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CONSTRUCTION QUALITY ASSURANCE PLAN

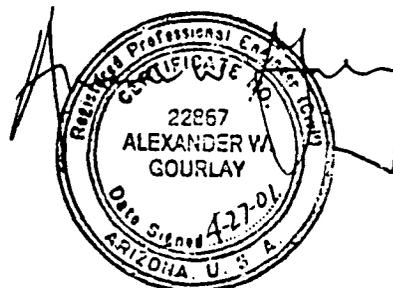
(Revised April 27, 2001)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30



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**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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CONSTRUCTION QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Construction Quality Assurance Plan (CQA Plan) applies to the provision of Construction Quality Assurance services for the procurement and construction of components of the Interim Dam Safety Improvements Project for the White Tanks FRS #3 (07.28).

1.1 PLAN PURPOSE

The purpose of this plan is to provide a project-specific technical guide to the Owner and its representatives to ensure a quality project, defensible documentation, and conformance with the drawings and specifications. This plan has been prepared on behalf of the Flood Control District of Maricopa County (the District), the owner and operator of the White Tanks FRS #3 located in west Phoenix, near the White Tanks mountains. This CQA Plan has been prepared by Dames & Moore as part of the Interim Dam Safety Project; White Tanks FRS #3, Contract No. FCD98-11.

1.2 SCOPE OF THIS DOCUMENT

This plan addresses the quality control and assurance of the construction work associated with this project. Assurance in the quality expected on this project and conformance with approved drawings and Special Provisions relies upon the execution of this plan, specifically the field monitoring and documentation of the activities. This CQA Plan therefore outlines in detail the CQA procedures that are provided and shall be considered in conjunction with the project contract, drawings, and Special Provisions. The construction activities requiring CQA procedures in this document include:

- Meetings
- Measurement and Payment Verification
- Site Visits and Observations
- Earthwork
- Corrugated Metal Piping
- Concrete

Any conflict between the requirements of this document and the approved drawings and Special Provisions shall be reported to the Engineer, for clarification or adjudication, as required. In general, however, the requirements of the Special Provisions shall prevail.

1.3 DEFINITION OF QUALITY CONTROL VERSUS QUALITY ASSURANCE

There is often considerable confusion between the definition of quality control and quality assurance. This document refers to the provision of quality control and quality assurance for various components of the project:

- **Quality Control** refers to those actions taken by all parties involved in the construction, including the Contractor, those parties charged with procurement and installation of manufactured materials, and the placement and compaction of the soil materials, which provide a means to determine and sometimes quantify the characteristics of the product. The results of a quality control program are compared to the Special Provisions or other contractual or regulatory requirements. During each aspect of the handling of these materials, quality control is provided by the manufacturer, fabricator, or installer of materials, or the supplier and earthworks contractor for the soils, to ensure that the materials and workmanship conform to the plans and Special Provisions. Quality control responsibility is retained by the Contractor, suppliers, and manufacturers because these entities have the most direct control over qualifications of personnel, specialized experience or expertise, choice in type and quantity of equipment, scheduling, sequencing, and workmanship that all factor in to the quality of the finished project.
- **Quality Assurance** is a planned and systematic pattern of all means and actions intended to provide adequate confidence that the materials and procedures conform to the plans and Special Provisions, and any applicable regulatory requirements. Quality assurance can either be provided by the Owner, or their designated representative, which is often an independent consulting, engineering, or construction management firm. Although quality assurance is as important during all phases of the project, construction quality assurance is often in association with those actions taken in relation to the installation of the geosynthetic materials, installation of structural concrete, and the placement and compaction of the soils materials. CQA is a critical component of a project because field conditions are the most variable and the most difficult to control and documentation is being recognized as invaluable to Owners and regulatory agencies.

2.0 PARTIES TO THE WORK AND RESPONSIBILITIES

The successful completion of the production and installation of the interim dam safety project is dependent on the interaction and cooperation of many parties. The following parties are represented in the project.

Engineer. The Engineer for this project is the Flood Control District.

Engineer of Record. The Engineer of Record for this project is URS Dames & Moore of Phoenix, Arizona.

General/Earthwork Contractor. The General/Earthwork Contractor is responsible for the mass earthworks, development of final slopes, placement of diaphragm filter sand, placement of riprap, placement of geotextile, placement and compaction of structural fill.

Subcontractors. The Subcontractor is retained directly by the General/Earthwork Contractor and is likely responsible for specialty work such as surveying, fencing, concrete, commercial sand and rock suppliers, etc.

Geosynthetics Manufacturer. The Manufacturer(s) of the geotextile filter fabric.

CQA Consultant. The CQA Consultant is responsible for the monitoring and documentation of the construction activities of the General/Earthworks Contractor.

CQA Director. The CQA Director, a designated person of the District or CQA Consultant, is responsible for overseeing the CQA Consultant and participates in the monitoring and documentation of the activities of the General/Earthworks Contractor.

Soils Laboratory. The Soils Laboratory is a party, independent of the General/Earthwork Contractor, that is responsible for the laboratory testing and reporting to verify the soil materials' conformance to the Special Provisions. In addition, quality control testing may be conducted to determine the as-compacted conditions of the soil materials for conformance with the Special Provisions. The Soils Laboratory testing can be retained by the District or the Engineer.

Owner. The Owner is the Flood Control District of Maricopa County (the District).

Responsible Regulatory Agencies. The regulatory agency for the design and construction of the Interim Dam Safety Project: FRS #3 is Arizona Department of Water Resources (ADWR).

2.1 CQA TEAM

The CQA Director assigned by the District will be the Owner's representative during the construction phase of the project.

- **CQA Director.** The CQA Director shall be a registered professional engineer (P.E.) in the state of Arizona and is responsible for all of the activities of the CQA Consultant. The CQA Project Director will be kept apprised of field progress and decisions and will visit the site to review the operations and progress by the CQA Consultant.

The CQA Consultant is responsible for the provision of construction quality assurance services for the construction of the Interim Dam Safety Project. The personnel of the CQA Consultant include:

- **CQA Consultant Manager.** The CQA Consultant Manager shall be a registered professional engineer (P.E.) in the state of Arizona and is responsible for all of the activities of the CQA Consultant. Duties include final reviewing all on-site activities, laboratory test results, and directly addressing any deficiencies that are encountered. In addition, the CQA Consultant Manager will be kept apprised of field progress and decisions and will visit the site to review the operations and progress by the CQA Consultant team members.
- **CQA Construction Manager.** The CQA Construction Manager, demonstrating experience in construction and field oversight, will be involved in design and construction issues and provide liaison activities which bridge the two phases of the project, and provide construction management insight and guidance as needed to the CQA Representatives in the field on a daily basis, and assist with quantity verification and scheduling.
- **CQA Project Engineer.** The Project Engineer, who is intimately knowledgeable with the design calculations and design intent, will interface in the field to provide technical guidance.
- **CQA Field Representative.** The on-site construction representative of the CQA Consultant, the CQA Field Representative, liaisons directly with the CQA Director, the General/Earthworks Contractor, and will coordinate with CQA Technicians on site.
- **CQA Field Technicians.** The CQA Field Technicians, either employed by the CQA Consultant or by an independent construction materials testing (CMT) company, performs soil materials testing, primarily compaction density testing. CQA Field Technicians may be used on an on-call, as-needed basis.

The specific functions and responsibilities of these personnel are presented in the following sections.

2.1.1 CQA Director

The CQA Director is the Owner's representative administers the contract and technical direction for the CQA Consultant. In particular, the CQA Director:

- Reviews the design, Plans, and Special Provisions for the project.
- Co-administers the CQA program with the CQA Consultant.
- Receives and reviews weekly reports, and provides final reviews laboratory and field test data submitted by the CQA Consultant.
- Participated in progress meetings.
- Periodically visits the site to review progress of the CQA program.
- Participates in any proposals for changes to the design, Plans, or Special Provisions that may be necessitated by field conditions.
- Receives and reviews the draft and final CQA report.

2.1.2 CQA Consultant Manager

The CQA Consultant Manager is the professional engineer (P.E.) in direct charge of the CQA program and certifies the work for submittal to the *regulatory agency*. In particular, the CQA Consultant Manager:

- Reviews the design, Plans, and Special Provisions for the project.
- Co-administers the CQA program with the District, including the supervision of the CQA Construction Manager, CQA Project Engineer, and CQA Field Representative.
- Review progress with the CQA Construction Manager and CQA Field Representative, review of all daily and weekly reports, review and interpretation of all laboratory test data, and engineering review of any aspects of the liner system during installation.
- Periodically visits the site to review progress of the CQA program.
- Participate in any proposals for changes to the design, Plans, or Special Provisions that may be necessitated by field conditions.
- Prepares, with the CQA Construction Manager and CQA Field Representative, the draft and final CQA report.

2.1.3 CQA Construction Manager

The CQA Construction Manager is involved in the office and fieldwork and will conduct the following:

- Attend Pre-Bid and Pre-Construction conferences.
- Attend periodic progress meetings and conduct site visit.
- Scheduling of CQA team.
- Supervises and reviews daily field reports from CQA Field Representative and Technicians.
- Review the schedule and progress to-date and provide recommendations for corrective actions, if any.
- Observe construction procedures and, with the CQA Project Engineer, assess that the intent of design is being met.
- Assist in resolving potential issues that may come up, including, but not limited to, schedules, non-conformance to drawings and Special Provisions, methods, equipment, payment, and sequencing.
- Prepare a weekly summary report for the designated District representative that outlines progress, problems, and resolutions.
- Assist with punch list development and final inspections.
- Assist with preparing draft and final CQA Report.

2.1.4 CQA Project Engineer

The CQA Project Engineer will be an integral part of the team both in the office and field, by conducting the following:

- Review of Contractor submittals.
- Review of CQA/QC results.
- Review of daily field notes.
- Assist with final acceptance of construction and report.
- Attend progress meetings (as necessary).

- Conduct routine site visits.
- Provide design clarification in general.
- Provide technical direction on critical start-up activities.
- Review material gradations and selection submittals.

2.1.5 CQA Field Representative

The CQA Field Manager is the full-time (or part-time) on-site representative of the CQA Consultant. The CQA Field Representative:

- Serves as the on-site representative of the CQA Consultant and supervises all other CQA Field Technicians.
- Reviews the CQA Plan, project Plans, and Special Provisions for the site, and ensures that all CQA Field Technicians are fully informed of the requirements of the work.
- Assigns the daily responsibilities of all CQA Field Technicians, to ensure that all relevant activities of the General/Earthworks Contractor are monitored and documented.
- The CQA Field Representative shall prepare daily field reports (notes) documenting the activities of the General/Earthworks Contractor for each day worked.
- Attends all progress meetings as required plus any activity-specific meetings necessary to review the installation of a critical component and/or CQA activities.
- Collects, collates, and reviews the documentation provided by the General/Earthwork Contractor and their suppliers of the materials to be used on the project.
- Observing and verifying by review of data made available by the contractor that construction is performed to the depths, lines, and grades as indicated on the drawings.
- Selects sample locations for conformance testing of all soils in accordance with the frequencies and test requirements specified, forwards these samples to the Soils Laboratory, and reviews all results for conformance and acceptability.
- When necessary, designates another of the on-site CQA personnel to act on his behalf whenever he is absent from the site, to ensure continuity during operations.
- Prepares, with the CQA team, the final completion report.

In addition, the CQA Field Representative regularly reports on both a verbal basis, and through periodic submittal of the daily CQA reports, to the designated District Representative to ensure that any problems are identified and communicated to all parties of the project on a timely basis.

2.1.6 CQA Field Technicians

One or more CQA Field Technicians will be assigned to the project on an on-call basis to ensure that the activities of the Earthworks Contractor are adequately tested for quality control and documented. The activities to be monitored, and duties to be carried out within the scope of the overall CQA program include:

- Schedule, observe, perform, and/or report construction materials testing.
- Examination of all soils delivered to the site and collection of samples for laboratory testing for conformance to the Special Provisions. Testing type and frequency is estimated in Table 1, however the actual test selection and frequency of testing will be at the discretion of the CQA team and the District based on field conditions and construction sequence.
- Testing, monitoring, and documenting the placement, backfilling, and compaction of all earthwork components and material types. Testing will include field moisture determinations, field compaction density by nuclear methods and by sand cone methods.

3.0 MEETINGS

Meetings of all parties are required at various times during the project based on the following objectives:

- Establish work schedules.
- Review Progress.
- Resolve problems.
- Generally maintain good lines of communication.

3.1 PRECONSTRUCTION MEETING

The Pre-construction Meeting is held in advance of the start of construction, to introduce all parties, and resolve any particular issues prior to the commencement of work, and to establish the requirements for construction quality assurance.

The following is a typical agenda for a pre-construction meeting:

- Use of site by contractor and owner.
- Owner's contract or site requirements.
- Construction facilities and temporary controls provided by Contractor.
- Survey layout.
- Security protocols.
- Housekeeping procedures.
- Public relations and confidentiality protocols.
- Inspections required.
- Quality control of major or critical activities in the project and a methodology.
- Proposed schedules and sequence of activities.
- Identification of the responsibilities project team.
- The timing and distribution of project correspondence.
- Establish the lines of authority and communication.
- Health and safety.

The Pre-construction Meeting, may also be concluded with a site walk-around to determine the status of activities, and re-discuss items during the meeting (if necessary).

This meeting shall be documented by the CQA Consultant and minutes prepared and circulated to all present, plus any other interested parties.

3.2 PROGRESS MEETINGS

Periodic progress meetings shall be held on a schedule to be determined by the CQA Consultant and the District in order to review the status of the schedule, problems, and measures for resolution of problems. These meetings shall be documented, as required, and the decisions reached promulgated to all affected parties.

Areas of concern and potential future problems shall also be outlined, and addressed at the next planned Progress Meeting, unless of sufficient importance or urgency as to warrant an *ad hoc* meeting.

The following is a typical agenda for a progress meeting:

- Review minutes of previous meetings.
- Review work progress.
- Field observations, problems, and decisions.
- Identification of problem which impede planned progress.
- Review submittals schedule and status of submittals.

- Review health and safety concerns and issues.
- Revisions to progress schedule.
- Corrective measures to regain projected schedules.
- Planned progress during succeeding work period.
- Coordination of projected progress.
- Effect of proposed changes on progress schedule and coordination.
- Potential change conditions or review of change order submittals.

4.0 MEASUREMENT AND PAYMENT VERIFICATION

Based on the final contract documents and bid schedule, the quantities are verified in the field using total count of items or survey of in-place volumes. Measurement calculation shall be initiated in the field by the CQA Representative and supported by independent registered land surveyor. The calculations are reviewed or checked by a second method to assess reasonableness. Report estimated pay measurements and explain any discrepancies.

4.1 PAYMENT REVIEW AND APPROVAL

Upon request of the District, review Contractor pay requests to render an independent opinion of progress and equitable request amount. The review is to include a written analysis discussing the major pay items and any discrepancy or suggested revision. Finally, the CQA Representative is to provide conclusions and recommendations for approval or rejection.

5.0 SITE VISITS AND GENERAL OBSERVATIONS

The CQA Project Director, CQA Project Engineer, or CQA Construction Manager shall conduct site visits, to ensure that all outstanding issues are resolved on a timely basis, and to review personally the progress and methodology of the Contractor and Subcontractor. The schedule of these site visits will be determined by project demands. In addition, the CQA Project Director, CQA Project Engineer, or CQA Construction Manager will have to make site visits when a problem arises which cannot be easily resolved or which impacts the design of the facility. In that regard, the CQA Project Director should make periodic site visits in order to review the progress and any aspects of the project that are particularly critical to the performance of the system.

6.0 EARTHWORK CQA

The earthwork, on-site soils fill, engineered fills, and rock associated with the Interim Dam Safety Project will consist of a variety of materials. The construction quality assurance of these soil materials is presented in the following subsections.

6.1 SOILS TESTING

6.1.1 Laboratory Soils Testing

Laboratory testing of the soils materials to be used at the site shall be carried out for the purpose of materials selection prior to construction and for materials quality control and evaluation during construction operations.

6.1.2 Laboratory Conformance and Quality Control Testing

Conformance testing associated with the selection of suitable materials for use in the project will be carried out by the Soils Laboratory and evaluated by the Engineer, the District, and the CQA Consultant in advance of the commencement of construction.

Tests are to be carried out to provide quality control and ensure that the source of the materials does not vary significantly or adversely from one area of the source to another and that the properties that are required in the Special Provisions are met. The frequency and need for a given test is shown in Table 1.

Mechanical Sieve Testing of foundation subgrade and soil buttress material must be completed prior to material placement. If any sieve test yields results outside of the specified gradation, the Engineer must review and approve the test results before material placement. If the foundation subgrade or soil buttress material is outside of the specified gradation, a field change may be considered.

6.1.3 Laboratory Testing Frequency

The frequency of testing required during the selection process for soil materials is a function of the quantity of each soil type required, in addition to the existing documentation of the source. In general, however, testing shall be conducted in accordance with the requirements of the project Special Provisions, and, at a minimum frequency as shown in Table 1 for material for each test procedure.

It should be noted that in all cases, at least one test shall be carried out, regardless of the quantity of materials placed and compacted, where relevant. The CQA Consultant shall review all laboratory test results and forward a summary of all testing to the designated District Representative and the Earthworks Contractor.

The CQA Representative shall coordinate the following laboratory testing:

- Nuclear moisture-density relation testing in accordance with ASTM D698.
- Relative density determinations in accordance with ASTM Methods D4253 and D4254.
- Sieve analysis in accordance with ASTM 422.

6.1.4 Field Soils Testing

The CQA Consultant shall be responsible for providing field *in situ* testing of the soils after placement and compaction, to determine their as-compacted properties and confirm conformance with the Special Provisions. Field quality control testing is carried out as a component of the construction quality assurance program by the CQA Consultant. The principal *in situ* testing carried out is the field determination of density and moisture content.

The CQA Representative shall conduct the following field soils testing activities:

- Nuclear moisture-density relation testing using a gauge in accordance with ASTM D2922 and D3017.
- Moisture-density relationship testing using the sand cone method in accordance with ASTM 1556.

6.2 CONTRACTOR'S MATERIAL SUBMITTALS

The CQA Representative shall conduct the following activities regarding contractor's materials submittals:

- Log the receipt of contractor's submittals and correspondence.
- Review submittals for schedules.
- Review quality control plan.
- Review submittal for corrugated metal pipe and accessories.
- Review submittals for geotextile filter fabric materials.
- Review submittals for import riprap materials.
- Review submittals for import filter sand materials.
- Review submittals for import drain sand.

- Review submittals for concrete.
- Review submittals for pneumatically placed mortar materials.
- Review submittals for landfill and disposal documentation.
- Review submittals for measurement and pay requests.
- Review submittals for as-built data.

6.3 OBSERVATIONS

The CQA Representative shall conduct the following observations:

- General/earthwork contractor's daily activities.
- Subcontractor's daily activities.
- Surveyor's activities.
- Removal of outlet headwall structure.
- Excavation limits.
- Borrow excavation and stockpiling.
- Pipe placement.
- Moisture conditioning.
- Filter sand placement.
- Fill placement.
- Geotextile filter fabric placement.
- Trash rack installation.
- As-built survey data collection.
- Construction materials testing.

6.4 EXCAVATIONS

The CQA Representative shall conduct the following prior to and during excavation:

- Verify the excavation limits are established and agreed upon.
- Verify clearing, grubbing, and stripping has been conducted as necessary.
- Verify the excavation is conducted to the limits and thickness required as shown on the drawings.

- Observe field conditions and evaluate laboratory data performed during construction to verify the foundation meets the gradation requirements as required in the specifications. Samples are to be collected and gradation tests performed to evaluate filter match with the diaphragm filter sand.

[**Note:** If a filter match is not achieved, the native foundation material shall be rejected, and one remedy to consider is overexcavation to a depth of 2 feet and replace with soil buttress fill material and compact in thin lifts.]

- Observe that the native foundation materials are prepared in accordance with the requirements of the Special Provisions, including scarification, moisture conditioning, and recompacting.
- Observe and verify unsuitable material (i.e. concrete, shotcrete, oversize rock) does not get commingled with structural fill that may be reused.

6.5 DIAPHRAGM FILTER SAND

The CQA Representative shall conduct the following prior to and during placement of filter sand:

- Verify the subgrade (foundation) is prepared and ready to receive sand.
- Observe the placement per project Special Provisions.
- Observe the compaction by method, equipment, and number of passes that may be necessary to achieve the desired results in the project Special Provisions.
- Observe and verify the field density based on relative determinations.
- Verify the sand is placed to the limits and thickness required as shown on the drawings. The thickness of 3 feet shown on the drawings is considered a minimum with a maximum of 3.5 feet. The Contractor shall target the dimension of 3 feet to the extent possible.
- Observe sand placement is not adversely affected or is damaged during placement of structural fill.

6.6 DRAIN SAND

The CQA representative shall conduct the following prior to and during placement of drain sand.

- Verify the subgrade (foundation) is prepared and ready to receive drain sand.
- Observe the placement per project Special Provisions.

- Observe the compaction by method, equipment, and number of passes that may be necessary to achieve the desired results in the project Special Provisions.
- Observe and verify the field density based on relative determinations.
- Verify the drain sand is placed to the limits and thickness required as shown on the drawings.
- Observe drain sand placement is not adversely affected or is damaged during placement of structural fill.

6.7 GEOTEXTILE FILTER FABRIC

The CQA Representative shall conduct the following prior to and during placement of geotextile filter fabric:

- Verify the subgrade is prepared and ready to receive fabric.
- Observe the deployment per manufacturer's recommendations and project Special Provisions.
- Verify the fabric is placed to the limits required as shown on the drawings.
- Verify overlap dimensions are achieved.
- Observe fabric is anchored properly to resist uplifting due to wind and sliding during drain sand placement.
- Observe rock placement and verify that fabric does not move or is damaged.

6.8 SOIL BUTTRESS FILL

The CQA Representative shall conduct the following prior to and during soil buttress fill or structural fill placement:

- Verify subgrade (foundation) is ready to receive fill materials, subgrade has been reviewed and approved by District and ADWR.
- Soil buttress fill materials shall consist of inorganic soils free of debris and gradation.
- Monitor loose lift thickness is within specification.
- Verify clearing, grubbing, or stripping necessary to eliminate organic matter.
- The soil should be within the required moisture content in the range for which the specified compaction is attainable.
- Coordinate field density testing and review results immediately (same day).

- Removal of oversize rocks beyond the required gradation may be accomplished by screen, handpicking, or scarification and windowing.
- The CQA Field Manager shall monitor material selection and placement.

6.9 RIPRAP

The CQA Representative shall conduct the following prior to and during placement of riprap:

- Verify the subgrade is prepared and ready to receive riprap.
- Verify the riprap meets the gradation requirements.
- Observe the placement per project Special Provisions.
- Verify the riprap is placed to the limits and thickness required as shown on the drawings.
- Observe hand placement of riprap to achieve desired results and intent of project requirements.

7.0 CORRUGATED METAL PIPING CQA

The CQA Representative shall ensure the manufacturer submits the appropriate certification of pipe and fitting materials for the application of this project.

7.1 SHIPPING, HANDLING, AND STORAGE

The CQA Representative shall be on-site at the time of receipt of material and observe off-loading procedures. The following verifications shall be made:

- Pipe and fitting material complies with specification requirements.
- Pipe and fitting material to be off-loaded is not damaged before or during off-loading operations.
- The pipe materials are placed out of the traffic so that damage does not occur.
- Inappropriate equipment and procedures such as fork lifts used with separation 2 by 4 boards.
- The pipe ends are kept clean and free of soil and debris during handling and storage.
- The pipe is inspected for possible damage within one hour of installation.

7.2 PIPE INSTALLATION

The CQA Representative shall monitor the installation of pipe at all times to the greatest extent possible. The CQA Representative shall ensure that in his absence the Owner's Representative or Contractor's superintendent is present during pipe placement, joining, and backfilling.

The CQA Representative shall observe several activities that may be occurring simultaneously, including, but not limited to, the following:

- Verify the pipe cutting procedure and work crew is qualified and to cut and demolish one (1) foot of the existing pipe. Verify the cut is marked and cut adequately to provide a uniform, tight butt joint between the two pipes.
- Verify the area to receive pipe is marked and the alignment and grade is correct.
- Verify the concrete foundation is ready to receive corrugated metal pipe, and has been reviewed and approved by District and ADWR prior to placement pipe.
- Upon observation and complete inspection of the installed pipe, the placement of backfill materials shall be monitored to prevent any dumping of bulk material directly onto the top of the pipe. Also observe the careful placement of the required uniform 6 inch loose lift on either side of the pipe and observe that proper haunching is being conducted.
- Observe that successive lifts of select material are properly placed without displacing the pipe and that the pipe is held firmly in place by the compacted fill.
- Document all verifications and observations made, including the number of passes with compaction equipment.

8.0 CONCRETE STRUCTURES

The CQA Representative shall perform sampling, laboratory testing, observation and monitoring for forms, reinforcement steel, and cast-in-place concrete pipe collar and encasement structure activities.

8.1 CONCRETE TESTING

Conformance testing of cast-in-place concrete and pneumatically-placed mortar will be conducted and evaluated by the Engineer, the District, and the CQA Consultant during construction.

8.1.1 Testing Frequency

The CQA Representative shall coordinate sampling, field testing, and laboratory testing at the following frequency:

Test	Frequency
Slump	1/9 CY
Concrete Compressive Strength	1 Set/ 18 CY
Mortar Compressive Strength	1 Set/ 500 SF

8.1.2 Field Sampling

Sampling shall be conducted of fresh concrete and pneumatically placed mortar (shotcrete). Samples of cured mortar panels shall also be collected of shotcrete.

8.1.3 Field Testing

The CQA Consultant shall be responsible for providing field sampling and testing of fresh concrete and mortar to determine their as delivered properties and confirm conformance with the Special Provisions. Field quality control testing is carried out as a component of the construction quality assurance program by the CQA Consultant.

The CQA Consultant shall conduct the following field concrete testing activities:

- Concrete field sampling and slump testing in accordance with ASTM C143.
- Mortar coring and cube preparation in accordance with ASTM C31.

8.1.4 Laboratory Testing

Conformance testing of the soils materials to be used at the site shall be carried out for the purpose of materials quality control and evaluation during construction.

The CQA Representative shall coordinate the following laboratory testing:

- Mortar cube compressive strength in accordance with ASTM C109.
- Concrete compressive strength in accordance with ASTM C39.

8.2 FORMS

The CQA Representative shall conduct the following prior to and during installation of forms:

- Verify subgrade is ready to received concrete, limits of excavation in accordance of drawings, elevation of subgrade, and compaction of subgrade.
- Observe forms are installed to limits, lines, elevations, depths required for pipe placement.
- Observe forms are supported and braced to prevent blow-out or movement.

8.3 STEEL REINFORCEMENT

The CQA Representative shall conduct the following prior to and during installation of forms:

- Observe rebar size, length, spacing, clearance, and placement.
- Observe “J” bolt imbed size, length, spacing and placement.

8.4 CAST-IN-PLACE CONCRETE

The CQA Representative shall conduct the following prior to and during installation of forms:

- Verify the forms, reinforcement steel, and “J” bolt imbeds are ready to receive concrete.
- Verify forms and reinforcement steel has been inspected and approved by the District and ADWR prior to concrete placement.
- Verify material submittal for concrete mix has been reviewed and approved.
- Verify CMT technician is ready to sample and test fresh concrete mix.
- Observe sampling testing of fresh concrete for slump and cylinders.
- Observe pour, placement, consolidation, screening, and finishing of fresh cast-in-place concrete.
- Observe position/placement of reinforcement steel and “J” bolt imbeds.
- Observe raking surface to receive additional concrete.
- Observe bonding agent is used on surface to receive additional concrete.

9.0 FIELD DOCUMENTATION

9.1 DAILY FIELD REPORTS

The CQA Representative shall document in his/her daily field reports following:

- Name
- Company name
- Date
- Start time and ending time
- Weather
- Job reference number
- Contractor or subcontractor onsite
- Major equipment onsite and/or used (or list)
- Page number
- Visitors to the site
- Activities performed that consumed the day
- Activities performed started or restarted that day
- Activities performed started or completed critical to the project
- Reference attached test results, sketches, etc

9.2 LOG FORMS

The CQA Representative shall use and maintain the following log forms:

- Soil sample collection and laboratory chain-of-custody
- Soil density results
- Concrete/mortar test results
- Contractor submittals
- Photographs
- Daily field reports
- Record of conversation

9.3 PHOTOGRAPHS

The CQA Representative shall document the following project activities using photographs:

- Existing conditions
- Progress of key activities at the various steps or phases of implementation
- Areas or items that are planned to be buried and not expected to be seen
- Completed components of work as project progress
- Completed project from various views (taken in last few days of work)

Photos are developed in duplicate to provide the District a full set of photo documentation.

10.0 CQA FINAL REPORT

Upon completion of the project, the CQA Consultant will prepare the CQA Final Report. This report will be the final record of the Construction Quality Assurance information for the site. In general, the report shall include all submittal items discussed in this CQA Plan. This shall include, at a minimum:

- The pipe manufacturer's certification and warranty documents.
- Field notes from the installation procedure, including such information as weather and unusual circumstances.
- Summary tables of results for soils.
- The geotextile filter fabric manufacturer's data.
- Compilation of copies of photo documentation.
- Field notes during construction and installation.
- The results of all soils testing, including both *in situ* field testing and laboratory testing in an appendix.

The report shall also provide a narrative description, in general, of the site's construction, noting all unusual occurrences encountered (i.e., failed seams, extreme weather, etc.). The report will be stamped by a Registered Professional Engineer to certify construction was completed in general accordance with approved design drawings, special provisions and other applicable contract documents, with exceptions noted. This report shall be provided to the District shortly after the completion of work.

TABLES

TABLE 1
MINIMUM CQA/QC EARTHWORK TESTING REQUIRED
CONTRACT FCD 2000C028
PCN 470-04-30
WHITE TANKS FRS#3
INTERIM DAM SAFETY

Test Methods		Frequency of Tests			
Reference	Description	Subgrade	Soil Buttress Fill	Drain Sand	Diaphragm Filter Sand
ASTM D422	Laboratory Test for particle size	3/outlet location per material	1/250 cy per material or change in material	1/100 cy	1/100 cy
ASTM D698	Laboratory Test for compaction-standard	1/outlet location per material	1/1000 cy per material or change in material	0	0
ASTM D4253	Laboratory Test for maximum index density using a vibrating table	0	0	1/500 cy per material or change of material source	1/500 cy per material or change of material source
ASTM D4254	Laboratory Test for minimum index density calculation relative density	0	0	1/500 cy per material or change of material source	1/500 cy per material or change of material source
ASTM D4643	Laboratory Test for Moisture content (oven-dry)	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests
ASTM D4318	Atterberg limits	3/outlet location per material	1/250 cy per material or change in material	0	0
ASTM D4564	Field test for Density of Soil in Place by Sleeve Method	0	0	0	2/lift
ASTM D1556	Field Test for In-place density by sand cone method	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests
ASTM D2922	Field Test for In-place density by nuclear gauge	5/lift	5/lift	2/lift	2/lift
ASTM D3017	Field test for moisture content	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods

1. The frequency of testing presented in this table is based on the minimum testing required. Final frequency and quantity of tests per method per material will be at the discretion of the District and CQA Consultant.
2. At any time the material and/or source changes, additional laboratory testing may be required at the discretion of the District and CQA Consultant.

TABLE 2

ESTIMATED MATERIAL QUANTITIES
CONTRACT FCD 2000C028
PCN 470-04-30
WHITE TANKS FRS#3
INTERIM DAM SAFETY

Material	Estimated Quantity
Diaphragm Filter Sand	330 cy
Drain Sand	115 cy
Soil Buttress Fill	5,060 cy