FINAL DESIGN
OF
POWERLINE F.R.S.
REPAIR
APACHE JUNCTION - GILBERT
W.P.P.

Flood Retarding Structure

PREPARED FOR

THE FLOOD CONTROL DISTRICT OF MARICOPA CO.

BY

THE U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

MARCH 1990

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PHOENIX, ARIZONA

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DESIGN REPORT

Job: Powerline FRS Embankment and Drainfill Repair

Project: Apache Junction - Gilbert Watershed Protection and Flood Prevention

Location: Pinal County, Arizona

Authority: Public Law 566

Phase: Final Design

Summary

Powerline Dam is one of many dams built in Arizona in the 1960's with a homogeneous fill. Several dams in Arizona were recommended for crack investigation and repair in the Interim Report of the SCS Study Team July 21, 1977. Powerline Dam was not originally considered for crack investigation but became a candidate at a later date.

This design is in accordance with "Cracking of Dams in Arizona", April 27, 1978, a report of the Crack Study Team, and "Crack Location Investigation", 1986, by Aubrey C. Sanders, Geologist with the Soil Conservation Service.

Description of Job

The project consists of constructing an internal filter system to provide stability to an existing embankment. The drain filter system consists of 2.5 miles of 3.0 foot wide trench along the center line of the embankment having an average depth of 18 feet and a maximum depth of 42 feet. A well graded drainfill will be used to backfill the trench. Due to subsidence in the area, approximately one foot of earthfill will be placed at the top of the embankment to restore the FRS to the design grade. A four inch layer of gravel will be placed on top of the dam because construction of this project will destroy the existing graveled O&M road at the top of the dam.

Design Objective

The design objective is to restore the embankment to the design grades and to provide a vertical transition zone as a defense against possible dam failure due to embankment cracking.

Basis for Design

1. Soil Mechanics Note No. 1.

2. As-Built Plans and Specifications for construction of Powerline FRS.

3. "Cracking of Dams in Arizona", 1978 Report.

4. "Cracking Investigation", by Aubrey Sanders 1986.

5. Soil Mechanics Test Results - 1961, 1974, 3/86, 11/16/89, and 12/5/89.

6. Letter to Jack Stevenson, Head, Engineering Staff, WNTC, from Ralph Arrington, SCS, Arizona, dated July 2, 1985.

7. Letter to Ralph Arrington, SCS, Arizona, from Jack Stevenson, Head, Engineering Staff, WNTC, dated January 17, 1989.

8. Letter to Ralph Arrington, SCS, Arizona from W.R. Evans, Head, Engineering Staff, WNTC, dated January 17, 1989.

9. Letter to R.M. Davis, Administrator, SCS, Washington, D.C., from Thomas G. Rockenbaugh, State Conservationist, dated April 27, 1979.

General Basic Data

> cause of cracking

There are a number of active fissures in the area west of Powerline FRS. One fissure called Junkers fissure is within 800 feet of Powerline FRS. The fissures are a result of ground water withdrawal and subsequent subsidence of the ground surface surrounding Hawk Rock. The rock surface is roughly 400 feet deep in the vicinity of Powerline FRS, and it continues sloping easterly to a depth of 1200 feet. Hawk Rock is within 0.8 miles of Powerline FRS. The design does not attempt to provide defense against possible fissuring at Powerline FRS. Monitoring of the area surrounding the FRS will continue and if a fissure intersects the fRS it will be addressed at that time. The Arizona Department of Water Resources agreed with this concept in their letter to Ralph Arrington dated February 20, 1990.

Foundation and/or Embankment Design

The depth of trench was established by reviewing the crack location investigation dated 1986, and by experience gained in repairing other dams in Maricopa and Pinal Counties. On other similar repair jobs, the final trench depth resulted in being deeper than was possible to evaluate during the investigational phase.

A comparison was made between the soils on Vineyard Road FRS and Powerline FRS. The gradation curves of the soils for the two dams are similar with Vineyard Road FRS soil generally having slightly more fines. Based on the similarity of soils, they will generally react in the same way in regard to shrink and swell characteristics, therefore, no drain outlets were designed for Powerline FRS. If, during construction there are areas where the cracking is severe or other anomalies are recorded in the geologic mapping done during this construction, the need for drain outlets can be considered at that time.

Also to be considered at a future date is a gravel surfacing on the slopes to

prevent rilling and to provide a moisture barrier which will help reduce the cracking due to dessication.

The drain fill gradation was based on Soil Mechanics Note 1 and establishing the limits on the finest soils found in Powerline FRS.

The trench depth was extended through the earthfill to the original foundation for the entire length of the dam. The design trench subgrades were adjusted for the settlement measured at the top of the dam so that the final trench depth is assured of extending into parent material.

Specifications

Standard specifications from NEH-20 were used for this repair design. A trench shield to be specially designed and provided by the contractor was included in the Items of Work for Construction Specification 21, Excavation.

Construction Review

A SCS Geologist will examine and map the embankment cracks exposed in the trench walls of the FRS. Timely notification of the construction activities will need to be given to the geologist in order to avoid any delays to the contractor.

A preconstruction meeting will be held with the project office personnel to review the design, specifications and drawings.

Arizona Department of Water Resources will be given the opportunity to inspect the dam foundation and trench sides as they feel is necessary.

AUTHORITY

Tom Jayo — 3/15/90

Submitted by: (Design Engineer) — Date

John McHarrington — 3/16/90

Approved by: (State Design Engineer) — Date

Ralph W Cronyn — 3-16-90

Approved by: (State Conservation Engineer) — Date

CONSTRUCTION SPECIFICATION

2. CLEARING AND GRUBBING

1. SCOPE

The work shall consist of the clearing and grubbing of designated areas by removal and disposal of trees, snags, logs, stumps, shrubs and rubbish.

2. MARKING

The limits of the areas to be cleared and grubbed will be marked by means of stakes, flags, tree markings or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about six feet above the ground surface.

3. REMOVAL

All trees not marked for preservation and all snags, logs, brush, stumps, shrubs and rubbish shall be removed from within the limits of the marked areas. Unless otherwise specified, all stumps, roots and root clusters having a diameter of one inch or larger shall be grubbed out to a depth of at least two feet below subgrade elevation for concrete structures and one foot below the ground surface at embankment sites and other designated areas.

4. DISPOSAL

All materials removed from the cleared and grubbed areas shall be burned or buried at locations shown on the drawings or as specified in Section 6 of this specification.

5. MEASUREMENT AND PAYMENT

The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

6. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and construction details are:

a. Subsidiary Item, Clearing and Grubbing

(1) This item shall consist of clearing and grubbing the borrow areas adjacent to the existing borrow channel as shown on the drawings and staked in the field.

(2) In Section 4, Disposal, all materials removed from the cleared and grubbed areas shall be burned or buried at locations approved by the Engineer or otherwise disposed of as approved by the Engineer.

(3) No separate payment will be made for clearing and grubbing. Compensation for this work will be included with the payment for Bid Item 3, Excavation Common.

CONSTRUCTION SPECIFICATION

5. POLLUTION CONTROL

1. SCOPE

The work shall consist of installing measures or performing work to control erosion and minimize the production of sediment, dust and other pollutants to water and air during construction operations in accordance with these specifications.

2. MATERIALS

All materials furnished shall meet the requirements of the Material Specifications listed in Section 8 of this specification.

3. EROSION AND SEDIMENT CONTROL MEASURES AND WORKS

The work and measures shall include but not be limited to the following, as shown on the drawings or as specified in Section 8 of this specification.

Staging of Earthwork Activities - The excavation and moving of soil materials shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

Seeding - Seedings to protect disturbed areas shall be as specified on the drawings or in Section 8 of this specification.

Mulching - Mulching shall be used to provide temporary protection to soil surfaces from erosion.

Diversions - Diversions shall be used to divert water away from work areas and/or to collect runoff from work areas for treatment and safe disposition.

Stream Crossings - Culverts or bridges shall be used where equipment must cross streams.

Sediment Basins - Sediment basins shall be used to settle and filter out sediment from eroding areas to protect properties and streams below the construction site.

Straw Bale Filters - Straw bale filters shall be used to trap sediment from areas of limited runoff. Bales are temporary and shall be removed when permanent measures are installed.

Waterways - Waterways shall be used for the safe disposal of runoff from fields, diversions and other structures or measures.

4. CHEMICAL POLLUTION

The Contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to be used to dispose of chemical pollutants (such as drained lubricating or transmission oils, greases, soaps, asphalt, etc.) produced as a by-product of the project's work. At the completion of the construction work, sumps shall be voided without causing pollution as specified in Section 8 of this specification.

Sanitary facilities such as pit toilets, chemical toilets, or septic tanks shall not be placed adjacent to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water sources. At the completion of construction work, facilities shall be disposed of without causing pollution as specified in Section 8 of this specification.

5. AIR POLLUTION

Local and state regulations concerning the burning of brush or slash or disposal of other materials shall be adhered to.

Fire prevention measures shall be taken to prevent the start or the spreading of fires which result from project work. Fire breaks or guards shall be constructed at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated fully suppress dust.

6. MAINTENANCE, REMOVAL ,AND RESTORATION

All pollution control measures and works shall be adequately maintained in a functional condition as long as needed during the construction operation. All temporary measures shall be removed and the site restored to as nearly to original conditions as practicable.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Pollution Control

(1) This item shall consist of all work and materials required for pollution control.

(2) The Contractor is responsible for maintaining air, water, and vegetative quality within the work area.

Methods include: Establishing turn areas, haul roads, worksite access roads, temporary building sites, equipment yards, etc., in approved locations best suited to prevent contamination of air and water and minimize erosion and destruction of existing vegetation.

(3) Section 7, Measurement and Payment, no separate payment will be made for pollution control. Compensation for this work will be included in the payment for Bid Item 5, Earthfill, and Bid Item 6, Drainfill.

CONSTRUCTION SPECIFICATION

7. ENGINEERING CONSTRUCTION SURVEYS

1. SCOPE

The work consists of performing all surveys required for (1) layout of the work, (2) construction control, and (3) quantity surveys for progress payment estimates from baselines and bench marks established by the Government. It includes furnishing all the necessary equipment, labor, and materials. Not included is work required for making the original and final surveys for computing quantities.

2. EQUIPMENT AND MATERIALS

Equipment used for all construction surveys shall be of a quality and condition that provides the specified accuracy. The equipment shall be maintained in good working order and good adjustment. Records of calibration tests and adjustments shall be maintained and be available for inspection by the Government

Materials include all the necessary field notebooks, stakes, templates, platforms, equipment, spikes, steel pins, tools, and other accessories required for layout and construction control of all of the work.

3. QUALITY OF WORK

Surveys shall be certified by a Land Surveyor or Engineer licensed by the State. The work shall be performed to the accuracy and detail appropriate for the location and type of job. Daily quantities of earthwork may be estimated from load count or equivalent measurement (within 25 percent ±); measurement for progress payments should be accurate within 10 percent ±/

Notes, sketches, and other data shall be complete, recorded neatly, and organized in a manner that will allow reproduction of copies for job documentation.

Differential leveling shall be third order with such precision that the error of closure (in feet) shall not exceed plus or minus 0.1 times the square root of the distance (in miles). The elevations of bench marks and temporary bench marks shall be determined and recorded to the nearest 0.01 foot.

Transit traverses shall be third order with such precision that; (1) the linear error of closure shall not exceed one foot in 3,000 feet, and (2) the angular error of closure shall not exceed 1.0 minute times the square root of the number of angles turned.

Surveys will be reviewed periodically and randomly checked by the Government to assure that the specified quality is being maintained.

4. PRIMARY CONTROL

The base lines and bench marks for primary control, which are necessary to establish the lines and grades needed for construction, will be established by the Government. They will be shown on the drawings and located on the ground before construction.

The base lines and benchmarks shall be used as the origin of all surveys needed to establish lines and grades for construction.

5. CONSTRUCTION SURVEY AND MEASUREMENT RECORDS

All survey data will be recorded in fully identified, bound field notebooks, Pages shall be numbered consecutively. The required books shall be turned over to and become the property of the Government, prior to acceptance of the work or any part of this work. All entries shall be legible, reproducible, and follow the format in Soil Conservation Service TR-62, "Engineering Layout, Notes, Staking and Calculations." The bound field note books shall be available at all times during the progress of the work for examination and use by the Government. Copies of field book notes shall be made available to the Contracting Officer upon request. Electronically generated survey data and computations shall be bound, paginated, and referenced in the bound field notebook containing the survey control in a manner that will make all of the information intelligible and permanent. All field notes and printed data shall include the purpose or description of the work, the date the work was performed, the weather (if field work), the individual or individuals who performed and checked the work and sketches and other information pertinent to the work.

6. STAKING

The location and marking of all stakes shall be as shown in Soil Conservation Service TR-62 as supplemented below.

a. Clearing and grubbing - The boundary of the clearing and grubbing areas shall be staked or flagged at 200-foot intervals or less if needed to clearly mark the limits of work.

b. Excavation - Cut stakes shall be placed on the centerline at the intersection of the planned side slopes and natural ground line. All slope stakes shall be marked with the required cut, horizontal distance, and slope ratio. Offset reference stakes and hubs shall be placed at full stations, on at least one side of the proposed excavation.

c. Earthfill - Fill stakes shall be placed on the centerline and at the toes of the planned slopes and shall be marked with the fill, horizontal distance, constucted slope ratio, and stationing. Offset reference stakes and hubs shall be provided as a minimum on both sides of the fill at full stations.

Earthwork slope stakes shall be placed as a minimum at full stations, break in the original ground surface, and at other intermediate stations as necessary to insure accurate location of construction. Slope stakes and cross sections shall be at right angles to the centerline. Distances shall be measured horizontally; rod readings shall be taken vertically and recorded to the nearest 0.1 foot.

7. MEASUREMENT AND PAYMENT

Payment will be made as the work proceeds, after receipt of invoices from the contractor showing (contractor or subcontractor) surveying costs and cost of supplies. If the total of incremental payments is less than the contract lump sum for surveys, the balance will be included in the final contract payment. Total payment will be the contract lump sum price for surveys, regardless of actual cost to the contractor.

Payment will not be made under this item for the purchase cost of materials and equipment having a residual value.

Payment of the contract lump sum price for surveys will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the item to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 1, Survey

(1) This items shall consist of furnishing personnel, equipment, materials and performing surveys required for:

(a) Construction Layout

(b) Computation of Quantities for monthly and final payments.

(c) "As-Built" Construction Drawings

(2) Section 1, SCOPE, the last sentence does not apply.

(3) The Contractor shall provide the Contracting Officer a statement of qualifications, inclulding specific experience of each of the survey personnel assigned to the job.

(4) The Contractor shall provide the Contracting Officer with a schedule of surveys to be performed each week.

(5) Monuments damaged by the Contractor which are due to negligence will be replaced by the government at the Contractor's expense. The actual cost to the government of replacing subsidence monuments will be deducted from the payment due to the Contractor.

CONSTRUCTION SPECIFICATION

8. MOBILIZATION

1. SCOPE

The work shall consist of the mobilization of the Contractor's forces and equipment necessary for performing the work required under the contract. Mobilization will not be considered as work in fulfilling the contract requirement for commencement of work.

Mobilization shall include the cost for transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities as the site not covered in specific bid items, and other preparatory work at the site. The cost of the entire amount of premiums paid for performance and payment bonds, including coinsurance and reinsurance agreements as applicable shall be paid upon request when evidence of full payment to the surety has been provided to the Contracting Officer.

Work done under this specification shall not include mobilization for any specific item of work for which payment for mobilization is provided elsewhere in the contract.

The specification covers mobilization for work required by the contract at the time of award. If additional mobilization costs are incurred during

performance of the contract as a result of changed or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

2. PAYMENT

Payment will be made as the work proceeds, after presentation of invoices by the Contractor showing his own mobilization costs and evidence of the charges of suppliers, subcontractors, and others for mobilization work performed by them. If the total of such payments is less than the contract lump sum for mobilization, the unpaid balance will be included in the final contract payment. Total payment will be the lump sum contract price for mobilization, regardless of actual cost to the Contractor.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

Payment of the lump sum contract price for mobilization will constitute full compensation for all labor, materials, equipment; and all other items necessary and incidental to completion of the work.

3. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 2, Mobilization

(1) This item shall consist of the mobilization of the Contractor's equipment and forces to perform the work required under this contract.

CONSTRUCTION SPECIFICATION

10. WATER FOR CONSTRUCTION

1. SCOPE

The work shall consist of furnishing, transporting, and using water for construction purposes in accord with the applicable specifications.

2. FACILITIES AND EQUIPMENT

The Contractor shall build and maintain such access and haul roads as are needed, and shall furnish, operate, and maintain all pumps, piping, tanks, and other facilities needed to load, transport, and use the water as specified.

These facilities shall be equipped with meters, tanks, or other devices by which the volume of water supplied can be measured.

3. DUST ABATEMENT AND HAUL ROAD MAINTENANCE

Water for dust abatement and haul road maintenance shall be applied to haul roads and other dust-producing areas as needed to prevent excessive dust and to maintain the roads in good condition for efficient operation while they are in use.

4. EARTHFILL, DRAINFILL, ROCKFILL

Water for earthfill, drainfill, or rockfill shall be used in the fill materials as specified in the applicable construction specifications.

5. CONCRETE, MORTAR, GROUT

Water used in mixing or curing concrete, pneumatically applied mortar, or other portland cement mortar or grout shall meet the requirements of the applicable construction specifications and shall be used in conformance with those specifications. Payment for water used in these items is covered by the applicable concrete, mortar or grout specification.

6. MEASUREMENT AND PAYMENT

Compensation for any item described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 7 of this specification.

7. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Water

(1) This item shall consist of furnishing, transporting, and applying all water necessary for performance of the work as described in this contract.

(2) In Section 6, Measurment and Payment, no separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Item 5, Earthfill; Bid Item 6, Drainfill; and Bid Item 8, Gravel Cover.

CONSTRUCTION SPECIFICATION

11. REMOVAL OF WATER

1. SCOPE

The work shall consist of the removal of surface water and ground water as needed to perform the required construction in accordance with the specifications. It shall include (1) building and maintaining all necessary temporary impounding works, channels, and diversions, (2) furnishing, installing and operating all necessary pumps, piping and other facilities and equipment, and (3) removing all such temporary works and equipment after they have served their purposes.

2. DIVERTING SURFACE WATER

The Contractor shall build, maintain and operate all cofferdams, channels, flumes, sumps, and other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site and away from the construction work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainage way in which its headworks are located.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer, in writing, his plan for diverting surface water before beginning the construction work for which the diversion is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

3. DEWATERING THE CONSTRUCTION SITE

Foundations, cutoff trenches and other parts of the construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. The Contractor shall furnish, install, operate and maintain all drains, sumps, pumps, casings, wellpoints, and other equipment needed to perform the dewatering as specified. Dewatering methods that cause a loss of fines from foundation areas will not be permitted.

Unless otherwise specified, the Contractor shall furnish to the Contracting Officer in writing, his plan for dewatering before beginning the construction work for which the dewatering is required. Acceptance of this plan will not relieve the Contractor of responsibility for completing the work as specified.

4. DEWATERING BORROW AREAS

Unless otherwise specified in Section 8, the Contractor shall maintain the borrow areas in drainable condition or otherwise provide for timely and effective removal of surface and ground waters that accumulate within the borrow areas from any source. Borrow material shall be processed as necessary to achieve proper and uniform moisture content for placement.

If pumping to dewater borrow areas is included as an item of work in the bid schedule, each pump used for this purpose shall be equipped with a water meter in the discharge line. Accuracy of the meters shall be such that the measured quantity of water is within 3 percent, plus or minus, of the true quantity. Means shall be provided by the Contractor to check the accuracy of the water meters when requested by the Contracting Officer.

5. EROSION AND POLLUTION CONTROL

Removal of water from the construction site, including the borrow areas shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized.

6. REMOVAL OF TEMPORARY WORKS

After the temporary works have served their purposes, the Contractor shall remove them or level and grade them to the extent required to present a sightly appearance and to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

Except as otherwise specified, pipes and casings shall be removed from temporary wells and the wells shall be filled to ground level with gravel or other material approved by the Contracting Officer.

7. MEASUREMENT AND PAYMENT

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Subsidiary Item, Removal of Water

(1) This item shall consist of the removal or diversion of storm water from the construction area as needed to perform the required work.

(2) In the case of storm runoff filling the reservoir during the work period, the Contractor should expect a minimum drawdown time to the principal spillway inlet elevation (el. 1563) to be ten (10) days.

(3) Section 7, Measurement and Payment, no separate payment will be made for this item. Compensation for this work will be included in the payment for Bid Items 3, Excavation, and Bid Item 4, Trench Excavation.

CONSTRUCTION SPECIFICATION

21. EXCAVATION

1. SCOPE

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. CLASSIFICATION

Excavation will be classified as common excavation or rock excavation in accordance with the following definitions or will be designated as unclassified.

Common excavation shall be defined as the excavation of all materials that can be excavated, transported, and unloaded by the use of heavy ripping equipment and wheel tractor-scrapers with pusher tractors or that can be excavated and dumped into place or loaded on to hauling equipment by means of excavators having a rated capacity of one cubic yard and equipped with attachments (such as shovel, bucket, backhoe, dragline or clam shell) appropriate to the character of the materials and the site conditions.

Rock excavation shall be defined as the excavation of all hard, compacted or cemented materials the accomplishment of which requires blasting or the use of excavators larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than one cubic yard in volume encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation.

Excavation will be classified according to the above definitions by the Engineer, based on his judgment of the character of the materials and the site conditions.

The presence of isolated boulders or rock fragments larger than one cubic yard in size will not in itself be sufficient cause to change the classification of the surrounding material.

For the purpose of this classification, the following definitions shall apply:

Heavy ripping equipment shall be defined as a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a tractor having a power rating of 200-300 net horsepower (at the flywheel).

Wheel tractor-scraper shall be defined as a self-loading (not elevating) and unloading scraper having a struck bowl capacity of 12-20 yards.

Pusher tractor shall be defined as a track type tractor having a power rating of 200-300 net horsepower (at the flywheel) equipped with appropriate attachments.

3. UNCLASSIFIED EXCAVATION

Items designated as "Unclassified Excavation" shall include all materials encountered regardless of their nature or the manner in which they are removed. When excavation is unclassified, none of the definitions or classifications stated in Section 2 of this specification shall apply.

4. BLASTING

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations.

Blasting shall be done in such a way as to prevent damage to the work or unnecessary fracturing of the foundation and shall conform to any special requirements in Section 12 of this specification.

5. USE OF EXCAVATED MATERIALS

To the extent they are needed, all suitable materials from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitablity of materials for specific purposes will be determined by the Engineer. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

6. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the location shown on the drawings.

7. BRACING AND SHORING

Excavated surfaces too steep to be safe and stable if unsupported shall be supported as necessary to safeguard the work and workers, to prevent sliding or settling of the adjacent ground, and to avoid damaging existing improvements. The width of the excavation shall be increased if necessary to provide space for sheeting, bracing, shoring, and other supporting installations. The Contractor shall furnish, place and subsequently remove such supporting installations.

8. STRUCTURE AND TRENCH EXCAVATION

Structure or trench excavation shall be completed to the specified elevations and to sufficient length and width to include allowance for forms, bracing and supports, as necessary, before any concrete or earthfill is placed or any piles are driven within the limits of the excavation.

9. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fills, additional materials shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as directed by the Engineer.

Borrow pits shall be excavated and finally dressed in a manner to eliminate steep or unstable side slopes or other hazardous or unsightly conditions.

10. OVEREXCAVATION

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the Engineer. Concrete that will be exposed to the atmosphere when construction is completed shall contain not less than 6 sacks of cement per cubic yard of concrete. Concrete that will be permanently covered shall contain not less than 4.5 sacks of cement per cubic yard. The concrete shall be placed and cured as specified by the Contracting Officer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved compacated earthfill, except that, if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding or drainfill.

11. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Regardless of quantities excavated, the measurement for payment will be made to the specified pay limits, except that excavation outside the specified lines and grades directed by the Engineer to remove unsuitable material will be included. Excavation required because unsuitable conditions result from the Contractor's improper construction operations, as determined by the Contracting Officer will not be included for measurement and payment.

The pay limits shall be as designated on the drawings.

Payment for each type and class of excavation will be made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all equipment, and all other items necessary and incidental to the performance of the work, except that extra payment for backfilling overexcavation will be made in accordance with the following provisions:

Payment for backfilling overexcavation, as specified in Section 10 of this specification, will be made only if the excavation outside specified lines and grades is directed by the Engineer to remove unsuitable material and if the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 12 of this specification.

12. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 3, Excavation, Common

(1) This item shall consist of all excavation required to excavate the top of the dam at the locations as shown on the plans.

(2) Excavation material will be stockpiled on the upstream toe of the dam between the dam and low flow channel and shall be reused as needed to refill the excavated areas.

(3) Ten (10) days prior to commencing the work for this bid item the Contractor shall submit to the Contracting Officer for approval a plan showing a continuous sequence of excavation, drainfill and earthfill which will minimize the breach time for the repair work at the locations shown on the plans.

(4) Section 11, MEASUREMENT AND PAYMENT, payment shall include compensation for Subsidiary Items, Removal of Water and Clearing and Grubbing.

b. Bid Item 4, Trench Excavation

(1) This item shall consist of excavation required for installation of the embankment drainfill material within the embankment as shown on the drawings.

(2) All trench excavation materials shall be spread uniformly on the upstream slope of the dam within the limits shown on the drawings.

(3) A motor grader shall be used to dress and provide final shape to waste material on 3:1 slope of dam.

(4) The trench shall be excavated to the elevations shown on the drawings or to the original excavated foundation material which ever is lower. The final depth will be approved by the Engineer.

(5) Section 7, BRACING AND SHORING, shall require furnishing, placing, moving, and removing a portable shield for the inspection operations in addition to bracing and shoring required for construction operations. The support works shall be designed and used in a manner to provide protection to the inspectors and contractor forces and permit inspection of both faces of the trench. The design shall include the following:

(a) A permanently installed steel ladder mounted to the interior of the steel side wall. The ladder sections shall be installed on alternating ends of each shield so that the ladder is not continuous in alignment.

(b) Guardrails and safety chains for the upper deck of the shield and guard rails for all other decks.

(c) The design shall be in compliance with all OSHA and AISC Standards. Design of the shield segments shall provide fastening devices that will join segments tightly together and provide strength equal to the non-segmented structure.

(d) The longer sides of the shield shall be solid steel plated except for 24± inch by 36± inch windows which will be on each side at the front and back three (3) feet of the shield as shown on the conceptual design layout.

(e) The interior of the shield shall be painted a bright white to provide light enhancement.

(f) Open non-skid grating used as deck platforms for inspection purposes shall be placed at eight (8) foot intervals and across the front of the shield exposed to the towing cables.

(g) The top platform shall be constructed such that it can be used by personnel to cross over the open trench, or a bridge type crossing will be provided.

A conceptual layout of a shield meeting the above requirements is available for review at the Project Office or can be obtained from the Contracting Officer.

The Contractor shall furnish to the Contracting Officer for approval a plan and design for the trench movable shield. The design shall be prepared and sealed by a licensed professional engineer. Approval of the plan will not relieve the Contractor of safety responsibilities.

(6) Appropriate signaling devices or methods and personnel shall be available during the trench investigation and mapping process to assure that full communication between the government geologist and the Contractor's equipment operator is maintained during repositioning of the portable shield.

(7) Time for SCS geologic examination and mapping of embankment cracks along the trench side walls will be required. The investigation and mapping will not begin until at least 24 hours after the trench has been excavated to allow the trench walls time to air dry for easier crack location. The rate of mapping is estimated to be 20 to 40 linear feet of trench per hour. The embankment crack investigation and mapping process will dislodge trench wall material onto the excavated trench bottom. The Contractor shall clean and prepare the trench bottom in accordance with paragraph 7 of Bid Item 5, Drainfill.

(8) No more than 1000 feet length of trench shall be opened at any time unless additional length is approved by the Contracting Officer.

(9) In Section 11, Measurement and Payment, payment shall include compensation for Subsidiary Item, Removal of Water.

c. Subsidiary Item, Borrow Excavation

(1) This item shall consist of all common excavation required to obtain fill material not available from the required excavations to complete the construction of the permanent works.

(2) The borrow material shall be obtained by extending the existing borrow channel in an upstream direction as shown on the plans.

(3) The borrow area shall be graded to provide drainage to prevent ponding of water and to be in harmony with the natural drainage pattern. All the final lines and grades will be as directed by the Engineer.

(4) No seperate payment will be made for borrow excavation. Compensation for this item will be included in the payment for Bid Item 5, Earthfill.

CONSTRUCTION SPECIFICATION

23. EARTHFILL

1. SCOPE

The work shall consist of the construction of earth embankments and other earthfills required by the drawings and specifications.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing and disposition of materials in the various fills shall be subject to approval by the Engineer.

Fill materials shall contain no sod, brush, roots or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to compaction of the fill.

The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

3. FOUNDATION PREPARATION

Foundations for earthfill shall be stripped to remove vegetation and other unsuitable materials or shall be excavated as specified.

Except as otherwise specified, earth foundation surfaces shall be graded to remove surface irregularities and shall be scarified parallel to the axis of the fill or otherwise acceptably scored and loosened to a minimum depth of 2 inches. The moisture content of the loosened material shall be controlled as specified for the earthfill, and the surface materials of the foundation shall be compacted and bonded with the first layer of earthfill.

Earth abutment surfaces shall be free of loose, uncompacted earth in excess of two inches in depth normal to the slope and shall be at such a moisture content that the earthfill can be compacted against them to effect a good bond between the fill and the abutments.

Rock foundation and abutment surfaces shall be cleared of all loose materials by hand or other effective means and shall be free of standing water when fill is placed upon them. Occasional rock outcrops in earth foundations for earthfill, except in dams and other structures designed to restrain the movement of water, shall not require special treatment if they do not interfere with compaction of the foundation and initial layers of the fill or the bond between the foundation and the fill.

Foundation and abutment surfaces shall be not steeper than 1 horizontal to 1 vertical unless otherwise specified. Test pits or other cavities shall be filled with compacted earthfill conforming to the specifications for the earthfill to be placed upon the foundation.

4. PLACEMENT

Fill shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill shall not be placed upon a frozen surface, nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers. The thickness of each layer before compaction shall not exeed the maximum thickness specified. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified thickness before being compacted. Hand compacted fill, including fill compacted by manually directed power tampers, shall be placed in layers whose thickness before compaction does not exceed the maximum thickness specified for layers of fill compacted by manually directed power tampers.

Adjacent to structures, fill shall be placed in a manner which will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure.

Earthfill in dams, levees and other structures designed to restrain the movement of water shall be placed so as to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

c. The top surfaces of embankments shall be maintained approximately level during construction, except that a crown or cross-slope of approximately 2 percent shall be maintained to insure effective drainage, and except as otherwise specified, for drainfill or sectional zones.

d. Dam embankments shall be constructed in continuous layers from abutment to abutment except where openings to facilitate construction or to allow the passage of stream flow during construction are specifically authorized in the contract.

e. Embankments built at different levels as described under (c) or (d) above shall be constructed so that the slope of the bonding surfaces between embankment in place and embankment to be placed is not steeper than 3 feet horizontal to 1 foot vertical. The bonding surface of the embankment in place shall be stripped of all material not meeting the requirements of this specification, and shall be scarified, moistened and recompacted when the new fill is placed against it as needed to insure a good bond with the new fill and to obtain the specified moisture content and density at the contact of the in place and new fills.

5. CONTROL OF MOISTURE CONTENT

During placement and compaction of fill, the moisture content of the Materials being placed shall be maintained within the specified range.

The application of water to the fill materials shall be accomplished at the borrow areas insofar as practicable. Water may be applied by sprinkling the materials after placement on the fill, if necessary. Uniform moisture distribution shall be obtained by disking.

Material that is too wet when deposited on the fill shall either be removed or be dried to the specified moisture content prior to compaction.

If the top surface of the preceding layer of compacted fill or a foundation or abutment surface in the zone of contact with the fill becomes too dry to permit suitable bond it shall either be removed or scarified and moistened by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

6. COMPACTION

Earthfill shall be compacted according to the following requirements for the class of compaction specified:

Class A compaction. Each layer of fill shall be compacted as necessary to make the density of the fill matrix not less than the minimum density specified. The fill matrix is defined as the portion of the fill material finer than the maximum particle size used in the compaction test method specified.

Class B compaction. Each layer of fill shall be compacted to a mass density not less than the minimum density specified.

Class C compaction. Each layer of fill shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified, or by an approved equivalent method. Each pass shall consist of at least one passage of the roller wheel or drum over the entire surface of the layer.

Fill adjacent to strutures shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping, or manually directed power tampers or plate vibrators. Unless otherwise specified, heavy equipment including backhoe mounted power tampers, or vibrating compactors and manually directed vibrating rollers, shall not be operated within 2 feet of any structure. Towed or self-propelled vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from a crane or hoist will not be permitted.

The passage of heavy equipment will not be allowed: (1) over cast-in-place conduits prior to 14 days after placement of the concrete; (2) over cradled or bedded precast conduits prior to 7 days after placement of the concrete cradle or bedding; or (3) over any type of conduit until the backfill has been placed above the top surface of the structure to a height equal to one-half the clear span width of the structure or pipe or 2 feet, whichever is greater.

Compacting of fill adjacent to structures shall not be started until the concrete has attained the strength specified in Section 10 for this purpose. The strength will be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determing when a structure may be put into service.

When the required strength of the concrete is not specified as described above, compaction of fill adjacent to structures shall not be started until the following time intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and spillway risers, cast-in-place (with inside forms in place)	7 days
Conduits and spillway risers, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents (backfilled both sides simultaneously)	3 days

7. REWORKING OR REMOVAL AND REPLACEMENT OF DEFECTIVE FILL

Fill placed at densities lower than the specified minimum density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the specifications shall be reworked to meet the requirements or removed and replaced by acceptable fill. The replacement fill and the foundation, abutment and fill surfaces upon which it is placed shall conform to all requirements of this specification for foundation preparation, approval, placement, moisture control and compaction.

8. TESTING

During the course of the work, the Engineer will perform such tests as are required to identify materials, to determine compaction characteristics, to determine moisture content, and to determine density of fill in place. These tests performed by the Engineer will be used to verify that the fills conform to the requirements of the specifications. Such tests are not intended to provide the Contractor with the information required by him for the proper execution of the work and their performance shall not relieve the Contractor of the necessity to perform tests for that purpose.

Densities of fill requiring Class A compaction will be determined by the Engineer in accordance with ASTM Method D 1556, D 2167, D 2922 or D 2937 except that the volume and moist weight of included rock particles larger than those used in the compaction test method specified for the type of fill will be determined and deducted from the volume and moist weight of the total sample prior to computation of density or if using the nuclear gauge, added to the specified density to bring it to the measure of equivalent compostion for comparision. The density so computed will be used to determine the percent compaction of the fill matrix. Unless otherwise specified, moisture content will be determined by one of the following methods: ASTM Method D-2216, D-3017.

9. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of each type and compaction class of earthfill within the specified zone boundaries and pay limits will be measured and computed to the nearest cubic yard by the method of average cross-sectional end areas. Unless otherwise specified, no deduction in volume will be made for embedded conduits and appurtenances.

The pay limits shall be as defined below, with the further provision that earthfill required to fill voids resulting from over excavation of the foundation, outside the specified lines and grades, will be included in the measurement for payment only where such overexcavation is directed by the Engineer to remove unsuitable material and where the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

The pay limits shall be as designated on the drawings.

Payment for each type and compaction class of earthfill will be made at the contract unit price for that type and compaction class of fill. Such payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in Section 10 of this specification.

10. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

Bid Item 5, Earthfill, Common

(1) This item shall consist of placing and compacting all earthfill required to reconstruct the excavated areas at washes and construct the top of the embankment as shown on the drawings.

(2) All earthfill shall be obtained from Bid Item 3, Excavation Common and the borrow areas as shown on the plans.

(3) The maximum thickness of a layer prior to compaction shall be nine (9) inches.

(4) Material for earthfill shall consist of silty sands, silty clay, clayey sand containing a minimum of 15 percent passing the No. 200 Sieve when determined on a dry weight basis in accordance with ASTM D 1140.

(5) The maximum size of rock fragement incorporated in the fill shall be three (3) inches.

(6) Section 6, COMPACTION, Class A shall apply. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained from compaction tests performed by ASTM D 698, Method A or the rapid compaction test (Test No. S-6, SCS Reference NEH Section 19.)

(7) Section 8, TESTING, The fill densities will be determined in accordance with ASTM 1556. The moisture content of the fill material at the time of compaction shall not be less that three (3) percent below nor more than one (1) percent above optimum moisture content, as detemined by ASTM D2216.

(8) Section 4, PLACEMENT, The Arizona Department of Water Resources (ADWR) shall be given the opportunity to inspect and approve all foundations before any earthfill or drainfill has been placed.

(9) Section 9, MEASUREMENT AND PAYMENT, payment shall include compensation for subsidiary items, water, pollution control, and borrow excavation.

CONSTRUCTION SPECIFICATION

24. DRAINFILL

1. SCOPE

The work shall consist of furnishing, placing and compacting drainfill required in the construction of structure drainage systems.

2. MATERIALS

Drainfill materials shall conform to the requirements of Material Specification 521. At least 30 days prior to the delivery of the materials to the site the Contractor shall inform the Contracting Officer in writing of the source from which he intends to obtain them. The Contractor shall provide the Engineer free access to the source for the purpose of obtaining samples for testing.

3. BASE PREPARATION

Foundation surfaces and trenches shall be clean and free of organic matter, loose soil, foreign substance, and standing water when the drainfill is placed. Earth surfaces upon or against which drainfill will be placed shall not be scarified.

4. PLACEMENT

Drainfill shall not be placed until the subgrade has been inspected and approved by the Engineer. Drainfill shall shall not be placed over or around pipe or drain tile until the installation of the pipe or tile has been inspected and approved.

Drainfill shall be placed uniformly in layers not more than 12 inches deep before compaction. When compaction is accomplished by manually controlled equipment, the layers shall be not more than 8 inches deep. The material shall be placed in a manner to avoid segregation of particle sizes and to insure the continuity and integrity of all zones. No foreign materials shall be allowed to become intermixed with or otherwise contaminate the drainfill.

Traffic shall not be allowed to cross over drains at random. Equipment crossovers shall be maintained, and the number and location of such crossovers shall be established and approved prior to the beginning of drainfill placement. Each crossover shall be cleaned of all contaminating materials and shall be inspected and approved by the Engineer before additional drainfill is placed.

Any damage to the foundation surface or the sides or bottoms of trenches occurring during placement of drainfill shall be repaired before drainfill placement is continued.

The upper surface of drainfill constructed concurrently with adjacent zones of earthfill shall be maintained at an elevation at least one foot above the upper surface of the adjacent fill.

Drainfill over or around pipe or drain tile shall be placed in a manner to avoid any displacement in line or grade of the pipe or tile.

Drainfill shall not be placed adjacent to structures until the concrete has attained the strength specified in Section 9 of this specification. The strength shall be determined by compression testing of test cylinders cast by the Engineer for this purpose and cured at the work site in the manner specified in ASTM Method C 31 for determining when a structure may be put in service.

When the required strength of the concrete is not specified as described above, placement of drainfill adjacent to structures shall not be started until the following item intervals have elapsed after placement of the concrete.

Structure	Time Interval
Retaining walls and counterforts (impact basins)	14 days
Walls backfilled on both sides simultaneously	7 days
Conduits and galleries, cast-in-place (with inside forms in place)	7 days
Conduits and galleries, cast-in-place (inside forms removed)	14 days
Conduits, precast, cradled	2 days
Conduits, precast, bedded	1 day
Cantilever outlet bents backfilled on both sides simultaneously	3 days

5. CONTROL OF MOISTURE

The moisture content of drainfill materials shall be controlled as specified in Section 9. When the addition of water is required, it shall be applied in such a way as to avoid excessive wetting to adjacent earth fill. Except as specified in Section 9, control of moisture content will not be required.

6. COMPACTION

Drainfill shall be compacted according to the following requirements for the class of compaction specified:

Class A Compaction. Each layer of drainfill shall be compacted to a relative density of not less than 70 percent as determined by ASTM Method D 4254.

Class I Compaction. Each layer of drainfill shall be compacted by at least 2 passes, over the entire surface, of a steel-drum vibrating roller weighing not less than 5 tons and exerting a vertical vibrating force of not less than 20,000 pounds at least 1200 times per minute, or by an approved equivalent method.

Class II Compaction. Each layer of drainfill shall be compacted by one of the following methods or by an approved equivalent method:

a. At least 2 passes, over the entire surface,of a pneumatic-tired roller exerting a pressure of not less than 75 pounds per square inch. A pass is defined as at least one complete coverage of the roller wheel, tire or drum over the entire surface of the layer.

b. At least 4 passes, over the entire surface, of the track of a crawler-type tractor weighing not less than 20 tons.

c. Controlled movement of the hauling equipment so that the entire surface is traversed by not less than one tread track of the loaded equipment.

Class III compaction. No compaction will be required beyond that resulting from the placing and spreading operations.

When compaction other than Class III compaction is specified materials placed in trenches or other locations inaccessible to heavy equipment shall be compacted by means of manually controlled pneumatic or vibrating tampers or by approved equivalent methods.

Heavy equipment shall not be operated within 2 feet of any structure. Vibrating rollers shall not be operated within 5 feet of any structure. Compaction by means of drop weights operating from cranes or hoists will not be permitted.

7. TESTING

The Engineer will perform such tests as are required to verify that the drainfill materials and the drainfill in place meet the requirements of the specifications. These tests are not intended to provide the Contractor with information he needs to assure that the materials and workmanship meet the requirements of the specifications, and their performance will not relieve the Contractor of the responsibility of performing his own tests for that purpose.

8. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of drainfill within the neat lines shown on the drawings will be measured and computed to the nearest cubic yard. Where the Engineer directs placement of drainfill outside the neat lines to replace unsuitable foundation material, the volume of such drainfill will be included, but only to the extent that the unsuitable condition is not a result of the Contractor's improper construction operations as determined by the Contracting Officer.

Payment for drainfill will be made at the contract unit price for each type of drainfill, complete in place. Except as otherwise specified in Section 9, such payment will consititute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subisdiary are identified in Section 9 of this specification.

9. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction detail are:

Bid Item 5, Drainfill

(1) This item shall consist of furnishing and placing all the drainfill material required in the embankment drain trench and excavated areas at washes as shown on the drawings.

(2) The drainfill shall meet the following gradation requirements.

Sieve Size	Percent Passing (By Weight)
2 inch	100
3/4 inch	90-100
#4	65-95
#10	45-75
#20	25-55
#40	9-40
#100	0-15
#200	0-5

(3) Section 4, PLACEMENT, TRENCH CONDITION, drainfill shall be placed in horizontal layers not to exceed 18 inches. Drainfill shall be conveyed using special equipment to prevent segregation and the free vertical drop shall not exceed 30 inches.

(4) In Section 6, COMPACTION, Class III shall apply.

(5) The moisture content shall be maintained in a range, as determined by the Engineer, that will minimize aggregate segregation.

(6) The material passing the #40 sieve shall be non-plastic when tested in accordance with ASTM D 4318.

(7) Prior to placement of drainfill, the trench surfaces, including the bottom of the trench shall be cleaned of all contaminating or loose materials and shall be inspected and approved by the Engineer. The Contractor shall take all necessary precautions to provide for the safety of workmen and government personnel who are required to enter the trench per OSHA Subparts L and P, and other appropriate safety requirements.

(8) Trenching in new earthfill to place drainfill in excavated areas at the washes as shown on the drawings will be limited to five (5) feet.

(9) Section 8, MEASUREMENT AND PAYMENT, payment shall include compensation for Subsidiary Items, Water and Pollution Control.

CONSTRUCTION SPECIFICATION

94. CONTRACTOR INSPECTION

1. Scope

The work shall consist of providing all equipment, materials, labor and services necessary to ensure that the specified quality is maintained on all work performed. The Contractor shall be responsible for the day-to-day quality control.

2. Equipment and Materials

Equipment for materials testing shall be of the quality and condition required to meet the test specifications cited in the contract references. Equipment shall be in good condition and properly adjusted. Calibration of equipment shall be done at the frequency specified in Section 8. Records of equipment calibration tests shall be available to the government at all times. Nuclear devices shall be operated and maintained by qualified operators and as prescribed by applicable state and federal regulations.

Materials include but shall not be limited to: sand for density tests, bound field books and forms for record-keeping, concrete specimen molds, and all other equipment and materials prescribed by the test procedures referenced in the contract.

The quality of materials used in quality control testing and the equipment employed shall: meet the appropriate standards specified and the standards of the industry, be appropriate for its intended use, and provide the accuracy specified by the contract requirements unless otherwise specified in Section 8 of this specification.

3. Inspection Personnel

Inspections and materials testing shall be accomplished by qualified personnel: a licensed engineering firm, testing laboratory, certified inspection technicians, or licensed and experienced personnel from the contractor's organization. The contractor's written inspection plan shall identify the names and qualifications, training, and experience of all quality control personnel who will actually be performing the inspection and quality control work.

4. Inspection System

The Contractor shall develop and conduct an inspection system adequate to maintain quality control of all work performed and materials and equipment used. The inspection system established shall be based upon a plan and implemented by the necessary mobilization of personnel, equipment and materials. Inspection shall include the initial work needed to verify

adequacy of completed work and provide controls for any corrective work. The inspection system and records to substantiate daily conduct of the system shall be kept by the Contractor and are subject to review by the Contracting Officer, at any time.

The Contrctor's inspection system shall cover all aspects of quality control and shall specifically address any testing and inspection requirements detailed in Section 8 of this specification. The planned inspection system shall also identify the Contractor's primary quality control manager and provide an organizational listing of the individual quality control personnel and their specific duties, experience and qualifications.

If the government's quality assurance inspections indicate that the contractor's inspection system is not adequate or is not producing the desired results, corrective actions shall be taken by the Contractor in both the inspection system, its plan and the work. The Contracting Officer may direct that changes be made in the inspection system including, but not limited to, the removal of unsatisfactory quality control personnel.

5. Pre-Construction Conference

After the contract is awarded and before construction operations are started the Contractor shall meet with the Contracting Officer and discuss the contractor's inspection plan. The meeting shall develop a mutual understanding regarding inspection details including the form of documentation to be used for recording the quality control operations, inspections, management procedures and the interrelationship of Contractor and government inspection efforts. The finalized plan will be approved by the Contracting Officer and it shall become a part of the contract.

6. Records

The inspection records shall be kept daily and shall document both acceptable and deficient features of the work. They shall include complete records of required material tests, submittal and approval of shop drawings, manufacturer's recommendation and certifications, and a complete record of materials delivery, quality examination, certification and storage. Tests performed by the Contractor (including sub contractors) shall be a part of the record. All records shall be on forms acceptable to the Contracting Officer and shall be legible, properly dated and identified as to the responsible tester, the material or item tested, and its location of placement in the structure. In addition, these records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:

1. Type and number of control activities and tests involved and the location (elevation, station and offset) of the work tested.

2. Result of control activities or tests.

3. Method of testing used (e.g. citation of reference specification).

4. Nature of defects, cause for rejection, etc.

5. Proposed remedial action.

6. Corrective actions taken and quality control testing.

7. Measurement and Payment

For items of work for which lump sum prices are established in the contract, payment for contractor inspection will be made at the contract lump sum price. Such payment shall constitute full compensation for all labor, materials, equipment, transportation and all other items necessary and incidental to completion of the work. Progress estimates for payment of this bid item will be based on the percent completion of all contract items (dollar value) used in preparing the regular progress payments.

Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 6, Contractor Inspection

(1) This item shall consist of furnishing the personnel, equipment and material required by the Contractor to perform the testing and inspection that is necessary to implement an inspection system that will insure the specified quality is being performed for:

(a) Trench Excavation
(b) Earthfill
(c) Drainfill
(d) Gravel Cover

(2) Visual and spot inspection shall be performed on a daily basis to insure that existing trench surfaces including the bottom of the trench are clean of all contaminating or loose materials.

(3) The moisture density determinations required for the quality control of earthfill shall be performed by the method outlined in Construction Specification 23, Section 10 (5), 10 (6) and by visually observing compaction operations. The test frequency shall be (1) test per 500 cubic yards of compacted earthfill for moisture and density control.

(4) The gradation of drainfill shall be determined in accordance with ASTM C136 and C117. The testing plan shall include those tests and inspections required during the processing or importation operations to verify that the processed material is within the specified limits. One sieve analysis per 500 cubic yards shall be taken. More frequent intervals will be used when ever the tested material does not meet the gradation requirements, or visual inspections indicate the need to increase the frequency.

The drainfill passing the #40 sieve shall be tested for plasticity in accordance with ASTM D 4318. One plasticity test per 500 cubic yards shall be taken unless visual inspections indicate a need for more frequent tests.

Placement of drainfill and moisture content of drainfill will be monitored on a daily basis.

(5) Gravel cover test reports shall be reviewed for compliance to MAG Specifications. Moisture application and compaction will be visually inspected for conformance to specifications on a daily basis.

(6) Testing equipment shall be calibrated after it is delivered to the site and whenever erratic or unreasonable test results are being obtained.

(7) Suitable lab facilities will be installed at the site and will be used exclusively for testing purposes.

(8) The Contractor shall designate an experienced quality control manager whose primary responsibility will be implementing the inspection system. The manager shall be on site during major construction activities and will not be involved in directing production oriented activities unless it pertains to achieving the specified quality for the work being performed.

(9) The names and qualifications of proposed quality control personnel shall be submitted to the Contracting Officer for review and approval prior to the preconstruction conference. Any changes in quality control personnel will require the approval of the Contracting Officer.

(10) Copies of all test results and inspection reports (visual inspections of trench excavation, earthwork, drainfill placement, and gravel cover placement, etc.), required by the approved inspection plan shall be submitted to the Contracting Officer or his representative within 24 hours of when the test or inspection report is completed and certified.

(11) All inspection and testing will be in accordance with the appropriate construction specifications, contract plans and NEH Section 19.

specification. Moisture control shall be that necessary to control dust during borrow and placing operations, unless otherwise specified in Section 8 of this specification.

6. TESTING AND MEASUREMENTS

The Engineer will perform such tests and measurements as are required to verify that the gravel material and work meet the requirements of this specification. These tests are not intended to provide the Contractor with the information he needs to assure that the materials and workmanship meet the requirements of this specification, and their performance will not relieve the Contractor of the responsibility of performing his own tests for that purpose.

7. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the volume of gravel will be measured within the specified pay limits and computed to the nearest cubic yard by the method average cross sectional end areas. Payment for the gravel will be made at the contract unit price. Such payment will be considered full compensation for all labor, materials, equipment, and all other items necessary and incidental to the placement of the gravel.

Compensation for any items or work described in the contract but not listed in the Bid Schedule will be included in the payment for the item of work to which it is made subisidary. Such items and the items to which they are made subsidiary are identified in Section 8 of this specification.

8. ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details are:

a. Bid Item 7, Gravel Cover

(1) This item shall consist of furnishing and placing gravel on the top of the embankment from Station 17+83± to Station 150+70± as shown on the drawings.

(2) In Section 2, MATERIALS, gravel cover shall be either crushed aggregate, processed and blended material or decomposed granite. The Contractor shall submit test reports to the Contracting Officer indicating that the source of material to be used for gravel cover meets the requirements of Section 702, Base Materials of the MAG Specifications.

(3) In Section 5, COMPACTION AND MOISTURE REQUIREMENTS, moisture application shall consist of sprinkling water during the placing and spreading of the gravel cover material. The final application of water shall be such that the gravel cover will be thoroughly wetted prior to the rolling operation. The gravel shall be bladed to a uniform layer that will net, after rolling, a thickness of not less than four (4) inches.

(4) Gravel cover shall be compacted by a minimum of two (2) passes, over the entire surface, of a steel drum vibrating roller weighing not less than five (5) tons and exerting a vertical vibrating force not less than 20,000 pounds a minimum of 1200 times per minute, or by an approved equivalent method.

(5) Section 7, MEASUREMENT AND PAYMENT, payment shall include compensation of Subsidiary Item water.