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Visually inspect to assure that mechanical vibrating equipment is used during concrete placement. | Continuous during concrete placement. | ACI 301 |

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Composite sheet membrane waterproofing system | Specification 071716. | Review Contractor approved product data and verify delivered material matches submittal. | Upon delivery and before installation | N/A |
| | | Review Contractor approved shop drawing showing location and extent of coverage and visually inspect application to assure correct installation. | During installation and before material is covered. | |

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Visually inspect to assure waterproofing applied under correct ambient conditions over entire outer surface of reactor vault. | During installation and before material is covered. | ASTM C898 and manufacturer's written instructions. |
| | | Document seams are taped, welded and fixed in place per manufacturer. | After application. | Manufacturer's written instructions. |
| | | | | |

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

<table>
<tr><th>TASK OR ITEM</th><th>SPECIFICATION OR DRAWING</th><th>REQUIRED OBSERVATION, TESTING OR DOCUMENTATION</th><th>INSPECTION OR TESTING FREQUENCY</th><th>CQA TEST METHOD</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Non- Woven Geotextile Separator Around ZVI Reactor Vault.</td><td>Specification 02771.
<table>
<tr><th>Property</th><th>ASTM Test Method</th><th>MARV Requirement</th></tr>
<tr><td>Mass/Area</td><td>D5261</td><td>8.0 oz/yd$^2$</td></tr>
<tr><td>Grab Tensile Strength</td><td>D4632</td><td>220 lbs</td></tr>
<tr><td>Puncture Strength</td><td>D4833</td><td>120 lbs</td></tr>
<tr><td>Trapezoidal Tear</td><td>D4533</td><td>95 lbs</td></tr>
</table></td><td>Review Contractor's approved submittal and manufacturer's quality control test data. Compare roll numbers of delivered material with roll numbers on MQC data. Document MQC test results indicate the materials meet specified requirements prior to installation</td><td>See Table in Section 02771.2.2 for MQC testing frequencies. There are no CQA testing requirements.</td><td>See Table in Section 02771.2.2 for MQC testing methods. There are no CQA testing requirements.</td></tr>
</table>

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

<table>
<tr><th>TASK OR ITEM</th><th>SPECIFICATION OR DRAWING</th><th>REQUIRED OBSERVATION, TESTING OR DOCUMENTATION</th><th>INSPECTION OR TESTING FREQUENCY</th><th>CQA TEST METHOD</th></tr>
<tr><td></td><td></td><td>Visually inspect to assure that geotextile is placed as shown on Drawings, or in accordance with Contractor approved Wok Plan.</td><td>As material is being installed.</td><td>Observation.</td></tr>
<tr><td></td><td></td><td>Visually inspect to assure that geotextile is overlapped.</td><td></td><td></td></tr>
<tr><td rowspan="3">Drainage Gravel for Drainage Gravel Around ZVI Reactor Vault.</td><td>Specification 02225. Material greater than ½ inch in largest dimension must be rounded to sub-rounded.</td><td rowspan="2">Review Contractor's approved submittals. Compare submitted sample to delivered material.</td><td rowspan="2">Complete one test per source prior to start of backfilling.</td><td>ASTM C136.</td></tr>
<tr><td>Specification 02225. Having a hydraulic conductivity of greater than or equal to 0.5 cm/sec when placed in accordance with this Section</td><td>ASTM D2434.</td></tr>
<tr><td>Specification 02225.<table><tr><th>U.S. Sieve Size</th><th>Percent Passing</th></tr><tr><td>2-inch</td><td>100</td></tr><tr><td>1½-inch</td><td>85-100</td></tr><tr><td>1-inch</td><td>50-85</td></tr></table></td><td></td><td></td><td></td></tr>
</table>

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

<table>
<tr><th>TASK OR ITEM</th><th>SPECIFICATION OR DRAWING</th><th>REQUIRED OBSERVATION, TESTING OR DOCUMENTATION</th><th>INSPECTION OR TESTING FREQUENCY</th><th>CQA TEST METHOD</th></tr>
<tr><td></td><td><table>
<tr><td>¾-inch</td><td>0-10</td></tr>
<tr><td>3/8-inch</td><td>0-5</td></tr>
<tr><td>#4</td><td>0-3</td></tr>
<tr><td>#40</td><td>0-3</td></tr>
<tr><td>#200</td><td>0-2</td></tr>
</table>
Gradation requirements are an index test. Gradation of materials below the 2-inch dimension and above the ½-inch sieve can be modified if the hydraulic conductivity requirements are met. Material must be of a gradation such that the $D_{85}$ size is greater than ½-inch.</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Drawings 6 and 7</td><td>Visually inspect to assure gravel is placed as shown on Construction Drawings, or Contractor's approved Work Plan.</td><td>During installation and before gravel is covered.</td><td>N/A</td></tr>
<tr><td>Piping Around ZVI Reactor Vault.</td><td>Specification 02711 and Drawings 6 and 7.</td><td>Review Contractor's approved submittal to verify delivered products matches submittal.</td><td>Upon delivery to the site and before installation.</td><td>N/A</td></tr>
</table>

**TABLE 4-5**

**WATERPROOFING AND BACKFILLING AROUND ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | | Document pipes placed at elevations 10 and 17 ft and vertical connection between pipes and riser to ground surface. | As piping placed and before covering with gravel. | |

**TABLE 4-6**

**PIPING INSIDE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Piping Inside ZVI Reactor Vault | Specification 02711 and Drawings 6 and 7. | Review Contractor's approved submittal to verify delivered products matches submittal. | Upon delivery to the site and before installation | N/A |
| | | Visually inspect pipes that penetrate concrete are placed at elevations 16.25 and 17.0. | As piping placed and before concrete pour. | |
| | | Visually inspect pipe layout on base of vault. | Following installation and before gravel installation. | |
| | | Visually inspect all pipe joints. | During welding. | |

**TABLE 4-6**

**PIPING INSIDE ZVI REACTOR VAULT**

<table>
<tr><th>TASK OR ITEM</th><th>SPECIFICATION OR DRAWING</th><th>REQUIRED OBSERVATION, TESTING OR DOCUMENTATION</th><th>INSPECTION OR TESTING FREQUENCY</th><th>CQA TEST METHOD</th></tr>
<tr><td></td><td></td><td>Visually inspect location of riser pipes relative to access lid design.</td><td>Following riser installation and before fabrication of lids.</td><td></td></tr>
<tr><td></td><td></td><td>Visually inspect pipe perforations.</td><td>Prior to installing pipes.</td><td></td></tr>
<tr><td rowspan="3">Drainage Gravel for Drainage Gravel Around and Over Pipes on Base of ZVI Reactor Vault</td><td>Specification 02225. Material greater than ½ inch in largest dimension must be rounded to sub-rounded.</td><td rowspan="3">Review Contractor's approved submittals. Compare submitted sample to delivered material.</td><td rowspan="3">Complete one test per source prior to start of backfilling</td><td>ASTM C136</td></tr>
<tr><td>Specification 02225. Having a hydraulic conductivity of greater than or equal to 0.5 cm/sec when placed in accordance with this Section</td><td>ASTM D2434</td></tr>
<tr><td>Specification 02225.<table><tr><th>U.S. Sieve Size</th><th>Percent Passing</th></tr><tr><td>2-inch</td><td>100</td></tr><tr><td>1½-inch</td><td>85-100</td></tr><tr><td>1-inch</td><td>50-85</td></tr><tr><td>¾-inch</td><td>0-10</td></tr><tr><td>3/8-inch</td><td>0-5</td></tr></table></td><td>ASTM C136</td></tr>
</table>

**TABLE 4-6**

**PIPING INSIDE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| | <table><tr><td>#4</td><td>0-3</td></tr><tr><td>#40</td><td>0-3</td></tr><tr><td>#200</td><td>0-2</td></tr></table> Gradation requirements are an index test. Gradation of materials below the 2-inch dimension and above the ½-inch sieve can be modified if the hydraulic conductivity requirements are met. Material must be of a gradation such that the $D_{85}$ size is greater than ½-inch. | | | |
| | Drawings 6 and 7 | Visually inspect to assure gravel is placed as shown on Construction Drawings, or Contractor's approved Work Plan. | During installation. | N/A |
| Linkseal Fittings | Drawing S0.1. | Review Contractor's approved submittal to verify delivered products matches submittal. | Upon delivery. | N/A |
| | | Visually inspect elevation of penetrations for fittings. | After each penetration through ZVI reactor vault walls is completed. | |
| | | Visually inspect installation of fittings. | | |

**TABLE 4-6**

**PIPING INSIDE ZVI REACTOR VAULT**

| TASK OR ITEM | SPECIFICATION OR DRAWING | REQUIRED OBSERVATION, TESTING OR DOCUMENTATION | INSPECTION OR TESTING FREQUENCY | CQA TEST METHOD |
|---|---|---|---|---|
| Valves | Drawing 2. | Review Contractor's approved submittal to verify delivered products matches submittal. | Upon delivery and prior to installation. | N/A |
| | | Review Contractor's approved shop Construction Drawings to verify installed valve supports comply with shop drawing. | Upon delivery and prior to installation. | |
| | | Visually inspect installation of valves and fittings for compliance with required elevation and approved shop drawings. | Following installation of each valve. | |

# 5 DOCUMENTATION

The quality assurance plan depends on thorough monitoring and documentation of all construction activities. Therefore, the Owner's Project Manager must document that all quality assurance requirements have been implemented. Documentation must consist of daily record keeping, daily test reports and installation reports, nonconformance reports (as necessary), progress reports, drawing and specification revisions, requests for information, test data summaries and an FCR.

## 5.1 Daily Record Keeping

Daily records must consist of a daily record of construction progress, list of equipment on site, observation and test data sheets as applicable, and as needed, nonconformance/ corrective measure reports.

### 5.1.1 Daily Record of Construction Progress

The daily field report must summarize ongoing construction activities and discussions with the Contractor. To the extent practicable without full-time on-site presence the report must include the following:

- Date, project name, project number, and location;
- A unique number for cross-referencing and document control;
- Weather data;
- A description of all ongoing construction for the day;
- An inventory of equipment utilized by the Contractor;
- Items of discussion and names of parties involved in discussions;
- A brief description of tests and observations, identified as passing or failing, or, in the event of failure, a retest;
- Areas of nonconformance/corrective actions, if any, (nonconformance and/or corrective action form to be attached);
- Summary of materials received and quality documentation;
- Follow-up information on previously reported problems or deficiencies; and
- Record of any site visitors; and
- Copies of any test data sheets.

### 5.1.2 Non-conformance Reports

In the occurrence of a nonconformance event, a nonconformance verification report form must be included with the daily report. Procedures for implementing and resolving any nonconformance to the contract are outlined in Section 2 of this CQA manual.

## 5.2 PHOTOGRAPHS

Construction activities must be photographed utilizing a digital camera. Photographs must be taken to document any significant problems encountered and corrective actions, and to document construction progress. Each photograph should identify the location, time, date, and photographer. Preferably, the time and date should be displayed on the photo itself. The photographer should document the subject of the photograph, in a photograph log. A compact disc (CD) containing copies of all digital photographs must be given to the Owner's Project Manager.

## 5.3 DRAWING AND SPECIFICATION CHANGES

Drawing and specification changes may be required during construction. Drawing and specification changes must only be made with written agreement of the Design Engineer of Record, Owner, and Contractor. These changes must be made by change order to the contract. When change orders are issued, the Owner's Project Manager must prepare them with technical input from the Design Engineer of Record. The Owner's Project Manager must distribute change orders for signature and execution to the required parties.

## 5.4 CONSTRUCTION REPORT

At the completion of the project, the CQA Engineer of Record must submit an FCR. This report must document the extent to which the project has been constructed in compliance with the Construction Drawings, Technical Specifications and design intent.

At a minimum, the report must contain:

- A summary of major construction activities;
- A summary of laboratory and field test results;
- Sampling and testing location drawings;
- A description of significant construction problems and the resolution of these problems;
- A list of changes from the Construction Drawings and Technical Specifications and the justification for these changes;
- Project Record Drawings; and
- A statement of compliance with the Construction Drawings, Technical Specifications, and design intent signed and stamped by a professional engineer registered in the state of Washington.

The Project Record Drawings must accurately locate the constructed location of all work items, including the location of the treatment system, slurry wall, geosynthetics limits, etc. All surveying and

base maps required for development of the record drawings must be prepared by the project surveyor. The CQA Engineer of Record, CQA Monitors and Contractors must review and verify that record drawings are correct. Record drawings must be included in the FCR.