WHEN RECORDED MAIL TO:
Rori Clark
Midvale City Recorder
655 W. Center Street
Midvale, UT 84047

9327848
03/21/2005 04:14 PM $482.00
Book - 9107 Pg - 7714-7950
GARY W. OTT
RECORDER, SALT LAKE COUNTY, UTAH
RORI CLARK
MIDVALE CITY RECORDER
655 W CENTER ST
MIDVALE UT 84047
BY: ZJM, DEPUTY - WI 237 P.

NOTICE OF INSTITUTIONAL CONTROLS

Pursuant to this Notice of Institutional Controls ("Notice"), **Jordan Bluffs Inc.**, a Utah corporation and Jordan Bluffs II L.C., a Utah Limited Liability Company ("Fee Owner") of that certain project known as Jordan Bluffs to be developed on real property located in Midvale City, Salt Lake County, Utah, as more particularly described in Exhibit A attached hereto and incorporated herein by this reference (the "Project"), hereby provides notice of the matters described herein to all subsequent owners, developers and other persons who may hereafter acquire any interest in the Project.

RECITALS:

WHEREAS, the Project is located on the former Sharon Steel Superfund Site which has been remediated under the supervision of the Environmental Protection Agency ("EPA"); and

WHEREAS, the EPA has permitted the redevelopment of the Project subject to compliance with certain institutional controls as set forth in the Institutional Control Process Plan approved by the EPA, the Utah Department of Environmental Quality and adopted by the Midvale City Council on May 4, 2004, as it may be amended from time to time ("Institutional Control Process Plan"); and

WHEREAS, future development of the Project is subject to compliance with the Institutional Control Process Plan, which is on file and available for review with Midvale City.

NOW, THEREFORE, Fee Owner hereby provides notice to all persons interested in acquiring any interest in the Project of the following requirements:

All future development within the Project is subject to compliance with the Institutional Control Process Plan and shall demonstrate conformance with the applicable provisions of the Institutional Control Process Plan;

A Site Modification Plan ("SMP") has been prepared to outline general construction practices for redevelopment within the Project and is attached as Exhibit B to the Institutional Control Process Plan.

DATED this 18 day of March, 2005.

"Fee Owner"

Jordan Bluffs, INC.,
a Utah corporation

By _____
Jason Ivins
President

Jordan Bluffs II L.C., a
Utah Limited Liability Company

By: _____
Jason Ivins
Manager

STATE OF UTAH)
ss.
COUNTY OF SALT LAKE)

The foregoing instrument was subscribed, sworn to and acknowledged before me this 18 day of March, 2005, by Jason Ivins, acting in the capacity of President for Jordan Bluffs, Inc., a Utah corporation, who acknowledged the forgoing was executed by authority.

SHARON L KEARNS
NOTARY PUBLIC • STATE of UTAH
64 EAST 6400 SOUTH # 100
MURRAY UT 84107
COMMISSION EXPIRES: 04-05-2005

_____
Notary Public

STATE OF UTAH)
ss.
COUNTY OF SALT LAKE)

The foregoing instrument was subscribed, sworn to and acknowledged before me this 18 day of March, 2005, by Jason Ivins, acting in the capacity of Manager of Jordan Bluffs II L.C., a Utah limited liability company, who acknowledged the forgoing was executed by authority.

_____
Notary Public

SHARON L KEARNS
NOTARY PUBLIC • STATE of UTAH
64 EAST 6400 SOUTH # 100
MURRAY UT 84107
COMMISSION EXPIRES: 04-05-2005

Exhibit "A"

Beginning at a point that lies North 00 degrees 29'40" West 335.21 feet along the Section Line from the Southeast Corner of Section 35, Township 2 South, Range 1 West, Salt Lake Base and Meridian and running thence North 00 degrees 29'40" West 1803.42 feet along said Section Line to the Northerly bank of the Galena Canal; thence along a fence line marking said Northerly bank the following (8) courses: North 58 degrees 43'52" West 280.03 feet, and North 20 degrees 38'28" West 50.85 feet, and North 03 degrees 23'34" West 140.14 feet, and North 14 degrees 03'34" West 230.09 feet and North 02 degrees 50'06" West 70.43 feet, and North 08 degrees 28'42" East 112.58 feet, and North 12 degrees 21'11" West 52.85 feet, and North 39 degrees 54'40" West 125.53 feet; thence leaving said Northerly bank North 77 degrees 21'33" East 407.53 feet along a fence marking the North line of the Midvale Packing Company property to the East line of said Section 35; thence North 00 degrees 12'34" East 635.25 feet along said East line; thence along an existing fence line the following (4) courses: North 89 degrees 39'38" West 628.13 feet, and North 44 degrees 57'24" West 294.72 feet, and North 01 degrees 34'34" West 118.60 feet, and North 87 degrees 09'51" East 61.15 feet to an existing fence line marking the West line of Holden Street; thence North 00 degrees 22'30" West 562.48 feet along said fence line; thence along fence an existing fence line the following (2) courses: South 89 degrees 40'06" West 234.95 feet, and North 00 degrees 39'00" West 178.80 feet to the centerline of Lennox Street; thence South 89 degrees 51'10" West 13.37 feet along said centerline; thence North 00 degrees 22'38" West 145.00 feet; thence North 89 degrees 51'10" East 67.00 feet to an existing fence line; thence North 00 degrees 22'38" West 153.75 feet along said fence line; thence South 89 degrees 51'10" West 152.07 feet; thence North 00 degrees 17'44" West 412.35 feet along an existing fence line to the South right-of-way line of Center Street as deeded to the State Road Commission of Utah; thence along said South right-of-way line the following (10) courses: South 84 degrees 59'59" West 327.17 feet, and South 77 degrees 33'30" West 153.21 feet, and South 85 degrees 15'24" West 147.80 feet, and North 81 degrees 32'25" West 102.50 feet to a point on a 4861.15 foot radius non tangent curve to the left, (radius bears South 05 degrees 59'56" East), and along the arc of said curve 494.28 feet through a central angle of 05 degrees 49'33", and South 59 degrees 42'12" West 103.69 feet to a point on a 4829.15 foot radius non tangent curve to the left, (radius bears South 12 degrees 53'27" East), and along the arc of said curve 195.95 feet through a central angle of 02 degrees 19'30", and South 74 degrees 46'34" West 146.30 feet, and South 81 degrees 38'00" West 249.51 feet, and South 74 degrees 43'59" West 64.19 feet to a point on the West bank of the Jordan River; thence leaving said South right-of-way line and running along said West bank the following (6) courses: South 05 degrees 54'45" West 189.03 feet, and South 04 degrees 52'14" East 66.01 feet, and South 28 degrees 15'14" East 307.98 feet, and South 15 degrees 41'49" East 136.97 feet, and South 05 degrees 35'12 East 145.35 feet, and South 37 degrees 43'31" East 42.50 feet; thence leaving said West line South 47 degrees 59'09: East 30.66 feet; thence along the Jordan River the following (7) courses: South 124.58 feet, and South 03 degrees 53'39" West 154.63 feet, and South 07 degrees 17'20" West 282.82 feet, and South 05 degrees 00'36" East 1109.12 feet to a point on a 4000.00 foot radius non tangent curve to the left (radius bears North 85 degrees 01'00" East), and along the arc of said curve 1395.88 feet through a central angle of 19 degrees 59'40", and South 24 degrees 58'40" East 838.81 feet, and North 88 degrees 37'38" East 1286.49 feet; thence South 80 degrees

30'01" East 105.53 feet to the North bank of the Jordan River; thence along said North bank the following (7) courses: South 20 degrees 33'59" East 64.11 feet, and South 18 degrees 07'28" East 98.62 feet, and South 35 degrees 42'23" East 85.29 feet, and South 75 degrees 55'41" East 171.55 feet, and North 38 degrees 00'44" East 59.69 feet, and North 23 degrees 47'27" East 47.77 feet, and South 59 degrees 54'19" East 55.73 feet; thence leaving said North bank North 24 degrees 04'44" East 75.08 feet to an existing fence line marking the North boundary of Fur Breeders Agricultural Cooperative property; thence South 65 degrees 55'16" East 317.16 feet along said fence line to the point of beginning.

Less and excepting any and all portions lying within the legal bounds of the Jordan River.
Also less and excepting any and all portions lying within the legal bounds of 7800 South street.

21-35-400-015-4001

21-35-400-015-4002

"Exhibit B"

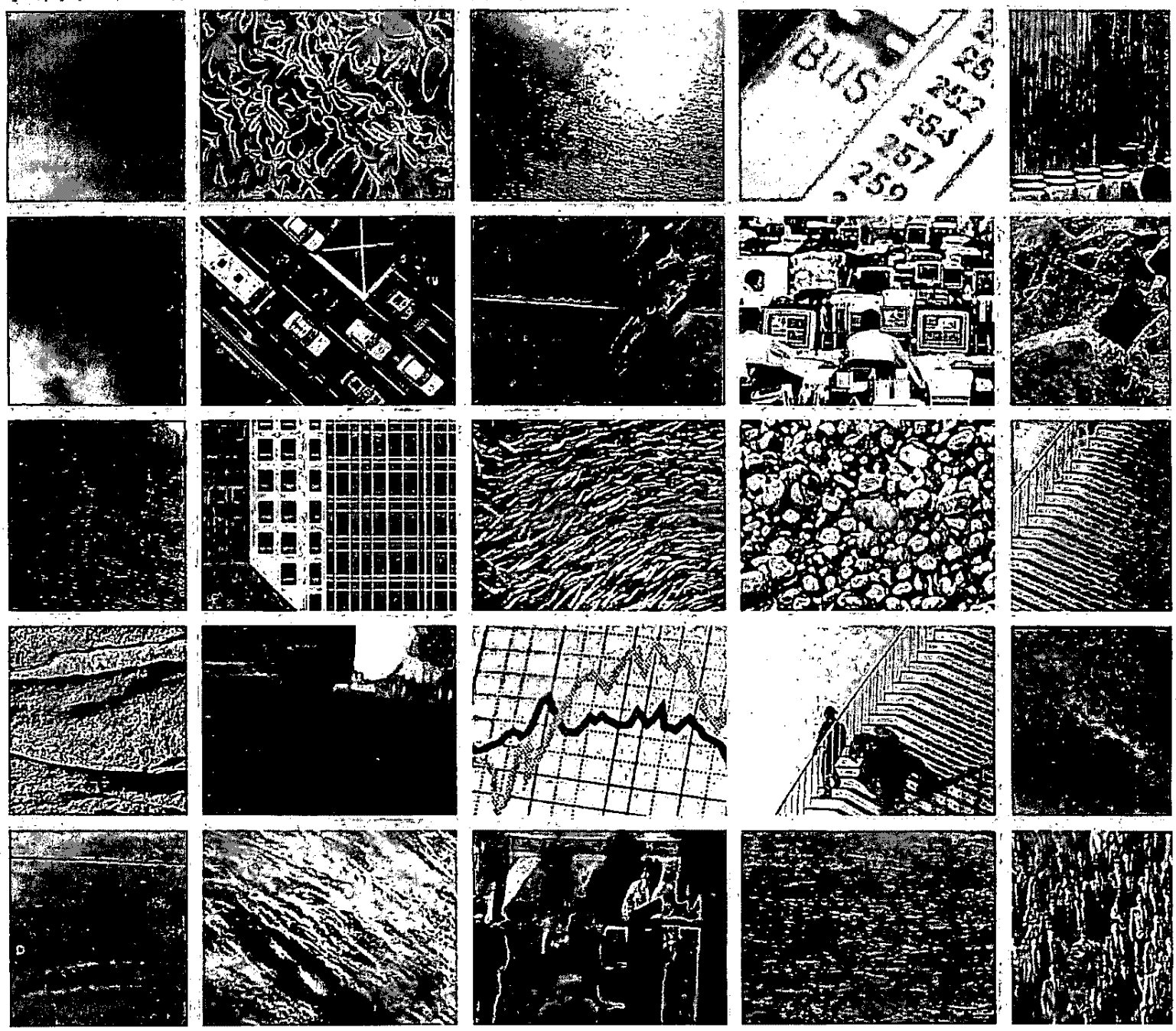

EXHIBIT B

Site Modification Plan for Redevelopment

Sharon Steel Superfund Site - Midvale, Utah

February 2, 2004

Presented to:
Mercury Financial

Environmental Resources Management
102 West 500 South, Suite 650
Salt Lake City, Utah 84101
(801) 595-8400
www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

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1.0 *INTRODUCTION*

ERM-Rocky Mountain, Inc. (ERM) has prepared this Site Modification Plan for Redevelopment ("Plan") on behalf of its clients Joel Kester, Benjamin Magelsen and James Telaroli, who are in the process of forming an entity and adding additional members (hereafter referred to as the "Development Group") to acquire and redevelop the Sharon Steel Superfund Site in Midvale, Utah (the "Site"). This Plan has been prepared for submittal to the U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality (UDEQ) (hereafter referred to as the "Agencies") for review and approval prior to taking the next steps toward purchasing the property for redevelopment.

1.1 *PLAN ORGANIZATION*

This Plan has been organized in the following five sections, consistent with discussions between the Development Group and the Agencies.

- **Section 1 – Introduction,** presents the Plan purpose, and Site background and regulatory status.
- **Section 2 – Scope of Site Modifications,** describes the proposed redevelopment plan, and identifies aspects of the work that will require controls to satisfy the ROD.
- **Section 3 – Engineering Controls,** describes the engineering controls to be incorporated into redevelopment planning, design, and construction.
- **Section 4 – Quality Assurance,** presents the quality assurance requirements associated with redevelopment.
- **Section 5 – Redevelopment Schedule,** presents the Development Group's estimated schedule for Site redevelopment.

1.2 *PLAN PURPOSE*

The Development Group has taken appropriate actions to establish its bona fide prospective purchaser ("BFPP") status under CERCLA § 101(40) and § 107(r). This Plan identifies the technical issues associated with redevelopment of the Site, which must be observed by the Development

Group, in order to establish and maintain its BFPP liability protection. Achievement and maintenance of the BFPP status will require the Development Group to complete its work in a manner consistent with the requirements of the Record of Decision ("ROD") prepared for the property in December 1993.

The purpose of this Plan is to identify the requirements that will ensure that no material modifications to the ROD result from redevelopment, and that the integrity and effectiveness of the remedy completed under the ROD will be maintained despite redevelopment. The Development Group anticipates that these objectives will be accomplished through the Agencies' review and approval of this Plan. The overall intent of the Plan is to identify potential impacts associated with redevelopment, and define the engineering controls to be used for protection of the original Site closure, human health, and the environment.

1.3 *SITE BACKGROUND AND REGULATORY STATUS*

The Sharon Steel Superfund site is an approximately 260-acre parcel that was historically used for ore milling and smelting lead, copper, zinc, and other metal sulfides. The milling operations were conducted from as early as 1906 until 1971; smelting ceased in the late 1950s. Over 10 million tons of mill tailings containing concentrations of lead, arsenic, cadmium, chromium, copper, and zinc were deposited on the site. Windblown mill tailings were also deposited over several hundred acres of residential property in Midvale. The UDEQ became involved at the site in 1982. Subsequent testing found elevated levels of heavy metals such as lead and arsenic in the site tailings and ground water. The site was listed on the CERCLA National Priorities List (NPL) in 1990, and a CERCLA Remedial Investigation/Feasibility Study (RI/FS) was performed. EPA issued the final ROD for the site in 1993. The following cleanup activities were completed by either the EPA or UDEQ:

- Fencing the site and stabilizing the banks of the Jordan River
- Demolition of old mill buildings
- Excavation of tailings and contaminated soil from the mill and wetland areas
- Backfilling mill and wetland areas with clean fill
- Restoration of the non-jurisdictional wetlands
- Consolidation of tailings and contaminated site soil in the area of the former tailings ponds and subsequent regrading and capping

- Installation of a ground water interception trench
- Installation of ground water monitoring wells along the perimeter of the site

Current operations and maintenance activities include ground water monitoring and monitoring of the cap integrity, which is performed by the UDEQ. As per the ROD, the UDEQ and EPA could institute a ground water pump and treat system at the northern and/or western site boundaries, if needed. The EPA has stated that they plan to delete the site from the NPL.

The Site background information and basis for design of the engineering controls presented in this Plan were developed based on ERM's review of available documents pertaining to this Site. A list of the reference materials is presented in **Appendix A** to this plan.

2.0 *SCOPE OF SITE MODIFICATIONS*

This section provides a brief summary of the proposed Site redevelopment plan, followed by descriptions of the Site restrictions and activities that will require engineering controls to ensure the integrity of the existing closure system.

2.1 *SUMMARY OF REDEVELOPMENT PLAN*

The Development Group is considering a mixed land use community for the Site, which may include uses such as regional commercial, office/commercial, business park/industrial, and a variety of residential uses (e.g., high, medium-high, medium, and low density). The community will include numerous parks and open spaces, and will likely include a neighborhood town center. The Development Group retained David Jensen Associates, Inc. of Denver, Colorado to prepare a conceptual plan for the Site. A drawing of this redevelopment concept is included as **Appendix B** to this Plan.

2.2 *RESTRICTIONS ON SITE MODIFICATION*

In accordance with the ROD, the Development Group must maintain compliance with all land use restrictions established or relied on in connection with the Sharon Steel remedy, and must not impede the effectiveness or integrity of any institutional control employed in connection with the Sharon Steel remedy. The land use restrictions and institutional controls associated with redevelopment of the Site are listed below:

- There is to be no use of ground water from the site
- There must not be structures that could damage the cap and influence its ability to isolate the tailings and preclude water infiltration
- Structures will need to be placed outside of certain off-set restrictions from the edges of the cap slopes (e.g., 60-foot off-set per BOR recommendations)
- Vegetation on the cap must be approved by the Agencies upon recommendations by geotechnical engineers and horticultural experts
- Continued access will need to be provided to UDEQ for ground water monitoring, cap and interceptor trench inspections, and possible

maintenance activities during reasonable business hours and in accordance with an agreed access easement

- Removal of contaminated soils or tailings will not be required, but may be performed (if needed) to facilitate redevelopment activities in certain areas (e.g., utility corridors); any materials removed will be managed/disposed appropriately
- The Agencies will defer to Midvale as to the types and mix of uses on the capped area, and are in agreement that residential uses are appropriate on the cap as long as the cap integrity is protected
- Restoration or reconstruction of the cap will not be required, except during site modification construction activities approved by the Agencies and Midvale City, or by future property owners if they damage the liner system
- The wetland area shown on the Final Site Plan, Drawing No. 1556-418-13 located on the southeast portion of the property will be left in its restored condition subject to the provisions outlined in Section 2.8 of this document

2.3 *SITE GRADING*

Redevelopment will require the placement of earth fill and some excavations to prepare the land for structures and other proposed infrastructure. The Development Group will generally work within the existing grades to the extent possible, as a means of minimizing the cost for earth movement and to limit potential impacts to the multi-layer cap system (where the cap is present). Placement of fill within the valleys will likely be performed to help level the site and for cover over utilities, which may be oriented within these valleys. The Development Group intends to add fill soil over the existing liner system to the extent practical to preclude or at least minimize cap penetrations. **Figure 2-1** shows the existing site contours overlain on the conceptual redevelopment plan prepared by David Jensen Associates, Inc.

The current ridge and valley topography on the top of the cap consists of elevation differences of up to 12 feet; hence, it is possible that the maximum constructed fills at the site may be about 10 to 15 feet thick, if the Development Group chooses to level the site. The minimum cover soil thickness overlying the synthetic components of the cap will continue to be two feet. The final grades will need to continue to remove rainwater from the capped area in a controlled manner to preclude storm water ponding on the cap and erosion of the cover soil. The final grades will need to be sufficiently sloped to account for differential settlement such

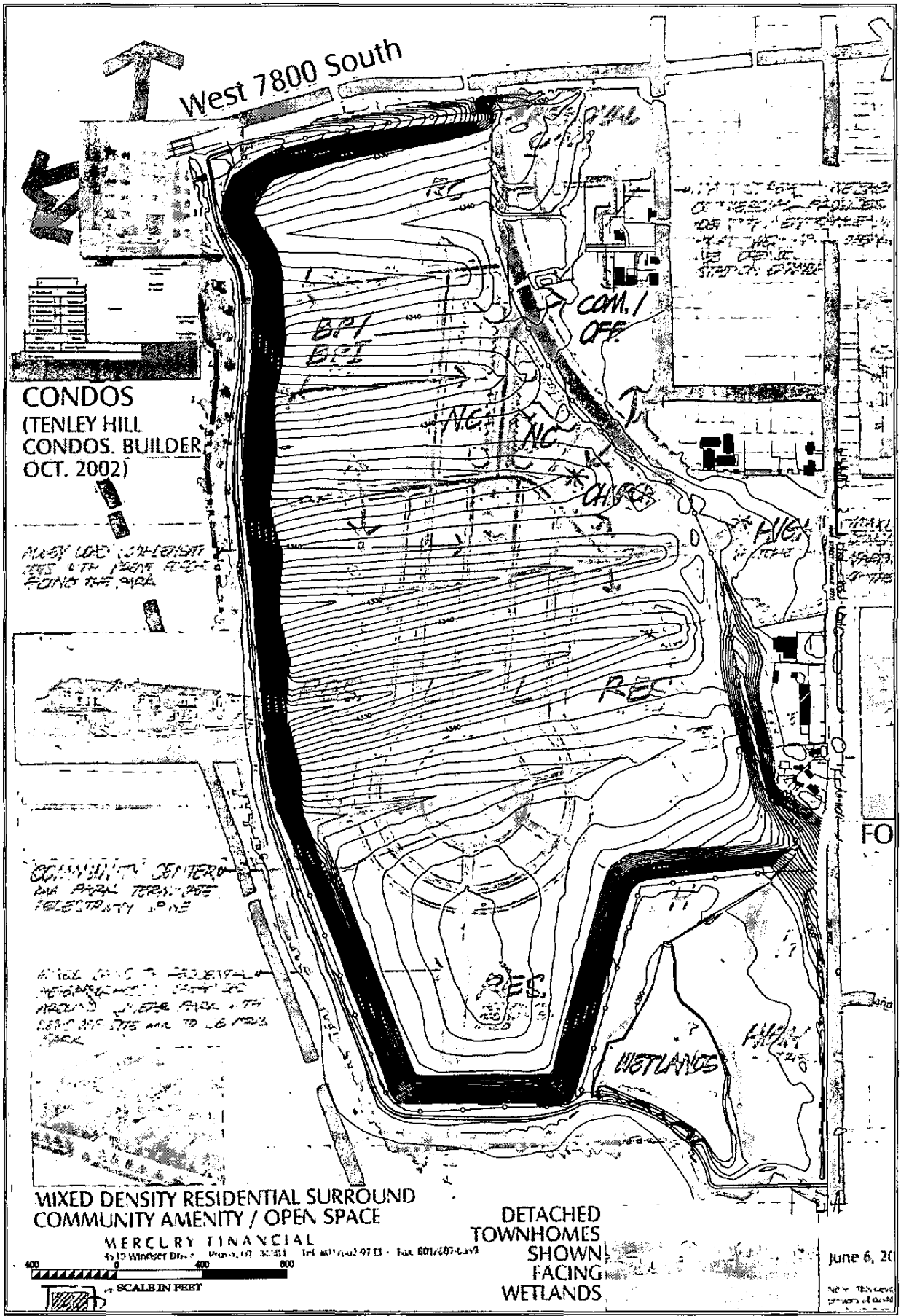


FIGURE	DESIGNED / DRAWN / CHECKED / DATE / TIME	DSW / RJE
2-1		

MERCURY FINANCIAL GROUP
FORMER SHARON STEEL SUPERFUND

EXISTING SITE CONTOURS
SHARON STEEL SITE
MIDVALE, UTAH

Environmental Resources Management
ERM
122 West 800 South
Suite 400
Salt Lake City, Utah 84101-2334
(801) 596-8400

N W E S

REVISION	DESCRIPTION	DATE

that storm water can be diverted over the life of the development. The Agencies will expect to review and approve the final site contours.

2.4 *UTILITY INSTALLATIONS*

Redevelopment will involve installation of general utilities required to serve light industrial, commercial, and residential communities. These will include general city services such as water, sanitary sewer, and storm drain utilities. They will also include power utilities including electrical and natural gas lines, and telecommunication services such as telephone, cable, and fiber optics.

Although efforts will be made to orient utilities and import fill such that cap penetrations are limited, it is likely that some utility lines (especially main lines) will require excavations that penetrate sections of the geosynthetic cap materials. The Development Group will observe appropriate protocols (e.g., original Technical Specifications) for opening (i.e., cutting) the liner, properly managing contaminated soil, replacing/repairing the geosynthetic components, ensuring proper backfill of the excavations, and sloping the utility trenches to allow water removal from the liner surface. The Agencies will expect to be informed of all liner openings, and they will provide written permission prior to any opening to ensure appropriate inspection and documentation of the liner reconstruction.

2.5 *GEOTECHNICAL INVESTIGATIONS*

The Development Group anticipates that additional geotechnical investigations will be required for final engineering for the redevelopment. This will include performance of soil borings through the cap to sample and assess the geotechnical properties of the tailings, contaminated soil, and debris relative to the planned structures to be placed on the cap. The number and locations of geotechnical borings will be limited to the extent reasonable to facilitate a safe interpretation of subsurface conditions. Geotechnical boreholes that penetrate the cover soil and/or liner will be properly repaired.

2.6 *STRUCTURAL FOOTINGS*

Structures at the site will likely vary in height from single story to perhaps as tall as four stories. The building sizes and footing pressures for

different areas of the site will be based on the footing dimensions and allowable bearing capacities of the foundation soils. Some structures will likely be completed entirely above grade, while others may include basements. The below grade structures will either be completed outside of the capped area, or in such a manner within the capped area that the liner system is not damaged, soil remains isolated, and surface water cannot infiltrate through the cap. The buildings will be complemented with associated parking, roadways, and open spaces.

The structures will be designed for construction using appropriate materials that are consistent with the footing dimensions and allowable soil bearing capacities. The building loads will likely be transmitted to the ground surface via spread footings, wall footings, and/or slab foundations. **Table 2-1** summarizes the typical maximum loads associated with the various structure types proposed for the Site.

Table 2-1 ***Maximum Loads Expected from Proposed Structures***

Structure Description	*Column Load (int/ext)*	*Continuous Wall Load*	*Floor Slabs on Grade*
One Story			
Commercial	50/25 k	2.5 k/ft	150 psf
Residential	20 k	1.5 k/ft	100 psf
Two Story			
Commercial	210/110 k	4.0 k/ft	150 psf
Residential	45 k	2.5 k/ft	100 psf
Three Story			
Commercial	370/220 k	4.0 k/ft	150 psf
Four Story			
Commercial	590/325 k	4.0 k/ft	150 psf

Assumptions:

Commercial Buildings: (30'-0" x 30'-0" bays, Composite steel fame @ floors and open web Joist @ roof)

Dead Load:	Floor	80 psf
	Roof	20 psf
Live Loads:	Floor	80 psf (office)+ 20 psf (partitions)
	Roof	30 psf (Snow)
Walls (Metal Studs Brick Veneer -16'-0" height Story)		
	1 story	2.5 kips
	2-4 story	4.0 kips

Residential (20'-0" x 20'-0" max bays, Wood framing @ floors and roof)

Dead Load:	Floor	20 psf
	Roof	15 psf
Live Loads:	Floor	40 psf + 10 psf (int. partitions)
	Roof	30 psf (Snow)
Walls (Wood Studs w/ Stucco-10'-0" height Story)		
	1 story	1.5 kips
	2 story	2.5 kips

2.7 *STORM WATER MANAGEMENT*

Storm water on the capped area of the Site that does not evaporate (or evapotranspirate) is currently managed through a series of parallel ridges and valleys that transmit the water into drain pipes in the valleys that trend from east to west at a slope of 1% or greater toward the Jordan River. Precipitation is allowed to seep into the pervious soil where it is intercepted by the synthetic liner and drainage layers and diverted by gravity flow toward the valley drains. The drains transmit the water to the western edge of the capped area, down the slope, and to discharge points along the Jordan River. Some storm water is also diverted toward the wetland area on the south side of the Site.

The proposed redevelopment is expected to result in additional storm water runoff due to more impervious surfaces. The Development Group will account for this runoff and provide appropriate storm water collection systems and retention basins (if needed) in accordance with the Utah Pollutant Discharge Elimination System (UPDES) Phase II requirements. Much of the additional runoff will come from roadways, and will be managed through a curb and gutter system that diverts the water to a below ground storm sewer system. This system will remove storm water from the cap such that ponding above the cap and erosion of the cover soil do not occur. Additional details are provided in Section 3. The storm water will ultimately be discharged to the Jordan River, after appropriate detention and sediment removal.

2.8 *WETLAND AREA*

The Final Site Plan, Drawing No. 1556-418-13 shows the proposed location and size of wetlands (8.04 acres) to be restored to its native condition in

accordance with the ROD. The Development Group will preserve these wetlands and incorporate them into the open space of the proposed redevelopment plans. The Development Group may prepare redevelopment plans that include enhancements to the current wetlands. Potential enhancements may include alterations in the vegetation types, adding footpaths, and aerating the ponded water to promote circulation as was intended in the original design. Any site modification that affects the size of the wetlands will be remedied by providing like wetlands located on the Development Group's property contiguous to the wetlands shown in the BOR's Final Site Plan. Thus preserving the designed size, function and appearance of the wetland.

2.9 *LANDSCAPING*

The cap design includes a topsoil layer of six inches, plus 18 inches of porous cover soil. The vegetative cover at present is restricted to shallow rooted plants that will not reach the geosynthetic drainage and liner materials through the total cover thickness of 24 inches. The Development Group anticipates that additional soil will be placed over most areas of the cap to bring the total thickness of cover soil up to five or more feet across the capped portion of the site. Appropriate landscaping plants (i.e., shrubs and trees) will be selected to ensure that the roots do not extend to the depth of the synthetic liners. A list of recommended landscaping plants has been prepared by G. Brown Design, Inc., a site design and landscape architect, to present to the Agencies the types of vegetation that may be used at the site without impacting the liner. This listing is included as **Appendix C** of this plan.

Institutional controls will be employed by the Development Group to preclude eventual property owners from penetrating the cap. Restrictive covenants will be included in each property owners purchase agreement that precludes excavations beyond an acceptable depth and unacceptable vegetation types, based on the minimum cover soil thickness after redevelopment. Any future damage to the cap caused by property owners will be repaired at the property owners expense.

2.10 *ACCESS PROVISIONS FOR AGENCY*

The cap system is currently inspected on a periodic basis by the UDEQ, and the Development Group understands that future operation and maintenance activities will remain the UDEQ's responsibility. Hence, accessibility will need to be maintained to areas of the cap that will require

inspection, maintenance, and monitoring, both during redevelopment and after redevelopment is completed. The Agencies will also require access to the site during redevelopment to inspect the redevelopment activities, especially those involving opening and resealing of the cap.

The current maintenance activities are described in the "Operation, Maintenance, and Monitoring Manual for Sharon Steel Superfund Site, Operable Unit 1" (October 2001). Redevelopment will likely alter some operation, maintenance and monitoring (OM&M) requirements for the Site, such as inspection of fencing, signs, and locks for damage. However, most of the OM&M requirements will remain unchanged, even though the surface of the site will be significantly modified.

2.11 *SITE PERMITS*

Redevelopment of this Superfund site will require special coordination with the Agencies, as is being sought through this Plan. This work will also require the completion of traditional permit applications relevant to this site. It is anticipated that the following construction and environmental permits will be required for this project from the listed agencies:

- Zoning review and possible adjustments for the proposed land uses by the Midvale City Planning & Zoning Commission and the Midvale City Council
- Construction permit, including approval of public utility plans by the Midvale City Public Works Department
- Construction storm water general permit from the UDEQ, Division of Water Quality
- Utah Pollutant Discharge Elimination System (UPDES) permit for discharge of storm water to the Jordan River from the UDEQ, Division of Water Quality
- Dust Control Permit from the UDEQ, Division of Air Quality
- Agency approval (in writing) each time there is a cap disturbance that requires penetration of the synthetic liner

3.0 *ENGINEERING CONTROLS*

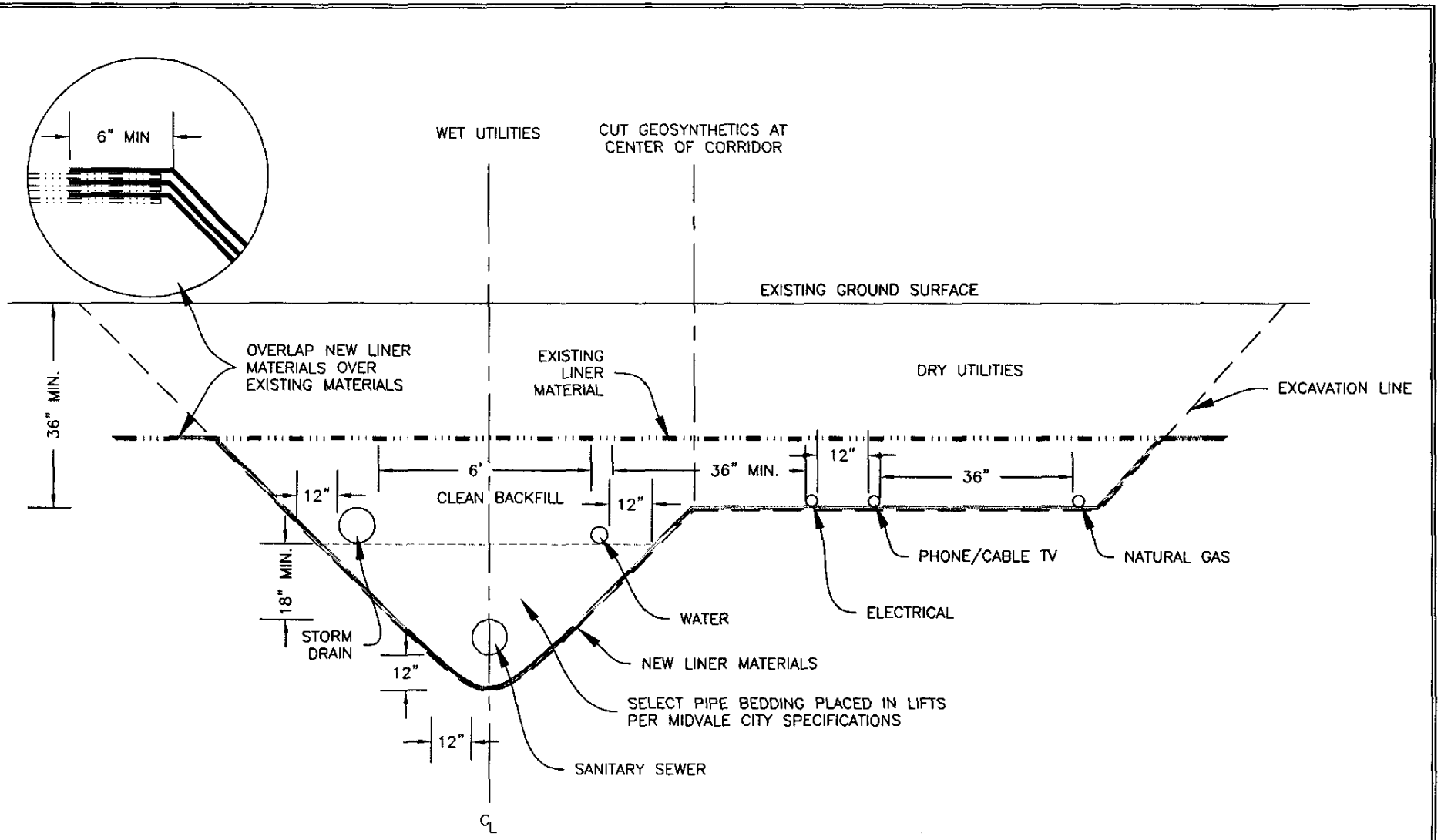
This section of the Plan describes the engineering controls to be employed to protect the existing cover system during redevelopment. In general, the same construction materials and methods used during the original Site closure will be observed during redevelopment. The Design Drawings and Technical Specifications for the original closure will be reviewed and incorporated into the redevelopment design, where applicable. A copy of the Technical Specifications from the original closure design are incorporated as part of this plan and provided as Appendix D. However, where current materials and methods of construction have been improved since the original Sharon Steel closure, these methods may be employed in place of the original construction plans and specifications, as approved by the Development Group's Professional Engineer and the Agencies.

3.1 *UTILITY CORRIDOR DEVELOPMENT*

All utility lines (i.e., main and distribution lines) will be grouped within corridors to simplify the routings of utilities, and to minimize the number and size of penetrations through the multi-layer cap. The corridors will include both wet and dry utilities with appropriate line spacings to satisfy the utilities' standard installation requirements.

It is anticipated that in most areas the utilities will be placed completely within the fill material above the liner, but that penetrations into the liner will be required at select locations. Fill soil will be placed over the existing liner system to the extent practical to preclude or at least minimize cap penetrations. In all cases, the utility lines will either be installed within the fill above the liner, or the liner will be penetrated and dropped such that the utilities are above the liner and backfilled with clean soil. **Figure 3-1** and **Figure 3-2** show typical utility corridor cross sections for each option. These figures show the minimum burial depth and spacing requirements for the types of utilities expected for redevelopment.

Where liner penetrations occur, appropriate protocols will be required for repairing the liner and managing the contaminated soil removed for this modification. These control procedures are described, respectively, in Sections 3.3 and 3.10 of this Plan. Where liner penetrations are required for utilities, the new liner materials will be placed at a grade (or slope) that promotes drainage of percolating surface water in a direction parallel to the utilities until the new corridor liners connect with the existing ridge



NOT TO SCALE

FIGURE	DESIGNED / DRAWN / CHECKED / DATE TIME	DSW / RJE
3-1		

MERCURY FINANCIAL GROUP
FORMER SHARON STEEL SUPERFUND

UTILITY CORRIDOR OPTION 1
SHARON STEEL SITE
MIDVALE, UTAH

Environmental Resources Management
102 West 500 South
Suite 600
Salt Lake City, Utah 84101-2334
(801) 595-8400
ERM

REVISION DESCRIPTION	DATE

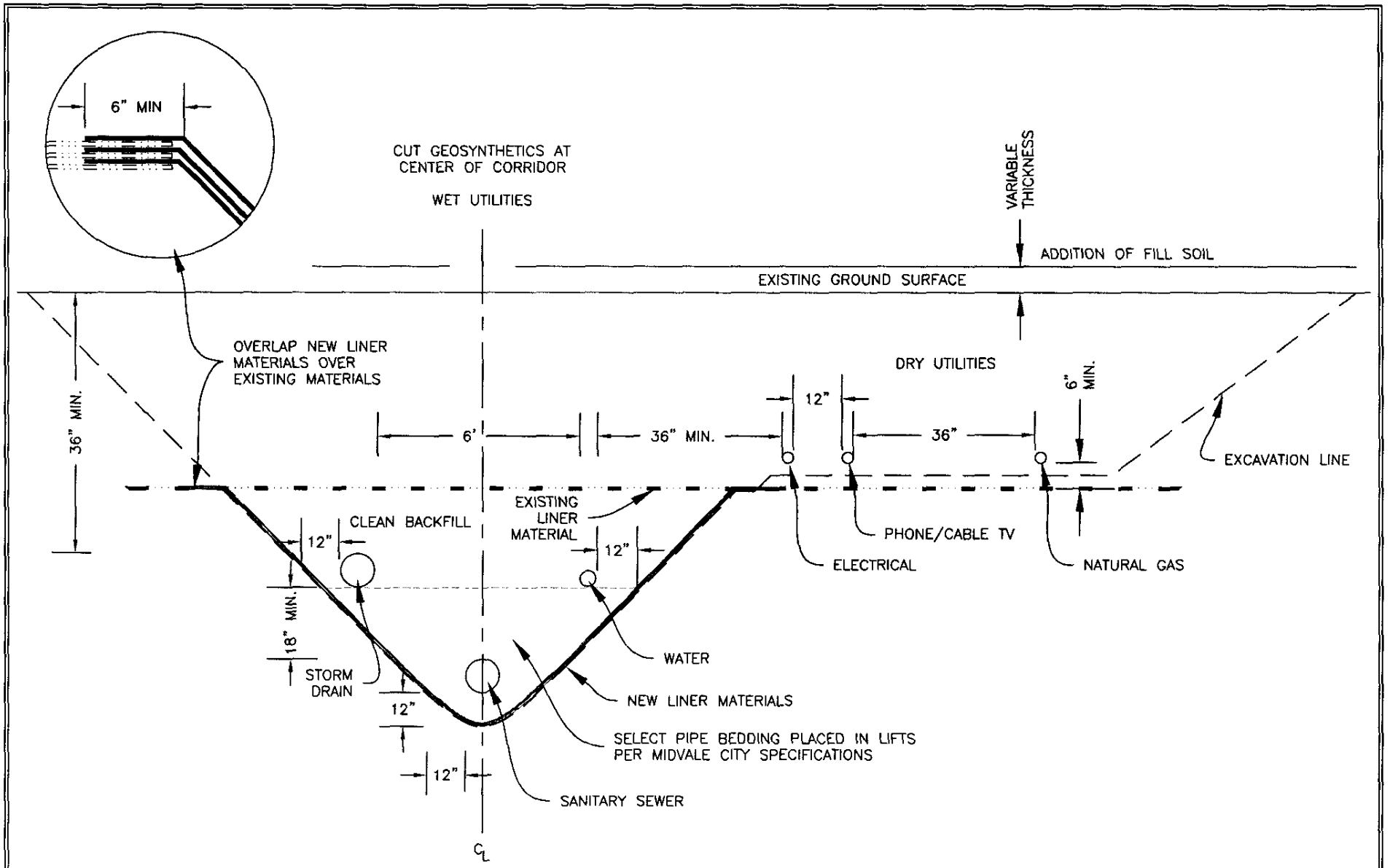


FIGURE	DESIGNED / DRAWN / CHECKED / DATE / TIME	DSW / RJE
3-2		

MERCURY FINANCIAL GROUP
FORMER SHARON STEEL SUPERFUND

UTILITY CORRIDOR OPTION 2
SHARON STEEL SITE
MIDVALE, UTAH

Environmental Resources Management
102 West 500 South
Suite 650
Salt Lake City, Utah 84101-2334
(801) 595-8400

REVISION DESCRIPTION	DATE

and valley contours of the cap. Percolating water will eventually be transmitted to the existing cap drainage pipes that carry water away from the liner surface to the Jordan River. The specific locations and slopes of utility corridors will be determined as part of the final design activities.

3.2 *LIMITS ON LINER PENETRATIONS*

Penetration of the existing liner system will be minimized to the extent practical by the Development Group. Redevelopment activities may result in the following types of liner penetrations:

- Geotechnical investigation borings
- Building foundations
- Utility corridors

The geotechnical borings will be of limited number and result in a small size hole in the liner (2 to 4 inches in diameter). These penetrations can be readily repaired as described in the next section.

The penetrations for utilities and footings will be more substantial. Hence, the Development Group will carefully plan the locations of utilities and building foundations to minimize the number and size of liner penetrations. This will be accomplished during the final design process by comparing the utility and building foundation locations (and required depths) against the proposed fill thicknesses overlying the liner in those locations. In general, the storm sewer grades will determine the maximum depths of the utility corridors. The typical depths for utility corridors are expected to range from 6 to 15 feet below ground surface (bgs), depending on their locations relative to the existing ridge and valley contours of the cap.

The minimum depth for shallow building foundations in the area will be three feet bgs. Therefore, liner penetrations are expected at locations where the fill thickness is less than six feet along utility routings and three feet beneath building footings. A two-foot buffer above the liner will be included in the design of footing and a minimum clearance of six inches will be required for utilities placed above the liner. The Development Group will apply appropriate judgment and value engineering to determine where liner penetrations are essential and where placement of additional fill may be used to preclude liner penetrations.

3.3 *LINER REMOVAL/REPAIR PROCEDURES*

Where liner penetrations are performed, the existing liner components will be cut along straight lines using a sharp blade or shears to ensure quality repairs and connections to any new liner materials. The liner system will be repaired in a manner consistent with the original Technical Specifications, or using current methods and materials that improve upon the original construction. The Technical Specifications (Appendix D) describe the cap materials and installation procedures. The geosynthetic clay liner (GCL), geomembrane liner, and geocomposite drain shall be of the same materials (or approved equal) prescribed in the specifications. The Agencies will be informed of all cap penetrations, and intrusive work will not proceed until written permission is received from the Agencies so that the repairs can be inspected and documented.

The geotechnical boreholes will be performed through the cover soil and liner materials without removing the cover soil. Upon completion of each borehole, the hole will be filled and closed in accordance with the rules for ground water well abandonment (UAC R655-4-12).. The liner penetration will then be uncovered by removing the cover soil with a small, smooth-bladed excavator and hand shovel. The liner penetration will then be repaired in accordance with the Technical Specifications.

Larger liner penetrations for utility corridors and building footings will be repaired by flapping the existing liner components into the excavations and providing patches of like materials with appropriate overlaps and tie-in completions per the Technical Specifications. The overlap requirements for each of the liner components is a minimum of six inches. This concept is shown in **Figures 3-1** and **3-2** for a utility corridors and in **Figure 3-3** for building foundations.

Where the contours of the existing liner materials are lowered to account for either utilities or building foundations, appropriate measures will be designed and implemented to assure drainage of percolating water that may collect in these depressed areas. An approach for draining utility corridors was previously described in Section 3.1. Drainage around building foundations will be accomplished by sloping the new liner beneath the footings to collection points where piping can be added to transmit the water to tie-ins with the existing liner drainage system. Additional details for these connections will be provided in the final design for any structures that require lowering of the liner.

Liner penetrations for building foundations may also be completed by securing the cut liner materials to the footing with non-corrosive battens

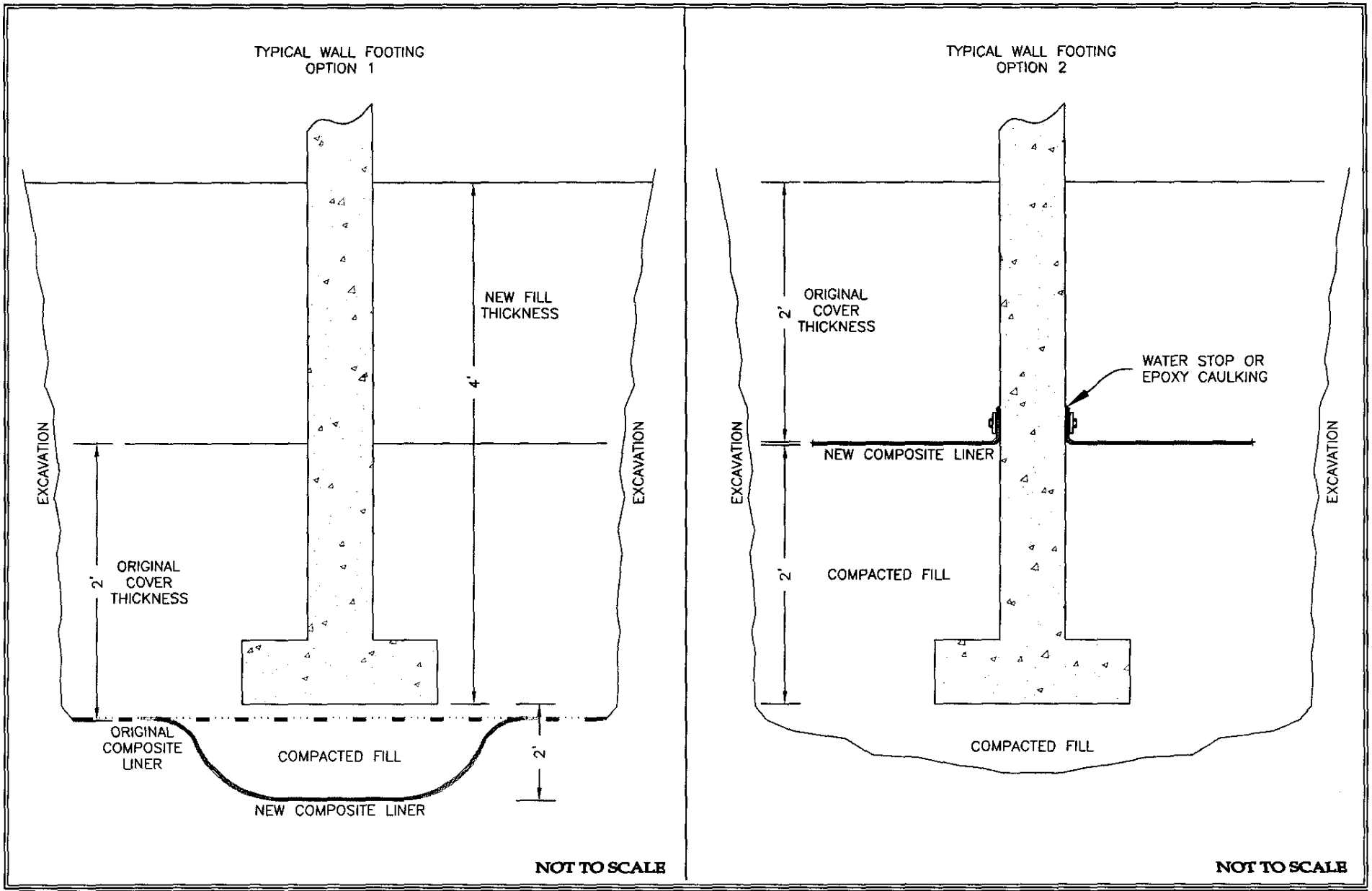


FIGURE	DESIGNED / DRAWN / CHECKED / DATE / TIME	DSW / RJE
3-3		

MERCURY FINANCIAL GROUP
FORMER SHARON STEEL SUPERFUND

TYPICAL FOUNDATION FOOTINGS
SHARON STEEL SITE
MIDVALE, UTAH

Environmental Resources Management
102 West 500 South
Suite 650
Salt Lake City, Utah 84101-2334
(801) 595-8400
ERM

REVISION DESCRIPTION	DATE

(e.g., stainless steel or hard plastic plates with mounting bolts). **Figure 3-3** shows an example of this method of liner completion. This approach may be applied for large wall footings that penetrate the liner, or for buildings that extend all the way through the liner. In this later case, the existing liner material will be battened against the outside walls of the structure, and the building itself will become an integral part of the cap system. In general, surface water will be diverted away from the footings using roof drains and by sloping the land away from the buildings. However, an additional water stop or epoxy seal will be applied to the liner/building connection to ensure that water cannot migrate beneath the liner at these locations. Additional details for these connections will be provided in the final design for any structural footings that penetrate the liner.

3.4 *GEOTECHNICAL EVALUATION*

ERM has performed a separate, preliminary, geotechnical evaluation of site conditions for the Development Group. A copy of this evaluation is provided as **Appendix D**. Based on the types of structures proposed for the Site and the available geotechnical data for the tailings and soil materials beneath the cap, ERM believes that the proposed redevelopment can be performed from a geotechnical perspective.

There are still some issues that warrant further investigation as part of the redevelopment design; however, these issues are related only to certain areas of the site and will be addressed during later phases of the design process. These issues are listed below:

- Areas northeast of the tailings pile reportedly contain old building foundations and basements that may require further investigation prior to site development. Identification of the old building footings and basements will enable construction contractors to incorporate these findings into their expected demolition (if needed) and redevelopment costs.

- The south side of the tailings pile was used as a fill repository; a smaller area on the north side of the pile also served as a repository. The materials placed in these areas will likely have different geotechnical characteristics than the remaining area of the tailings. Therefore, geotechnical investigations for site development will include some additional soil borings and sampling in these areas, particularly to assess potential settlement of materials.

- Engineering analysis by the BOR showed that the expected placement of fill materials and structural loads on the closed tailings pile will not pose a detrimental impact to the protective cover over the tailings as long as the loads are about 3,000 pounds per square foot, which is approximately equal to 30 feet of common fill.

- The ground water level in the wetland area and low-land near the Jordan River may influence the drainage and construction requirements for structures in these areas because excavations will likely extend into the shallow ground water.

- Slope stability analysis performed by the BOR in 1993 showed the completed slopes to be stable, except under an earthquake load that induces liquefaction of the saturated tailings. A revised slope stability analysis will be performed following an updated geotechnical investigation of current site conditions. The updated analysis will include assessment of redevelopment loads at the top of the slope.

- Calculations performed by ERM show the allowable bearing capacity for capped areas of the site to range from about 2,800 to 3,800 psf, which is suitable for the types of structures planned for the site. The factor of safety against bearing failure is a function of the structural load and foundation dimensions, which can be adjusted to fit within this allowable range.

- The potential settlement induced by adding 5 to 30 feet of fill soil onto the capped area may range from 0.05 to 0.39 feet. This is much less than the deformation expected from the remediation loads that were placed in 1997. Differential settlement is not expected to pose significant development problems, as long as structures are not placed across different sub-base materials (e.g., tailings and native soil).

- Redevelopment activities will account for the presence of the 1400-foot-long interceptor trench located along the eastern side of the tailings pile, outside the capped area. The interceptor trench collects shallow ground water and spring water from the east side of the site and diverts it to the wetland area. Redevelopment of the site will not alter the trench's ability to remove this water. The inceptor trench, which is constructed with a synthetic liner on the west side and bottom of the trench, will be protected in a manner similar to the cap liner. The final redevelopment plan will be prepared to preclude (or at least minimize) trench liner penetrations for utilities or footings in this area. The surveyed location of the interceptor trench is shown on existing site drawings, and will be incorporated into the final redevelopment

plans. The east edge of the cap and interceptor trench (per design drawings) will be physically demarked on the land surface by a road alignment or other feature to facilitate future site inspections.

3.5 *SOIL PLACEMENT AND COMPACTION*

In order to preserve the overall integrity of the geosynthetic cap components, a minimum thickness of two feet of cover soil will be maintained upon completion of redevelopment. A maximum soil cover thickness of 30 feet was considered allowable over the geosynthetics, based on the BOR design of the cap. The Development Group will apply this 30-foot maximum thickness as a requirement for redevelopment, although placement of this much soil over any portion of the cap is highly unlikely.

The placement and compaction of soil will be governed by the original closure Technical Specifications, where they are applicable. Additionally, typical specifications of the public and private utility companies will be observed for new utility lines (unless alterations are approved), and appropriate structural fill specifications will be developed for soils placed for building foundations. Development of these specifications at this time is beyond the scope of this Plan.

3.6 *LANDSCAPING LIMITATIONS*

Redevelopment landscaping on the cap will be performed in a manner that protects the integrity of the cover system. Appropriate vegetation types will be selected for specific areas of the redevelopment based on the amount of fill above the liner and the maximum root-penetration depth of the vegetation. It is expected that vegetative cover will consist of grasses, flowers, shrubs, and trees. A list of recommended landscaping plants and their typical root depths has been prepared by G. Brown Design, Inc., a site design and landscape architect, to demonstrate the types of vegetation that may be used at the site without impacting the liner. This listing is included as **Appendix C** of this plan.

The Development Group anticipates that additional soil will be placed over most areas of the cap to bring the total thickness of cover soil up to five or more feet across the capped portion of the site. This additional soil will generally allow the planting of most types of vegetation because the root depth of most plants, including many tree species, is less then one to two feet bgs. The root systems of these plants are generally expected to

terminate within the top one to two feet of soil, as the root systems require conditions typically present at shallow depths, such as adequate oxygen content (aerobic conditions) and soil moisture.

Any water features (e.g., ponds, fountains, etc.) included as part of the landscaping will require additional liners to ensure that additional water contained in the ponds does not have the potential to penetrate the cap.

The Development Group will develop and ensure adherence to landscaping guidelines for the community. This will be accomplished by incorporated landscaping restrictions into deed restrictions and the by-laws of the community home-owner's association. Inspections to ensure compliance with the community by-laws will be provided by officers in the home-owner's association, as well as Midvale City and the Agencies during their continued site inspections.

3.7 *FIRE PREVENTION*

The current Site OM&M Plan notes that the property owner shall periodically inspect the property for accumulation of weeds, brush, and other flammable vegetation, in accordance with Midvale City Codes. The property owner is responsible for ensuring the site is mowed as often as necessary to prevent a fire hazard.

The Development Group will perform inspections and preventative maintenance to minimize the potential for fires at the site. During construction activities, fire prevention will consist of proper training of personnel, and limiting vehicular traffic to graded roads. As an emergency response measure, a water truck with hose and spray nozzle will be maintained at the site. Additionally, maintenance and heavy equipment vehicles will carry fire extinguishers to quickly respond to fires.

The requirements for fire prevention will eventually diminish as the site is developed, and fire protection service for the developed community will be provided by the City of Midvale.

3.8 *WETLAND PRESERVATION*

Preservation of the wetland area will be assured by including design offsets for structures from this area. Buildings shall not be placed within 20 feet of the wetland as defined in the Final Site Plan. Also, measures

shall be taken to ensure protection of the influent and effluent watercourses that connect the wetland area to the Jordan River. Protections shall be provided to the subsurface interceptor trench that borders the capped area on the east side and discharges shallow ground water and spring water into the wetland area. Protective measures will include specifications for the contractor to protect the influent and effluent structures during redevelopment, and provision of rip rap or other apron materials at the openings of culvert pipes to prevent vegetation growth that could impede the flow of water to the wetlands. The Development Group will consider the "Sharon Steel Wetland Plan" (June 1996), prepared by Utah State University, as it looks to preserve the wetlands.

The Development Group intends to enhance the visual appearance of the wetlands, without compromising its functional ability or size. These enhancements may include alternative vegetation types, footpaths along the edge of the wetlands, and aeration equipment (if needed) to promote water circulation as was intended in the original design. Any modifications that affect the size of the wetlands through site enhancement will be replaced with like habitat located on the Development Group's property contiguous to the wetlands shown in the Final Site Plan. Thus preserving the designed size for the wetland.

3.9 *STORM WATER MANAGEMENT AND SOIL EROSION CONTROL*

Storm water management planning will be required as part of the final redevelopment design. Appropriate management methods will be implemented for both the redevelopment (i.e., during construction) and post-construction phases of the project in accordance with the UPDES Phase II requirements.

Potential increases in storm water runoff during construction will be minimized to the extent possible through phased development of the Site. The existing, surface vegetation and drainage features will not be disturbed until necessitated by the redevelopment schedule. Temporary storm water diversions and channels, erosion control devices, and sediment retention ponds will be installed and maintained during redevelopment. The storm water management and erosion control methods will be as described in the Technical Specifications for the original Site closure. Particular erosion control measures will be specified and implemented during the handling of affected materials from beneath the cap. If possible, excavated materials will be relocated directly to their final destination to preclude the need for staging and protective measures. However, if staging is required, the materials will be placed within

plastic-lined berms to preclude erosion or migration of site constituents via surface water runoff. Stockpiled soil will be covered with plastic at times when precipitation is anticipated to preclude accumulation of rainwater in the bermed staging areas. If rainwater does accumulate where it may come in contact with affected soil/tailings, the water will be allowed to evaporate if possible, and any sediment or residue will be managed appropriately based on analytical testing, or it will be placed back under the liner system. In the unlikely event that weather conditions do not allow evaporation of the water, an alternative disposal or treatment method may be identified, e.g., temporary storage in tanks, filtration, and on- or off-site disposal (based on water quality testing).

Post-construction storm water management will be provided through installation of a curb and gutter system that diverts the water to below ground pipes. The pipes will carry the water primarily to the west side of the property where it can be discharged either directly to the Jordan River or to retention basins (if needed) prior to discharge to the river. The retention basins will likely be placed on the land between the toe of the tailings pile slope and the Jordan River; the detailed locations of the basins will be determined as part of the final design.

The new storm water management system will overlap the existing subsurface drainage pipe system that was installed for cap development, and divert much of the water away from the liner system before it percolated. However, there may be some areas where the new storm water piping and existing subsurface drain system will need to be tied together to most efficiently manage the water. This approach will likely be applied on the western slope of the cap where the subsurface drains daylight to convey water to the Jordan River. Details pertaining to these connections will be provided in the Final Design.

Details pertaining to piping locations and connections, and the calculation of post-construction storm water runoff rates and velocities, pipe sizes, and retention pond volumes is beyond the scope of this Plan. However, these evaluations will be performed as part of the final redevelopment design.

3.10 *MANAGEMENT OF CONTAMINATED SOIL FROM BENEATH THE CAP*

Contaminated soil and tailings removed from beneath the liner will be managed in accordance with the Technical Specifications for the original Site closure (Appendix D). Materials containing concentrations of arsenic

greater than 70 mg/kg or lead greater than 500 mg/kg is above the action level for the site, and must be managed appropriately. The Development Group understands that there may be some soil materials exhibiting total concentrations of these metals below the action levels, which are not considered hazardous and may be used as fill during redevelopment. The Development Group will retain all soil on the site, but any clean soil (i.e., below the action levels) may be used to fill the lower portions of the valleys above the liner. Soil above the action levels will be placed in a constructed repository area beneath the liner, as described later in this section.

Soil testing will be performed during utility corridor or foundation excavations that penetrate the liner to segregate the clean and contaminated materials. The Development Group will perform some preliminary analysis of the near surface soil and tailings below the liner during the geotechnical investigation to assess the concentrations of arsenic and lead. Preliminary planning of the geotechnical investigation include a total of 13 borings, eight of which would be through the liner system into the tailings. This will provide a preliminary indication whether there is a basis for testing the soil for segregation purposes.

The general approach for managing the soil will include the following steps (in order):

- Temporary staging of the soil in stockpiles within plastic-lined berms
- Representative sampling and analysis of the soil for total lead and arsenic concentrations to determine whether they exceed the Site action levels
- If the soil does not exceed the action levels, the soil may be retained as fill for redevelopment in Valley areas above the liner
- If the soil exceeds the action levels, the soil will be placed back under the cap in a designed repository area

Based on the historical arsenic and lead concentrations for the site, the Development Group anticipates that some soil and tailing materials removed from beneath the liner will require replacement beneath the cap in a new location. Therefore, the final redevelopment design will include a repository area for consolidation of materials that exceed the action levels. The repository will likely be created within one of the current topographic valleys of the cap. The specific repository location will be decided based on the redevelopment schedule for different areas of the cap, with the repository being placed in one of the later areas to be developed. It is anticipated that only one repository area will be required, and that the operating period for the repository will be limited to the

extent possible by completing all liner penetrations early in the redevelopment construction period.

The repository will be constructed through a phased opening of the existing cover soil and synthetic liner components. The cover soil will be removed and the liners flapped back to open the repository to the required size, which is yet to be determined. The opening will begin at the elevated end of one of the topographic valleys, and extend into the valley as needed based on the volume of material requiring relocation. The materials will be placed and compacted in lifts per the Technical Specifications. Temporary controls, such as temporary liners and berms will be used to preclude rainwater infiltration, erosion, or storm water impacts from the repository. Some limited water may be applied to the repository soil during the dry season to control dust generation, if needed. The repository area will be secured by fencing to preclude uncontrolled access to this area.

Following relocation of all the affected soil, the original liner materials will be flapped back over the soil, and new liner materials will be installed and welded per the specifications to seal the repository. Final contouring of the liner and protective cover soil will be designed to match the existing cap at the edges of the repository, and the repository surface will be sloped to promote drainage of percolating storm water. Details pertaining to the repository will be developed during the final design.

Activities associated with liner penetrations, soil/tailings removal, and repository management will be performed under the direction of the Development Group's Professional Engineer. It is anticipated that the Agencies will perform inspections of the repository during redevelopment to observe proper management of the affected soil and tailings. The testing methods, sample frequencies, and quality assurance procedures for management of soil from beneath the cap and construction of the repository are presented in **Section 4**, Quality Assurance.

3.11 SITE WORKER HEALTH AND SAFETY

Redevelopment activities such as penetrations through the cap and management of potentially contaminated soil will require special hazardous waste safety provisions for the workers. The "Hazardous Waste/Materials Safety and Health" requirements of the original Site closure Technical Specifications will be observed.

This will include development of a health and safety plan for site workers, appropriate personnel training, and medical monitoring in accordance with 40 CFR 1920.120. These Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements will only be applicable to personnel involved in managing the potentially contaminated media at the site. All other redevelopment activities will not require HAZWOPER certifications and precautions.

3.12 *MONITORING WELL PROTECTION*

Existing monitoring wells will be protected during redevelopment to preclude damage. Most of the monitoring wells are located at the toe of the west embankment, which is generally outside of the proposed area for redevelopment. Hence, damage to these wells is not expected. Wells located within the areas for potential development will be protected during construction activities to allow future monitoring and well maintenance by the oversight Agencies. If wells are damaged, the Development Group will repair or replace the damaged wells.

3.13 *SITE SECURITY AND ACCESS*

The security fence surrounding the site will be maintained around areas where redevelopment has not been completed. It is expected that during redevelopment, certain sections of the fence will be removed to enable vehicle and equipment access. These fences will be repaired to ensure the security of the site where redevelopment is not complete. A security officer (or site foreman) will be on site during working hours to ensure that only authorized workers and visitors are allowed on site. The security fence and locked gates will preclude site access during the night and weekends. All authorized visitors and contractors will be advised as to the general site safety and health requirements.

During intrusive activities into the synthetic liner, special precautions will be taken to secure open excavations. Barricades and flagging will be used to denote the boundaries of excavations and to control access to these work areas. Additional access requirements and work area designations will be specified in the Site Health and Safety Plan to be prepared per Section 3.11.

Dust generation and migration of airborne constituents will be precluded by applying limited amounts of water to control the dust. The water will

be applied judiciously so as not to flood the work area and cause water to seep deeper into the soils and tailings.

4.0 *QUALITY ASSURANCE REQUIREMENTS*

This section describes the general quality assurance protocol to be observed during redevelopment of the site, including inspections, testing, record keeping, and reporting. Where applicable, EPA guidance on quality assurance project plans and data quality objectives will be used.

4.1 *LINER REPAIR TESTING*

The installation of all liner materials for repairs (i.e., GCL, FML, and drainage net) shall be in accordance with the original Technical Specifications for the Sharon Steel Site remedial action. This will include all requirements for selection of materials, surface preparation, deployment, overlaps, defects and repairs, delivery, storage, and handling of materials, submittals, manufacturer and installer qualifications, and field sampling and testing. Alternative, current methods and materials that improve upon the original construction may be used, upon approval by the Agencies.

The field sampling and testing requirements for the flexible membrane liner (FML) component of the cap will be as follows:

1. Non-destructive field seam testing. All field seams shall be non-destructively tested over their full length using approved testing equipment and procedures as prescribed in the Technical Specifications. Seam testing shall be performed as the seaming work progresses. Any seams that fail shall be documented and repaired in accordance with the Specifications.

2. Destructive Field Seam Testing. A minimum of one destructive test sample shall be obtained per 500 feet of field seam length. The sample locations, dimensions, and identification names shall be as indicated in the Specifications. The liner sample shall be cut such that at least 2 portions can be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer per the Specifications. If the field or laboratory tests fail, the seam shall be documented and repaired in accordance with the Specifications.

The overlaps and tie-ins for the other cap components (e.g., geosynthetic clay liner [GCL] and drainage net) are based on visual inspections.

4.2 *ENVIRONMENTAL SOIL TESTING*

The management of tailings and other materials removed from beneath the cap to accommodate redevelopment will be performed in a manner consistent with the original Technical Specifications for the Sharon Steel Site remedial action. Environmental testing will be performed using the following methods.

Table 4-1 Environmental Analytical Methods

Parameter	*Total Analysis*
Arsenic	ICP - SW846-6010A
Lead	ICP - SW846-6010A

ICP = Inductively Coupled Plasma

It is possible that the Development Group may chose to expedite the sampling and analysis program by employing an on-site method for performing the arsenic and lead analysis. If this approach is taken, appropriate methods will be employed that are equivalent to those listed above, and confirmation samples will be collected for analysis at a fixed-site laboratory according to the methods listed in **Table 4-1**.

Samples for environmental testing will be collected from the materials excavated and staged in a secure manner on the site (e.g., within containment berms on plastic). Composite samples will be collected to represent the materials removed from each area where intrusion into the cap is required. Additional samples will be collected if the amount of material removed from a particular area exceeds 50 cubic yards. Hence, an individual composite sample result will represent the average concentrations of no more than 50 cubic yards of soil. Each composite sample will be comprised of six grab samples from different areas of the stockpiled soil. The Agencies may observe and provide direction during the sampling to ensure that the samples are representative of the stockpiled soil. The results from this sampling will be used to determine the proper disposition method for the respective stockpiled materials represented by the samples.

During redevelopment, a significant volume of imported, clean fill will be brought to the site. The fill materials will be inspected by the Development Group's Professional Engineer to ensure that the materials are free of contamination and suitable from a geotechnical perspective. The sources of all imported materials will be evaluated by the Professional Engineer through interviews with the fill providers regarding the origin of

materials. Periodic environmental analyses of imported soil samples will be performed at the discretion of the Professional Engineer. Samples may be analyzed for concentrations of select metals and/or petroleum constituents.

4.3 *GEOTECHNICAL SOIL TESTING*

During redevelopment, the placement of fill materials on the cap and possible replacement of affected tailings/soil beneath the cap will be controlled through prescribed compaction requirements and field density testing. The placement of fill materials will be performed in a manner consistent with the original Technical Specifications for the Sharon Steel Site remedial action.

Any tailings/soil removed from beneath the cap and replaced at another location beneath the cap will be performed in accordance with the Technical Specifications. The materials will be placed in 6- to 12-inch lifts, and be compacted to 95% of Standard Proctor density to meet the minimum compaction requirements for the City of Midvale. The frequency of field density and moisture testing for these materials will be at least one test per 500 cubic yards.

Other soil materials placed on top of the cap will be given appropriate specifications for compaction density and moisture content, depending on the soil's use as structural fill, select fill, or common backfill. The frequency of field density and moisture testing will vary depending on the use of the soil and structural requirements.

4.4 *VISUAL INSPECTION*

In addition to the testing protocol described above, the Development Group will retain a qualified, Professional Engineer for support during redevelopment construction activities. The environmental engineer will particularly oversee all penetrations through the cap and inspect the liner repair processes. The engineer will also perform visual inspections of materials removed from beneath the liner and direct the sampling and analysis to determine the proper management procedures for the excised materials.

The environmental engineer will provide on-site, visual inspections during completion of the intrusive work into the tailings, and during placement of fill materials within two feet of the synthetic liner materials.

However, upon completion of the intrusive activities, the remaining redevelopment work above this liner is expected to consist of general construction activities in a clean environment. The environmental engineer will be on-call for consultation to the Development Group during these later activities, but is not expected to be on site for visual inspections.

4.5 *FIELD RECORDS*

Daily construction reports will be maintained by the Development Group and/or his representative during the intrusive activities described in **Section 4.4** - Visual Inspections). An example daily construction report is attached as **Figure 4-1**. These reports will identify the activities performed each day, on-site personnel, site conditions, and any environmental and/or safety incidents. The daily reports will also contain links to the testing results each day for liner testing, environmental sampling, and geotechnical testing. These reports will be signed daily by the Construction Manager and the Professional Engineer's on-site CQA Representative.

The daily construction reports will be maintained for use in developing progress reports and a final Redevelopment Construction Quality Assurance Report for the Agencies, as described below.

4.6 *AGENCY REPORTING REQUIREMENTS*

During the intrusive redevelopment activities, the Development Group or his representative will provide monthly progress reports to the Agencies to inform them of the work completed during the prior month, upcoming activities, and any specific issues or actions that need to be addressed. The report will include copies of test results and daily reports for that month as attachments. In the event that unexpected site conditions are discovered during the work that would require deviations from this Site Modification Plan, the Development Group will contact the Agencies by phone to discuss the finding and reach an appropriate resolution.

Upon completion of the intrusive redevelopment activities, the Development Group will provide to EPA and UDEQ a final Construction Quality Assurance (CQA) Report. This report will document the construction activities performed to prepare the site for redevelopment. It will include copies of all daily construction reports, liner certification and testing results, environmental testing results, and geotechnical testing

CQA DAILY CONSTRUCTION REPORT

PROJECT:		**DATE:**	
		DAY:	
JOB NUMBER:		**WEATHER:**	
CLIENT/OWNER:		**REPORT NUMBER:**	
CONTRACTOR(S):			

VISITORS		
NAME:	**REPRESENTING:**	**REMARKS:**

CONSTRUCTION ACTIVITIES

CONSTRUCTION MNGR. DATE CQA REPRESENTATIVE DATE

results relating to the integrity of the cap. The CQA Report will also identify the final disposition of all tailings/soil materials removed from beneath the cap, and will include disposal manifests for any materials removed from the site for disposal.

The CQA Report will be certified by a Utah Licensed Professional Engineer, who has provided oversight and direction during the work.

4.7 *TERM OF QUALITY ASSURANCE BY DEVELOPMENT GROUP*

During the intrusive activities associated with redevelopment, the Development Group will be responsible for ensuring the security of the site. This will include implementation of the engineering controls and quality assurance measures described in this plan.

Upon completion of the intrusive work, submittal of the CQA Report, and acceptance of the CQA Report by the Agencies, the Development Group expects that the Agencies will resume responsibility for ensuring the integrity of the containment system. In particular, it is expected that the UDEQ will continue to perform the site inspections and ensure the longevity of the engineered cover system.

5.0 *REDEVELOPMENT SCHEDULE*

As per the correspondence between the Development Group and the Agencies, the Development Group understands that the Agencies have accepted this final Site Modification Plan for Redevelopment. This acceptance has been based on the incorporation of comments and recommendations provided by the Agencies in letters dated October 20, 2003 and December 23, 2003.

The Development Group will now proceed with the next phases of redevelopment design, and provide appropriate details for review by the Agencies and Midvale City. The additional geotechnical investigation activities will be performed within the next few months. In addition, the Development Group's legal counsel will work with the Agencies to complete the explanation of significant differences and termination of the Partial Consent Decree for the site.

In general, the Development Group intends to focus the next phase of engineering toward obtaining site development approvals from Midvale City. When conceptual redevelopment plans are agreed upon, the Development Group will prepare engineering designs in accordance with this Site Modification Plan. These future detailed designs (submitted to Midvale City) will also be routed to the Agencies for review. However, the Development Group expects that inasmuch as the detailed designs comply with this Plan (and no comments to the contrary are received from the Agencies) that Midvale will approve engineering drawings as part of their standard development, construction, and permitting process.

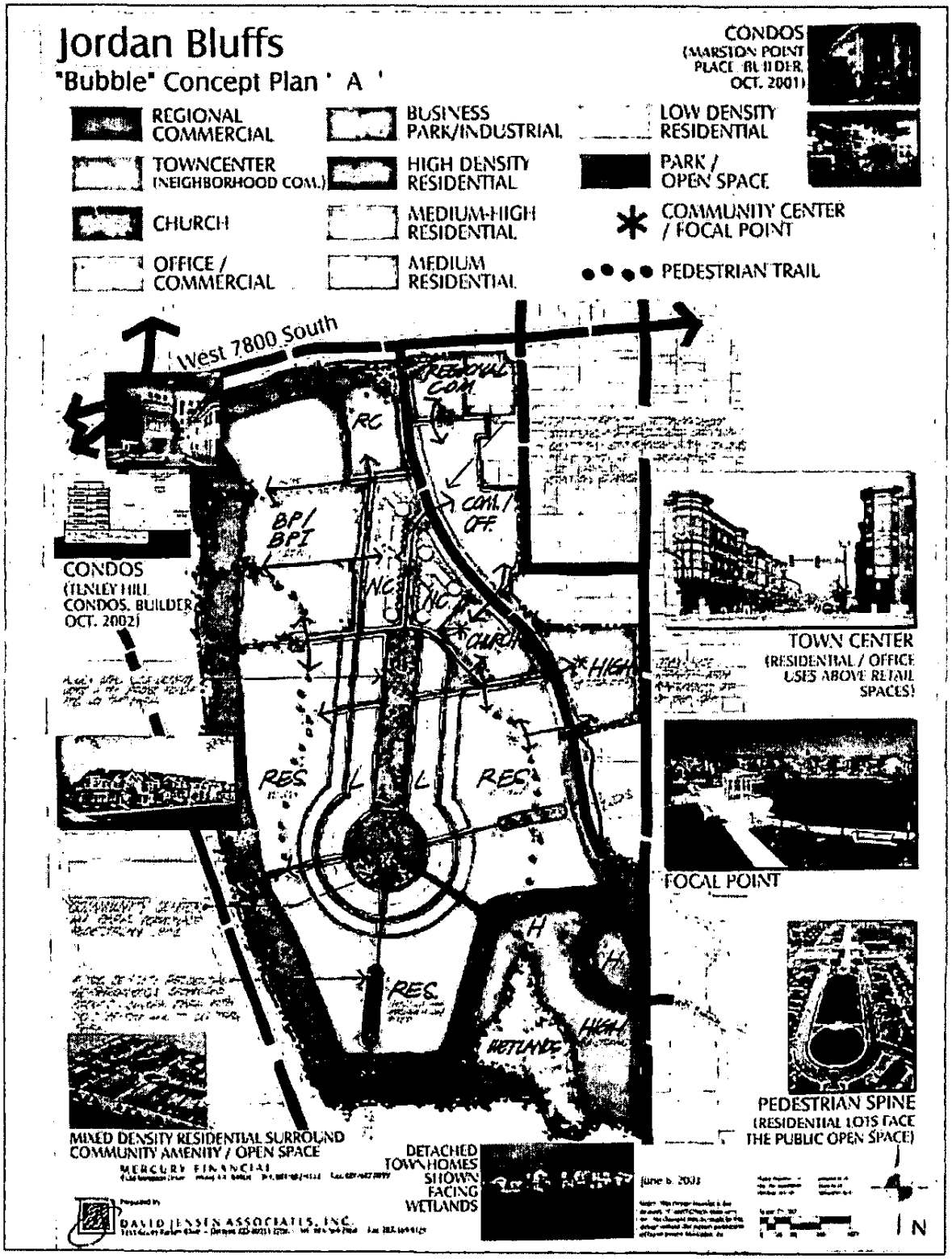
As an additional point of clarification, as future conceptual plans (the first step in the entitlement process) are approved by Midvale City, the Development Group will prepare concept utility plans. At this point, cap penetrations will be identified and relevant information will be forwarded to the Agencies. Actual detailed designs will be submitted as construction drawings through Midvale City's platting and construction process. The construction drawings will come in several phases as development proceeds and will generally mirror the concept plans. The Development Group expects to be starting on the north end of the site and working south. The phasing of detailed site drawings and associated construction is expected to happen starting as soon as possible (e.g., Summer 2004) and continuing over three to six years.

Appendix A
List of References

List of References
Site Modification Plan for Redevelopment
Sharon Steel Superfund Site

- CDM, July 14, 1989, Final FS Report for OU#1 of Sharon Steel Site.
- U.S. Bureau of Reclamation, Oct. 2001, Operation, Maintenance, and Monitoring Manual for Sharon Steel Superfund Site OU1.
- AMEC Earth & Environmental, Inc., November 14, 2000, Draft – Environmental Review, Sharon Steel/Midvale Tailings OU-1, Midvale, Utah.
- EPA, December 1993, Final Decision Summary (ROD).
- TechLaw, Inc., July 16, 1987, Draft Final Report – Sharon Steel/Midvale Tailings Site.
- CDM, Field Investigation and Sampling Plan – Sharon Steel Corp./Midvale Tailings Site RI/FS (1-86 Rev).
- U.S. Bureau of Reclamation, March 1999, Remedial Action Report for Sharon Steel/Midvale Tailings Operable Unit No. 1.

Appendix B
Preliminary Site Development Drawing(s)



Appendix C
List of Plant Types for Redevelopment

Tree Rooting

G Brown Design was retained to review the Sharon Steel plant list and make recommendations on the appropriateness of the attached plant list based on the site's location and planting conditions, and the local climate. We based our evaluation of the proposed plant list on the following assumptions.

Assumptions

1. The post-construction planting conditions on the Sharon Steel site will consist of 5 to 8 feet of cover over a synthetic membrane. The cover will include 12 to 18 inches of manufactured topsoil or other planting medium.

2. Trees will be nursery grown and will be delivered as B&B or container stock. They will have been started from seed or will have been vegetatively propagated. Some will be grafted onto hardy rootstock. Any threat from potentially taprooted trees will be eliminated by the root pruning inherent in the transplanting and harvesting of nursery stock.

3. The irrigation system will use soil moisture sensors or evapotranspiration (ET) calculations to control the frequency, duration and depth of watering, which is critical to controlling the depth of root penetration.

Recommendations for Controlling Root Depth

Current research into plant root morphology indicates that roots on transplanted trees typically grow in the top 2 to 18 inches of soil. The depth of root penetration can be controlled by the irrigation routine, and by the drainage methods used to keep water from encouraging downward growth. Irrigating on a schedule, duration and intensity to prevent water from penetrating deeper than 12-18 inches will cause most water to be absorbed by plant material. Two physical barriers to root growth should also be considered: 1) creation of a layer of air gaps, and 2) the creation of an exclusion zone in the soil profile.

An Exclusion Zone created by compacting the soil is one way to prevent root colonization to undesirable soil depths. A 9 to 12 inch layer of compacted soil above the synthetic liner would prevent root penetration by inhibiting the water movement and air exchange necessary for root growth and nutrient uptake.

Another effective means of controlling root growth is the creation of an Air Gap using a layer of stone with extremely large pores that will dry up quickly and have poor water holding capacity. Large gravel (> ¾ inch) and cobble-sized stones, or clean, graded, medium-sized rubble would provide an excellent gap material if it is covered by a layer of filter fabric to prevent infiltration of finer particles.

Root Depth Research

Roots utilize soil spaces for access to water and essential elements, and to provide structural support. They grow following pathways of interconnected soil pores. Roots survive and grow where adequate water is

available, temperatures are warm, and oxygen is present. They are generally shallow as limited by oxygen contents, anaerobic conditions, and water saturation in deeper soil. Near the base of the tree, deep growing roots can be found, but they are oxygenated through fissures and cracks generated as a result of mechanical forces moving the crown and stem under wind loads (sway).[1]

Trees' root systems are made up of large, permanent roots (which mainly provide anchorage and transport), and many small, temporary feeder roots and root hairs. It is these small parts of the root system that are the primary water and nutrient absorbers. Most tree roots do not penetrate very deeply into the soil. Unless the topsoil is bare or unprotected, trees will concentrate most of their absorbing roots in the top 6 to 18 inches of soil, where water, nutrients, and oxygen can be found.

Tree root systems usually extend out in an irregular pattern 2 to 3 times larger than the crown area. The type of roots formed initially is specific to a given species; with age the initial root form is often modified by the growing environment. Such things as soil hardpans, water tables, texture, structure, and degree of compaction all influence the mature root form.[2]

Mike Kuhns, USU Extension Forester, noted, "Though the tendency of a tree to have a tap root early in life may be somewhat genetically based, for the most part, tree root system morphology in established trees is dependent on a combination of root biology and soil characteristics, with soil having a dominant effect."[3]

Recent root excavation studies in the Environmental Horticulture Department at the University of Florida, IFAS, are beginning to suggest that tree roots grow differently than popularly believed. Existence of a tap root appears to be dependent on the tree species, tree age, soil profile and whether the tree was grown in the field from seed or transplanted from a nursery container. At planting, taproots of container-grown plants are often cut, causing initiation of lateral branch roots. These roots either grow down to form multiple taps roots or stay fairly shallow, depending on soil condition. Roots grow close to the surface in soil that is highly compacted or low in oxygen content. This appears to be evident on tap-rooted and non-tap-root species. Therefore, in urban environments, where soil is often compacted, taproots rarely can be found.[4]

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[1]Coder, Dr. Kim D., "Tree Root Growth Requirements," University of Georgia, July 2000.
[2]Iowa State University Extension.
[3]Kuhns, Michael, USU Extension Forester. Correspondence, November 2003.
[4]Gilman, Edward F., "Where are Tree Roots?" Florida Cooperative Extension Service document ENH 137, 1999.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
LARGE DECIDUOUS TREES							
Acer platanoides 'Deborah'	Deborah Norway Maple	shallow	40-50' x 40-50'	NA	2" Caliper		
Acer platanoides 'Emerald Lustre'	Emerald Luster Norway Maple	shallow	40-50' x 30-40'	NA	2" Caliper		
Acer platanoides 'Royal Red'	Royal Red Norway Maple	shallow	30-40' x 25-30'	NA	2" Caliper		
Acer x fremanii 'Autumn Blaze'	Autumn Blaze Maple	very shallow	40-50' x 30-40'	NA	2" Caliper		
Betula platyphylla 'Whitespire'	Asian White Birch	shallow	30-40' x 20-30'	NA	2" Caliper		
Catalpa speciosa	Western Catalpa	deep	40-60' x 30-50'	NA	2" Caliper	X	
Celtis occidentalis	Common Hackberry	deep	50-60' x 40-50'	NA	2" Caliper	X	X
Fraxinus americana 'Autumn Purple'	Autumn Purple Ash	shallow/deep	40-60' x 40-50'	NA	2" Caliper		
Fraxinus pennsylvanica 'Patmore'	Patmore Ash	shallow/deep	40-50' x 30-40'	NA	2" Caliper		
Fraxinus pennsylvanica 'Summit'	Summit Ash	shallow/deep	40-50' x 30-40'	NA	2" Caliper	X	
Gleditsia triacanthos in. 'Shademaster'	Shademaster Honeylocust	shallow/deep	40-50' x 30-35'	NA	2" Caliper	X	
Gleditsia triacanthos inermis 'Imperial'	Imperial Honeylocust	shallow/deep	30-35' x 30-35'	NA	2" Caliper	X	
Gleditsia triacanthos inermis 'Skyline'	Skyline Honeylocust	shallow/deep	40-50' x 30-35'	NA	2" Caliper	X	
Gymnocladus dioica	Kentucky Coffeetree	deep	50-60' x 40-50'	NA	2" Caliper	X	
Phellodendron amurense	Amur Cork Tree	shallow	30-35' x 30-35'	NA	2" Caliper		
Populus x accuminata	Lanceleaf Cottonwood	shallow	40-60' x 30-40'	NA	2" Caliper		
Populus angustifolia	Narrowleaf Cottonwood	shallow	30-50' x 20-30'	NA	2" Caliper		X
Pyrus calleryana 'Chanticleer'	Chanticleer Flowering Pear	shallow	20-30' x 15-20'	NA	2" Caliper		
Quercus macrocarpa	Bur Oak	deep	50-80' x 50-80'	NA	2" Caliper		
Quercus robur	English Oak	deep	40-60' x 40-60'	NA	2" Caliper		
Quercus robur 'Fastigiata'	Columnar English Oak	deep	40-60' x 15-20'	NA	2" Caliper		
Salix alba 'Vittelina'	Russian Golden Willow	shallow	40-50' x 30-40'	NA	2" Caliper	X	
Salix matsudana 'Navajo'	Globe Navajo Willow	shallow	30-40' x 35-45'	NA	2" Caliper		
Sophora Japonica	Japanese Pagoda Tree	shallow	40-50' x 30-40'	NA	2" Caliper		
Tilia americana 'Redmond'	Redmond Linden	deep	40-50' x 30-40'	NA	2" Caliper		
Tilia cordata 'Greenspire'	Greenspire Linden	deep	30-40' x 25-35'	NA	2" Caliper		
Tilia tomentosa	Silver Linden	deep	40-50' x 30-40'	NA	2" Caliper	X	
Ulmus 'Homestead'	Homestead Elm	deep	40-50' x 30-40'	NA	2" Caliper		

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
ORNAMENTAL DECIDUOUS TREES							
Acer ginnala	Amur Maple	shallow	15-20' x15-20'	NA	1.75" Caliper		
Acer tataricum	Tatarian Maple	shallow	20-25' x 15 20'	NA	6' Clump	X	
Amelanchier canadensis	Shadblow Serviceberry	shallow	15-25' x 15-20'	NA	6' Clump		
Amelanchier x grand. 'Autumn Brilliance'	Autumn Brilliance Serviceberry	deep	15-25' x 15-20'	NA	6' Clump		
Cercis canadensis	Eastern Redbud	shallow	15-20' x 15-20'	NA	8' Clump		
Cornus alternifolia	Pagoda Dogwood	shallow	15-25' x 10-20'	NA	6' Clump		
Crataegus sp.	Hawthorn	shallow	15-30' x 15-30'	NA	6' Clump		
Koelreutaria paniculata	Goldenrain Tree	shallow	20-30' x 20-30'	NA	2" Caliper	X	
Malus sp.	Crabapple	shallow	15-25' x 15-25'	NA	2" Caliper	X	
Prunus maackii	Amur Chokecherry	deep	20-30' x 20-25'	NA	2" Caliper		
Prunus padus	Mayday Tree	deep	20-30' x 20-30'	NA	6' Clump		
Prunus virginiana 'Canada Red'	Canada Red Chokecherry	deep	20-30' x 15-20'	NA	2" Caliper		
Syringa reticulata	Japanese Tree Lilac	shallow	15-25' x 15-20'	NA	8' Clump		
EVERGREEN TREES							
Juniperus scopulorum	Rocky Mountain Juniper	shallow	30-40' x 3-15'	NA	6'	X	X
Pinus aristata	Bristleone Pine	shallow/deep	20-40' x Irregular	NA	6'	X	X
Pinus edulis	Pinyon Pine	deep	20-30' x 10-20'	NA	6'	X	
Pinus flexilis	Limber Pine	shallow/deep	20-30' x 12-15'	NA	8'	X	X
Pinus nigra	Austrian Pine	deep	40-60' x 20-40'	NA	10'		
Pinus ponderosa	Ponderosa Pine	deep	60-80' x 25-30'	NA	10'	X	
Pinus sylvestris	Scotch Pine	shallow	30-50' x 20-30'	NA	10'		
Thuja occidentalis	American Arborvitae	shallow/deep	40-60' x 10-15'	NA	6'		
EVERGREEN AND BROADLEAF EVERGREEN SHRUBS							
Euonymus kiautschovicus 'Manhattan'	Manhattan Euonymus	shallow/moderate	4-6' x 6-8'	4' o.c.	5 Gallon		
Juniperus sp.	Spreading Juniper	shallow/moderate	8"-3' x 6-10'	4' o.c.	5 Gallon	X	X
Juniperus virginiana 'Skyrocket'	Skyrocket Juniper	shallow/moderate	40-50' x 8-20'	NA	6'	X	
Mahonia aquifolium	Oregon Grape Holly	shallow/moderate	4-6' x 4-6'	4' o.c.	5 Gallon		
Pinus mugo	Mugo Pine	shallow/moderate	5-20' x 5-20'	4' o.c.	24" B&B	X	
Taxus x media 'Densiformis'	Dense Yew	shallow/moderate	3-4' x 6-8'	4' o.c.	24" B&B		

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Taxus x media 'Tauntonii'	Taunton Yew	shallow/moderate	3-4' x 6-7'		24" B&B		
DECIDUOUS SHRUBS							
Large Shrubs (over 6' high)							
Acer glabrum	Rocky Mountain Maple	shallow/moderate	10-20' x 10-15'	10' o.c.	6' Clump		X
Alnus incana ssp. tenuifolia	Thinleaf Alder	shallow/moderate	15-30' x 15-20'	10' o.c.	6' Clump		X
Amelanchier utahensis	Utah Serviceberry	moderate	6'-12' x 6'-12'	6' o.c.	5 Gallon	X	X
Amelanchier alnifolia	Saskatoon Serviceberry	moderate	6-12' x 6-12'	6' o.c.	6' Clump	X	X
Aronia arbutifolia 'Brilliantissima'	Brilliant Red Chokecherry	shallow/moderate	6-8' x 4-6'	4' o.c.	5 Gallon		X
Betula occidentalis fontinalis	Western Water Birch	shallow	15-25' x 15-25'	15' o.c.	7 Gallon		X
Buddleia alternifolia	Alternate-Leaf Butterfly Bush	shallow/moderate	10-15' x 8-12'	6' o.c.	5 Gallon		
Buddleia davidii	Butterfly Bush	shallow/moderate	6-12' x 4-8'	4' o.c.	5 Gallon		
Caragena arborescens	Siberian Peashrub	moderate	10-15' x 8-12'	5' o.c	5 Gallon	X	
Cercocarpus ledifolius	Curlleaf Mountain Mahogany	shallow/moderate	10-25' x 10-20'	10' o.c.	5 Gallon	X	X
Cercorpus montanus	True Mountain Mahogany	shallow/moderate	10-20' x 10-20'	10' o.c.	5' Clump	X	X
Cornus alba 'Argenteo-marginata'	Variegated Dogwood	shallow/moderate	6-8' x 5-8'	4' o.c.	5 Gallon		
Cornus sericea	Redtwig Dogwood	shallow/moderate	6-8' x 6-10'	4' o.c.	5 Gallon		X
Cotinus coggygria	Smoketree	shallow/moderate	8-10' x 8-10'	5' o.c.	5 Gallon		
Cotoneaster lucidus	Peking Cotoneaster	shallow/moderate	6-12' x 4-6'	4' o.c.	5 Gallon		
Cotoneaster multiflorus	Many-Flowered Cotoneaster	shallow/moderate	8-12' x 4-6'	4' o.c.	5 Gallon		
Euonymus alatus	Burning Bush	moderate	8-12' x 8-12'	4' o.c.	5 Gallon		
Euonymus europaeus	Spindle Tree	moderate	12-15' x 8-12'	6' o.c	5' Clump		
Forsythia x intermedia	Forsythia	shallow/moderate	6-10' x 6-8'	5' o.c.	5 Gallon		
Hibiscus syriacus	Rose of Sharon	shallow/moderate	8-10' x 6-8'	4' o.c.	5 Gallon		
Jamesia americana	Waxflower	shallow/moderate	3-6' x 3'-6'	3' o.c.	2 Gallon		X
Kolkwitzia amabalis	Beautybush	shallow/moderate	10-12' x 10-12'	6' o.c.	5 Gallon		
Ligustrum vulgare	Common Privet	shallow/moderate	6-8' x 4-6'	3.5' o.c.	5 Gallon		
Lonicera tatarica	Tatarian Honeysuckle	shallow/moderate	6-12' x 6-12'	5' o c.	5 Gallon		
Purshia tridentata	Antelope Bitterbrush	shallow/moderate	2-10' x 2-6	2' o.c.	2 Gallon	X	X
Physocarpus opulifolius	Golden Ninebark	shallow/moderate	6-10' x 6-10'	6' o.c.	5 Gallon		X
Prunus americana	American Plum	shallow/moderate	8-12' x 6-8'	5' o.c.	5 Gallon		
Prunus fruticosa	European Dwarf Cherry	shallow/moderate	6-8' x 6-8'	5' o.c.	5 Gallon		

Assumptions
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2. All trees will be nursery grown, eliminating taproots.
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Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Prunus tomentosa	Nanking Cherry	shallow/moderate	8-12' x 6-8'	5' o.c.	5 Gallon		
Prunus virginiana melanocarpa	Chokecherry	shallow/moderate	8-12' x 6-8'	5' o.c.	5 Gallon		
Prunus x cistena	Purple Leaf Plum	shallow/moderate	6-8' x 4-6'	8' o.c.	5 Gallon		
Quercus gambelii	Gambel Oak	moderate	8-20' x 6 -12'	6' o.c.	4' Clump	X	X
Rhamnus frangula 'Columnaris'	Columnar Buckthorn	shallow/moderate	8-12' x 3-4'	3' o.c.	5 Gallon		
Rhus glabra	Smooth Sumac	moderate	8-15' x 8-10'	6' o.c.	5 Gallon	X	X
Rhus typhina	Staghorn Sumac	moderate	10-25' x 10-25'	6' o.c.	5 Gallon	X	
Rhus typhina 'Laciniata'	Cutleaf Staghorn Sumac	moderate	6-8' x 6-8'	4' o,c.	5 Gallon	X	
Rubus deliciosus	Boulder Raspberry	shallow/moderate	3'-6' x 3'-6'	3' o.c.	2 Gallon	X	X
Rubus idaeus	Red Raspberry	shallow/moderate	4-6' x 3'-6'	4' o.c.	1 Gallon	X	X
Rubus parviflorus	Thimbleberry	shallow/moderate	3-4' x 3-4'	3' o.c.	2 Gallon	X	X
Rosa woodsii	Woods Rose	shallow/moderate	3-6' x 3'-6'	3' o.c.	5 Gallon	X	X
Salix exigua	Coyote Willow	moderate	6-12' x 4-8'	6' o.c.	5 Gallon		X
Salix purpurea pendula	Blue Fountain Willow	moderate	6-8' x 8-12'	5' o.c.	5 Gallon		
Sambucus racemosa	Red Elderberry	shallow/moderate	4-12' x 6-12'	4' o.c.	5 Gallon		X
Shepherdia argentea	Silverleaf Buffaloberry	moderate	8-12' x 6-12'	6' o.c.	5 Gallon	X	X
Symphoricarpos albus	Common Snowberry	shallow/moderate	3-4' x 3-5'	3' o.c.	5 Gallon		X
Syringa sp.	Lilac	shallow/moderate	8-12' x 8-12'	varies	5 Gallon	X	
Viburnum dentatum	Arrowwood Viburnum	moderate	6-8' x 6-8'	4' o.c.	5 Gallon		
Viburnum lantana	Wayfairing Tree	moderate	10-15' x 6-8'	8' o.c.	5 Gallon		
Viburnum lentago	Nannyberry Viburnum	moderate	8-15' x 6-8'	6' o.c.	5 Gallon		
Viburnum opulus 'Roseum'	Snowball Viburnum	moderate	8-12' x 8-12'	6' o.c.	5 Gallon		
Viburnum trilobum	Highbush Cranberry	moderate	8-12' x 6-10'	6' o.c.	5 Gallon		
Viburnum x burkwoodii	Burkwood Viburnum	moderate	8-12' x 10-12'	3' o.c.	5 Gallon		
Medium Shrubs (4-6' high)							
Berberis sp.	Barberry	shallow/moderate	4-6' x 4-6'	3' o.c.	5 Gallon		
Chaenomeles speciosa	Flowering Quince	shallow/moderate	4-6' x 4-8'	4' o.c.	5 Gallon		
Cotoneaster divaricatus	Spreading Cotoneaster	shallow/moderate	4-6' x 6-8'	4' o.c.	5 Gallon		
Euonymus alatus 'Compactus'	Dwarf Burning Bush	shallow/moderate	4-6' x 4-6'	3' o.c.	5 Gallon		
Fallugia paradoxa	Apache Plume	moderate	3-6' x 3-6'	4' o.c.	5 Gallon	X	
Prunus glandulosa rosea	Pink Flowering Almond	moderate	4-6' x 4-6'	4' o.c.	5 Gallon		
Prunus tenella	Dwarf Russian Almond	shallow/moderate	4-5' x 4-5'	4' o.c.	5 Gallon		

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Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Ribes alpinum	Alpine Currant	shallow/moderate	3-6' x 3-6'	3' o.c.	5 Gallon		
Ribes aureum	Golden Currant	shallow/moderate	4-6' x 4-6'	4' o.c.	5 Gallon		
Rosa sp.	Shrub Roses	shallow/moderate	2-6' x 2-6'	4' o.c.	5 Gallon	X	
Sorbaria sorbifolia	Ural Falsespirea	moderate	4-6' x 6-8'	4' o.c.	5 Gallon		
Spirea x vanhouttei	Vanhoutte Spirea	shallow/moderate	5-7' x 6-8'	4' o.c.	5 Gallon		
Syringa meyeri	Dwarf Korean Lilac	shallow/moderate	4-6' x 4-6'	3' o.c.	5 Gallon		
Syringa patula 'Miss Kim'	Miss Kim Lilac	shallow/moderate	3-5' x 3-5'	3' o.c.	5 Gallon		
Viburnum trilobum 'Compactum'	Compact American Cranberrybush	moderate	4-5' x 4-5'	4' o.c.	5 Gallon		
Viburnum carlesii	Korean Spice Viburnum	moderate	4-6' x 4-6'	3' o.c.	5 Gallon		
Viburnum juddii	Judd Viburnum	moderate	4-6' x 4-6'	4' o.c.	5 Gallon		
Viburnum opulus 'Compactum'	Compact European Cranberrybush	moderate	4-5' x 5-6'	4' o.c.	5 Gallon		
Weigela florida	Weigela	shallow/moderate	4-6' x 4-6'	3' o.c.	5 Gallon		
Low Shrubs (under 4' high)							
Caragana pygmaea	Pygmy Peashrub	moderate	3-5' x 3-5'	3' o.c.	5 Gallon		
Caryopteris clandonensis	Blue Mist Spirea	shallow/moderate	3-4' x 2-4'	3.5' o.c.	5 Gallon	X	
Cornus serica 'Kelseyii'	Kelsey Dogwood	shallow	2-3' x 2-3'	3' o.c.	5 Gallon		
Cotoneaster apiculatus	Cranberry Cottoneaster	shallow/moderate	2-3' x 2-3'	3' o.c.	5 Gallon		
Daphne x burkwoodi 'Carol Mackie'	Carol Mackie Daphne	shallow/moderate	3-5' x 3-5'	3' o.c.	5 Gallon		
Daphne x burkwoodi 'Somerset'	Somerset Daphne	shallow/moderate	3-5' x 3-5'	3' o.c.	5 Gallon		
Ephedra viridis	Mormon Tea	moderate	2-3' x 2-3'	2'o.c.	5 Gallon	X	
Forsythia Intermedia 'Arnold's Dwarf'	Arnolds Dwarf Forsythia	moderate	2-3' x 3-6'	2'o.c.	5 Gallon		
Hydrangea arborescens	Annabelle Hydrangea	shallow/moderate	3-4' x 3-4'	3' o.c.	5 Gallon		
Ligustrum vulgare 'Lodense'	Lodense Privet	shallow/moderate	2-3' x 3-4'	18" o.c.	5 Gallon		
Lonicera syringantha	Tiny Trumpet Honeysuckle	shallow/moderate	3-4' x 4-6'	3' o.c.	5 Gallon		
Potentilla sp.	Cinquefoil	shallow/moderate	2-4' x 2-4'	3' o.c.	5 Gallon	X	
Prunus besseyi	Western Sandcherry	moderate	3-6' x 3-5'	4'o.c.	5 Gallon	X	
Rhus aromatica 'Grow-Low'	Dwarf Fragrant Sumac	moderate	2-3' x 6-8'	4'o.c.	5 Gallon	X	
Rhus glabra cismontana	Rocky Mountain Sumac	moderate	2-3' x 2-3'	2'o.c.	5 Gallon	X	
Salix purpurea nana	Blue Arctic Willow	moderate	3-5' x 3-5'	3' o.c.	5 Gallon		
Spirea bumalda	Anthony Waterer Spirea	shallow/moderate	2-3' x 2-3'	3' o.c.	5 Gallon		
Spirea Japonica	Japanese Spirea	shallow/moderate	12-13' x 2-4'	varies	5 Gallon		
Spirea nipponica	Snowmound Spirea	shallow/moderate	3-4' x 3-4'	3' o.c.	5 Gallon		

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Viburnum opulus 'Nanum'	Dwarf European Cranberry	moderate	1-2' x 1-2'	18' o.c.	5 Gallon		
Yucca filamentosa	Adam's Needle	moderate	2-3' x 3-4'	3' o.c.	5 Gallon	X	X
VINES AND CLIMBERS							
Campsis radicans	Trumpet Vine	moderate	25-50'	As desired	1 Gallon		
Clematis sp.	Clematis	shallow/moderate	6-10'	As desired	1 Gallon		
Euonymous fortunei var. coloratus	Purpleleaf wintercreeper	shallow/moderate	18-24" x 3-4'	3' o.c.	5 Gallon	X	
Hedera helix	English ivy	shallow/moderate	50'+	As desired	1 Gallon		
Lonicera japonica 'Halliana'	Hall's Honeysuckle	shallow/moderate	15-25'	As desired	1 Gallon		
Parthenocissus quinquefolia	Virginia Creeper	shallow/moderate	30-50'	As desired	1 Gallon		
Parthenocissus tricuspidata	Boston Ivy	shallow/moderate	30-50'	As desired	1 Gallon		
Polygonum aubertii	Silverlace Vine	shallow/moderate	25-35'+	As desired	1 Gallon		
Rosa sp.	Climbing Rose	moderate	8-20'	As desired	5 Gallon		
Vitis sp.	Grape	moderate	30-50'	As desired	1 Gallon		
Wisteria sinensis	Wisteria	shallow/moderate	20-30'	As desired	1 Gallon		
GROUNDCOVERS							
Ajuga sp.	Carpet Bugle	shallow	4-6" x 12-24"	12" o.c.	2.25" Pots		
Arctostaphylos uva-ursi	Kinnikinnick	shallow/moderate	3-6" x 2-3'	24" o.c.	1 Gallon	X	SV*
Convallaria majalis	Lily of the Valley	shallow	6-10" x 12-15"	18" o.c.	2.25" Pots		
Cotoneaster dammeri 'Coral Beauty'	Coral Beauty Cotoneaster	shallow/moderate	1-2' x 4-6'	3.5' o.c.	5 Gallon		
Duchesnia indica	False Strawberry	shallow	2-6" x 18-24"	12" o.c.	2.25" Pots	X	
Euonymus fortunei sp.	Wintercreeper	shallow/moderate	12-18" x 3-6'	12" o.c.	1 Gallon		
Galium odoratum	Sweet Woodruff	shallow	6-8" x 8-12"	12" o.c.	2.25" Pots		
Hedera helix	English ivy	shallow/moderate	6-8" x spreading	12" o.c.	2.25" Pots		
Heuchera sp.	Coral Bells	shallow	Varies	Varies	4" Pots		SV
Iberis sempervirens	Candytuft	shallow	8-12" x 18-24"	12" o.c.	2.25" Pots		X
Juniperus sp. (low growing)	Spreading Juniper	moderate	6"-3' x 4-8'	3.5' o.c.	5 Gallon	X	X
Mahonia repens	Oregon Grape	shallow/moderate	12-18" x 12-18"	12" o.c.	2.25" Pots	X	
Phlox subulata	Creeping Phlox	shallow	4-6" x 12-18"	12" o.c.	2.25" Pots		
Sedum sp.	Stonecrop	shallow	Varies	Varies	2.25" Pots	X	SV
Thymus sp.	Thyme	shallow	1/2"-4" x 12-18"	12" o.c.	2.25" Pots	X	

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Veronica sp.	Speedwell	shallow	Varies	12" o.c.	2.25" Pots	X	
Vinca major	Big Leaf Periwinkle	shallow/moderate	6-12" x 12-18"	12" o.c.	2.25" Pots		
Vinca minor 'Bowlesii"	Bowles Periwinkle	shallow/moderate	4-6" x 12-18"	12" o.c.	2.25" Pots		
PERENNIALS, ORNAMENTAL GRASSES AND BULBS							
Achillea millefolium	Common Yarrow	shallow/moderate	18-24" x 2-3'	24" o.c.	1 Gallon	X	
Alchemilla mollis	Lady's Mantle	shallow	18-24" x 18-24"	18" o.c.	1 Gallon	X	
Anemone sp.	Windflower	shallow	1-2' x 12-18"	12" o.c.	1 Gallon		SV
Anemone sylvestris	Snow Drop Windflower	shallow	12-18" x 12-18"	12" o.c.	4" Pots		X
Aquilegia caerulea	Colorado Columbine	shallow	18-24" x 12-18"	12" o.c.	4" Pots		X
Aster sp.	Aster	shallow/moderate	1-3' x 12-30"	12" o.c.	1 Gallon		
Aster frikartii 'Monch'	Monch Aster	shallow/moderate	24-36" x 18-24"	18" o.c.	1 Gallon		X
Astilbe x arendsii	False Spirea	shallow/moderate	18-24" x 18-24"	18" o.c	1 Gallon		
Aubrieta deltoidea 'Purple Gem'	Purple Gem Rock Cress	shallow	4-6" x 8-12"	8" o.c.	4" Pots		
Bergenia cordifolia	Heartleaf Bergenia	shallow	12-18" x 18-24"	18" o.c.	1 Gallon		
Campanula carpatica	Carpathian Harebell	shallow	6-12" x 12-18"	12" o.c	4" Pots		
Campanula persicifolia	Peachleaf Bellflower	shallow	18-24' x 12-18"	12" o.c	1 Gallon		SV
Campanula rotundifolia	Bluebell	shallow	6-18" x 12-18"	12" o.c	4" Pots		
Centaurea montana	Perennial Bachelor Button	shallow/moderate	12-24" x 24-36"	18" o.c.	4" Pots		
Cerastium tomentosum	Snow-in-Summer	shallow	6-18" x 12-18"	12" o.c	4" Pots	X	
Coreopsis verticullata 'Moonbeam'	Moonbeam Coreopsis	shallow	12-18" x 12-18"	12" o.c	4" Pots	X	
Crocus vernus	Dutch Crocus	shallow	4-6" x 4-6"	4-6" o .c.	bulb		
Echinacea purpurea	Purple Coneflower	shallow/moderate	24-36" x 18-24".	18" o.c	4" Pots		
Erysimum kotschyanum	Wallflower	shallow	1-3" x 4-6'	4-6" o.c.	2.25" Pots		
Euphorbia epithymoides	Cushion Spurge	shallow/moderate	12-24" x 24-36"	18" o.c.	4" Pots	X	
Gaillardia aristata	Blanket Flower	shallow/moderate	18-24" x 18-24"	18" o.c.	1 Gallon		SV
Galanthus nivalis	Snowdrop	shallow	6-8" x 6-8"	4-6" o.c.	bulb		
Geranium sp.	Cranesbill	shallow	12-18" x 18-24"	18" o.c.	4" Pots		
Hemerocallis sp.	Daylily	shallow	12-36" x 12-36"	18" o.c	1 Gallon	X	
Hosta sp.	Hosta	shallow	12-24" x 12-24"	14" o.c.	1 Gallon		
Hypericum patulum 'Hidcote'	St. Johnswort	shallow/moderate	18-24" x 18-24"	18" o.c.	1 Gallon		
Ipomopsis aggregata	Scarlett Gilia	shallow/moderate	6-24" x 12-18"	12" o.c	4" Pots		

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Note: Rooting depth depends on planting conditions (see assumptions). Using a target maximum depth of 18", the relative rooting depths are assumed to be:
Very Shallow: 2-4" Shallow: 4-6" Moderate: 6-12" Deep: 2-18"

Botanical Name	*Common Name*	*Rooting Depth*	*Height x Spread*	*Recommended Spacing*	*Minimum Size*	*Drought Tolerant*	*Native*
Iris germanica	Bearded Iris	very shallow	2-3' x 12-18"	12" o.c	1 Gallon		
Iris pumila	Dwaf Iris	very shallow	8-12" x 8-12"	8" o.c.	4" Pots		
Iris siberica	Siberian Iris	very shallow	3-4' x 18-24"	18" o.c.	1 Gallon		
Lupinus sp.	Lupine	shallow/moderate	Varies	Varies	1 Gallon	X	SV
Monarda sp.	Beebalm	shallow	2-3' x 12'-3'	12" o.c	1 Gallon		SV
Muscari armeniacum	Grape Hyacinth	shallow	3-4" x 3-4"	4-6" o.c.	bulb		
Narcissus sp.	Daffodil	shallow	12-18" x 8-12"	6-8" o ,c.	bulb		
Paeonia lactifolia	Peony	shallow/moderate	24-36" x 24-36"	18" o .c.	1 Gallon		
Papaver orientale	Oriental Poppy	shallow/moderate	24-36" x 18-24"	18" o.c.	1 Gallon		
Penstemon sp.	Penstemon	shallow/moderate	Varies	Varies	1 Gallon		SV
Salvia superba	Blue Salvia	shallow	18-24" x 12-18"	12" o.c	4" Pots		
Scilla siberica	Bluebell	shallow	3-6" x 3-6"	4-6" o.c.	bulb		
Sedum sp.	Stonecrop	shallow	2-4" x 12-18"	12" o c	1 Gallon		
Stachys byzantina 'Silver Carpet'	Flowerless Lamb's Ear	shallow	12-18" x 12-18"	12" o.c	4" Pots		
Thalictrum sp.	Meadowrue	shallow/moderate	1-4' x 12-24"	12" o.c	1 Gallon		SV
Thermospsis montana	Mountain Goldenbanner	shallow/moderate	18-24" x 12-18"	12" o.c	1 Gallon		
Viola sp.	Violet	shallow	6-12" x 8-12"	8" o c	4" Pots		
Viola cornuta	Tufted Pansy	shallow	6-18" x 12-18"	12" o.c.	4" Pots	X	

Assumptions
1. The site will have 2-8' of cover over the membrane, including 6-18" inches of topsoil.
2. All trees will be nursery grown, eliminating taproots.
3. The irrigation system will control watering depth.

Appendix D
Technical Specifications from Original Sharon Steel Site Closure

SHARON STEEL/MIDVALE TAILINGS
OPERABLE UNIT NUMBER ONE
CAPPING REMEDIAL ACTION
MIDVALE, UTAH

REQUISITION NO. RA-5048
SPECIFICATIONS

Prepared for:

Utah Department of Environmental Quality
State of Utah
and
United States Environmental Protection Agency
Region VIII

Prepared by:

United States Bureau of Reclamation
Provo Area Office

EXHIBIT "D"
LIST OF CONTRACT TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

CAPPING REMEDIAL ACTION

SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 1.1 - GENERAL

1.1.1 THE REQUIREMENT

It is required that there be constructed and completed, in accordance with the contract provisions and articles, these specifications, and the drawings for Sharon Steel/Midvale Tailings, Operable Unit 1, the Capping Remedial Action, Midvale, Utah.

The work is situated at approximately 7800 South and 700 West in unincorporated Salt Lake County, Utah. The site is listed on the EPA's National Priority List of Superfund Sites.

1.1.2 DESCRIPTION OF THE WORK

The primary objective is to remove the potential of human contact with the contaminated materials on this site by capping the tailings and contaminated soils. The principal components of the work to be performed under these specifications include the following:

a. It is required that all contaminated material on the site be covered with a designed cap to resist infiltration of precipitous water through the contaminated material and into the local groundwater system, and to prevent fugitive migration of the contaminated material by wind distribution.

b. Removal and relocation of the contaminated material along the Jordan River, 7800 South, Southeast tailings area, and areas east of the tailings pile.

c. Furnish and place clean fill as required to finish the site to the lines and grades shown on the final grading plan.

d. Grading of the site according to specified grading plan.

e. Restoration of wetlands as specified in the contract documents.

f. Construction of an interceptor trench as shown on the plan and profile and specified in the contract documents.

g. Construction of a piped conveyance as shown on the plan and profile and specified in the contract documents.

h. Restoration of the area west of the Jordan River as shown on the site grading plans and specified in the contract documents.

i. Installation of groundwater monitoring wells.

1.1.3 LAYOUT OF WORK AND QUANTITY SURVEYS

a. General. - The Contractor shall perform all layout surveys required the control and completion of the work, and all necessary surveys to compute quantities of work performed. The Contractor shall provide experienced construction surveyors, and survey work shall be under the supervision and direction of a licensed surveyor with a minimum of 5 years responsible charge of construction surveys for construction similar in nature to that required by the contract. The Contractor shall maintain sufficient qualified personnel to perform required surveying work.

All survey work performed by the Contractor shall be subject to field and office review by the Engineer.

The Government has established primary control to be used by the Contractor for establishing lines and grades required for the work. Primary control consists of section and ¼ section corners within the Utah State plane coordinate system. Before beginning work, the Contractor shall check and verify primary control, and discrepancies shall be resolved before proceeding.

The Contractor shall preserve and maintain primary control points until otherwise authorized. Primary control points damaged or destroyed by the Contractor prior to authorization may be reestablished by the Engineer, and the expense of reestablishment will be deducted from amounts due, or to become due, to the Contractor.

b. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4

At least 20 days prior to beginning any surveying work, the Contractor shall submit, for approval, a complete plan for the surveying required to layout the work, including methods and timetables for establishing lines and grades. The plan shall include drawings or sketches to indicate baseline locations for cross-sections, intervals of cross-sections, and specific locations of cross-sections in relationship to irregularly shaped construction.

At least 15 days prior to beginning surveying work, the Contractor shall submit, for review and resolution as required, results of the Contractor's check on the accuracy of the Engineer's established primary control.

At least 15 days prior to beginning surveying work, the Contractor shall submit, for approval, resumes of qualifying experience for the engineer or surveyor who will be responsible for the supervision and direction of Contractor survey work.

Within 2 days of completing and reducing notes for a survey or portion of survey, the Contractor shall submit, for review and filing, a copy of such notes. Within 2 days of completing a field survey book, the Contractor shall submit, for review and filing, the original field survey book.

Accompanying progress payment requests, the Contractor shall submit, for approval, a copy of applicable quantity survey notes and computations and an itemized statement for work performed or placed during the progress period measured on the basis of surveying.

If requested by the Engineer, the Contractor shall submit, for review and filing, a copy of the workday's survey notes at the conclusion of that workday.

c. Layout of work. - From Government-established primary control points, the Contractor shall establish all lines and grades necessary to control the work, and shall be responsible for all measurements that may be required for execution of the work to the tolerances prescribed in these specifications or on the drawings.

The Contractor shall establish, place, and replace as required, such additional stakes, markers, and other controls as may be necessary for control, intermediate checks, and guidance of construction operations.

d. Quantity surveys. - Unless specified otherwise, the Contractor shall perform such surveys and computations as are necessary to determine quantities of work performed or placed during each progress payment period, and shall perform all surveys necessary for the Engineer to determine final quantities of work in place. The Engineer will determine final quantities based on the Engineer's and Contractor's surveys. Government-established original terrain data (computer-generated contours) and/or actual surveys will be used to spot check original cross-sections.

The Contractor shall notify the Engineer at least 24 hours before performing a quantity survey and, unless specifically waived, quantity surveys shall be performed in the presence of an authorized representative of the Engineer.

e. Surveying. -

(1) Surveys required. -

(a) Cross-section. - Original, final, and intermediate as required, for hazardous waste sites and other locations as necessary for quantity surveys. Contaminated areas require cross-sections prior to excavation and after final excavation. Additional cross-sections shall be performed after backfilled to final shape.

(b) "As-built". - As required for final grading and other features of the work.

(c) Alignment staking. - Each 50 feet on tangent; each 25 feet on curves.

(d) Slope staking. - Each 50 feet on tangent; each 25 feet on curves; restake every 10 feet in elevation.

(e) Structures. - Stake out structures; checkouts prior to and during construction.

(f) Road. - Blue tops each 50 feet on tangent and each 25 feet on curves.

(2) Accuracy. - Degree of accuracy shall be of an order high enough to satisfy tolerances specified for the work and the following:

(a) Cross-section points shall be located within 0.1 foot, horizontally and vertically.

(b) Alignment of tangents and curves shall be within 0.1 foot.

(c) Structure points shall be set within 0.01 foot, except where installation or operation considerations require tighter tolerances.

(d) Blue tops shall be set within 0.05 foot.

(e) Vertical elevation surveys shall close within 0.05 foot times the square root of the circuit length in miles.

(3) Materials and equipment. - Except for field books, the Contractor shall provide all materials and equipment required for surveying work, including, but not limited to, instruments, stakes, spikes, steel pins, templates, platforms, and tools, and except as required to be incorporated in the work or left in place, all such materials and equipment shall remain property of the Contractor.

Instruments shall be accurate and shall be subject to rigid inspection for proper operation at least every 2 weeks of use. Defective instruments, as determined by the Engineer, shall be promptly replaced, repaired, or adjusted to the satisfaction of the Engineer.

f. Records. - Survey data shall be recorded in accordance with recognized professional surveying standards. Original field notes, computations, and other surveying data shall be recorded in Government-furnished field books. Notes or data not in accordance with standard formats will be rejected. Illegible notes or data, or erasures on any page of a field book will be considered sufficient cause for rejection of part or all of the field book. Copied notes or data will not be permitted; therefore, rejection of part or all of a field book may necessitate resurveying. Corrections by ruling or lining out errors will be satisfactory.

At the Contractor's option survey data may be recorded on electronic data collectors. All electronic data shall be submitted on floppy disks accompanied by printed copy of all data using a standard format approved by the Engineer.

g. Grade Verification. - The Contractor shall establish intermittent grades before placement of succeeding layers or grades, of geo-synthetics or overlying cover soils. Additionally, this survey shall demonstrate that drainage patterns have not been changed unless specifically authorized by the Engineer.

h. Final Grade. - The Contractor shall establish the final grade before seeding begins, by resurveying the points established in subparagraph c. Additionally, this survey shall demonstrate that drainage patterns have not been changed unless specifically authorized by the Engineer.

i. Cost. - The cost of all material, equipment, and labor required for surveys for the layout of work and quantity surveys required by this paragraph shall be included in the prices bid in the schedule for items of work requiring the surveys.

1.1.4 SUBMITTAL REQUIREMENTS

a. General. - The Contractor shall furnish all materials and perform all work required for furnishing submittals, in accordance with this paragraph, Table 1A, and the requirements in the provisions, articles, and paragraphs of this solicitation/specifications.

The word "submittals" shall be interpreted to include drawings, data, manuals, certifications, test reports, curves, samples, color chips or charts, brochures, and other items furnished by the Contractor for approval, informational, or other purposes.

b. List of submittals. - Table 1A lists the submittals required except those submittals which are required conditionally, required by entities other than the Engineer, or which are periodic in nature. Any submittal required to be submitted by the Contractor, but which is not listed in the table, shall be submitted in accordance with the applicable requirements of this solicitation/specifications. In case of a conflict between the requirements of this paragraph and the requirements included elsewhere in this solicitation/specifications, the requirements elsewhere shall take precedence over the requirements contained in this paragraph.

c. Submittals. - Each item in Table 1A has been assigned an RSN (Required Submittal Number). The "Submittals required" column of the table specifies the material to be submitted for each RSN. All of the material specified for an RSN will be considered a complete set; and where the material required for an RSN is specified as separate or distinguishable parts, a complete set shall include all parts. Only complete sets shall be submitted.

The number of complete sets to be submitted, and the location to which they are to be sent, shall be in accordance with the "No. of sets to be sent to:" column of the table, except as provided below for sets of original material.

When an RSN involves submittal of original (non-copied) material, all original material, or as much thereof as is necessary to form a complete set, shall be included in just one complete set. This "originals" set shall be sent to the proper address, given in subparagraph e. below, as determined by the "Responsible code" column of the table. The "originals" set shall be counted as one of the complete sets required to be submitted under the "No. of sets to be sent to:" column of the table.
Each drawing submitted by the Contractor shall have the Contractor's or supplier's title and drawing number on it. Drawings and data shall be labeled with the contract numbers.

For each RSN, the Contractor shall submit complete sets of required submittal material under the cover of a transmittal letter. At the Contractor's option, complete sets for more than one RSN may be submitted under cover of the same transmittal letter, provided they have the same responsible code designation as shown in the table. The Contractor's transmittal letter shall include:

(1) Reference to contract numbers and title.
(2) Identification of responsible code as shown in the table.
(3) Complete list of RSN(s) for which material is being submitted.
(4) For each RSN, number of complete sets and list of materials included.
(5) For each RSN, identification of the submittal as an initial submittal or a resubmittal.

Each drawing submitted by the Contractor shall have the Contractor's or supplier's title and drawing number on it. Drawings and data shall be labeled with the contract numbers and the bidding schedule item number.

Manufacturer's data for commercial products or equipment, such as catalog cut sheets, shall be clearly marked to indicate the item(s) to be furnished. The data shall be sufficiently comprehensive to identify the manufacturer's name, type, model, size, and characteristics of the product or equipment, as well as to fully demonstrate that the product or equipment meets the requirements of these specifications.

Submittals requiring certification by a registered professional shall be signed and sealed.

d. Review of submittals furnished for approval. - The time required for review of each submittal or resubmittal furnished under an RSN for appro· will not begin until the responsible office receives complete sets of a: the submittal materials required for that particular RSN. The number of calendar days required for review of drawings or data submitted or resubmitted for approval will include the date the drawings or data are received by the responsible office, and will extend through the date of return mailing to the Contractor.

Except as otherwise provided in the specifications for specific submittals, the responsible office will require 30 calendar days for review of each submittal or resubmittal furnished by the Contractor for approval, and this review time will apply to each separate submittal or resubmittal whether the submittals are approved, not approved, or returned for revision.

If the responsible office uses time in excess of the specified number of calendar days for review of any submittal or resubmittal, additional time, not to exceed the excess time, will be added to the time allowed the Contractor for completion of the work affected by such excess time, to the extent it is demonstrated that the excess time caused delay. If the review of two or more separate submittals or resubmittals is late and results in concurrent days of excess time, such days will be counted only once in computing an extension of the completion date. Further, if the Contractor fails to make complete approval submittals in the sequence and within the time periods specified in this specification, and thus precludes the responsible office from approving or considering for approval such submittals within the specified calendar day period, then the Contractor shall not be entitled to an extension of time allowed for completion of the work.

Unless otherwise specified, one set of the submittals required for approval will be returned to the Contractor either approved, not approved, or conditionally approved, and will be marked to indicate changes, if required. Submittals that are not approved or that require changes or revisions shall be revised and resubmitted for approval, and shall show changes and revisions with revision date. All requirements specified for the initial submittal shall apply to any resubmittals required. Unless otherwise specified, all submittals which are to be resubmitted shall be resubmitted by the Contractor within 30 calendar days after the Contractor has received the responsible office's comments.

e. Addresses. - The Contractor shall send the submittals to the applicable addresses listed below as required by Table 1A.

The Contractor shall also send a copy of the transmittal letter to each of the addresses listed below that are not sent the submittal.

Submittals shall be sent as required by Table 1A to:

(1) Engineer, Attention: PRO-200, Bureau of Reclamation, 302 East 1860 South, Provo, Utah 84606-7317.

(2) State of Utah, Division of Environmental Response and Remediation, Department of Environmental Quality, 168 North 1950 West, Salt Lake City, Utah 84116.

f. Cost. - Unless otherwise specified, no separate payment will be made for preparing and furnishing submittals to the Government, and the cost thereof shall be included in the prices bid in the schedule for the applicable items of work requiring the submittals or other items of work.

Table 1A. - List of submittals - Continued

Table 1A. - List of Submittals

RSN	Item	Reference provision, article, or paragraph	Respon-sible Code	Submittals required	No. of sets to be sent to:*		Due date or delive time
					UDEQ	E	
1	Final Payment	Article 5.6	UDEQ	Warranties, release of "Liens", record (as-built) drawings, permits, further documentation as UDEQ requires.	2	0	Prior to final paym
2	Construction Schedule	Article 11.1	E	Blackline prints and computer disk in PRIMAVERA format. Schedule updates on computer disk.	1	1	Within 5 days after work commences on th contract or another period of time as determined by the Engineer. Updated a resubmitted monthly.
3	Bonds	Article 14.3	UDEQ	Performance and payment bonds	1	0	At the time the contract is executed
4	Plan	1.1.3	E	Plan, methods, and timetables for establishing lines and grades	0	1	20 days prior to beginning survey wor
5	Resumes	1.1.3	E	Resume of qualifying experience	0	1	15 days prior to beginning survey wor 15 days prior to personnel change
6	Accuracy check	1.1.3	E	Results of accuracy check on Government control	0	1	15 days prior to beginning survey wor
7	Survey notes	1.1.3	E	Completed and reduced survey notes	0	1	Within 2 days of completing and reducing notes
8	Field survey books	1.1.3	E	Original field survey book	0	1	Within 2 days of completing a book
9	Quantity survey notes	1.1.3	E	Applicable quantity survey notes and computations	0	1	Accompanying progress payment requests
10	Reference standards and definitions	1.1.6	UDEQ	Copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents.	1	1	At the end of every month

Table 1A. - List of submittals - Continued

RSN	Item	Reference provision, article, or paragraph	Respon-sible Code	Submittals required	No. of sets to be sent to:*		Due date or delive time
					UDEQ	E	
11	Quality Control Plan	1.2.3	E	Quality Control Plan	2	1	30 days after contra award
12	CQC Inspection Reports	1.2.3	E	CQC Inspection Reports	2	0	Within 5 days after the inspection
13	Access to the work and haul routes	1.3.2	E	Proposed haul routes	0	1	Prior to hauling materials
14	Use of land for construction purposes	1.3.9	E	Proposed areas for Contractor use including a landscape rehabilitation plan for each area on the site to be impacted by Contractor use.	0	1	10 days prior to use of land for construction purposes
15	Hazardous waste/materials safety and health	1.4.3	E	Key personnel, Contractor personnel and their training, air monitoring programs, Site Safety and Health Plan, certification of safety training for each person entering the reduction or exclusion zones.	0	1	Prior to starting wor
16	Hazardous materials	1.4.4	E	Material safety data sheets	0	1	Prior to delivery of materials
17	Site Safety and Health Plan	1.4.5	E	Site Safety and Health program	1	2	Review and comment prior to any onsite work
18	Prevention of water pollution	1.5.1	E	Pollution prevention plan	0	1	Not less than 30 days prior to the start of onsite construction work
19	Prevention of water pollution	1.5.1	E	SPPC plan and certified statement regarding review and certification of the SPCC plan by a registered professional engineer	0	1	At least 30 days prior to the delivery or storage of oil
20	Dust Abatement	1.5.3	E	Fugitive dust control plan	0	1	Prior to onsite activities

Table 1A. - List of submittals - Continued

RSN	Item	Reference provision, article, or paragraph	Responsible Code	Submittals required	No. of sets to be sent to:*		Due date or deliver time
					UDEQ	E	
21	Removal of water from excavations	2.1.2	E	Complete and detailed plan which includes a description of the Contractor's proposed method, equipment (type and size), capacities, procedures, and other pertinent details for removal of water from excavations.	1	1	Prior to beginning a unwatering or dewatering work
21 b	Railroad trestle demolition	2.2.1	E	Railroad trestle demolition plan	0	1	Submitted and approve prior to demolition work
22	Soil amendments	2.3.1	E	Contractor's Soil Test	0	1	45 days prior to delivery of seeding materials on the site
23	Fencing	2.4.1	E	Manufacturer's certification	0	1	30 days prior to purchase of materials
24	Excavation and Re-grading plan	3.1.2	E	Detailed Excavation and Re-grading Plan	0	1	Within 20 days after the receipt of the notice to proceed
25	Earthwork materials, general	3.3.1	E	Locations of borrow areas from which earthwork materials will be excavated.	0	1	14 days prior to usin a borrow area
26	Test section	3.3.4	E	Test fill location, construction equipment, cap materials and placement techniques.	0	1	7 days prior to the construction of the test section
27	Cap survey	3.3.5	E	As-built survey of the completed cap	0	1	Within 30 days after completion of the cap
28	Care of the Jordan River and surface water diversion	4.1.3	E	Water control plan showing the proposed method for diversion of surface water and care of the Jordan River.	1	0	Within 20 days after receipt of notice to proceed
29	Geosynthetic filter fabric	4.2.1	E	Certification of the physical properties of the geotextile, one square yard sample.	0	1	30 days prior to purchase

Table 1A. - List of submittals - Continued

RSN	Item	Reference provision, article, or paragraph	Responsible Code	Submittals required	No. of sets to be sent to:*		Due date or delivery time
					UDEQ	E	
30	Concrete	4.3.2	E	Name and manufacturer of each cementitious material, admixture, curing compound, and aggregate source	0	1	Thirty days prior to placement of concrete
31	Concrete	4.3.2	E	Concrete mix design	0	1	Prior to the use of the concrete mix
32	Cap installation	4.5.1	E	Detailed 'cap installment' layout drawing.	0	1	Within 20 days after notice to proceed
33	Cap installation	4.5.1	E	Cap area completion notice	0	1	Upon completion of a zone
34	Interface friction testing	4.5.1	E	Interface friction testing results	0	1	Prior to delivery of geosynthetics to the site
35	Geosynthetic clay liner	4.5.2	E	Manufacturer's qualifications, Quality Control Manual, and product literature. GCL material property specifications. Name of testing laboratory. One square foot sample of the GCL.	0	1	30 days prior delivery
36	Geomembrane liner	4.5.3	E	Manufacturer's qualifications, Quality Control Manual, and product literature. Geomembrane material property specifications. Name of testing laboratory. One square foot sample of the geomembrane liner.	0	1	30 days prior to delivery
37	Destructive field seam testing	4.5.3	E	Certified test results on all field seams.	0	1	Prior to the acceptance of the seam
38	Repair procedures	4.5.3	E	Certified test results on all repaired seams	0	1	Prior to covering th seamed areas

Table 1A. - List of submittals - Continued

RSN	Item	Reference provision, article, or paragraph	Responsible Code	Submittals required	No. of sets to be sent to:*		Due date or delive time
					UDEQ	E	
39	Geocomposite drain	4.5.4	E	Manufacturer's qualifications, Quality Control Manual, and product literature. Geonet property test specifications. Name of testing laboratory. One square foot sample.	0	1	30 days prior to delivery
40	Monitoring well installation methods	4.6.1	E	Methods of monitoring well drilling, installation, development, and water disposal, and documentation	0	1	30 days prior to monitoring well installation
41	Monitoring well installation	4.6.1	E	As-built drawings of the monitoring well installations	0	1	Within 2 working day after each installation is completed
42	Mannoles	4.8.1	E	Contractor's proposed method of connection, list of materials selected and specials required.	0	1	Prior to purchase an installation
43	Subdrainage system	4.10.1	E	Manufacturer's pipe installation recommendations.	0	1	Prior to installing the pipe

* UDEQ indicates State of Utah, Utah Department of Environmental Quality, and E indicates the Engineer. For mailing addresses, see entitled "Addresses" of entitled "Submittal Requirements."

1.1.5 MOBILIZATION AND PREPARATORY WORK

a. General. - For the purposes of providing for expenses incident to initiation of construction and discouraging unbalanced offers, an item . been included in the schedule to provide for payment for mobilization and preparatory work. The item for payment for mobilization and preparatory work is intended to compensate the Contractor for operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings, plants, and other facilities at the project site; for payment of premiums for bonds and insurance; for any necessary costs of acquisition of equipment, including purchase and mobilization expense; and for any other work and operations that must be performed or costs that must be incurred incident to the initiation of meaningful work at the site and for which payment is not otherwise provided for under the contract.

All facilities, plant, and equipment that are established at or brought to the worksite shall be deemed to be subject to the provisions of this paragraph unless the Engineer specifically provides otherwise in writing for a particular item or items. The Contractor shall be solely responsible for the adequacy, efficiency, use, protection, maintenance, repair, and preservation of all facilities, plant, and equipment.

b. Payment. - Payment for mobilization and preparatory work will be made at the lump-sum price offered therefor in the schedule. Progress payments for mobilization and preparatory work will be made as follows:

(1) The total amount of premiums paid by the Contractor to obtain performance and payment bonds (and specified insurance) will be paid at one time together with the first progress payment otherwise due.

(2) When 5 percent of the total original contract amount is earned from other schedule items, $ 1,500,000 or 50 percent of the amount offered for mobilization and preparatory work (whichever is the low will be paid, exclusive of any amount already paid the Contractor fo. performance and payment bond premiums (and specified insurance).

(3) When 10 percent of the total original contract amount is earned from other schedule items, $ 1,500,000 or the balance of the amount offered for mobilization and preparatory work (whichever is the lower) will be paid.

(4) If the amount offered for mobilization and preparatory work exceeds the total of the payments allowed under (2) and (3) above, the balance will be paid when the contract work is substantially complete as determined by the Engineer.

(5) Progress payments for mobilization and preparatory work will be subject to retainage as provided in the Articles.

1.1.6 REFERENCE STANDARDS AND DEFINITIONS

a. Definitions. -

(1) General. - Basic contract definitions are included in the conditions of the contract.

(2) Indicated. - The term "indicated" refers to graphic representations, notes or schedules on the drawings, or other paragraphs or schedules in the specifications, and similar

requirements in the contract documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

(3) Directed. - Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

(4) Approve. - The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the conditions of the contract.

(5) Regulation. - The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

(6) Day. - The term "day" means calendar day.

(7) Installer. - An "Installer" is an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

(a) Experienced. - The term "experienced," when used with the term "Installer," means having a minimum of five previous projects similar in scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.

(b) Trades. - Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

(c) Assignment of Specialists. - Certain paragraphs of the specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

(8) Testing Laboratories. - A "testing laboratory" is an independent and separate entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

b. Industry standards. -

(1) Applicability of Standards. - Except where the contract docume include more stringent requirements, applicable construction indust standards have the same force and effect as if bound or copied directly into the contract documents to the extent referenced. Such standards are made a part of the contract documents by reference.

(2) Publication Dates. - Comply with the standard in effect as of the date of the contract documents.

(3) Conflicting Requirements. - Where compliance with two or more standards is specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to the Engineer for a decision before proceeding.

Minimum Quantity or Quality Levels. - The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.

(4) Copies of Standards. - Each entity engaged in construction on the remedial action is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the contract documents.

Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies direc from the publication source.

(5) Abbreviations and Names. - Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the specifications or other contract documents, they mean the recognized name of the trade association, standards generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. The following acronyms or abbreviations, as referenced in contract documents, are defined to mean the associated names. Names and addresses are subject to change and are believed to be, but are not assured to be, accurate and up-to-date as of date of contract documents. For those not listed, refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol St., Suite 225 Washington, DC 20001	(202) 624-5800
ACI	American Concrete Institute P.O. Box 19150 Detroit, MI 48219	(313) 532-2600
ACIL	American Council of Independent Laboratories 1725 K St., NW	

	Washington, DC 20006	(202) 887-5872
ACPA	American Concrete Pipe Assoc. 8300 Boone Blvd., Suite 400 Vienna, VA 22180	(703) 821-1990
AI	Asphalt Institute Research Park Drive P.O. Box 14052 Lexington, KY 40512-4052	(606) 288-4960
A.I.A.	American Insurance Assoc. 1130 Connecticut Ave., NW Washington, DC 20036	(202) 626-7100
AIHA	American Industrial Hygiene Assoc. 345 White Pond Dr. P.O. Box 8390 Akron, OH 44320	(216) 762-7294
AISC	American Institute of Steel Construction One East Waker Drive, Suite 3100 Chicago, IL 60601-2001	(312) 670-2400
AISI	American Iron and Steel Institute 1133 Fifteenth St., NW Washington, DC 20005	(202) 452-7100
AITC	American Institute of Timber Construction 11818 E. Mill Plain Blvd. Vancouver, WA 98684	(206) 254-9132
ALI	Associated Laboratories 500 S. Vermont St. Palatine, IL 60067	(708) 358-7400
ALSC	American Lumber Standards Committee P.O. Box 210 Germantown, MD 20874	(301) 972-1700
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018	(212) 354-3300
AOSA	Association of Official Seed Analysts c/o Jim Lair Illinois Department of Agriculture Seed Lab. Box 19281 Springfield, IL 62794	(217) 782-7655
APA	American Plywood Assoc. P.O. Box 11700 Tacoma, WA 98411	(206) 565-6600
API	American Petroleum Institute 1220 L St., NW Washington, DC 20005	(202) 682-8000
ASC	Adhesive and Sealant Council 1627 K Street, NW, Suite 1000 Washington, DC 20006	(202) 452-1500
ASME	American Society of Mechanical Engineers	

	345 East 47th St. New York, NY 10017	(212) 705-7722
ASPE	American Society of Plumbing Engineers 3617 Thousand Oaks Blvd., Suite 210 Westlake, CA 91362	(805) 495-7120
ASSE	American Society of Sanitary Engineering P.O. Box 40362 Bay Village, OH 44140	(216) 835-3040
ASTM	American Society for Testing and Materials 1916 Race St. Philadelphia, PA 19103	(215) 299-5400
AWS	American Welding Society 550 LeJeune Road, NW P.O. Box 351040 Miami, FL 33135	(305) 443-9353
AWWA	American Water Works Assoc. 6666 W. Quincy Ave. Denver, CO 80235	(303) 794-7711
BHMA	Builders' Hardware Manufacturers Assoc. 355 Lexington Ave., 17th Floor New York, NY 10017	(212) 661-4261
CISPI	Cast Iron Soil Pipe Institute 5959 Shallowford Road, Suite 419 Chattanooga, TN 37421	(615) 892-0137
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Rd. Schaumburg, IL 60173	(312) 517-1200
GRI	Geosynthetic Research Institute Drexel University West Wing, Rush Building Philadelphia, PA 19104	(215) 895-2343
MBMA	Metal Building Manufacturer's Assoc. c/o Charles M. Stockinger Thomas Associates 1230 Keith Building Cleveland, OH 44115	(216) 241-7333
MCAA	Mechanical Contractors Association of America 1385 Piccard Dr. Rockville, MD 20832	(301) 869-5800
NEC	National Electric Code (from NFPA)	
NECA	National Electrical Contractors Assoc. 7315 Wisconsin Ave. Bethesda, MD 20814	(301) 657-3110
NEMA	National Electrical Manufacturers Assoc. 2101 L St., NW, Suite 300 Washington, DC 20037	(202) 457-8400

NFPA	National Fire Protection Assoc. One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101	(617) 770-3000
N.F.P.A.	National Forest Products Assoc. 1250 Connecticut Ave., NW, Suite 200 Washington, DC 20036	(202) 463-2700
NLGA	National Lumber Grades Authority 1055 W. Hastings St., Suite 260 Vancouver, British Columbia Canada V6E 2E9	(604) 687-2171
NPA	National Particleboard Assoc. 18928 Premiere Court Gaithersburg, MD 20879	(301) 670-0604
NPCA	National Paint and Coatings Assoc. 1500 Rhode Island Ave., NW Washington, DC 20005	(202) 462-6272
NSF	National Sanitation Foundation 3475 Plymouth Rd. P.O. Box 1468 Ann Arbor, MI 48106	(313) 769-8010
PCA	Portland Cement Assoc. 5420 Old Orchard Road Skokie, IL 60077	(312) 966-6200
PDI	Plumbing and Drainage Institute c/o Sol Baker 1106 W. 77th St., South Dr. Indianapolis, IN 46260	(317) 251-6970
UL	Underwriters Laboratories 333 Pfingsten Rd. Northbrook, IL 60062	(708) 272-8800
USP	U.S. Pharmacopoeia 12601 Twinbrook Parkway Rockville, MD 20852	(301) 881-0666
WRI	Wire Reinforcement Institute 1760 Reston Parkway, Suite 403 Reston, VA 22090	(703) 790-9790
WWPA	Western Wood Products Assoc. Yeon Building 522 SW 5th Avenue Portland, OR 97204-2122	(503) 224-3930
W.W.P.A.	Woven Wire Products Assoc. 2515 N. Nordica Ave. Chicago, IL 60635	(312) 637-1359

(6) Federal Government Agencies. - Names and titles of federal government standard or Specification producing agencies are often abbreviated. The following acronyms or abbreviations referenced in

the contract documents indicate names of standard or Specification producing agencies of the federal government. Names and addresses are subject to change but are believed to be, but are not assured to be accurate and up to date as of the date of the contract documents.

CE	Corps of Engineers (U.S. Department of the Army) Chief of Engineers - Referral Washington, DC 20314	(202) 272-0660
CFR	Code of Federal Regulations Available from the Government Printing Office N. Capitol St. between G and H St. NW Washington, DC 20402 (Material is usually first published in the "Federal Register")	(202) 783-3238
CPSC	Consumer Product Safety Commission 5401 Westbard Ave. Bethesda, MD 20816	(800) 638-2772
CS	Commercial Standard (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	(202) 377-2000
DOC	Department of Commerce 14th St. and Constitution Ave., NW Washington, DC 20230	(202) 377-2000
DOT	Department of Transportation 400 Seventh St., SW Washington, DC 20590	(202) 366-4000
EPA	Environmental Protection Agency 401 M St., SW Washington, DC 20460	(202) 382-2090
FAA	Federal Aviation Administration (U.S. Department of Transportation) 800 Independence Ave., SW Washington, DC 20590	(202) 366-4000
FCC	Federal Communications Commission 1919 M St., NW Washington, DC 20554	(202) 632-7000
FHA	Federal Housing Administration (U.S. Department of Housing and Urban Development) Director, Manufactured Housing and Construction Standards Division 451 Seventh St., SW, Room 9158 Washington, DC 20201	(202) 755-5210
FS	Federal Specification (from GSA) Specifications Unit (WFSIS) 7th and D St., SW Washington, DC 20406	(202) 472-2205 or 472-2140
GSA	General Services Administration F St. and 18th St., NW	

	Washington, DC 20405	(202) 472-1082
MIL	Military Standardization Documents (U.S. Department of Defense) Naval Publications and Forms Center 5801 Tabor Ave. Philadelphia, PA 19120	
NIST	National Institute of Standards and Technology (U.S. Department of Commerce) Gaithersburg, MD 20899	(301) 975-2000
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor) Government Printing Office Washington, DC 20402	(202) 523-6091
PS	Product Standard of NBS (U.S. Department of Commerce) Government Printing Office Washington, DC 20402	(202) 783-3238
REA	Rural Electrification Administration (U.S. Department of Agriculture) 14th St. and Independence Ave., SW Washington, DC 20250	(202) 447-8732
USDA	U.S. Department of Agriculture Independence Ave. between 12th and 14th Sts., SW Washington, DC 20250	(202) 447-8732
USPS	U.S. Postal Service 475 L'Enfant Plaza, SW Washington, DC 20260	(202) 268-2000

c. Submittals. - For UDEQ's records, the Contractor shall submit at the end of every month copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

d. Cost. - The cost of all work described in this paragraph shall be included in the prices bid in the schedule for other items of work.

1.2.7 VALUE ENGINEERING

a. General. - The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's in accordance with subparagraph f. below.

b. Definitions. - "Collateral costs," as used in this paragraph, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this paragraph, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this paragraph, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes requir by Government acceptance of a VECP.

"Government costs," as used in this paragraph, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this paragraph, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractor's development and implementation costs (see subparagraph g. below).

"Value engineering change proposal (VECP)" means a proposal that -

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; *provided*, that it does not involve a change -

(a) In deliverable end item quantities only; or

(b) To the contract type only.

c. VECP preparation. - As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. I the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for (i) the affected portions of the existing contract requirement and (ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under subparagraph g. below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract change accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

d. Submission. - The Contractor shall submit VECP's to the Engineer.

e. Government action. -

(1) The Engineer will notify the Contractor of the status of the VECP within 45 calendar days after the Engineer receives it. If additional time is required, the Engineer will notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Engineer will notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Engineer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Engineer's award of a change to this contract citing this paragraph. The Engineer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a change order. Until a change order is issued or a contract change applies a VECP to this contract, the Contractor shall perform in accordance with this contract. The Engineer's decision to accept or reject all or part of any VECP shall be final.

f. Sharing. -

(1) Rates. - The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by 45 percent.

(2) Payment. - Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a change to this contract to:

(a) Accept the VECP;

(b) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(c) Provide the Contractor's share of savings by adding the amount calculated to the contract total price.

g. Subcontracts. - The Contractor shall include an appropriate value engineering paragraph in any subcontract of $50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under subparagraph f. above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any

value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; *provided*, that these payments shall not reduce the Government share of the savings resulting from the VECP.

h. Data. - The Contractor may restrict the Government's rights to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

> "These data furnished under the Value Engineering - Construction paragraph of contract _____, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the paragraph. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."
>
> If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract changes implementing the VECP and shall appropriately mark the data.

SECTION 1.2 - MATERIALS

1.2.1 MATERIALS TO BE FURNISHED BY THE CONTRACTOR

a. General. - The Contractor shall furnish all materials required for completion of the work.

The words "material" or "materials" as used in these specifications to denote items furnished by the Contractor shall be construed to mean equipment, machinery, product, component, or any other item required to be incorporated in the work.

When a separate item which includes the furnishing of any material is provided in the schedule, the cost of furnishing, hauling, storing, and handling shall be included in the price bid for that item. When a separate item is not provided in the schedule for furnishing any material required to be furnished by the Contractor, the cost of furnishing, hauling, storing, and handling shall be included in the price bid for the work for which the material is required.

Materials furnished by the Contractor shall be of the type and quality described in these specifications. The Contractor shall make diligent effort to procure the specified materials from any and all sources, but where because of Government priorities or other causes, materials required by these specifications become unavailable, substitute materials may be used in accordance with Article 9.

b. Inspection of materials. - Materials furnished by the Contractor which will become a part of the completed construction work shall be subject to inspection at any one or more of the following locations, as determined by the Engineer: at the place of production or manufacture, at the shipping point, or at the site of the work. To allow sufficient time to provide for inspection, the Contractor shall submit to the Engineer, at the time of issuance, copies in triplicate of purchase orders, including drawings and other pertinent information, covering materials on which inspection will be made as advised by the Engineer, or shall submit other evidence in the event such purchase orders are issued verbally or by letter.

The inspection of materials at any of the locations specified above or the waiving of the inspection thereof shall not be construed as being conclusive as to whether the materials and equipment conform to the contract requirements nor shall the Contractor be relieved thereby of the responsibility for furnishing materials meeting the requirements of these specifications. Acceptance of all materials will be made only at the site of the work.

1.2.2 MATERIALS AND WORKMANSHIP

a. Materials. - All materials furnished by the Contractor shall be new and of the most suitable grade for the purpose intended considering strength, ductility, durability, and best engineering practice.

Except as specified, materials shall conform to Federal specifications or standards, or, if there are no applicable Federal specifications or standards, materials shall conform to the specifications or standards of ANSI (American National Standards Institute), ASTM (American Society for Testing and Materials), ASME (American Society of Mechanical Engineers), SAE (Society of Automotive Engineers), IEEE (Institute of Electrical and Electronic Engineers), NFPA (National Fire Protection Association), or other nationally recognized standards organization. If the Contractor proposes to deviate from, or to use materials not covered by, the aforementioned specifications and standards, the Contractor shall submit, for approval, the justification for and exact nature of the deviation, and complete specifications for the materials proposed for use.

b. Workmanship. - The Contractor shall be responsible for the accurate manufacture and fabrication of materials in accordance with best modern practice and the requirements of these specifications, notwithstanding minor errors or omissions therein.

1.2.3 QUALITY CONTROL TESTING

a. General. - Quality control testing includes inspections and tests and related actions including reports, performed by independent and separate agencies, governing authorities, and the Contractor. Testing of materials may be done at random. They do not include contract enforcement activities performed by the Engineer.

Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with contract document requirements.

Requirements of this paragraph relate to customized fabrication and installation procedures, not production of standard products. Specific quality control requirements for individual construction activities are specified in the paragraphs that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with contract document requirements.

Requirements for the Contractor to provide quality control services required by the Engineer, UDEQ, or authorities having jurisdiction are not limited by provisions of this paragraph.

b. Responsibilities. -

(1) Contractor Responsibilities. - The Contractor shall provide inspections, tests, and similar Construction Quality Control (CQC) services, specified in individual paragraphs, those required by governing authorities except where they are specifically indicated to be UDEQ's or the Engineer's responsibility, and the Contractor's submitted and accepted CQC Plan. CQC Services is defined as a planned system of inspections that is used to directly monitor and control the quality of a construction project. CQC refers to measures taken by the Contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

The Contractor shall submit, for approval, to UDEQ and the Engineer any separate and independent agencies proposed for hire for this function. Upon approval, the Contractor shall employ and pay a separate and independent agency, to perform specified quality control services.

The Engineer will perform Quality Assurance testing and may engage and pay for the services of a separate agency to perform inspections and tests specified as the Engineer's responsibility. Where the Engineer has engaged a testing agency or other entity for testing and inspection of a part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Engineer, unless otherwise agreed in writing with the Engineer.

The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and do not indicate compliance with contract document requirements, regardless of whether the original test was the Contractor's responsibility. Cost of retesting construction, revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. The Contractor shall notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:

(a) Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.

(b) Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.

(c) Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.

(d) Providing the agency with a preliminary design mix for material mixes that require control by the testing agency.

(e) Security and protection of samples and test equipment at the site.

The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

The Contractor, upon completion of inspection, testing, sample-taking and similar services, shall repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

(2) The Engineer's Responsibility. - The Engineer will provide inspections, tests and similar quality assurance tests specified to be performed by the Engineer and not by the Contractor. Payment for completed items in the bid schedule will be based upon the quality assurance testing performed by the Engineer. At the Engineer's option, the Contractor's Quality Control testing may be accepted as Quality Assurance. Construction Quality Assurance(CQA) is defined as " a planned system of activities that provide the owner and permitting agency assurance that the facility was constructed as specified in the design. Cost for these services are not included in the contract price. CQA includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. CQA refers to measures taken by the Engineer to assess if the installer or Contractor is in compliance with the plans and specifications for a project."

(3) Duties of the Testing Agency. - The Contractor's independent and separate testing agency engaged to perform inspections, sampling and testing of materials and construction specified in individual paragraphs, shall cooperate with the Engineer and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

The agency shall notify the Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of it's services.

The agency is not authorized to release, revoke, alter, or enlarge requirements of the contract documents, or approve or accept any portion of the Work.

The agency shall not perform any duties of the Contractor.

(4) Coordination. - The Contractor's and the Engineer's agencies engaged to perform inspections, tests, and similar services shall coordinate the sequence of activities with the Engineer to accommodate required services with a minimum of delay. In addition, the Contractor shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

c. Submittals. -

(1) Construction Quality Control Plan. - The Contractor shall submit for approval, 30 days after contract award, a Construction Quality Control Plan, for all installations, which provides the following elements:

(a) Title Page and Introduction
(b) Table of Contents
(c) Project Description
(d) Project Organization
(e) Quality Assurance Objectives for Data Measurement

(f) Geosynthetic Manufacturer Quality Assurance
(g) Sampling Procedure for Backfill
(h) Sample and Document Custody Procedures
(i) Calibration Procedures and Frequency
(j) Analytical Procedures
(k) Data Reduction, Validation and Reporting
(l) Internal Quality Control Checks
(m) Performance and System Audits
(n) Preventive Maintenance
(o) Data Measurement Assessment Procedures
(p) Corrective Action
(q) Quality Assurance Reports to Management

All testing shall be completed in strict conformance with the approved plan.

(2) Inspection Reports. - Within 5 days following an inspection, the Contractor's independent and separate testing agency shall submit a certified written report of each inspection, test or similar service, to the Engineer, in duplicate, unless the Contractor is responsible for the service. If the Contractor is responsible for the service, the Contractor shall submit a certified written report of each inspection, test or similar service to the Engineer, in duplicate.

Additional copies of each written report shall be given to the Engineer, when the Engineer so directs.

Written reports of each inspection, test or similar service shall include, but not be limited to:

1-Date of issue.
2-Contract title and number.
3-Name, address, and telephone number of testing agency.
4-Dates and locations of samples and tests or inspections.
5-Names of individuals making the inspection or test.
6-Designation of the Work and test method.
7-Identification of product and Specification section.
8-Complete inspection or test data.
9-Test results and an interpretation of test results.
10-Ambient conditions at the time of sample-taking and testing.
11-Comments or professional opinion as to whether inspected or tested Work complies with contract document requirements.
12-Name and signature of laboratory inspector.
13-Recommendations on retesting.

d. Cost. - All costs for work incurred by this paragraph shall be included in those items for which testing is required.

SECTION 1.3 - LOCAL CONDITIONS

1.3.1 GENERAL SITE INFORMATION

a. Facility description. - The Sharon Steel site includes a former milling operation that operated from 1906 to 1971. During the milling operation, lead, copper, and zinc were extracted from the ore by the froth flotation process. The facility operated as a custom mill, receiving ore from many sources, then concentrating and extracting a variety of metals. The majority of the tailings from the milling operations are currently located at the mill site, designated as Operable Unit 1 (OU1).

An environmental health problem was first suspected in 1982 when the Utah Department of Health was notified that local citizens were gathering windblown tailings and then using them for sandboxes and gardens. The tailings had high concentrations of lead, cadmium, and arsenic.

b. General description of site. - The site covers approximately 270 acres. Tailings from the processing of ores was disposed of on the site. The tailings were slurried into several settlement ponds over the years of milling operations. Approximately 10.7 million cubic yards of tailings cover the site.

The mill buildings were demolished in 1993 and foundation remnants remain at the site. Debris not suitable for decontamination and recycling was disposed of on the tailings pile, including material containing asbestos.

Miscellaneous debris and equipment from past operations is present at the surface and is expected to be found throughout the tailings pile. This debris consists of wood, pipe, concrete, stone, brick, metal, steel, and household trash of varying sizes, types, and quantities.

The site is in a populated area with nearby residential communities.

c. Chemical hazards. - The chemical hazards associated with the site are primarily those associated with the metal concentrations** in the unoxidized subsurface tailings (Un-Tailings), surficial soils (Soils), and shallow groundwater. Bulk chemical analysis performed on the tailings material shows maximum recorded concentration* of components of concern as follows:

	Concentration		
Component	Un-Tailings (max) (mg/Kg)	Soils (max) (mg/Kg)	Groundwater (max) (ug/l)
Arsenic	5,621.0	815	1530.00
Cadmium	302.8	66	3.00
Copper	3,312.0	838	5.93
Iron	101,011.	101,700	82.03
Lead	44,609.	10,100	1.19
Manganese	4,688.0	2,700	218.65
Silver	123.9	31	5.23
Zinc	54,444.	7,600	49.96

*Volume II Feasibility Study - OU1 Tables 1-2, 1-6, and 1-7.
**Higher concentrations may be present.

The groundwater concentrations listed are geometric means except for the arsenic concentration. The arsenic concentration is a maximum detected level.

1.3.2 ACCESS TO THE WORK AND HAUL ROUTES

a. General. - The Contractor shall make its own investigation of the condition of available public or private roads and of clearances, restrictions, bridge-load limits, bond requirements, and other limitations that affect or may affect transportation and ingress and egress at the jobsites. It shall be the Contractor's responsibility to construct and maintain, at its own expense and at its own risk, any haul roads, access roads, bridges, or drainage structures required for construction operations. Access roads on the site shall be maintained in well graveled condition and shall be accessible to the Engineer, UDEQ, and EPA personnel.

Existing access to the site is available through a gate located at approximately 8400 South and 700 West.

b. Existing roads. - Existing roads are available for the Contractor's use subject to existing restrictions. The Contractor shall meet all conditions properly imposed upon the use of existing roads by those having jurisdiction thereover, including (without limitation of the generality of the foregoing) seasonal or other limitations or restrictions, the payment of excess size and weight fees, and the posting of bonds conditioned upon repair of road damage caused by the Contractor. The Contractor shall comply with all Midvale City, West Jordan, and Salt Lake County loading and use restrictions for city roads.

c. Haul routes. - Hauling over public highways, roads, or bridges shall be in compliance with the applicable State and local regulations and shall be such as to minimize interference with or congestion of local traffic. Prior to hauling materials the Contractor shall submit proposed haul routes to the Engineer for approval. Where haul routes cross public highways or roads, the Contractor shall provide barricades, flagmen, and other necessary precautions for safety of the public as provided in paragraph 1.4.1.

d. Cost. - The cost of all work described in this paragraph shall be included in the prices bid in the schedule for other items of work.

1.3.3 MAINTAINING PUBLIC TRAFFIC

The Contractor shall make all necessary provisions for maintaining the flow of public traffic and shall conduct all operations for the construction so as to offer the least possible obstruction and inconvenience to public traffic. If the Contractor intends to close any public roads to traffic, it shall receive approval from the Engineer, State, and local authorities. Convenient access to driveways, houses, and buildings along the line of the work shall be maintained, and temporary approaches to crossings or intersecting roads shall be provided and kept in good condition. The Contractor shall, when required, provide and station competent flagpersons whose sole duties shall consist of direction and controlling the movement of public traffic either through or around the work.

Where public traffic is required to cross over or pass through the work, construction operations shall be conducted so as to provide a reasonably smooth, even, dustless, and unobstructed passageway for one lane of traffic at all times. At any and all points along the work where the nature of the construction operations in progress and the equipment and machinery in use are of such character as to endanger passing traffic, the Contractor shall provide such guards as may be necessary to ensure against accidents and avoid damage or injury to passing traffic.

Except for watering for dust abatement as provided in these specifications, the cost of all work involved in maintaining public traffic, as described in this

paragraph, shall be included in the prices bid in the schedule for other items of work.

1.3.4 CONSTRUCTION AT EXISTING WATERCOURSES AND UTILITIES

Where the work to be performed under the contract documents may cross or otherwise interfere with water, sewer, gas, or oil pipelines; buried cable; cathodic protection; or other public or private utilities, or with artificial or natural watercourses, the Contractor shall provide for such utilities and watercourses, and shall coordinate with the affected owners to determine who will perform such construction so that no damage will result to either public or private interests.

The term "watercourses" includes ditches, terraces, furrows, or other features of surface irrigation systems. Location, sizes, depths, clearances, dimensions, and identification of watercourses and utilities shown on the drawings are considered approximate, not all inclusive, and subject to changes. It shall be the responsibility of the Contractor to determine the actual locations, sizes, depths, clearances, and identity of and make provision for all watercourses and utilities in all work areas prior to construction. Approval of the Engineer is required before any watercourse or utility is taken out of service, and permission shall be obtained from the owners.

Where the work to be performed under these specifications is in close proximity to the Jordan River, the Contractor shall provide for such watercourse, and shall perform such construction during the progress of the work so that no damage will result to either public or private interests. If the Contractor does not maintain the existing watercourse in such condition that no damage will result to either public or private interests, the Engineer will cause the necessary repairs to be made, and backcharge the Contractor for such work.

The cost of all work described in this paragraph shall be included in the prices bid in the schedule for other items of work.

1.3.5 ELECTRIC POWER FOR CONSTRUCTION PURPOSES

The Contractor shall make all necessary arrangements and shall provide all electric power required for it's construction purposes. This shall include providing all necessary transmission lines, distribution circuits, transformers, and other electrical equipment required for distributing the power to the place or places of use by the Contractor.

At the termination of the contract under these specifications, and with the approval of the Engineer, the Contractor shall dismantle and remove all distribution lines serving its installations, or those of its subcontractors, that are not part of the permanent power installation. The Contractor is prohibited from using a property owner's electrical power unless prior written approval is obtained from the Engineer and Property Owner.

No direct payment will be made to the Contractor for providing electric power for construction purposes, and the cost thereof shall be included in the prices bid in the schedule for other items of work.

1.3.6 WATER FOR CONSTRUCTION PURPOSES

a. General. - The Contractor shall furnish all water required for construction purposes. The Contractor shall make all arrangements for obtaining water and provide all means for conveying water to points of use. Water rights of 7 cfs are available from the Jordan River. Pumping is required to utilize this water, and arrangements for use of this water can be made with MRRC, the land owner.

b. Cost. - The cost of providing necessary facilities and conveying water to points of use shall be included in the prices bid in the schedule for other items of work.

1.3.7 UTILITY LINES

a. General. - The Contractor shall make all provisions, and shall perform all work, required by the Contractor's operations under this contract incident to any interference with the operation or maintenance of utility lines, existing on the date bids are received, in a manner satisfactory to the owners and operators thereof and to the Engineer, including providing and maintaining all necessary or required temporary structures; making any necessary repairs, replacements, or similar operations; and furnishing indemnity or other bonds.

Where an existing overhead powerline or communication line crosses a feature of the work to be constructed under this contract, the Government will provide information regarding physical clearances at the crossing site between the line and the higher of (i) original ground; or (ii) final elevation of constructed work. Such clearances will be in accordance with NESC/ANSI C2 unless the Government specifies higher clearances. Any powerline or communication line poles or other accessories lying within the section of a feature of the work will be moved by the Government.

Prior to stringing conductors or overhead ground wires which cross over energized electric powerlines, the Contractor shall notify the owners and operators thereof of the periods of time the Contractor intends to perform such stringing; shall obtain a written acknowledgment of such notification; and shall submit such acknowledgment to the Engineer.

b. Cost. - The cost of providing and maintaining all work required by this paragraph shall be included in the prices bid in the schedule for other items of work.

1.3.8 COORDINATION OF SITE ACTIVITIES WITH OTHER CONTRACTORS AND AGENCIES

a. General. - In accordance with Article 7.4 the Contractor shall fully cooperate with the other contractors.

There are a number of agencies and contractors presently involved at this site. The State of Utah in conjunction with the U.S. Environmental Protection Agency (USEPA) and the U.S. Bureau of Reclamation (USBR), are presently conducting clean-up activities of OU2 soils in the surrounding communities. These clean-up activities include disposing of contaminated soils in a repository area located within the northern area of the site. The clean-up work, together with destruction of the mill buildings, were segregated into 5 phases. Phases 1 and 2 are complete, and phase 3 is scheduled to be completed in November, 1994. It is anticipated that phase 4 will be awarded beginning in early 1995, and phase 5 the following year. Phases 4 and 5 will be administered concurrently, but under separate contracts.

Total volume increase from phases 4 and 5 are estimated to be between 70,000 and 80,000 cubic yards. This volume of contaminated material hauled in from phases 4 and 5 will be covered under this contract and incorporated into the work.

b. Cost. - The cost of all work required by this paragraph shall be included in other items of work.

1.3.9 USE OF LAND FOR CONSTRUCTION PURPOSES

a. General. - The Contractor will be permitted to use land designated on drawing 1556-418-12 as "OU1 Contractor Staging Area" for field offices, construction plants and buildings, storage yards, shops, roads, spoil areas, and other construction facilities required for construction purposes. This area is contaminated and will require excavation and backfill as specified prior to the installation of Contractor facilities.

If private land outside the site boundary is used for construction facilities, or other construction purposes, the Contractor shall make all necessary arrangements and shall pay all rental and other costs associated therewith.

b. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4.

At least 10 days prior to use of land for construction purposes, the Contractor shall submit, for approval, proposed areas for Contractor use including a landscape rehabilitation plan for each area on the site to be impacted by Contractor use.

Each landscape rehabilitation plan shall include the following:

(1) A drawing showing the location and extent of the impact of the Contractor's use of the site. The drawing shall show proposed offices; shops; storage areas including those for fuel and oil; fabrication yards; parking areas; utilities; temporary access and haul roads; areas for processing, storing, and disposal of waste materials from construction operations; storage area for explosives, if blasting is utilized; temporary fences, and other uses of the site by the Contractor, including any other information required to show the Contractor's intended use of the area available.

(2) Description of the Contractor's methods to:

(a) Preserve, protect, and repair if damaged, all vegetation (such as trees, shrubs, and grass) and other landscape features on or adjacent to the worksite, which are not to be removed and which do not unreasonably interfere with the work required under this contract, including methods to mark work area limits and to protect disturbed areas and prevent erosion.

(b) Protect from damage, and repair if damaged, all existing improvements and utilities at or near the worksite, the locations of which are made known to or should be known by the Contractor.

(3) Drawing and written description of the Contractor's methods to rehabilitate the site, after completion of construction activities, removal of Contractor structures and facilities, and clean up.

c. Site land. - The Contractor's use of land for construction purposes shall not interfere with any part of the work under this contract, nor with the work of other contractors or the Government in the vicinity, nor with reservations made, or as may be made, by the Government for the use of s land.

Arrangements shall be made by the Contractor with the OU2 contractor to excavate and backfill the area designated for the OU2 contractor as "OU2 Contractor Staging Area". In the event arrangements cannot be made with the OU2 Phase 4 contractor, a 21 day period of time will be made available during the interim between the phase 4 contract and phase 5 contracts of the OU2 cleanup.

Housing for Contractor personnel will not be permitted on site.

Upon completion of the work, and following removal of construction facilities and required cleanup, land used for construction purposes and not required for the completed installation shall be regraded and rehabilitated.

d. Cost. - No charge will be made to the Contractor for the use of land for construction purposes. All work required by this paragraph shall be at the expense of the Contractor, except the excavation and demolition which will be paid according to these specifications.

1.3.10 EXISTING FENCES

Fences on the site shall be removed by the Contractor where necessary for the performance of the work, and where required. Where designated, existing fences shall be maintained until the work is completed or their removal is authorized. Where the Contractor removes existing fences to facilitate the work, temporary fence protection for lands shall be provid at all times during the continuation of the contract. Temporary fencing constructed on the site shall be removed by the Contractor as part of the cleanup operations prior to final acceptance of the completed work.

The existing fence material removed shall be treated as a contaminated material. Fencing may be salvaged if properly decontaminated. Fencing buried on site shall be buried in a manner that all the materials are flat, and incompressible.

Temporary fencing material removed shall be treated as a contaminated material. Fencing may be salvaged if properly decontaminated.

The cost of all work described in this paragraph shall be included in the prices bid in the schedule for other items of work.

1.3.11 GEOLOGIC INVESTIGATIONS

The drawings, logs, and water-level data referred to in the Contract can be examined at the location specified in the Invitation for Technical Offers (see Article 4.5). The Government does not represent that the available information and records show the conditions that will be encountered in performing the work, and the Government represents only that such information shows the condition encountered at the particular point when the information was obtained.

The water-level data show only the conditions at the particular time or times the information was obtained and may not indicate variations such as

those caused by periods of drought or increased rainfall, seasonal fluctuations in rainfall, or application of irrigation water.

The maximum depth of the tailings is 61 feet as indicated by borehole numbers MW-201, MW-202, MW-203, MW-751, and MW-753. The groundwater table has apparently risen above the original ground level so that the lower portion of the contaminated material may require dewatering prior to excavation.

Bidders and the Contractor must assume all responsibility for assumptions and conclusions which may be made as to the nature of the materials to be excavated, the difficulties of making and maintaining the required excavations, and of doing other work affected by the geology and the groundwater elevations at the site of the work.

1.3.12 PROTECTION OF EXISTING INSTALLATIONS

In performing work at the Sharon Steel Superfund Site, the Contractor shall take all necessary precautions to safeguard existing installations which are to remain in place. The Contractor shall obtain the location of all monitoring wells, water quality measurement points, survey control points, buried conduit, pipe, cable, ground mat, telephone lines, and other buried items prior to performing any snow plowing or excavations on the site and shall use proper methods for their protection during excavating and backfilling operations. The Contractor shall protect adjacent installations when installing equipment and materials.

All protective installations shall be arranged so as to permit operation of the existing equipment and facilities by the Government while work under these specifications is in progress. The Contractor shall remove all protective installations provided by him after they have served their purpose. The materials furnished by the Contractor to provide protection shall remain the property of the Contractor.

The Contractor shall be responsible for and shall repair, at it's expense, any damage to existing installations due to the Contractor's operations or it's failure to provide proper protection; or at the option of the Engineer, any such damage may be repaired by the Government, and the Contractor will be backcharged for the cost thereof.

The cost of all protection, as described in these specifications, including furnishing all necessary materials, shall be included in the prices bid in the schedule for other items of work.

SECTION 1.4 - SAFETY

1.4.1 SAFETY OF THE PUBLIC

Roads subject to interference by the work shall be kept open or suitable temporary passages provided through the work. As required by paragraph 1.3.3 shall be provided and maintained by the Contractor. Detours shall be provided and maintained by the Contractor. The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient flasher lights, flagpersons, danger signals, and signs, and shall take all necessary precautions for the protection of the work and the safety of the public.

Roads closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning and detour signs. All barricades and obstructions shall be illuminated at night, and all lights shall be kept illuminated from sunset until sunrise.

No construction work along public or private roads may proceed until the Contractor has proper barricades, flasher lights, flagpersons, signals, and signs in place at the construction site.

Specific signs, signals, barricades, and flagpersons requirements are detailed in the American National Standards Institute "Manual on Uniform Traffic Control Devices for Streets and Highways" (ANSI D6.1).

The cost of all work described in this paragraph shall be included in the prices bid in the schedule for applicable items of work.

1.4.2 SAFETY MONITORING EQUIPMENT AND SUPPLIES

All safety and monitoring equipment and supplies shall be furnished by the Contractor. Safety equipment and supplies for the Engineer and UDEQ personnel will be furnished by UDEQ. However all decontamination facilities shall be provided by the Contractor and shall be available for the Engineer, UDEQ, EPA and their representatives to use, including waste disposal facilities.

1.4.3 HAZARDOUS WASTE/MATERIALS SAFETY AND HEALTH

a. General. - The requirements of this paragraph shall apply to all work under these specifications involving the exposure of employees to hazardous substances.

b. References. -

(1) American National Standards Institute (ANSI) Publications.

Z88.2, Practices for Respiratory Protection

(2) Code of Federal Regulations (CFR)

(a) 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response

(b) 29 CFR 1910.134, Respiratory Protection

(c) 49 CFR 171, Hazardous Materials Regulations

c. Definitions. - The following terms are defined for use under this contract. Additional definitions of terms used in conduct of hazardous waste and hazardous substances operations shall be as contained in 29 CFR 1910.120.

(1) Cleanup operations. - An operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleaned up or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

(2) Contamination reduction zone. - An area of the site which provides a transition between contaminated and clean zones. Decontamination operations are conducted in this zone to assure that contaminating substances are not spread to clean areas by persons, equipment or work activities. The contamination reduction zone may not be static but subject to change with the work activity at the site.

(3) Decontamination. - The removal of hazardous substances from employees, their equipment and vehicles to the extent necessary to preclude the spread of the contaminant(s) to undesired locations.

(4) Emergency response. - A response effort by employees from outside the immediate release area or by other designated responders to an occurrence which results, or is likely to result in an uncontrolled release of a hazardous substance due to an unforeseen event. Responses to the incidental release of hazardous substances where the substance can be absorbed, neutralized or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses. Releases of hazardous substances where there is no potential safety or health hazard are not considered emergency responses.

(5) Exclusion zone. - A designated control area of a hazardous waste operation where contaminant cleanup operations are occurring or the greatest exposure potential exists. An entry and exit check point shall be established to regulate the flow of personnel and equipment into, and out of, the zone. The perimeter of the zone shall be enclosed by fencing or other appropriate barricade and/or marking.

(6) Hazardous substance. - Any substance which results or may result in adverse effects to the health or safety of employees:

(7) Hazardous waste. - (1) a waste or combination of wastes defined in 40 CFR 261.3; or (2) those substances defined in 49 CFR 171.

(8) Health hazard. - A chemical, biological or physical agent, or mixture of agents, which may cause acute or chronic health effects in exposed persons.

(9) Immediately dangerous to life or health (IDLH). - An atmospheric condition that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

(10) Permissible exposure limits. - (PELs) means levels published by OSHA which establish limits of inhalation exposure. There are three basic PEL classifications; time weighted average (TWA), short term exposure limit (STEL), and ceiling limit. The TWA and STEL limits are an "averaged" concentration over two different time periods. The TWA is generally calculated by averaging measured concentrations of a contaminant over an 8-hour time period, whereas the STEL is calculated by averaging measured concentrations of a contaminant over a 15-minute time period. The third type of PEL is a ceiling limit, which is an absolute threshold. No averaging occurs with the measured concentration. It is an "instantaneous" limit which is not to be exceeded for any period of time.

(11) Support zone. - The area outside the exclusion and contamination reduction zones. This area has been determined to have minimum probability of contaminant release. This zone is the area where support activities are conducted in which personal protective equipment is not usually required. The location of support facilities in this zone should be based upon consideration of accessibility, prevailing wind directions and resource availability.

(12) Uncontrolled hazardous waste site. - An area where an accumulation of hazardous waste creates a threat to the health and safety of individuals and/or the environment.

d. Submittals. - Submittals shall be in accordance with paragraph 1.1.4 and these specifications.

Prior to starting work the Contractor shall submit for approval the following:

(1) List of key personnel and data showing for each key person, their responsibilities, qualifications, and training.

(2) List of other Contractor personnel and their training. See subparagraph f.

(3) Copy of plan for the air monitoring programs. See subparagraph i.

(4) Air sampling results. See subparagraph i.

(5) Site Safety and Health Plan (SSHP) developed and submitted in accordance with paragraph 1.4.5. The Contractor shall submit with the SSHP for personal protective equipment, the following:

(a) manufacturer's data
(b) recommendation of selected equipment to verify the acceptability of the use of the equipment in the hazardous waste site.

If this data is not available from the manufacturer of the protective equipment on the specific substance to be protected against, the Contractor shall submit for approval testing results of the equipment and its use.

(6) Reports of site(s) assessment or reassessment. See subparagraph k.

(7) Certification for each person entering the reduction or exclusion zones. This certification shall show that:

(a) The person is capable of wearing respiratory protection and using any appropriate personal protective equipment necessary.

(b) The person is fit for duty at hazardous waste sites.

(c) Adequate medical screening tests have been obtained which address the contaminants associated with the specific hazardous waste site. See subparagraph j.

Prior to Employee(s) beginning work onsite the Contractor shall submit for each employee certification of 40 hour hazardous waste safety training.

e. Documents on site. - The Contractor shall maintain the following on site(s) and shall make them available to the Engineer or the Engineer's representative upon request:

(1) Site safety briefings records. See subparagraph h.

(2) Air monitoring log. See subparagraph i(3)(b).

(3) Completed "Hazardous Waste Site Employee Pre-Entry Check Sheets" and "Hazardous Waste Site Management Pre-Entry Check Sheets". See subparagraph l.

(4) Respirator use procedure. See subparagraph m.

(5) Employee training records. See subparagraphs g and p.

(6) Medical surveillance records. See subparagraph p.

(7) Records required by subparagraph p.

f. Contractor key personnel. - The Contractor shall identify key personnel and their responsibilities. The minimum required positions and their responsibilities are as follows, but are not limited to:

(1) Project Manager. - The Project Manager's responsibilities shall include:

(a) Management of all site operations and personnel.

(b) Development and Review of the Contractor's written comprehensive site work and organization plan contained in the Site Specific Safety and Health Plan (SSHP) and assurance of adequate funding for personnel protective equipment, medical surveillance, personal monitoring, training, facilities and equipment to assure safe and healthful work accomplishment.

(c) Conduct of Contractor's operations in compliance with all Federal, State, and local safety and health laws, regulations, codes and standards.

(d) Coordination of the Contractor's safety and health program with all other entities involved in site operation assuring compliance with all appropriate site safety and health plans.

(2) Project Superintendent(s). - A Contractor employee(s) shall be designated by the Project Manager as a Project Superintendent. The designated Project Superintendent shall be onsite whenever operations are occurring. The Project Superintendent shall assure that all onsite operations are conducted in accordance with the site specific safety and health plan and all applicable Federal, State and local safety and health laws, regulations, codes, and standards. The Project Superintendent shall have the knowledge and authority to direct onsite operations to minimize workplace exposures. If the Contractor's site safety officer will not always be present when personnel are working on the hazardous waste site or the Project Superintendent is also assigned the site safety and health officer duties, the Project Superintendent shall meet the same training requirements as those listed for the site safety and health officer.

(3) Site safety and health officer (SSHO). - A SSHO shall be officially designated by the Project Manager and approved by the Engineer for each hazardous waste operation. The SSHO shall be the principle developer of the SSHP as required by paragraph 1.4.5 for each site to which the SSHO is assigned. The SSHO shall have the authority and knowledge necessary to develop and implement the entire site safety and health program and verify compliance with applicable safety and health requirements. The SSHO shall have the necessary knowledge and background to conduct a comprehensive monitoring program which will establish relevant data on which to assess employee exposures and adequacy of personal protective equipment and procedures.

The SSHO shall be a certified industrial hygienist (CIH) or work under the oversight of a CIH. Additionally the SSHO shall have a minimum of two years of experience overseeing, for the purposes of site safety

and health, the excavation, transportation and disposal of hazardous and solid waste.

g. Training. - All Contractor personnel involved with a designated hazardous waste site shall have completed training satisfying the requirements of 29 CFR 1910.120 and this paragraph. The required training type and the minimum training required for Contractor personnel are as follows:

(1) Type A - General Onsite Worker. - Contract workers exposed to hazardous substances that require them to wear a respirator.

(a) 40-hr classroom instruction

(b) 3-day onsite on-the-job instruction

(c) 8-hr annual refresher

(d) 8-hr annual First Aid-CPR refresher

(2) Type B - General or Occasional Onsite Worker. - Employees not exposed to hazardous substances that require them to wear a respirator, as documented by site monitoring.

(a) 24-hr classroom instruction

(b) 1-day onsite on-the-job instruction

(c) 8-hr annual refresher

(3) Type C - Onsite Management and Supervision. -

(a) 8-hr safety and health management

(b) Same training as required of the personnel managed or supervised

(4) Type D - Project Superintendent and Site Safety and Health Officer. -

(a) 8-hr safety and health management

(b) Same training as required for personnel managed or supervised

h. Site safety briefings. - A site specific informational program shall be developed by the Contractor to inform employees, subcontractors, and employees of the Engineer actually engaged in hazardous waste operations of the nature, level and degree of exposure. The Contractor shall conduct this program prior to initial entry to any onsite activities involving hazardous waste operations.

The Contractor shall hold pre-entry briefings prior to initiating any new site activity and a safety meeting held prior to each shift to ensure that employees are appraised of the requirements of the safety and health plan and that it is being followed. These safety meetings shall describe the assigned employee tasks and their potential hazards, coordinate activities, identify methods and precautions to prevent injuries, plan for emergencies, describe any changes in the site safety plan, and get worker feedback on conditions affecting safety and health. The Contractor shall keep a record of these briefings and make them available at the jobsite.

i. Air Monitoring Program. - The Contractor shall conduct employee exposure monitoring in accordance with applicable OSHA standards for hazardous substances at each hazardous waste site to document compliance with standards and to assure adequacy of control measures and proper selection of personal protective equipment. The Contractor shall submit all sampling results to the Government.

The Contractor shall provide air monitoring at the site perimeter to determine levels of contaminants migrating offsite.

The Contractor's air monitoring program shall meet the following requirements:

(1) Identify and quantify airborne levels of hazardous substances to which employees are exposed, based upon site analysis of contaminants which have been identified at the site.

(2) Periodic monitoring shall be conducted during regular work cycles. Additional monitoring shall be conducted when sufficient changes at the site have occurred which may effect the exposure potential of personnel engaged in activities onsite.

(3) Monitoring shall be representative of employee exposure at the site.

(a) If exposure monitoring results equal or exceed the action level, excursion limit, ceiling limit, STEL or TLV/ PELs, a more comprehensive and continuous monitoring program shall be initiated for all effected personnel until adequate documentation of exposure shows no threat of repeated or continued exposure.

(b) All monitoring shall be recorded in an appropriate log and kept onsite during operations and submitted to the Government upon request.

j. Medical surveillance. - All persons who are exposed to hazardous substances or health hazards determined by personal exposure sampling or who meet the provisions of 29 CFR 1910.120 shall participate in a medical surveillance program. All personnel conducting tasks on a UDEQ hazardous waste site within the contamination reduction zone, exclusion zone, or are required to wear personal protective equipment, shall be provided a baseline physical which meet the requirements of 29 CFR 1910.120.

k. Site characterization and hazard analysis. - The Contractor shall initially assess the site for hazards and then re-assess the site characterization as site operations or conditions change. Accordingly the personal protective equipment requirements and other controls shall be modified.

l. Site control. - In no case shall visitors (i.e., personnel not regularly assigned to work on the site who have legitimate business at the site) be allowed entrance to designated exclusion or decontamination zones. The Contractor shall fence, barricade, and or mark to prevent unauthorized personnel into the restricted zones. All personnel who are cleared for access into the controlled zones shall fill out site pre-entry check list (see Forms No. 1 and 2) which shall be filed and kept on site by the Contractor. The Contractor shall not allow any personnel into the restricted zones until the checklist is completed and signed by the Contractor's Project Manager.

m. Engineering control, safe work practices and personal protective equipment. - Construction operations shall employ engineering controls and safe work practices to reduce and maintain employee exposure to less than established TLV/PELs exposure limits for hazardous substances. Employee exposure monitoring shall be conducted to assure adequacy of control measures and to provide a documented record of employee safe work exposures. Only when engineering controls and work practices are not adequate shall PPE be used to reduce worker exposure. The Contractor shall provide all necessary personal protective equipment to reduce worker exposure to less than the TLV/PELs.

The Contractor shall select personal protective equipment which will protect employees from the hazards and potential hazards they are likely to encounter. The selection shall be based upon the information obtained from the site characterization and analysis process, employee monitoring, and 29 CFR 1910 (Subpart I - Personal Protective Equipment).

The Contractor shall develop a respirator use program in accordance with 29 CFR 1910.134. This written respirator use procedure shall be available at each hazardous waste site where respirators are used by the Contractor.

Quantitative fit testing of respirators shall be required as part of the respirator program in accordance with recommendations prescribed in ANSI Z88.2.

n. Material handling. - Hazardous waste and toxic substances shall be handled, packaged, labeled, stored and transported in accordance with DOT, OSHA, EPA, state and local regulations.

o. Sanitation. - Toilet facilities, potable water, and washing facilities shall be provided at hazardous waste sites. Showers shall be provided if required for decontamination. These facilities shall be in near proximity to the work site, within controlled access work zones.

p. Recordkeeping. - Accurate records of dates and hours of personnel exposure, types of contaminants, levels and durations of contaminant exposure, and medical surveillance, shall be maintained for each person performing work within the exclusion and contamination reduction zones. Medical surveillance records shall be submitted to the Engineer, which shall include at least the following information:

(1) Name and Social Security number

(2) Physicians written opinion, recommended limitations, and results of examinations and tests

(3) Any employee complaints related to exposure to hazardous substances

(4) A copy of any background information provided to the examining physician

These records shall also be available on site for review. Additionally, all employee training records shall be maintained by the Contractor with a copy available at the work site.

q. Inspection. - Inspections shall be conducted by the Engineer and the Contractor's site safety and health officer or, in the absence of these individuals, individuals acting on behalf of the site safety and health officer necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected immediately by the Contractor.

The Engineer has the authority to stop any operation which the Contractor has been directed to correct and has not corrected. All expenses resulting from such a work stoppage shall be the responsibility of the Contractor.

r. Costs. - Except as provided in subparagraph q for expenses, due to work stoppage being at the Contractor's expense, the costs of complying with this paragraph shall be included in the applicable prices bid in the schedule for other items of work involving exposure to contaminated materials.

Form No. 1

HAZARDOUS WASTE SITE
EMPLOYEE PRE-ENTRY CHECK SHEET

HAZARDOUS WASTE SITE DATA: (completed by Project Manager)
Name of site:_____ Location:_____
Administering Agency:_____ Office:_____
Status of Site:_____

Project Manager's Name:_____ Address:_____
Phone:_____

Project Superintendent's Name:_____ Address:_____
_____
Phone:_____

Safety & Health Officer's Name:_____ Address:_____
Phone:_____

EMPLOYEE DATA: (completed by employee)
Name:_____ Title:_____
Office:_____ Code:_____
Date of 40-hr course:_____attach certificate
Date of 8-hr refresher course:_____attach certificate
Date of First Aid-CPR course:_____attach certificate
Medical Surveillance Date:_____attach certificate
Previous Experience at HW sites:_____
_____

ASSIGNMENT DATA: (completed by Project Superintendent)
Supervisor's Name:_____ Title:_____
Phone:_____ Work Assignment:_____
_____
_____
Work Hours:_____
Equipment:_____

SAFETY & HEALTH DATA: (completed by SSHO)
Known contaminants:_____
Suspected contaminants:_____
Employee briefed on site safety plan (copy attached), Date:_____
Decontamination procedures discussed with employee, Date:_____
Medical symptoms, if contaminated, discussed, Date:_____
Level of protection:_____ Safety equipment instructions:_____
_____
_____

SIGNATURES:
THE ABOVE INFORMATION, TO THE BEST OF MY KNOWLEDGE, IS CORRECT:
Employee:_____ Date:_____
Site Manger:_____ Date:_____
Safety & Health Officer:_____ Date:_____
THE EMPLOYEE IF HEREBY APPROVED TO ENTER AND WORK AT THE SITE:
Project Manager:_____ Date:_____

Form No. 2

HAZARDOUS WASTE SITE
MANAGEMENT PRE-ENTRY CHECK SHEET

HAZARDOUS WASTE SITE DATA: (completed by Project Manager)
Name of Site:_____Location_____
Administrating Agency:_____Office: _____
Status of Site:_____

Project Manager's Name:_____Address:_____
_____Phone: _____

Safety and Health Officer's Name_____Address:_____
_____Phone: _____

EMPLOYEE DATA: (completed by employee)
Name:_____Title:_____
Office:_____Code:_____
Date of 40-hr course:_____attach certificate
Date of 8-hr refresher:_____attach certificate
Date of First Aid-CPR course_____attach certificate
Date of 8-hr Management course:_____attach certificate
Date of Medical Surveillance_____attach certificate
Date of Specific Screening_____attach certificate
Previous Experience at HW sites:_____
_____

ASSIGNMENT DATA: (completed by Project Superintendent)
Supervisor's Name:_____Title:_____
Phone:_____ Work Assignment:_____
_____
Work Hours: _____
Equipment: _____

SAFETY & HEALTH DATA (completed by SSHO)
Known contaminants: _____
Suspected contaminants: _____
Date employee briefed on SSHP (copy attached): _____
Date decontamination procedures discussed with employee: _____
Level of Protection:_____Safety equipment instruction:_____
_____
_____

SIGNATURES:
THE ABOVE INFORMATION, TO THE BEST OF MY KNOWLEDGE, IS CORRECT:
Employee:_____Date:_____
Project Superintendent:_____Date:_____

SSHO:_____Date:_____

THE EMPLOYEE IS HEREBY APPROVED TO ENTER AND WORK AT THE SITE
Project Manager:_____Date:_____

1.4.4 SUBMISSION OF MATERIAL SAFETY DATA SHEETS FOR HAZARDOUS MATERIALS

Federal Standard No. 313, as amended, for the preparation and submission of material safety data sheets is hereby incorporated and made a part of these specifications. The Contractor shall submit a completed MSDS (Material Safety Data Sheet), Department of Labor Form OSHA-174, or GSA-approved Alternate Form A for each hazardous material as required by Federal Standard No. 313, as amended. The Contractor shall send the completed MSDS and identification and certification for each hazardous material to be delivered to the jobsite, to the Engineer.

The cost of complying with this paragraph shall be included in the applicable prices bid in the schedule for the items of work for which the hazardous materials are required.

1.4.5 SITE SAFETY AND HEALTH PLAN

The Contractor shall have a copy of the site safety and health plan onsite at all times. The Contractor shall arrange for the services of a Certified Industrial Hygienist to formulate a toxic material program that complies with Occupational Safety and Health Administration (OSHA) requirements in 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response. The primary health risk at the site is the potential for human exposure to lead, cadmium, and arsenic through direct contact with tailings and contaminated soils. The site safety and health program shall be submitted to the Engineer prior to any onsite work for review and comment, and shall address the applicable portions of the following outline:

a. Site Identification
   (1) Site name
   (2) Site location
   (3) Site ownership
   (4) Brief description of site task to be addressed by this site safety plan
   (5) Information contact

b. Site Characterization
   (1) Site physical description
   (2) Site history
      (a) Operations at site
      (b) Cleanup
         1. Details of all stages completed
         2. Current status

c. Site Work Objectives
   (1) Planned site activities/work plans
   (2) Task description with related levels of personal protection and training.
   (3) Projected organization - personnel needs
   (4) Duration (dates) of work

d. Site Organization and Key Personnel
   (1) Lead organization and responsibilities - personnel
      (a) Contractor role onsite
      (b) Key Personnel
         1. Project Manager
         2. Project Superintendent
         3. Site Safety and Health Coordinator

e. Site Control
   (1) Structure of Site (Map)
      (a) Name of person responsible for site access and security
      (b) Boundaries - method of marking
      (c) Established exclusion zones
      (d) Entry/exit procedures (sign-in)
   (2) Entry requirements
      (a) Training (1910.120) (site specific)
      (b) Medical surveillance with site specific requirements
      (c) Respirator fit-testing
      (d) Verification of knowledge of procedures at site (signature)

f. Hazard Identification
   (1) Inherent safety hazards
   (2) Site specific hazards as determined by previous activities
      (a) Waste Type(s)
         1. Solid
         2. Liquid
         3. Sludge
         4. Gas
         5. Other
      (b) Hazard Classification
         1. Heat stress
         2. Corrosive
         3. Ignitability/explosivity
         4. Radioactive
         5. Volatile
         6. Toxic
         7. Reactive
         8. Biological
         9. Chemical
            a) Inorganic
            b) Organic
         10. Other
      (c) Routes of Exposure
         1. Inhalation
         2. Ingestion
         3. Dermal
         4. Other
   (3) Identified site contaminants
      (a) Permissible exposure limits/threshold limit values
      (b) IDLH concentrations
      (c) Modes of exposure
      (d) Symptoms - hazard
      (e) Carcinogenicity
   (4) Activity - hazard evaluation
      (a) Type (invasive, noninvasive)
      (b) Level of protection
      (c) Applicable action levels for contaminants with appropriate action

g. Site Monitoring - Environmental/Personal
   (1) Identify contaminants for monitoring
   (2) Detail previous sampling and results
   (3) Identify operations/tasks to be sampled
   (4) Frequency of sampling
   (5) Method of sampling
   (6) Equipment requirements including maintenance and calibration
   (7) Sampling results update
   (8) Action levels for initiating re-evaluation

h. Personal Protective Equipment
   (1) Level of protection [D,C,B,A]
      (a) Specify tasks covered
      (b) Types of equipment (respirator, cartridges, etc.)
   (2) Garments - specify material for each level
   (3) Gloves - specify material
   (4) Boots and/or boot covers
   (5) Specify person to confer equipment section

i. Decontamination
   (1) Specify times decontamination is required (breaks, lunch, etc.)
   (2) Specify means of decontamination, including engineers drawings of facilities.
      (a) Personnel
      (b) Equipment
      (c) Vehicles
      (d) Emergency
   (3) Specify disposal methods

j. Recordkeeping
   (1) Personal exposure
   (2) Medical surveillance
   (3) Environment monitoring

The cost of complying with this paragraph shall be included in the applicable items bid in the schedule.

SECTION 1.5 - ENVIRONMENTAL QUALITY PROTECTION

1.5.1 PREVENTION OF WATER POLLUTION

a. General. - The Contractor shall control hazardous substances, pollutants, and contaminants by use of sediment and erosion controls, wastewater and stormwater management controls, construction site management practices, treatment of contaminated water as needed, and other controls, including State and local control requirements.

(1) Sediment and erosion controls. - The Contractor shall establish methods in addition to those specified elsewhere for controlling sediment and erosion which shall address vegetative practices, structural control, silt fences, straw dikes, sediment controls or operator controls as appropriate. Stormwater management measures shall be instituted as needed, including velocity dissipators, and solid waste controls shall address controls for building materials and offsite tracking of sediment.

(2) Wastewater and stormwater management controls. -

(a) Pollution prevention measures. - The Contractor shall use methods of dewatering, unwatering, excavating, or stockpiling earth and rock materials which include prevention measures to control silting and erosion, and which will intercept and settle any runoff of sediment-ladened or contaminated waters. Wastewater from general construction activities, such as unwatering and dewatering, drainwater collection, aggregate processing, concrete batching, drilling, grouting, or other construction operations, shall not enter flowing or dry watercourses without the use of approved treatment methods. Stormwater runoff from upslope areas shall be diverted away from disturbed areas.

(b) Turbidity prevention measures. - Contractor methods for prevention of excess turbidity shall include, but are not restricted to, intercepting ditches, settling ponds, gravel fi entrapment dikes, flocculating processes, recirculation, combinations thereof, or other approved methods that are not harmful to aquatic life. All such wastewaters discharged into surface waters, shall contain the least concentration of settleable material possible. The Contractor shall operate mechanized equipment in waterbodies, only as necessary, to construct crossings or perform the required construction.

(3) Construction site management. -

(a) Contractor construction operations. - The Contractor shall perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes, into streams, flowing or dry watercourses, lakes, wetlands, reservoirs, or underground water sources. Such pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing, tailings, mineral salts, and thermal pollution.

(b) Stockpiled or deposited materials. - The Contractor shall not stockpile or deposit excavated materials, or other construction materials, near or on stream banks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff, or can, in any way, encroach upon the watercourse.

(c) Oil storage tanks management. -

1. Storage tank placement. - All oil or other petroleum product, (hereinafter referred to collectively as oil), storage tanks shall be placed at least 20 feet from streams, flowing or dry watercourses, lakes, wetlands, reservoirs, and any other water source.

2. Storage area dikes. - Storage areas shall be diked at least 12 inches high or graded and sloped to permit safe containment of leaks and spills equal to the capacity of all tanks and/or containers located within each area, plus a sufficient amount of freeboard to contain the 25-year rainstorm.

3. Diked area barriers. - Diked areas shall have an impermeable barrier at least 10 mils thick. Areas used for refueling operations shall have an impermeable liner at least 10 mils thick buried under 2 to 4 inches of soil.

4. Underground tank prohibition. - The Contractor shall not use underground storage tanks.

(4) Reclamation safety and health standards. - The Contractor shall comply with the sanitation and potable water requirements of section 7 of Reclamation's "Reclamation Safety and Health Standards", or equivalent OSHA standards.

(5) Laws, regulations, and permits. - The Contractor shall perform construction operations in such a manner as to comply, and ensure all subcontractors to comply, with all applicable Federal, State, and

local laws, orders, regulations, and Water Quality Standards concerning the control and abatement of water pollution. In the event there is a conflict between Federal, State, and local laws, regulations, and requirements, the most stringent shall apply.

(6) Contractor violations. - If noncompliance should occur, the Contractor shall report this to the Engineer immediately (orally), with the specific information submitted in writing within 2 calendar days. Consistent violations of applicable Federal, State, or local laws, orders, regulations, or Water Quality Standards may result in the Engineer's Representative stopping all site activity until compliance is ensured. The Contractor shall not be entitled to any extension of time, claim for damage, or additional compensation by reason of such a work stoppage. Corrective measures required to bring activities into compliance shall be at the Contractor's expense.

b. Contractor responsibilities. -

(1) Monitoring. - The Contractor is required to conduct monitoring in order to meet the requirements of local, state, and federal regulations which may include: (a) sampling, (b) site inspections, and (c) all required laboratory tests to determine effluent characteristics.

(2) Reporting results. - The Engineer will report all required monitoring results to the appropriate agencies.

(3) Recordkeeping. - The Contractor shall retain all records and data required by law for the time period specified in the contract.

c. Contractor required plan submittals. -

(1) General. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4.

(2) Pollution prevention plan. - The Contractor shall prepare a pollution prevention plan for discharges from construction sites. The Contractor shall submit the pollution prevention plan to the Engineer not less than 30 days prior to the start of onsite construction work.

(3) Spill Prevention Control and Countermeasure Plan (SPCC). - Whereas the location of the site is such that petroleum products from an accidental spillage could reasonably be expected to enter into or upon the navigable waters, or groundwater, of the United States or adjoining shorelines, and the aggregate storage of petroleum products at the site is over 1,320 gallons or a single container has a capacity in excess of 660 gallons, the Contractor shall prepare an SPCC Plan. The Contractor shall submit the SPCC Plan to the Engineer at least 30 days prior to delivery or storage of petroleum products at the site. The Plan shall have been reviewed and certified by a registered professional engineer in accordance with 40 CFR, part 112, as required by the Clean Water Act (Public Law 92-500 as amended).

d. Cost. - Except as specified herein, the cost of complying with this paragraph shall be included in the prices bid in the schedule for items of work which necessitate the water pollution prevention measures required by this paragraph.

1.5.2 ABATEMENT OF AIR POLLUTION

The Contractor shall comply with applicable Federal, State, and local laws a regulations concerning the prevention and control of air pollution.

Equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustments, or other inefficient operating conditions, shall not be operated until corrective repairs or adjustments are made.

Burning of cleared trees, brush, and rubbish will not be permitted. Storage and handling of flammable and combustible materials and provisions for fire prevention shall be in accordance with the applicable provisions of the National Fire Protection Association, NFPA 30 or 29 CFR 1910.106.

The cost of complying with this paragraph shall be included in the applicable prices bid in the schedule.

1.5.3 DUST ABATEMENT

During the performance of the work required by these specifications or any operations appurtenant thereto, the Contractor shall furnish all the labor, equipment, materials, and means required, and shall carry out proper and efficient measures wherever and as often as necessary to reduce the dust nuisance, and to prevent dust which has originated from the Contractor's operations and from the site from migrating off site, or causing a nuisance to persons.

The Contractor will be held liable for any damage resulting from dust originating from the Contractor's operations under these specifications. The Contractor shall utilize water or other methods approved by the Engineer to suppress dust produced by it's operations. A water mist shall be sprayed continuously throughout any excavation activity to knock down dust. Special care shall be required to minimize excess water use.

Dust abatement at the site and along haul routes shall be thorough and continuous. As the site will have exposed potentially contaminated materials, a dust suppression operation shall be provided during nights, weekends, and other non-work periods to assure the levels are not exceeded at any time.

A fugitive dust control plan in accordance with local and state requirements shall be submitted for approval to the Engineer prior to activities onsite. The Contractor shall control fugitive dust emissions from the construction site using established dust suppression techniques (water, chemical treatment, etc.), which must be approved, by the Engineer.

Visible dust will not be allowed. The Contractor shall devise a plan to keep visible dust from being blown offsite and prevent the production of dust onsite on windy days. The Contractor shall sample the site to check that dust levels do not exceed State standards. If samples indicate the State standards are being exceeded, the Contractor shall cease operation until corrections are made in it's operations.

If visible dust occurs the Contractor shall cease dust producing operations until proper engineering controls are employed.

The cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work: Provided, That payment for applying water used for dust abatement will be made in accordance with paragraph 2.1.1.

1.5.4 NOISE ABATEMENT

a. General. - The Contractor shall comply with applicable Federal, State, and local laws and regulations, and with the requirements of this paragraph regarding the prevention, control, and abatement of harmful noise levels. Should a conflict exist in the requirements for noise abatement, the most stringent requirement shall apply.

Noise levels of 50 decibels (nighttime) and 55 decibels (daytime), as measured from noise sensitive areas such as residences, shall not be exceeded.

b. Cost. - The cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work.

1.5.5 LIGHT ABATEMENT

The Contractor shall exercise special care to direct all stationary floodlights to shine downward at an angle less than horizontal. These floodlights shall also be shielded so as not to be a nuisance to surrounding areas. No lighting shall include a residence in its direct beam.

The Contractor shall be responsible for correcting lighting problems when they occur.

The cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work.

1.5.6 CONSTRUCTION TIME RESTRICTIONS

The Contractor may perform construction operations unrestricted between the hours of 7:00 am and 7:00 pm. Between the hours of 7:00 pm and 7:00 am the Contractor shall perform construction operations at a distance of 1,000 feet or more from the nearest residence. Time and distance restrictions may change as the job progresses based on input from citizens living near the construction site.

No work will be allowed on Sundays and holidays as specified herein, unless such is approved in advance by the Engineer.

The cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work.

1.5.7 PRESERVATION OF HISTORICAL AND ARCHEOLOGICAL DATA

Federal legislation provides for the protection, preservation, and collection of scientific, prehistorical, historical, and archeological data (including relics and specimens) which might otherwise be lost due to alteration of the site.

The Contractor agrees that should he or any of it's employees in the performance of this contract discover evidence of possible scientific, prehistorical, historical, or archeological data will notify the Engineer immediately giving the location and nature of the findings. Written confirmation shall be forwarded within 2 days. The Contractor shall exercise care so as not to damage artifacts or fossils uncovered during excavation operations and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition.

Where appropriate by reason of a discovery, UDEQ may order delays in the time of performance, or changes in the work, or both. If such delays, or changes, or both, are ordered, the time of performance and contract price shall be adjusted in accordance with the applicable articles of this contract. The Contractor agrees to insert this paragraph in all subcontracts which involve the performance of work on the site.

Except as provided above, the cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work.

1.5.8 CLEANUP AND DISPOSAL OF CONTRACTOR GENERATED WASTE MATERIALS

a. General. - The Contractor shall be responsible for cleanup and for disposal of waste materials or rubbish to include all Engineer and UDEQ generated waste at the site. The disposal of waste materials and rubbish shall be in accordance with this article and all applicable Federal, State, and local regulations, standards, codes, and laws.

In the event there is a conflict between the requirements contained in this article, and Federal, State, or local regulations, standards, codes, and laws, the more stringent requirement shall prevail.

b. Cleanup. - The Contractor shall at all times keep the construction area, including storage areas used by the Contractor, free from accumulations of waste materials or rubbish. Prior to completion of the work, the Contractor shall remove from the vicinity of the work all buildings, rubbish, unused materials, concrete forms, and other like material, belonging to the Contractor or used under the Contractor's direction during construction. All work areas shall be graded and left in a neat manner conforming to the natural appearance of the landscape.

c. Disposal of Contractor-generated hazardous waste materials. - Hazard materials as defined by 40 CFR 261.3; Federal Standard No. 313, as amended; and/or other applicable Federal, State, and local regulations, standards, and codes used by the Contractor shall be disposed of in accordance with these specifications and applicable Federal, State, and local regulations, standards, codes, and laws.

Contractor-generated waste materials that may be hazardous shall be tested, and the test results shall be submitted to the Engineer for review. Contractor-generated waste materials known or found to be, by testing, hazardous waste shall be disposed of in approved treatment or disposal facilities in accordance with Federal, State, and local regulations, standards, codes, and laws. A copy of the hazardous waste manifest shall be sent to the Engineer.

Hazardous wastes may be disposed of on site if approved by the Engineer. On site disposal decisions shall be in accordance with EPA's determination of ARARs and the appropriateness of onsite disposal.

d. Disposal of waste materials. - Waste material including, but not restricted to organic materials, refuse, garbage, sanitary wastes, waste resulting from demolition and site clearing operations, industrial wastes, and oil and other petroleum products, or any other waste generated by the work shall be disposed of by the Contractor.

Decontamination water and personal protective materials and equipment shall be disposed of in the North or South repository. Excluding petroleum products, industrial wastes, sanitary wastes, garbage, household refuse, cleaning solutions and liquids in general, waste materials may be disposed

of in the Repository. Waste material not disposed of in the Repository shall be disposed of in accordance with applicable laws and regulations. It shall be the responsibility of the Contractor to make any necessary arrangements with private parties and with government officials pertinent to locations and regulations of any off-site disposal.

Waste materials to be disposed of by removal from the construction area shall be removed from the area prior to completion of the work required by the contract documents. All waste materials removed from the remedial action project site shall become the property of the Contractor. Any fees or charges required to be paid for disposing of waste materials shall be included in the contract price.

Under no circumstances is any waste material, rubbish, or debris which is not a result of the work required by the contract Documents to be disposed of in the Repository.

e. Cost. - The cost of complying with this paragraph shall be included in the prices bid in the schedule for other items of work.

DIVISION 2 - SITEWORK

SECTION 2.1 - CONTROL AND USE OF WATER

2.1.1 WATER FOR COMPACTION AND DUST ABATEMENT

a. General. - The Contractor shall procure and apply water for dust abatement and for compaction needs. To minimize the amount of water entering the groundwater through the contaminated materials, water applied shall be the minimum required to perform the work.

The Contractor shall provide at his expense all means of conveying the water to the point of use. The amounts of water applied for dust abatement will be subject to the approval of the Engineer. In the event that it is determined by the Engineer that excessive water is being applied, the Engineer will notify the Contractor, and the practice shall stop immediately. No payment will be made for distribution of excessive water.

The Contractor shall make every effort to utilize the water resulting from the decontamination , dewatering and unwatering, and surface water control operations for compaction and dust abatement of contaminated materials only.

b. Measurement and payment. - Measurement, for payment, of water for dust abatement and compaction will be made to the nearest 1000 gallons by means of watermeters of approved types which shall be furnished and installed by the Contractor at the Contractor's expense and will include only the quantity of water applied for dust abatement and compaction as approved by the Engineer.

Payment for furnishing and applying water for dust abatement and compaction will be made at the unit price per M (1,000) gallons bid therefor in the schedule.

2.1.2 REMOVAL OF WATER FROM EXCAVATIONS

a. General. - The Contractor shall design as necessary, furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering and unwatering the various parts of the work and for maintaining the excavations and other parts of the work free from water as required for constructing each part of the work. For the purposes of this solicitation "unwatering" shall mean the removal of ponded or flowing surface water from within excavations, channels, ditches, or sumps and the control of such water. For the purposes of this solicitation "dewatering" shall mean the removal of groundwater and/or seepage from below the surface of the ground or other surfaces, and the control of such water. The Contractor shall construct sumps and drainage trenches as necessary for the removal of all water from the excavation or the materials being excavated, and shall intercept and control all surface water which enters along the perimeter of the excavations.

Excavation possibly requiring water removal and control include three separate areas across the site: the 150 foot setback areas near the Jordan River and 7800 South; the wetland and south-east tailings area; and the interceptor trench.

Control of groundwater in the 150 setback area near the Jordan River and 7800 South shall be accomplished in a manner consistent with the Contractor's proposed method of excavating the tailings and contaminated materials. Excavations shall be done in a safe and sound manner that will ensure stable permanent excavation slopes, and shall not jeopardize the

overall safety of the excavation operation. The specified excavation slopes were designed under the assumption that water removal and excavat operations would be performed in such a manner and at a reasonable rate ensure a safe excavation operation.

The Contractor shall be responsible for proper treatment and disposal of all water generated from unwatering and dewatering activities. Possible options for water disposal include:

(1) Re-use of water for dust abatement and compaction on contaminated materials.

(2) Discharge to existing off-site sewer system. The Contractor shall be responsible to obtain necessary permits and permission for this disposal alternative.

(3) Discharge the water off-site as surface run-off. All discharges shall be in compliance with Utah Admin. Code R317-8, Standards for Quality of Waters of the State, and Utah Pollution Discharge Elimination System(UPDES) permit, except that, Contractor will not be required to obtain a UPDES permit for on-site discharges.

(4) Remove the water from the site. The Contractor shall be responsible for proper treatment and disposal of the water and shall comply with all applicable regulations.

The Contractor shall deliver all collected water to be treated consistent with the Contractor's proposed and accepted pollution prevention plan.

The water to be removed and controlled will consist of groundwater of questionable water quality, and relatively clean surface water which enters the excavations from the vicinity. The Contractor shall comply with all applicable regulations as provided for in paragraph 1.5.1. As the work progresses, it may be necessary to separate and divert the collected wat by source to reduce the amount of water which will require treatment.

The Contractor shall design, install, maintain, operate and modify the removal of water systems for each area as necessary. The Contractor shall also be required to control seepage along the bottom of all excavations, which may require supplementing the approved unwatering systems. The Contractor shall be responsible for modifying and supplementing the unwatering facilities at any time as required for maintaining the excavations and other parts of the work free from water as required for constructing each part of the work. The Contractor is cautioned that the loss of unwatering capability could result in delays in completing the specified tasks, and/or threaten the safety of on-site personnel. The Contractor shall take appropriate measures to provide backup facilities in the event of a loss of his primary system.

Since limited groundwater data is available, the Contractor shall anticipate variable groundwater surfaces, seepage flow rates, contaminant concentrations, and material water contents across the excavations depending significantly on the seasonal weather conditions. The actual quantity of anticipated seepage can not be accurately predicted. The Contractor should also anticipate possibly encountering artesian pressures across the excavations.

b. Submittal . - Prior to beginning any unwatering or dewatering work, the Contractor shall submit, for review, a complete and detailed plan which includes a description of the Contractor's proposed method, equipment (type and size), capacities, procedures, and other pertinent details for removal of water from excavations. The plan may be placed in operation upon review

and approval by the Engineer. The plan shall be submitted, for review and approval, in accordance with the requirements of this paragraph and paragraph 1.1.4.

c. Removal of water from excavations. - The Contractor's method of removal of water from excavations shall be subject to review of the Engineer. The unwatering shall be accomplished in a manner that will maintain stability of the excavated slopes and bottom of the excavations, and will result in all construction operations being performed in a manner to ensure that excavation objectives are achieved. The power for operating and maintaining any unwatering equipment shall be supplied by the Contractor.

All water collected from removal operations shall be delivered consistent with the water removal plan submitted by the Contractor.

Following the completion of required excavations and backfilling, and construction, the water removal and control operations may be terminated as directed by the Engineer. All equipment and materials furnished to perform this work shall remain the property of the Contractor and shall be removed in an approved manner including decontamination procedures. The Contractor shall excavate and remove all temporary facilities as required, and dispose of the materials in an approved manner.

d. Cost. - The cost for unwatering and dewatering and of all work incident thereto shall be included in the unit prices bid in the schedule for excavating, transporting, placing, and compacting contaminated materials, which shall include the cost of furnishing all labor, equipment, and materials for maintaining the work free from water as required by this paragraph.

SECTION 2.2 - DEMOLITION

2.2.1 DEMOLITION

a. General. - The following items shall be demolished, reduced to small compactable units, and relocated to be incorporated below the cap:

(1) Structures, as shown on drawing 1556-418-17.

(2) Miscellaneous concrete features including, but not limited to piers, slabs, pads, retaining walls, foundation walls, pipes, and blocks or chunks as shown on drawing 1556-418-17.

(3) Structural timbers, including but not limited to utility poles, crib walls, railroad ties, and miscellaneous structural timbers shown and not shown on drawing 1556-418-17.

Structural timbers are defined as woody material located on the site which have the obvious appearance as once being used as structural members.

(4) Miscellaneous items that interfere with the excavation and grading within the site boundaries, with the exception of active utility poles and pipes near the site boundaries, and concrete foundation as described in sub-paragraph b. below. No size requirement for demolished items is specified. Compactible units is defined as material that can be efficiently transported and placed in such a manner as to exclude voids within the material, which do not diminish or alter the density of overlying soils, and will not promote differential settlement.

b. Mill foundations. - The Mill buildings were demolished in 1992-1993. Demolition of the buildings at this time was done only to the grade of the surrounding soils. What remains are various concrete pads, concrete floors, concrete structures, and concrete foundation walls. The flotation building was a multi-story building with reinforced concrete floors, with a portion of the building extending two or three floors below grade. Demolition of the flotation building was also demolished to grade, with building rubble backfilled into portions of the building below grade. Backfilling was done through various holes in a concrete floor located at approximately grade.

The Contractor shall excavate as specified on the drawings to the outside of the remaining foundation walls and shall remove the soil and debris above and around the building remnants, including the soil and debris above concrete floor at grade of the flotation building. Vertical concrete walls 12 inches or less shall be demolished to a depth 3 feet below grade, excavated, and relocated to the repositories. Vertical concrete walls greater than 12 inches shall remain in place. Horizontal concrete pads 8 inches or less with firm subgrade soils below, will be demolished, excavated, and removed to repositories. Horizontal concrete pads greater than 8 inches will remain in place.

Following excavation of surrounding soils and applicable concrete and debris, the Contractor shall allow for the Engineer to perform an as-built survey of the remnants of the buildings.

Following the Engineer's as-built survey, and any change orders, the Contractor shall backfill the area consistent with the local terrain as directed by the Engineer.

c. Trestle. - The abandoned railroad trestle overpassing 7800 South as shown on drawing 1556-418-17 is to be demolished by the Contractor. The trestle is a 4 span structure with reinforced concrete abutments on both sides of the total span, and 3 reinforced concrete piers. Two of the reinforced concrete piers are located on either side of 7800 South, and a third is located in the center of 7800 South.

The Contractor shall remove all materials pertaining to the railroad trestle structure, including, but not limited to; structural timbers, railroad ties and rails, metal plating, piping, steel girders and beams, and concrete piers and abutments as described below:

The Contractor shall remove the reinforced concrete abutment on the South side of 7800 South. The reinforced concrete abutment on the North side of 7800 South is to remain in place. All 3 of the reinforced concrete piers are to be removed and excavated to a depth of no less than 24 inches below the existing grade of the nearest shoulder of 7800 South. The Contractor shall backfill and compact pier excavations with an approved roadbase material. In the event asphalt roadway is destroyed, the Contractor shall replace and compact sub-base and asphalt roadway with methods, materials and density specifications approved and as specified by the Utah Department of Transportation (saw cuts, design mix, gradations, etc.).

Demolition materials shall be reduced to small compactible units, and relocated to the South Repository to be incorporated below the cap.

The Contractor shall coordinate with local authorities prior to all demolition work. A demolition plan for railroad trestle demolition and removal shall be submitted by the Contractor and approved in writing by the Engineer prior to beginning demolition work. Plan shall address traffic routing, demolition methods, and safety.

d. Payment. - Payment, for demolition will be made at the lump sum price bid therefor in the schedule, which lump-sum price shall include the cost of furnishing all labor, equipment, and materials for maintaining the work as required by this paragraph for items exclusive of railroad trestle demolition.

Payment, for railroad trestle demolition, will be made at the lump sum price bid therefor in the schedule, which lump sum price shall include the cost of furnishing all labor, equipment, and materials for maintaining the work as required by this paragraph for demolition of railroad trestle demolition.

2.2.2 CLEARING AND GRUBBING

a. General. - The Contractor shall clear and grub those portions of the work to be occupied by permanent construction under these specifications and those portions required for access to the work, stockpile sites, and wastepile sites, of all vegetation such as trees, shrubs, brush, stumps, exposed roots, down timber, branches, grass, and weeds; of all rubbish; and of all other objectionable material.

Vegetation designated for preservation within clearing limits, and all vegetation outside clearing limits shall be preserved and protected.

The ground surface and the surface of all excavation shall be cleared of all stumps, roots, and vegetable matter of every kind. The stumps shall be pulled or otherwise removed, and the roots shall be grubbed. The stumps and roots and any other combustible material removed shall be disposed of in the manner described in this paragraph for the disposal of cleared materials.

b. Disposal of cleared material. - Nonvegetative material from clearing and grubbing operations shall be disposed of in accordance with paragraph 1.5.8.

Vegetative material from clearing and grubbing operations shall be disposed of by chipping, spreading, and burying. Chipping and spreading of all woody materials 1.0 inches in diameter and larger will be required. Structural timbers as defined in paragraph 2.2.1 will not be require chipping and spreading. Material to be disposed of by chipping and spreading shall be reduced to chips of 1/2-inch maximum thickness. Chips shall be distributed uniformly to a 4.0-inch maximum thickness on the repository areas as indicated on the drawings, and shall be mixed with underlying soils so as to not float or support combustion. The chips shall be covered with a minimum of 6 feet of compacted soils in the South repository area.

c. Cost. - The cost of clearing and grubbing and of all work incident thereto, including disposal of the cleared and grubbed materials, shall be included in the unit prices bid in the schedule for excavating, transporting, placing, and compacting of contaminated materials.

d. Payment. - Payment, for chipping vegetation will be at the lump sum price bid therefor in the schedule, which lump-sum price shall include the cost of furnishing all labor, equipment, and materials for maintaining the work as required by this paragraph.

SECTION 2.3 - SOIL EROSION CONTROL

2.3.1 EROSION CONTROL

a. General. - The erosion control operations shall conform to drawing 1556-418-23 and this paragraph.

b. Seed Materials

(1) Seed Classification. - State certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable State seed laws.

(2) Seed mixtures. - Seed mixtures shall be proportioned by weight as follows:

Table 2A - Seed Mixture

COMMON NAME	MIXTURE PERCENT BY WEIGHT	POUNDS PURE LIVE SEED PER ACRE
Smooth Bromegrass	15	6
Western Wheatgrass	15	6
Streambank Wheatgrass	17.5	7
Covar Sheep Fescue	7.5	3
Shermans Big Bluegrass	5	2
Buffalograss	5	2
Wasatch Penstemon	5	2
Lance-leaved Coreopsis	5	2
California Poppy	5	2
Arrowleaf Blasamroot	2.5	1
Blanket Flower	7.5	3
Fireflower	5	2
Blue Flax	5	2
TOTAL		40.0 lbs

All seeds furnished shall be free from such noxious weeds such as a Russian or Canadian Thistle, European Bindweed, Johnson Grass, and Leafy Spurge. Verification shall be given as to the point of origin for each kind of seed. Seed and seed labels shall conform to current State and Federal Regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. Computations for quantity of seed required are based on the percent of purity and percent of germination. If seed available on the market does not meet the minimum purity and germination percentages specified, the

Contractor must compensate for a lesser percentage of purity or germination by furnishing sufficient additional seed to equal the specified product.

(3) Quality. - Seed shall conform to FS JJJ-S-181. Weed seed shall not exceed 1 percent by weight of total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

(4) Temporary Seed. - Temporary seed for erosion control shall be Annual Ryegrass applied at 80 pounds pure live seed per acre.

(5) Seed Mixing. - The mixing of seed shall be performed prior to delivery on the site. Bulk quantities of seed shall be labeled as required in paragraph 2.3.1.b, Seed Classification.

The following formula shall be used to determine the amount of commercial seed required to provide in each kind of seed the specified quantities of Pure Live Seed with Purity and Germination expressed as whole numbers:

$$\frac{\text{Pounds Pure Live Seed} \times 100 \times 100}{\text{Purity} \times \text{Germination}} = \text{Pounds of Seed Required}$$

(6) Soil amendments shall consist of fertilizer meeting the following requirements.

Fertilizer shall be commercial grade, free flowing, low in salts, uniform in composition and conforming to FS O-F-241. For bid purposes, the fertilizer consists of nitrogen phosphorus potassium ratio: 16 percent nitrogen, 38 percent phosphorus, and 0 percent potassium. Actual fertilizer will depend on the soil test. When slow release nitrogen forms are used in the fertilizer mixture they shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated prills, or isobutylenediurea. This fertilizer shall be used for grass establishment and post-fertilization.

(7) Mulch. - The Contractor shall use native straw fixed in place with paper fiber mulch overspray, or other approved mulch overspray on all surfaces with slopes less than 4 horizontal to 1 vertical. All slopes shown on the plans equal to or steeper than 4 horizontal to 1 vertical will require an erosion control blanket. Mulch shall be free from weeds, mold, and other objectionable materials. Contractor has the option to use erosion control blanket in those areas indicated to have paper fiber mulch overspray.

Straw mulch shall be long stem threshed straw of oats, wheat or rye that is free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50 percent by weight of the material to be 10 inches or longer. Straw shall be in an air-dry condition and suitable for placing with blower equipment.

(8) Water. - Water shall be uncontaminated and shall not contain elements toxic to plant life and shall be obtained from an approved source prior to use.

(9) Pesticide. - Pesticide shall be insecticide, herbicide, fungicide. For the purpose of this specification, soil fumigant shall

have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

c. Soil Erosion Control Material. - Soil erosion control shall conform the following:

(1) Soil Erosion Control Blanket. - Machine produced mat of knitted straw or Aspen wood fiber blanket-like mat construction. Straw blanket shall be covered with a biodegradable interwoven cotton thread on both the top and bottom side of the blanket. Straw blanket shall weigh approximately ½ pound per square yard.

Wood fiber blanket shall be bound on one side with photodegradable extruded plastic binding that firmly secures the outer netting to the wood fiber. Wood fiber blanket shall weigh approximately one pound per square yard.

(2) Anchors. - Erosion control anchors material shall be as recommended by the manufacturer and as approved by the engineer for the type of erosion control material used. The anchors shall not infringe on the stability of the cap by either puncturing the geotextiles or providing an unacceptable vertical flow path for water into the cap.

(3) Soil Erosion Control Fence. - Silt fencing shall be made of a strong rot-proof synthetic fiber. The fibers shall be resistant to deterioration due to ultraviolet light and heat exposure. The synthetic fibers shall be woven into a fabric. No additional fencing or wire backing is required. The fencing material shall have a strong tie cord in the top of the material. Low porosity silt fence shall have the same as or equal to Propex-Silt Stop, Mirafi 700x, or Beltech 755 or approved equal.

d. Installation. -

(1) Seeding Times and Conditions. - Seed shall be sown for spring planting from April 1 to June 1(Preferred), for fall planting from September 15 to November 15 or until consistent ground freeze unless otherwise approved by the Engineer.

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed by the Engineer. When special conditions warrant a variance to the operations, proposed times shall be submitted to and approved by the Engineer.

(2) Site Preparation. - The Engineer will verify that finished grades are as indicated on the drawings, and the placing of topsoil and smooth grading have been completed in accordance with paragraph 3.3.5. Any deviations therefrom shall be corrected prior to seeding. Soil used for repair or erosion and correction of grade deficiencies shall conform to that specified in paragraph 3.3.5.

Soil on slopes less steep than 3 horizontal to 1 vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3 horizontal to 1 vertical and 1-½ horizontal to 1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, rotating chains drawn by tractor from the top of the slope or by other approved methods. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-½ horizontal to 1 vertical and steeper, no tillage is required, however, the surfaces shall be

roughened by cat tracking or other approved method to sufficiently provide seed bedding.

Seeded areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Seeded areas compacted by construction operations shall be completely pulverized by tillage. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

(3) Topsoil Test. - A soil test shall be performed by the Contractor for pH, chemical analysis and mechanical analysis to establish the quantities and type of amendments required to meet local growing conditions for the type and variety of seed specified. The soil test shall be performed, analyzed, and the soil properly amended (if required) by the Contractor a minimum of one time for every 20 acres of placed topsoil, or at any time where an obvious change in topsoil quality and/or composition occurs.

(4) Amendments. -

(a) Application Rates. - Fertilizer shall be applied at the rates determined by the Contractor's Soil Test. Test reports shall be submitted to the Engineer 45 days prior to delivery of seeding materials on the site. Bids shall be based on the following application rate of actual or available fertilizer; if the following rate is more or less than the rate required by the Soil Test.

SEEDING:

Nitrogen (N)	43 lbs./acre
Phosphorus (P_2O_5)	90 lbs./acre
Potassium (K_2O)	0 lbs./acre
Lime	0 tons/acre

(b) Lime. - Lime, or any other material which is believed to modify the integrity of the geosynthetic clay liner's hydraulic properties shall not be applied.

(c) Fertilizer. - Fertilizer shall be applied at a rate recommended by the Soil Test and incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

(5) Seeding. - Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic, or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

Equipment to be used and the methods of seeding and mulching shall be subject to the inspection and approval of the Engineer prior to commencement of seeding operations. Immediately prior to the commencement of seeding operations, the Contractor shall conduct seeding equipment calibration tests in the presence of the Engineer.

(a) Broadcast Seeding. - Seed shall be uniformly broadcast at the rates specified using broadcast seeders. Half of seed shall be

broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth o ¼ inch but no more than ½ inch by disk harrow, steel mat drag, cultipacker, or other approved device.

(b) Drill Seeding. - On slopes 3 horizontal to 1 vertical or flatter, seed shall be uniformly drilled to an average depth of ½ inch and at the rate specified using a Brillon type seeder having drills not more than 4 inches apart. Row markers shall be used with the drill seeder. The drill shall be operated in a direction that parallels the contours.

(c) Rolling. - Immediately after seeding, except for slopes 3 horizontal to 1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with seed drills equipped with rollers shall not be rolled.

(d) Mulch. - Mulching shall be performed the same day as seeding. Mulch shall be spread uniformly, in a continuous blanket, at the rate of 2 tons per acre for hay and 2½ tons per acre for straw. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

(6) Erosion Control Material. - The surface of ditches and slopes to receive soil erosion control material shall be finished to a smooth and even condition with all debris, roots, stones and lumps raked out and removed.

(a) Erosion Control Blanket. - Straw mulch will not be used with soil erosion control blanket. Soil erosion control blanket shall be unrolled and placed on 3 horizontal to 1 vertical structural fill slopes as shown on the drawings, and according to the manufacturer's instructions. Apply wire staples vertically through the netting and blanket into the ground, keeping netting taut against anchor staples. Number and spacing of staples shall be as recommended by the manufacturer for the position on the slope and the type of fabric used. Erosion control blanket placement shall be accomplished without damage to the installed material or distortion of established grades.

(b) Erosion Control Fence. - Soil Erosion Control Fence shall be installed where indicated on the plans. A six inch deep trench shall be dug just outside the posts for the full length of the silt fence. Set the studded "T" posts a maximum of 6 feet on center. Incline the posts toward the runoff source at angle of not more than 20 degrees from vertical. Drive the posts into the ground to firmly establish the fence. The posts shall not puncture the geosynthetic materials or provide an unacceptable vertical flow path for water into the cap. If necessary, soil in the area of the silt fences shall be mounded to provide for bearing of the posts, or a brace type apparatus may be installed.

Attach the fabric to the posts, and place the fabric into the trench and backfill and compact the soil. All splice joints shall overlap a minimum of 18 inches. Fence shall be installed in accordance with drawing 1556-418-27.

e. Maintenance. - The erosion control material shall be maintained until all work on the entire contract or designated portion thereof has been completed and accepted. Maintenance shall consist of the repair of eroded areas and the repair or replacement and re-stapling of loose or undermined erosion control material, including reseeding. The Contractor shall remove the silt on the uphill side of the silt fence whenever the silt is above 18 inches from the original grade. At the option of the Engineer, the silt fence shall be removed at the completion of the project and the silt removed and disposed of as directed by the Engineer. Areas where the silt has been removed shall be reseeded and re-mulched as specified.

When there are contract delays in the seeding operation or a quick cover is required to prevent erosion, the areas designated for seed shall be seeded with a temporary seed as directed by the Engineer. When no other seeding materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with this paragraph. Seed shall be uniformly broadcast and applied at the rate specified. The area shall be watered as required.

When necessary to remove a pest or disease, a Utah State certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A pesticide plan shall be provided to the Engineer for approval 5 days prior to pesticide application if required. Pesticide shall not be applied within 3 weeks of grass seed germination and shall meet all Federal, DOD, and State guidelines.

f. Restoration. - Existing seeded areas, pavements and facilities that have been damaged from the seeding or subsequent operation shall be restored to original condition at Contractor's expense.

Excess and waste material for the seeding operation shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

g. Protection of Seeded Areas. - Immediately after seeding and mulching operations have been completed, the area shall be protected against traffic or other use by erecting barricades and providing signs as required or as directed by the Engineer to provide protection against traffic and trespass.

h. Grass Establishment Period. - The Grass Establishment Period for establishing a healthy stand of grass shall begin on the first day of seeding under this contract and shall end (60) sixty days after the last day of seeding and mulching operations required by this contract or until all work on this entire Contract has been completed and accepted, whichever period is longer.

A satisfactory stand of grass from the seeding operation for an area is defined as a minimum of 30 grass plants per square foot and have a mat like appearance. Bare spots shall be no larger than 6 square inches per foot. The total bare spots shall not exceed 2 percent of the total seeded area.

Establishment of the seeded areas shall include eradicating weeds, insects, and diseases, protecting and repairing embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting seeded ares from traffic, mowing if necessary, and post fertilization.

In the event of drought or excessive dry periods, watering shall be started within 24 hours after completing the seeded area. Water shall be applied

at a rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches. Run-off and puddling shall be prevented. Soil shall be maintained in a moist condition for the first four weeks after the start the watering program. Thereafter the seeded areas shall be watered ever. other day for a total of ½ inch of water per day over all seeded areas.

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

i. Final Acceptance. -

(1) Preliminary Inspection. - Prior to the completion of the Grass Establishment Period, a preliminary inspection shall be held by the Engineer. Time for the inspection shall be established in writing. The acceptability of the grass in accordance with the Grass Establishment Period shall be based upon a stand of grass as defined in this paragraph as a satisfactory stand of grass. An unacceptable stand of grass shall be repaired as soon as conditions permit. Rejected areas shall be replanted and repaired as directed by the Engineer.

(2) Post Fertilization. - All seeded areas shall be fertilized just prior to the Final Inspection. Fertilizer shall be applied to supply no less than 1 pound of actual nitrogen per 1,000 square feet.

(3) Final Inspection. - A final inspection shall be held by the Engineer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. The Contractor shall restore any area damaged by the Contractor's personnel or equipment after final acceptance. This includes damage that may occur during construction or required adjustments for the completion of this project, whether or not such work occurs after Government use and or acceptance. Restoration sha meet the requirements of the contract drawings and specifications.

j. Measurement and payment. - Measurement for payment, for seeding, will be based upon the nearest tenth of an acre of area seeded in accordance with these specifications and approved by the Engineer.

Payment for seeding will be made at the unit price per acre bid therefor in the schedule, which unit price shall include the cost of all labor, materials, and equipment required for preparation of seedbed, the cost of furnishing and applying fertilizer, the cost of furnishing, sowing, and covering the seed and cost of furnishing and placing the mulch.

Measurement for payment, for the silt fence, will be of the actual length of silt fence placed.

Payment for silt fence will be made at the unit price per linear foot bid therefor in the schedule.

Measurement for payment, for furnishing and placing the erosion control blanket, will be the actual area covered in square yards of blanket placed. No allowance will be made for overlaps.

Payment for furnishing and placing the erosion control blanket will be made at the unit price per square yard bid therefor in the schedule.

SECTION 2.4 - FENCING

2.4.1 FENCING

a. General. - The Contractor shall furnish and erect a 6.0 foot high chain link fence around the cap where shown on the drawings. The chain link fence shall be complete with fabric and barbed wire; posts, gates, and accessories; concrete; and other materials required for complete erection of the fences, except padlocks.

The fence shall be standard chain link fence with gates and a guard of three strands of barbed wire in accordance with the details shown on drawings 1556-418-9 and 1556-418-10. The supporting arms for the barbed wire shall be mounted 45 degrees from the vertical, and directed away from the site.

b. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4. At least 30 days prior to purchase of materials the Contractor shall submit the manufacturer's certification that the chain link fence materials to be furnished under these specifications meet the specifications requirements. The certification shall include the manufacturers' names, catalog numbers and names, Federal Specification references, weights and gauges of materials, and weights of zinc or aluminum coatings.

c. Materials. - Chain link fencing shall conform to Federal Specification RR-F-191K/GEN and the following detail Federal Specifications and requirements.

(1) Chain link fabric. - The chain link fabric shall be one of the following only:

(a) Zinc-coated steel fabric. - Federal Specification RR-F-191/1D, type I, 2-inch mesh, No. 11 gauge (0.120-inch nominal wire diameter after coating), and minimum weight of zinc coating of 1.2 ounces per square foot of uncoated wire surface area.

(b) Aluminum-coated steel fabric. - Federal Specification RR-F-191/1D. type II, 2-inch mesh, No. 11 gauge (0.120-inch nominal wire diameter after coating), and minimum weight of aluminum coating of 0.35 ounce per square foot of uncoated wire surface area.

(c) Aluminum alloy fabric. - Federal Specification RR-F-191/1D, type III, 2-inch mesh, No. 9 gauge (0.148-inch nominal wire diameter).

(2) Fenceposts, toprails, ,and braces. - Federal Specification RR-F-191/3D, class 1, grade A, except all steel pipe shall be ASTM A 53, schedule 40, standard weight and as otherwise provided in this paragraph or shown on the drawings. The fenceposts, toprails, and braces shall be hot dip, zinc coated with not less than 1.8 ounces per square foot of coated surface area.

(3) Gates and gate accessories. - Federal Specification RR-F-191/2D, type I or II, except as otherwise provided in this paragraph or shown on the drawings.

Gates shall be swing-type gates with hot-dip, zinc-coated steel pipe frames. Steel pipe shall conform to ASTM A 53, schedule 40, standard weight. The zinc coating shall have a weight of not less than 1.8

ounces per square foot of coated surface area. The gate fabric shall be the same as the fabric that is furnished for the fence.

Each gate leaf shall be equipped with one pair of heavy hinges that will allow a full gate opening between gate posts. The hinges shall be designed to not twist or turn under gate action and shall allow the gate to swing a full 180° to lie along and parallel to the fence line. The gate latch shall be of the fulcrum type with center drop rod or of the plunger-bar type of full gate height and arranged to engage the center stop, except that for the single gate less than 10 feet wide, a forked latch may be provided. The latch shall have suitable provisions for padlocking. The locking device for the center drop rod and plunger-bar-type latch shall be constructed so that the center drop rod or plunger bar cannot be raised when locked.

Gate hinges, latches, stops, keepers, and other accessories shall be of zinc-coated steel, ductile iron, or malleable iron, except that wire ties and clip bolts and nuts may be of aluminum alloy. The minimum weight of the zinc coating shall be 1.2 ounces per square foot of coated surface area. The barbed wire guard at the top of each gate shall be in accordance with the details shown on the drawings.

(4) Chain link fence accessories. - Federal Specification RR-F-191/4D, except as otherwise provided in this paragraph or shown on the drawings.

Post caps, rail ends, and barbed wire support arms shall be of zinc-coated steel, malleable iron, or ductile iron, except that post caps and rail ends may be of cast iron. Rail sleeves, wire ties and clips, brace bands, tension bands, reinforcing wire, and tension or stretcher bars shall be of zinc-coated steel, except that wire ties, clip bolts, and nuts may be of aluminum alloy. Two No. 12-1/2-gauge twisted barbless zinc-coated strands may be substituted for the No. 7-gauge bottom reinforcing wire.

The barbed wire shall be either zinc-coated steel or aluminum alloy - barbed wire to match the type of fence fabric furnished.

d. Erection. - Before starting to erect the fence, trees, brush, ground-surface irregularities, and other obstacles which would interfere with proper erection of the fence shall be cleared, removed, and disposed of as provided in paragraph 2.2.2. The Contractor shall perform all required excavating, backfilling, and compacting of backfill for posts, gate stops, and gatekeepers. Posts shall be set plumb and in alignment. Posts and gate stops shall be set in concrete. Gatekeepers shall be set in concrete. Where the nature of the material to be excavated is such that the holes for the footings cannot be excavated to the required dimensions and the concrete placed directly against the surfaces of the excavation, forms shall be used for the concrete.

The cement (cementitious materials) content of the concrete shall be not less than 5-1/2 bags per cubic yard of concrete.

Gates shall be erected at the location shown, and shall be adjusted to operate in an approved manner. Where required for passage of pipes, fabric shall be cut in an approved manner.

One tension or stretcher bar shall be provided for each gate and end post and two for each corner and pull post.

Damaged areas of galvanizing shall be cleaned and repaired in accordance with ASTM A 780.

e. Measurement and payment. - Measurement, for payment, of chain link fence will be made along the toprail from centerline to centerline of posts, including gates and braces.

Payment for furnishing and erecting chain link fence will be made at the unit price per linear foot bid therefor in the schedule.

SECTION 2.5 - WELLS

2.5.1 GROUTING EXISTING MONITOR WELL CASINGS

a. General. - The Contractor shall grout all existing monitoring well casings within the cap boundary, including those not identified and located on drawing 1556-418-17.

The grout shall consist of a neat cement mix, with 4 pounds of powdered bentonite and approximately 7-1/2 gallons of water added per 94-pound bag of cement.

b. Materials. -

(1) Cement. - Portland cement meeting requirements of ASTM C 150 for type I, II, or III, including optional false-set limitations.

(2) Powdered bentonite. - As manufactured by American Colloid Co., Water/Mineral Division, One North Arlington, 1500 West Shure Drive, Arlington Heights IL 60004, or equal, having the following characteristics:

(a) Minimum purity of 90 percent montmorillonite clay.

(b) Moisture content not more than 10 percent as packaged.

(c) Minimum 70 percent dry particle size finer than 200 mesh with minimum dry bulk density of 54 pounds per cubic foot.

(3) Water. - Free from objectionable quantities of silt, organic matter, salts, and other impurities.

c. Grouting existing monitor wells. - The protective covers shall be removed and the casings cut 2.0 feet below finish grade of tailings. The grout shall be placed by pumping the mixture through a pipe or hose extending initially to the bottom of the casing. The grouting shall be done from the bottom of the casing to the top in one continuous operation, until the casing is completely filled with grout.

d. Measurement. - Prior to grouting, each casing will be sounded to determine its depth. Measurements will be rounded to the nearest foot for each casing.

e. Payment. - Payment for grouting casings will be made at the unit price per linear foot bid therefor in the schedule.

2.5.2 PROTECTING EXISTING OBSERVATION WELLS

a. General. - The Contractor shall protect the existing observation we not included within the limits of the cap from any damage during the performance of the work under this contract. If any observation well is damaged or destroyed during the performance of work under this contract, it shall be repaired or replaced, as directed by the Engineer, by and at the expense of, the Contractor.

b. Cost. - The cost of protecting existing observation wells shall be included in the prices bid in the schedule for other items of work.

DIVISION 3 - EARTHWORK

SECTION 3.1 - EXCAVATION

3.1.1 EXCAVATION, FINAL GRADING, AND COMPACTION, GENERAL

a. General. - Excavation shall be made to the lines, grades, and dimensions shown on the drawings and/or specified herein, or established by the Engineer based on confirmatory testing as described in paragraph 3.2.

Excavation of material shall be performed in the dry to the greatest extent possible. No excavation shall be made in frozen materials without prior approval by the Engineer. No additional allowance above the unit prices per cubic yard bid in the schedule for excavation will be made due to any of the materials being wet or frozen.

The Contractor shall provide and operate all unwatering and dewatering facilities necessary to complete excavations in accordance with paragraph 2.1.2.

The Contractor shall install and maintain temporary sumps, ditches, and dikes as necessary to unwater, collect and direct seepage and surface water away from the excavations in accordance with paragraph 2.1.2.

The Contractor shall be responsible to maintain stable excavation slopes in any stockpile, waste pile or any excavation, or other excavation location at all times.

b. Final Grading. - The surfaces upon or against which capping materials are to be placed shall be finished to the dimensions shown on the drawings or prescribed by the Engineer, and the surfaces shall be free of snow, frost, loose, or saturated materials prior to placement of capping materials.

c. Compaction. - Where compacting of earth materials is required, the materials shall be deposited in horizontal layers and compacted as specified in the material specification paragraphs. The excavation, placing, moistening, and compacting operations shall be such that the material will be uniformly compacted and will be homogeneous, free from lenses, pockets, streaks, voids, laminations, or other imperfections.

The excavating and placing operations shall be such that the materials when compacted will be blended sufficiently to secure the highest practicable density and lowest permeability and highest shear strength. If the surface of any compacted layer of earthfill is too dry or smooth to bond properly with the layer of material to be placed thereon, it shall be moistened and/or scarified in an approved manner to provide a satisfactory bonding surface before the next succeeding layer is placed. The moisture content shall be uniform throughout each layer.

The optimum moisture content is defined as that moisture content which will result in the laboratory maximum dry density of the soil when subjected to either of the Bureau of Reclamation laboratory compaction test procedures listed in Table 3.A.

Insofar as practicable, as determined by the Engineer, moistening of the material shall be performed at the site of excavation; but if necessary, such moistening shall be supplemented by sprinkling at the site of compaction. If the moisture content is less than optimum for compaction by more than 2 percentage points or is greater than optimum for compaction by more than 3 percentage points, the compaction operations shall not proceed, except with the specific approval of the Engineer, until the material has

been wetted or allowed to dry out, as may be required, to obtain a moisture content within the tolerances permitted above, and no adjustment in price will be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned as herein before specified, it shall be compacted by rollers or by hand or power tampers. Where hand or power tampers are used to compact soils in confined areas such as under pipe, they shall be equipped with suitably shaped heads to obtain the required density.

The earth manual designations in this paragraph refer to the procedures described in the Bureau of Reclamation "Earth Manual, Part 2, Third Edition."

The dry density of the portion of the soil passing the No. 4 sieve in the compacted material shall not be less than percent of the laboratory maximum dry density as specified in the material paragraphs and as determined by the Bureau of Reclamation laboratory compaction test. The maximum dry density of the soil obtained by either of the Bureau of Reclamation procedures shown in Table 3.A

Table 3.A. - Procedures for laboratory maximum dry density

Test	Earth Manual designation
Proctor Compaction Test	USBR 5500
Rapid compaction control	USBR 7240

The optimum moisture content is the moisture content that corresponds to the laboratory maximum dry density.

In-place densities. - The in-place density of the compacted material in pipe trenches will be determined by Field Density Test Procedures, designation (USBR 7205), Bureau of Reclamation "Earth Manual, Part 2, Third Edition"; or other tests or methods designated by the Engineer. The data for compacted material testing procedures will be available on request from the Engineer.

d. Cost. - The cost of all excavation and finish grading work required by this paragraph shall be included in the unit price bid in the schedule for excavating, transporting, placing, and compaction of contaminated materials.

The costs of compacting earth materials as described in this paragraph, including furnishing water and moistening the materials, shall be included in the prices bid in the schedule for those items where materials are required to be compacted under these specifications.

3.1.2 CONTAMINATED MATERIALS EXCAVATION, TRANSPORTATION, PLACEMENT AND COMPACTION

a. General. - This section covers excavation, drying, transporting, placing and compaction of contaminated materials from the Sharon Steel tailings, contaminated materials identified in these specifications and on the drawings as tailings or contaminated soils, and all material that becomes contaminated as part of this work.

Excavation of the tailings material within the 7800 South and Jordan River 150 foot setback areas shall conform to the limits as shown on drawing 1556-418-24, the typical slope cross-sections as shown on drawing 1556-418-11, and to the bottom elevation at each station as shown on profile cross-sections, drawings 1556-418-56, 1556-418-57, 1556-418-58, 1556-418-59, and 1556-418-60.

Excavation of the wetland and southeast tailings areas shall conform to the limits and instructions as shown on drawing 1556-418-14. All remaining materials located within the site boundary shall be excavated, transported, placed and compacted according to these specifications and drawing 1556-418-24.

Drill logs indicate the lowermost portions of the tailings and natural soils are saturated and may require special excavation techniques. Transportation of the excavated tailings and sediments shall be in such a manner to prevent leakage and spillage between the point of excavation and the point of placement. The addition of dry materials at the point of excavation to facilitate excavation, loading, and transportation will be permitted. The Contractor may use material for drying from other areas of the tailings pile as approved by the Engineer.

If dewatering of the in-situ tailing is required, the Contractor shall follow the submitted and accepted dewatering plan.

b. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4. The Contractor shall submit a detailed Excavation and Re-grading Plan within 20 days after the receipt of the notice to proceed, which shall provide the specific details for excavation, transportation, and placement of the tailings and/or contaminated materials. This plan as a minimum should include: sequence and schedule of various required excavations, method of excavation, equipment to be used, anticipated rates of excavation, temporary stockpile locations (if anticipated), method of transport, and haul roads and haul patterns for each excavation area, spreading and/or grading equipment and methods, compaction equipment, and all health and safety concerns.

c. Measurement and payment. - Measurement, for payment, for excavating, transporting, placing, and compaction of contaminated materials will be based on surveys of the volume of material excavated, transported, placed, and compacted. The Contractor shall perform surveys prior to excavation of contaminated materials and after final excavation of contaminated materials has been accomplished. All surveys shall be in accordance with paragraph 1.1.3. Monthly progress payments will be based on load count, adjusted for 20% swell, and will be adjusted after final surveys are performed.

Payment for excavating, transporting, placing, and compaction of the contaminated materials will be made at the unit price per cubic yard bid therefor in the schedule, which price shall include the cost of all work required by this paragraph, paragraph 3.1.1, 3.2.1, and other paragraphs within these specifications which indicate costs shall be included with excavating, transporting, placing, and compaction of contaminated materials.

The unit prices bid in the schedule for excavating, transporting, placing, and compaction of contaminated materials shall include the cost of all labor, equipment, materials, temporary construction and all other work necessary to maintain the excavations in good order during construction a of removing such temporary construction where required.

If at any point in excavation the material is excavated beyond the required depths and limits as specified, the overexcavation shall be filled and compacted in accordance with these specifications and at the expense of the Contractor. Any and all excess excavation for the convenience of the Contractor or overexcavation performed by the Contractor for any purpose or reason, except as may be ordered in writing by the Engineer, shall be at the expense of the Contractor. Where required to complete the work, all such excess excavation and overexcavation shall be refilled with backfill material furnished and placed at the expense of and by the Contractor.

No payment will be made for excavation performed in previously placed embankment, refill, or backfill. No additional payment will be made for material placed in temporary stockpiles.

Measurement, and payment, for excavation, transporting, placing, and compaction of contaminated materials for wetland construction will be made according to paragraph 4.1.1.

SECTION 3.2 - CONTAMINATED MATERIAL

3.2.1 CONTAMINANT CLEANUP CRITERIA

a. General. - Contaminant cleanup criteria established for the site are listed in Table 3B below.

Table 3B - Allowable Concentrations

Element	Maximum Allowable Concentration - mg/kg (ppm)
Arsenic	70
Lead	500

Tailings material and soil containing the listed metals above these limits and identified in areas to be excavated, shall be classified as contaminated and excavated, and relocated to areas under the cap.

Excavation of the tailings and contaminated materials shall be initially performed visually as directed by the Engineer. Upon removal of materials to the initial limits established by the drawings, and if analysis of collected soil samples indicates that the concentration of contaminates is still above cleanup criteria, the Contractor shall excavate additional material and the Engineer will retest. This cycle shall be repeated until the soil sample results indicate a concentration of contaminants below the cleanup levels identified in this paragraph.

When removing subgrade contamination, the Contractor shall conduct his excavation operations in a manner that will prevent the spread of contamination to subsequent exposed layers of soil. Equipment shall be used that will not spread or track contamination.

of 4315.0 feet. Relocated tailings and contaminated materials from elevation 4315.0 feet shall be sloped as described on drawing 1556-418-24 and shown on drawing 1556-418-13. The structural fill shall overly the tailings and geosynthetic capping materials from the 4315.0 ft. elevatio. plus 2 feet to elevation 4317.0 feet, down at a slope of 3 horizontal to 1 vertical until the contact with the common backfill below as shown on drawing 1556-418-11.

Excavated material from the 150 foot setback along the Jordan River between stations 60+00 and 70+00, the 150 setback along 7800 South, contaminated soils east of the interceptor trench as shown in the drawings, and materials from phases 4 and 5 of the OU2 clean-up shall be located in the North Repository as shown on the drawings. The Contractor shall make provisions within the submitted and accepted Excavation and Re-grading plan for accepting, grading, and capping the additional material from OU2 as described. In the event that grade is met as established in the North Repository, additional material shall be transported and placed on the uncapped South Repository.

b. Placement. - The repository shall be constructed at the locations and to lines and grades indicated on the drawings. The completed fill shall correspond to the shape of the typical sections shown on the drawings and shall meet the requirements herein specified.

Material to be excavated, transported, placed, and compacted consists of a widely variable mixture of materials of different particle sizes (clay, silt, sand, and possibly gravel and cobbles), moisture contents, and consistencies. The Contractor shall attempt to spread and place these materials in continuous, approximately horizontal layers, while compacting the materials by equipment travel or roller compactors, and avoid the creation of any open-work voids. Successive loads of materials shall be dumped in such a manner to secure the best possible practical distribution of material and eliminate segregation or soft zones. The natural water content of the waste materials will be quite variable, therefore whenever possible, successive loads shall be placed and spread to attempt to mix overly wet materials with dryer materials to facilitate development of a more uniform material.

The material shall be placed in successive horizontal layers of 8 inches to 12 inches in loose depth for the full width of the cross section, and compacted. Each layer shall be compacted before the overlying lift is placed.

c. Compaction. - Compaction of the tailings and/or contaminated materials shall be performed conforming to this paragraph and paragraph 3.1.1. Each layer of the repository constructed under this paragraph, and all disturbed tailings, shall be compacted to a density of at least 92 percent of laboratory density.

d. Costs. - The costs of complying with this paragraph shall be included in the unit prices bid in the schedule for excavating, transporting, placing, and compaction of contaminated materials.

The Government, through the Engineer, reserves the right to direct additional excavation and handling for any portion of the site, and other applicable soils as deemed necessary.

b. Cost. - The costs of complying with this paragraph shall be included in the unit prices bid in the schedule for excavating, transporting, placing, and compaction of contaminated materials.

3.2.2 CONFIRMATORY SOIL SAMPLING

a. General. - Following excavation of contaminated materials as described in paragraphs 3.1.1 and 3.1.2, the Engineer will collect confirmatory soil samples as described in this paragraph. The turn around time for confirmatory testing will be 24 hours from the time the samples reach the lab. The Contractor shall plan on delays due to testing and sample gathering.

b. Grid layout. - Relatively flat contaminated areas will be divided by the Engineer into square grids with 75 foot sides. Grid labeling systems will be established for identification of sample locations at the 75 foot x and y grid intersection points (i.e., establish grid coordinate systems for grid intersection points). At each sample grid location, 5 random samples will be taken in the immediate vicinity of the grid location by the Engineer. The 5 random samples will be consolidated into 1 sample for testing. At the Engineer's discretion, additional locations may be established, (i.e. for sloping or irregular areas), and samples taken.

c. Results. - Laboratory analytical results of confirmatory samples will be compared to approved contaminant cleanup criteria listed in paragraph 3.2.1. Grid locations with contaminant concentrations exceeding approved cleanup criteria will require additional excavation and testing. The depth of continued excavation will be determined by the Engineer based on confirmatory testing of the soil profile.

3.2.3 REPOSITORIES

a. General. - Two separate areas within the site have been designated as Repository areas designed to receive the excavated materials from within the site and OU2. These areas have been designated as the South and North repository areas as shown on drawing 1556-418-24.

Tailings material excavated from the 150 foot setback area near the Jordan River from stations 0+00 to 60+00 as shown on drawing 1556-418-24, the wetland area as shown on drawing 1556-418-14, the southeast tailings area as shown on drawing 1556-418-14, and other materials in the southern portion of the site shall be primarily placed and compacted on the South Repository area. The South Repository area is shown on drawing 1556-418-24. Excavation and placement shall be according to the Contractor's submitted and accepted Excavation and Re-grading Plan.

Prior to the placement of capping materials in the South Repository, grade as established on the drawings for other areas of the site, including the North Repository shall be met. In other words, the South Repository shall remain un-capped so as to accept more material until all the excavation, transportation, placement, compaction and final grading of materials is complete and accepted by the Engineer.

Excavation of the tailings along the perimeter of the cap below the South Repository shall be performed with a slope of 2 horizontal to 1 vertical from the toe of tailings line shown on drawing 1556-418-24 to an elevation

SECTION 3.3 - EARTHWORK MATERIALS

3.3.1 EARTHWORK MATERIALS, GENERAL

a. General. - The earthwork materials incorporated in to the work brought in from out side sources shall be subject to the minimum contaminate levels described in paragraph 3.2.1. Earthwork materials shall be obtained from approved borrow sources. The Engineer will test borrow areas for contaminate levels and if the levels exceed the applicable limits shown in Tables 3B, other borrow sources shall be used.

b. Submittals. - At least 14 days prior to using a borrow area, the Contractor shall submit to the Engineer the locations of borrow areas from which earthwork materials will be excavated. The Engineer will test the materials at the borrow site(s) for contaminate levels and gradation and notify the Contractor of it's findings. Additional testing will be done on topsoil to determine compliance with paragraph 3.2.1. Where material is processed to meet gradation, the stockpiles of processed material will be tested.

3.3.2 COMMON BACKFILL

a. General. - Areas so noted on the drawings as "Common Backfill" shall be backfilled according to this paragraph.

b. Materials. - Common backfill shall consist of an uncontaminated, non-expansive soil. The material selected for the common backfill shall contain a minimum of 85 percent by dry weight of soil particles passing a United States Standard No. 4 sieve. The portion passing the United States Standard No. 40 sieve shall be classified by the USDA triangle chart as a loam, sandy loam, sandy clay loam, or clay loam textural ranges, and shall be free of debris, solid waste, roots, organic or frozen materials, concrete or asphalt particles, or soil particles with a maximum dimension larger than 3.5 inches.

c. Preparation of ground surface for fill. - Prior to the placement of any fill, all contaminated materials as determined by paragraph 3.2.1 shall be excavated and removed to the repository areas to be included under the cap. All vegetation, such as roots, brush, heavy sods, grass, and all decayed vegetable matter, rubbish, and other unsuitable material within the area upon which fill is to be placed, shall be stripped or otherwise removed before placement of the fill is started. In no case shall unsuitable material remain in or under the fill area. Stumps, logs, and roots more than 1 inch in diameter shall be removed and disposed of according to paragraph 2.2.2. Sloped ground surfaces steeper than four horizontal to one vertical on which fill is to be placed shall be plowed, stepped, or broken up, in such a manner so that the fill material will bond with the existing surface. Prepared surfaces on which compacted fill is to be placed shall be wetted or dried as may be required to obtain the specified moisture content and density.

d. Backfill adjacent to structures. - Backfill adjacent to structures shall be placed and compacted uniformly in such manner as to prevent wedging action or eccentric loading upon or against the structures. Slopes bounding or within areas to be backfilled shall be stepped or serrated to prevent sliding of the fill. During backfilling operations and in the formation of embankments, equipment that will overload the structure in passing over and compacting these fills shall not be used.

Newly formed and placed concrete will be allowed 7 days for a curing period prior to any adjacent backfilling operation.

e. Placement. - Backfill herein designated as common backfill shall be constructed at the locations and to lines and grades indicated on the drawings. Where no grade is indicated, sufficient fill shall be placed to provide a continuous surface representative of the original grade prior to the tailings, as determined by the Engineer. The completed fill shall correspond to the shape of the typical sections shown on the drawings and shall meet the requirements of the particular case. If backfill material is too wet, it shall be aerated or dried to provide the moisture content specified for compaction. The material shall be placed in successive horizontal layers of 8 inches to 12 inches in loose depth for the full width of the cross section, and compacted. Each layer shall be compacted before the overlying lift is placed.

f. Compaction. - Unless specified otherwise, each layer of the backfill constructed under this paragraph shall be compacted to a density of at least 85 percent of the maximum laboratory density.

g. Measurement and payment. - Measurement, for payment, for furnishing, placing, and compacting common backfill will be based on Contractor performed surveys (before and after) of the volume of material that has been placed. Monthly progress payments will be based on load count, with volume adjusted for 20% swell, and will be adjusted after surveys are performed.

Payment for furnishing, placing, and compacting common backfill will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of excavation from the borrow area and transportation of materials to the site, labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, place, and compact common backfill.

Payment for furnishing and placing common backfill for wetlands will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of excavation from the borrow area and transportation of materials to the site, labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, and place common backfill for wetlands.

3.3.3 STRUCTURAL FILL EMBANKMENT

a. General. - Embankment shall be constructed to the established lines and grades which, in general, will be the lines and grades shown on the drawings, increased by such heights and widths as necessary to allow for settlement. The embankments shall be maintained by the Contractor to proper heights, dimensions, and slopes until the final completion and acceptance of all of the work under the contract.

b. Material. - The Structural Fill Embankment shall consist of hard durable particles or fragments of granular aggregates. This material shall be mixed or blended with fine sand, clay, stone dust or other similar binding or filler materials produced from approved sources. This mixture shall be uniform and shall comply with the requirements of these specifications as to gradation, soil constants, and shall be capable of being compacted into a dense and stable subbase.

Table 3C GRADATION REQUIREMENTS

Sieve Designation (Square Openings) As per ASTM D-2940	Passing Percent By Weight
4 inch	100
2 inch	70-95
3/4 inch	45-95
#4	28-75
#10	20-62
#40	5-40
#200	0-15

The portion of the material passing the #40 sieve shall have a liquid limit of not more than 20 and a plasticity index of not more than 6 when tested in accordance with ASTM D-4318.

No brush, roots, sod, or other perishable or unsuitable materials shall be placed in embankments. Material containing sand in such proportion as to prevent it from compacting properly shall not be used, except with prior approval. Clods or hard lumps of earth having maximum dimensions of more than 8 inches shall be broken up before or after being placed on the embankments. Where there is a choice of materials, the best shall be used on the top of the embankment for at least 12 inches in depth. No material shall be placed in the embankments when either the material or the surface on which it would be placed is frozen.

c. Construction. - All material shall be deposited in embankments so that rock, cobbles, and gravel will be well distributed through the other materials and not nested in any position within or under the embankments. Embankment shall be built carefully so that the larger rock will be well distributed and the unfilled spaces shall be filled completely with smaller rock and earth so as to form a dense, stable embankment. Rock shall be deposited within the outer portions of embankments to protect the slopes against erosion. The combined excavation and placing operations shall be such that the materials in the embankment will be blended sufficiently to secure the best practicable degree of compaction and stability, and for this purpose the Engineer may designate the locations in the embankment where the individual loads shall be deposited.

The embankments shall be placed in continuous, approximately horizontal layers not more than 8 inches in loose thickness prior to being compacted. The layers shall be carried across the entire width of the embankments and shall be built to the required slopes and not widened with loose material from the top: Provided, that sidehill fills where the width is too narrow to accommodate hauling equipment may be placed by end dumping until the width of the embankment becomes great enough to permit the use of hauling equipment, after which the remainder of the embankment shall be placed in layers as specified herein. The Contractor shall route hauling equipment over the layers already in place and shall distribute the travel evenly over the entire width of the embankment so as to obtain the most practicable compacting effect of the equipment.

d. Compaction and Moistening. - Compactive effort shall comply with this paragraph and paragraph 3.1.1. The dry density of the portion of the soil passing the No. 4 sieve in the compacted material shall not be less than percent of the laboratory maximum dry density as determined by the Bureau of Reclamation laboratory compaction test.

Where embankment materials do not contain sufficient moisture to ensure satisfactory compaction, additional moisture shall be provided by sprinkling with water as the layers of materials are placed on the embankments. The materials shall be moistened uniformly and, where directed, shall be harrowed or otherwise mixed to produce the required uniformity of moisture content. Materials containing an excess of moisture shall be permitted to dry to the extent required before being compacted.

e. Measurement and payment. - Measurement, for payment, for furnishing, placing, and compacting structural fill embankment will be based on Contractor performed surveys (before and after) of the volume of material that has been placed. Monthly progress payments will be based on load count and will be adjusted after surveys are performed.

Payment for furnishing, placing, and compacting structural fill embankment will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of excavation from the borrow area and transportation of materials to the site, labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, place, and compact structural fill embankment.

3.3.4 SELECT FILL

a. General. - The select fill portion of the cap shall be constructed to the established lines and grades which, in general, will be the lines and grades shown on the drawings. The select fill portion of the cap shall be maintained by the Contractor to proper heights, dimensions, and slopes until final completion and acceptance of all of the work under this contract.

b. Material. - The select fill shall consist of a cohesionless or low plasticity soil type classified as either silty sands (SM or SW-SM), clayey sands (SC), or lean clays (CL) according to the Unified Soil Classification System. In addition, the material shall have one hundred percent of the material by weight passing the 3/4 inch sieve, at least 70 percent passing a No. 4 sieve, and 12-60 percent passing the No. 200 sieve. The material shall have a plasticity index (PI) no greater than 12. The soil shall have a Coefficient of Uniformity (Cu) value greater than 6 but less than 64.28 times D_{50}. The Coefficient of Uniformity is defined as the D_{60} divided by the D_{10}. The D_{60} is the grain size (diameter) in millimeters (mm) corresponding to 60 percent passing by weight. The D_{10} is the grain size (diameter) in millimeters (mm) corresponding to 10 percent passing by weight. The D_{50} is the grain size (diameter) in mm corresponding to 50 percent passing by weight.

No brush, roots, sod, or other perishable or unsuitable materials shall be placed within the select fill. Material containing sand in such proportion as to prevent it from compacting properly shall not be used, except with prior approval. Clods or hard lumps of earth having maximum dimensions of more than 8 inches shall be broken up before or after being placed on the cap. No material shall be placed on the cap when either the material or the surface on which it would be placed is frozen, or with the presence of ice or snow.

c. Placement and Compaction. - Prior to placement of select fill over the geocomposite drain material, the geocomposite drain shall be inspected and approved by the Engineer. The select fill shall be placed at the location and to the lines and grades indicated on the drawings and shall be placed over the geocomposite within 3 days after the geocomposite has been installed.

No equipment shall be pulled or driven directly on the geocomposite material. Equipment will be allowed on areas underlain by the geocomposite only after the first layer of fill has been placed. The Contractor shall temporarily anchor the geocomposite at the top and wherever is necessary to eliminate geosynthetic displacement prior to placement of select fill. The first layer of select fill material and each subsequent layer shall be placed in a minimum of 15 inch and a maximum of 18 inch loose lifts. The select fill material shall be placed in a moist near saturated condition. The Contractor shall place the select fill starting at the toe of the slopes and working up the slopes, parallel to the toe. The Contractor shall not drop or dump select fill directly onto the geosynthetic material. The select fill shall be placed onto the geocomposite material by dropping the select fill onto previously dropped select fill and graded into place with a dozer which has low ground pressure tracks that do not exceed a ground pressure of 10.5 psi. Wheeled vehicles will not be allowed on the cover, until after the select fill is graded into place and traffic compacted. The select fill shall not be stockpiled on the geocomposite material. All equipment shall be used in such a way as to not cause excessive rutting in the lift. Pushing select fill material across the geocomposite material will not be permitted.

The select fill is not subject to specific density requirements. The Contractor shall utilize a minimal effort to compact the select fill using two passes of only the tracks of the placement equipment. The Contractor shall cover the geocomposite material as soon as possible after placement to reduce the potential for damage from ultra violet radiation, wind, temperature extremes, and on going construction activities. Any damage to the geocomposite, or underlying geomembrane caused by the Contractor's operations in placing select fill upon the geocomposite materials shall be repaired at the Contractor's expense.

d. Test Section. - Before placement of select fill on the underlying geocomposite materials, the Contractor shall demonstrate that the placement and compaction technique will prevent damage to the geocomposite. The Contractor will have the opportunity to demonstrate his placement method over a portion of the completed liner or over a separate test section outside the limits, but in the vicinity of the cap. Construction of the test section shall incorporate the same cap materials, equipment, and procedures proposed for the full scale cap system. In either case, the demonstration area shall be a minimum of two times wider than the widest piece of construction equipment proposed. The demonstration area shall be long enough to allow construction equipment to achieve normal operating speed over a minimum 25 foot length. The demonstration area shall be constructed on a surface having a slope equal to the maximum slope required for the full scale cap. The geocomposite shall be anchored at the top. The Contractor shall monitor the downslope movement by placing pins on each side of the test section. A straight line shall be painted on the geocomposite between the control pins. After placement of the select fill to the specified design depth over this area, the Contractor shall remove a 20 foot by 20 foot section of the select fill by non-destructive methods near the center of the demonstration area. The Contractor shall video tape the placement of the test section and the exposed geocomposite. The geocomposite and geomembrane materials shall be first inspected by the Engineer. Any detrimental puncturing of the geosynthetic or geomembrane materials resulting from the Contractor's placement method, as determined

by the Engineer, will result in rejection of the Contractor's placement method. After the geocomposite materials are exposed, the Contractor sha measure and document any downslope movement of the painted line relative the control pins.

Full scale cover soil placement shall not commence until the placement method is approved by the Engineer and all failed demonstration areas within the limits of the full scale cap are repaired.

e. Submittal. - At least 7 days prior to the construction of the test section the Contractor shall submit a proposal to the Engineer which identifies the test fill location, construction equipment, cap materials and placement techniques.

f. Cost. - The cost of test section demonstration(s) shall be included in the unit price bid in the schedule for furnishing and placing select fill.

g. Measurement and payment. - Measurement, for payment, for furnishing and placing select fill will be based on Contractor performed surveys (before and after) of the volume of material placed. Monthly progress payments will be based on load count and will be adjusted after surveys are performed.

Payment for furnishing and placing select fill will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of excavation from the borrow area and transportation of materials to the site, labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, and place select fill.

Any additional work required in moistening and/or drying select fill shall be considered as work required by the provisions of this paragraph and no separate payment shall be made for such work. Provided, That payment for furnishing and applying water for compaction will be made in accordance with paragraph 2.1.1.

3.3.8 TOPSOIL

a. General. - Areas so noted on the drawings as topsoil shall be covered with topsoil in accordance with this paragraph.

b. Material. - The topsoil is defined as selectively excavated natural, fertile, friable, naturally occurring loam soil that is representative of soils in the vicinity that produce heavy growths of crops, grass or other vegetation and is reasonably free from underlying subsoil, clay lumps, objectionable weeds, litter, brush, matted roots, toxic substances or any material that might be harmful to plant growth or be a hindrance to grading, planting or maintenance operations. Soils from ditch bottoms, drained ponds, or eroded areas, handled when too wet or soggy, or frozen are not acceptable. Topsoil shall not contain more than five percent by volume of stones, stumps, or other objects larger than 1 inch in any dimension for field seeded areas. Topsoil shall not be excessively acid or alkaline and shall have a final pH value of between 6.5 and 8.3. If the pH is not within the 6.5 to 8.3 range, the Contractor shall add the material required to achieve that pH balance. Topsoil shall contain from 2.0 to 10.0 percent organic matter as determined by ASTM D 2974.

c. Placement and Compaction. - The topsoil shall be uniformly distributed on the designated areas and evenly spread to a minimum thickness of 6 inches. The spreading shall be performed in such manner that planting can proceed with little additional soil preparation or tillage. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry,

or in a condition otherwise detrimental to proper grading or the proposed planting. No percent of the laboratory maximum dry density criteria is established for compaction of the topsoil, however, the Contractor shall ensure the topsoil is stable against erosional forces, e.g. wind, water. Any loss of topsoil due to erosional forces shall be replaced by the Contractor at no additional cost to the Government.

All areas covered by the project, including filled sections and adjacent transition areas, shall be uniformly smooth graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader operations, except as otherwise specified. The finished surface shall be not more than 0.15 foot above or below the established grade or approved cross section and shall be free of depressed areas where water can pond. All areas shall be finished so as to drain readily according to the Erosion Control and Site Drainage Plan, drawing 1556-418-23.

During construction, the site shall be kept shaped and drained. Ditches along the perimeter of the cap shall be maintained in such manner as to drain effectively and consistent with the Contractors runoff plan at all times. Where ruts occur in the cap, the cap shall be brought to grade, reshaped if required, and recompacted prior to the placing of additional fill. The storage and stockpiling of materials on the cap will not be permitted.

d. Submittal. - Within 30 days after completion of the cap an as-built survey of the completed cap shall be submitted to the Engineer by the Contractor which delineates the topsoil elevations. The survey shall consist of vertical elevations of the cap on a 50-foot grid relative to the project control. Included with the submittal shall be the survey notes and drawing showing contours and features.

e. Cost. - The cost of providing as-built survey of the completed cap shall be included in the prices bid in the schedule for other items of work.

f. Measurement and payment. - Measurement, for payment, for furnishing and placing topsoil will be based on Contractor performed surveys (before and after) of the volume of material placed. Monthly progress payments will be based on load count, with volume adjusted for 20% swell, and will be adjusted after surveys are performed.

Payment for furnishing and placing topsoil will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of excavation from the borrow area and transportation of materials to the site, labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, and place topsoil.

Any additional work required in moistening and/or drying topsoil shall be considered as work required by the provisions of this paragraph and no separate payment shall be made for such work.

3.3.6 CAPILLARY MATERIAL

a. General. - The capillary material shall be constructed to the established lines and grades which, in general, will be the lines and grades shown on the drawings. The capillary material shall be maintained by the Contractor to proper heights, dimensions, and slopes until the final completion and acceptance of all of the work under the contract.

b. Material. - Capillary material shall be constructed of crushed stone or gravel meeting any one of AASHTO Designation M43-82 size number 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, and 8. All capillary material shall meet AASHTO Designation 283-81 Class C Aggregate. Table 3D contains the standard gradations of capillary material that can be utilized.

Table 3D Amount Finer Than Each Laboratory Sieve (Square Openings). Weight Percentage

Size #	2½in 63mm	2in 50mm	1½in 37.5mm	1in 25mm	¾in 19mm	½in 12.5mm	⅜in 9.5mm	#4 4.75mm	#8 2.36mm	#16 1.18mm
3	100	90-100	35-70	0-15	-	0-5	-	-	-	-
357	100	95-100	-	35-70	-	10-30	-	0-5	-	-
4	-	100	90-100	20-55	0-15	-	0-5	-	-	-
467	-	100	95-100	-	35-70	-	10-30	0-5	-	-
5	-	-	100	90-100	20-55	0-10	0-5	-	-	-
56	-	-	100	90-100	40-85	10-40	0-15	0-5	-	-
57	-	-	100	95-100	-	25-60	-	0-10	0-5	-
6	-	-	-	100	90-100	20-55	0-15	0-5	-	-
67	-	-	-	100	90-100	-	20-55	0-10	0-5	-
68	-	-	-	100	90-100	-	30-65	5-25	0-10	0-5
7	-	-	-	-	100	90-100	40-70	0-15	0-5	-
78	-	-	-	-	100	90-100	40-75	5-25	0-10	0-5
8	-	-	-	-	-	100	85-100	10-30	0-10	0-5

c. Placement. - Capillary material shall be placed to the lines and grades presented on the drawings and referenced paragraphs found elsewhere in these specifications. After pipe for subdrains has been laid, inspected, and approved by the Engineer, capillary material shall be placed around and over the pipe to the depth indicated. No compaction of the capillary material is required, however the material shall be distributed evenly to the lines and grades shown on the drawings.

No brush, roots, sod, or other perishable or unsuitable materials shall be placed within the capillary material. No material shall be placed when either the material or the surface on which it would be placed is frozen, or with the presence of ice or snow.

d. Cost. - The cost of furnishing and placing capillary material shall be included in the unit prices bid in the schedule for furnishing and placing various sizes of perforated pipe.

DIVISION 4 - SPECIAL CONSTRUCTION

SECTION 4.1 - WETLAND

4.1.1 WETLAND CONSTRUCTION, GENERAL

a. Purpose. - The purpose for this portion of the work is to replace wetlands which have formed in the area of the tailings. Natural wetlands are typically diverse systems that include irregular features and random variation. Natural wetlands do not include straight lines or square corners. This project will duplicate natural wetland conditions to the greatest extent possible while paying attention to the feasibility of construction.

The Contractor's portion of the work consists of excavation, channels, and islands, and the placement of topsoil for planting. Planting of the wetlands area will not be included in this contract.

b. Clearing and grubbing. - The area shall be cleared and grubbed as specified in paragraph 2.2.2.

c. Excavation. - The area designated as wetlands (see drawing 1556-418-12) shall be uniformly excavated as described on drawing 1556-418-14. At this point confirmatory sampling will be done to determine the extent of additional excavation. The soil contaminate standards for the wetlands area are as described in paragraph 3.2.1.

Embankments adjacent to the wetlands area shall be sloped for safety.

d. Additional excavation. - After confirmatory sampling has been completed and results indicate that concentrations of contaminates are below the acceptable levels, the Contractor may proceed with constructing the features of the wetlands area. If results of confirmatory sampling indicate that acceptable levels of contaminates have not been achieved, an additional six (6) inches of contaminated soil shall be excavated and resampled. This process shall be followed until acceptable levels have been achieved.

At the direction of the Engineer, additional excavation may be discontinued before acceptable levels of contaminates are reached.

e. Dike and Island Construction. - Dike construction is described in Section 4.2. Islands are to be constructed to the lines and grades shown on the drawings. The maximum slope permissible in the wetlands area shall be 3 horizontal to 1 vertical with the exception of the roadway and dike embankment. Except for the last 6 inches of topsoil, materials used to bring the wetlands area to grade and to construct the dike and islands shall be as specified for common backfill in paragraph 3.3.2. Topsoil shall be furnished and placed in accordance with paragraph 3.3.5.

f. Compaction. - Common backfill material shall be compacted to at least 95 percent of laboratory maximum dry density.

g. Measurement and payment. - Measurement, for payment, for excavating, transporting, placing, and compaction of contaminated materials for wetland construction will be based on surveys of the volume of material excavated, transported, placed, and compacted. The Contractor shall perform surveys prior to excavation of contaminated materials and after final excavation of contaminated materials has been accomplished. All surveys shall be in accordance with paragraph 1.1.3. Monthly progress payments will be based on load count adjusted for 20 percent settlement, and will be adjusted after final surveys are performed. The excavation limits for wetland

construction shall be outlined as noted for Wetland Boundary as shown on drawing 1556-418-12. Pior to any work in this area, the Engineer will establish ground markers indicating the extent of the Wetland Boundary. Markers will closely represent the line as established for Wetland Boun on drawing 1556-418-12.

Payment for excavating, transporting, placing, and compaction of the contaminated materials for wetland construction will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of all work required by this paragraph, paragraph 3.1.1. 3.2.1, and other paragraphs within these specifications which indicate costs shall be included with excavating, transporting, placing, and compaction of contaminated materials.

The unit prices bid in the schedule for excavating, transporting, placing, and compaction of contaminated materials for wetland construction shall include the cost of all labor, equipment, materials, temporary construction and all other work necessary to maintain the excavations in good order during construction, and of removing such temporary construction where required.

If at any point in excavation the material is excavated beyond the required depths and limits as specified, the overexcavation shall be filled and compacted in accordance with these specifications and at the expense of the Contractor. Any and all excess excavation for the convenience of the Contractor or overexcavation performed by the Contractor for any purpose or reason, except as may be ordered in writing by the Engineer, shall be at the expense of the Contractor. Where required to complete the work, all such excess excavation and overexcavation shall be refilled wih backfill material furnished and placed at the expense of and by the Contractor.

No payment will be made for excavation performed in previously placed embankment, refill, or backfill. No additional payment will be made for material placed in temporary stockpiles.

Measurement and payment of furnishing, placing, and compacting common backfill for wetland construction shall be included in the unit price bid in the schedule for furnishing, placing, and compacting common backfill. Measurement, and payment for furnishing and placing topsoil for wetland construction shall be included in the unit price bid in the schedule for furnishing and placing topsoil.

4.1.2 CONCRETE INLET/OUTLET STRUCTURES

a. General. - The Contractor shall construct 2 reinforced concrete inlet/outlet structures in the river channel, which shall include a Waterman C-20 canal gate, or approved equal, and approximately 20 feet of outlet pipe.

Construction shall conform to paragraphs 1.3.4 and 3.3.2.

Cast in place concrete shall conform to the requirements of Section 4.3. All exposed formed surfaces shall be trowled to a smooth finish.

b. Payment. - Payment for wetland inlet/outlet structures will be made at the lump-sum price bid therefor in the schedule, which lump-sum price shall include all fabricated metal work and piping, excavation for piping, placing pipe and fittings, transition mechanical fittings if required, placing and compacting backfill, associated surface restoration, excavation for the inlet/outlet structure, forming, placing, and finishing of concrete, and control of the Jordan River.

4.1.3 CARE OF THE JORDAN RIVER AND SURFACE WATER DIVERSION

a. General. - The Contractor shall furnish all materials for, and shall construct and maintain all temporary diversion and protective works necessary for diversion of surface water run off and care of portions of the Jordan River during construction, including, but not limited to, channels, flumes, drains, sheet piling, and sumps. The Contractor shall be responsible for the area directly impacted by the Contractor's operations associated with work along the Jordan River.

After having served their purpose, all temporary diversion and protective works shall, in a manner approved by the Engineer, be removed or leveled to give a sightly appearance and so as not to interfere in any way with the operation or usefulness of the Jordan River.

Any damage to the work caused by floods, water, or failure of any part of the diversion or protective works shall be repaired by, and at the expense of, the Contractor.

b. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4.

Within 20 days after receipt of notice to proceed, the Contractor shall submit, for approval, a water control plan showing the proposed method for diversion of surface water and care of the Jordan River during construction, as well as describing the measures to be taken to control water quality standards.

The water control plan may be placed in operation upon approval, but nothing in this paragraph shall relieve the Contractor from full responsibility for the adequacy of the diversion and protective works.

c. Jordan River. - The Contractor shall not interrupt or interfere with the natural flow of Jordan River through the site for any purpose or reason without the prior written approval of the Engineer.

d. Cleanup. - After having served their purpose, all materials placed for temporary diversion and protection shall remain the property of the Contractor and shall be decontaminated and removed from the site.

e. Cost. - The cost for care of the Jordan River and surface water diversion shall be included in the lump sum price bid in the schedule for wetland inlet/outlet structure, which cost shall include the cost of furnishing all labor, equipment, and materials for constructing and maintaining channels, flumes, drains, sumps, sheet piling and other temporary diversion and protective works; removing or leveling such works, where required; disposing of materials; and all other work required by this paragraph.

SECTION 4.2 - ROADWAY AND DIKE

4.2.1 RIPRAP AND GEOSYNTHETIC FILTER FABRIC

a. General. - The riprap and geosynthetic filter fabric shall be placed to the prescribed outlines and thicknesses as shown on the drawings.

The geotextile shall be designed to allow passage of water while retaining embankment soil without clogging.

b. Materials. -

(1) Riprap. - Riprap shall be hard and durable quarry stone with less than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. Bulk density shall not be less than 160 pounds per dry cubic foot.

The nominal thickness of the riprap shall be 24 inches and shall be reasonably well graded from the maximum size down to the minimum size as shown in Table 4A.

Table 4A
Rock Sizes and Riprap Thickness

Size (lb)	Percent smaller[1] (by weight)
1250	100
640	65-80
200	35-50
40	[2]0-12

1. - Sand and rock dust shall be less than 5 percent, by weight of total riprap material.

2. - The percentage of this size shall not exceed an amount which will fill the voids in larger material.

(2) Geosynthetic filter fabric. - Fibers used in the manufacture of geotextile, and the threads used in joining geotextiles by sewing, shall consist of long chain synthetic polymers, composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a woven network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. These materials shall conform to the physical requirements of Table 4B.

Geotextile rolls shall be furnished with suitable wrapping for protection against moisture, and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient for inventory and quality control purposes. Rolls shall be stored in a manner which protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

Table 4B Physical Requirements for Geosynthetic Filter Fabric		
Property	Requirement	Test Method
Grab Strength(lbs.)	200	ASTM D1682
Elongation (%)(min.)	15	ASTM D1682
Seam Strength(lbs.)	180	ASTM D1682
Puncture Strength(lbs.)	80	ASTM D751
Burst Strength($lb./in^2$)	320	ASTM D3786
Apparent Opening Size U.S. standard sieve	1.Soil with 50% or less particles by weight passing U.S. no. 200 sieve, AOS less than 0.6 mm (greater than #30 U.S. std. sieve) 2.Soil with more than 50% particles by weight passing U.S. no. 200 sieve, AOS less than 0.297 mm(greater than #50 U.S. std. sieve.)	COE CW 02215-77
Permeability(cm/sec)	$k_{fabric} > 10 \times k_{soil}$	ASTM D4491-85
Ultraviolet Degradation at 150 hours	70% strength retained	ASTM D4335

c. Placing. - Exposure of geotextiles to the elements between lay down and cover shall be maximum of 14 days to minimize damage potential. The geotextile shall be placed and anchored on a smooth graded surface approved by the Engineer. The geotextile shall be placed in such a manner that placement of the overlying riprap will not excessively stretch or tear the fabric. Anchoring of the terminal ends of the geotextiles shall be accomplished through the use of key trenches or aprons at the crest and toe of the slope as recommended by the manufacturer and approved by the Engineer.

Successive geotextile sheets shall be overlapped in such a manner that the upstream sheet is placed over the downstream sheet and/or upslope over downslope. In underwater applications, the geotextile and required thickness of backfill material shall be placed the same day. The backfill placement shall begin at the toe and proceed up the slope.

Riprap shall not be dropped onto the geotextile from a height of more than 1.0 feet. Slope protection if desired by the Contractor, and smaller sizes of stone filling shall not be dropped onto the geotextile from a height exceeding 3.0 feet. Any geotextile damaged during placement shall be replaced or repaired as directed by the Engineer at the Contractor's expense.

The geotextile shall be joined either by sewing or overlapping. All seams shall be subject to approval by the Engineer. Overlapped seams shall have a minimum overlap of 18 inches except where placed under water where the overlap shall be a minimum of 3.0 feet.

In the event a repair to the geotextile filter fabric is necessary, a geotextile patch of the same material shall be placed over the damaged area and extend 3.0 feet beyond the perimeter of the tear or damage.

The inclusion of earth, sand, or rock dust in excess of 5 percent, by volume, in riprap will not be permitted.

d. Submittals. - At least 30 days prior to purchase, the Contractor shall submit to the Engineer the following:

(1) Certification that the physical properties of the geotextile meet the properties specified in this paragraph.

(2) One square yard sample of the geotextile fabric.

e. Cost. - Slope preparation, excavation, and backfill, and cover material are separate items whose measurement and payment are included in paragraph 4.2.2.

f. Measurement and payment. -

(1) Riprap. - Measurement, for payment, of riprap will be made to the neat lines of the riprap to be placed as shown on the drawings.

Payment for riprap will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of procuring or furnishing, hauling, and placing the rock for riprap, including the rock spalls and gravel to fill the voids in the riprap

(2) Geotextile filter fabric. - Measurement, for payment, of geotextile filter fabric will be made to the lines of the geotextile filter fabric as actually placed, as shown on the drawings. Overlaps of geotextile filter fabric shall not be included in the measurement for payment

Payment for geotextile filter fabric will be made at the unit price per square yard bid therefor in the schedule, which unit price shall include the cost of furnishing, hauling, and placing the fabric.

4.2.2 CONSTRUCTION OF ROADWAY AND DIKE EMBANKMENT

a. General. - Embankments shall be constructed to the established lines and grades which, in general, will be the lines and grades shown on the drawings, increased by such heights and widths as necessary to allow for settlement. The embankments shall be maintained by the Contractor to proper heights, dimensions, and slopes until the final completion and acceptance of all of the work under the contract.

b. Materials. - Materials for construction of roadway and dike embankment shall be the common backfill described in paragraph 3.3.2. Clods or hard lumps of earth having maximum dimensions of more than 8 inches shall be broken up before or after being placed on the embankments. Cobbles or rocks more than 6 inches in size shall not be placed in the upper 12 inches of embankments. The Contractor may elect to remove the oversize material from material to be placed in the upper 12 inches of embankments by raking or other approved methods. Where there is a choice of materials, the best shall be used on the top of embankments for at least 12 inches in depth.

No material shall be placed in the embankments when either the material or the surface on which it is placed is frozen.

c. Construction. - All material shall be deposited in embankments so that rock, cobbles, and gravel will be well distributed through the other materials and not nested in any position within or under the embankments. Embankments formed of rock shall be built carefully so that the large rock will be well distributed and the unfilled spaces shall be filled completely with smaller rock and earth so as to form a dense, stable embankment. Where directed, rock shall be deposited within the outer portions of embankments to protect the slopes against erosion. The combined excavation and placing operations shall be such that the materials in the embankment will be blended sufficiently to secure the best practicable degree of compaction and stability, and for this purpose the Engineer may designate the locations in the embankment where the individual loads shall be deposited.

Embankments shall be placed in continuous, approximately horizontal layers not more than 8 inches in loose thickness prior to being compacted. The layers shall be carried across the entire width of the embankments and shall be built to the required slopes and not widened with loose material from the top. The Contractor shall route his hauling equipment over the layers already in place and shall distribute the travel evenly over the entire width of the embankment so as to obtain the most practicable compacting effect of the equipment. The embankments shall be compacted to 95 percent of laboratory maximum density in accordance with paragraph 3.1.1.

The slopes of embankments shall be reasonably true to line and grade. Where directed, side slopes shall be left rough to facilitate natural revegetation. All projections of more than 6 inches and which may puncture the geotextile filter fabric outside of the neat lines of slopes on which rock riprap is to be placed shall be removed at the Contractor's expense before the fabric is placed.

Where pipe culverts are to be constructed in the roadway embankments, embankment construction operations shall be performed to accommodate the culvert construction as described in paragraph 4.2.4.

d. Measurement and payment. - Measurement, for payment, for furnishing and placing roadway and dike embankment will be measured to the cubic yard to the final neatline dimensions of embankment actually placed.

Payment for furnishing and placing roadway and dike embankment will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of all work required by this paragraph, including the cost of excavation from the borrow area and transportation of materials to the site. The unit prices shall also include the cost of all labor, equipment, materials, temporary construction and all other work necessary to procure, deliver, place, and compact roadway and dike embankment materials.

4.2.3 CRUSHED-GRAVEL OR CRUSHED-ROCK SURFACING

a. General. - The surfacing for the roadway shall consist of a crushed-rock base, as shown on the typical cross section on the drawings. All materials for the roadway surfacing shall be furnished by the Contractor. Equipment not suitable to produce the quality of work required for the surfacing will not be permitted to operate on the work. The Contractor shall place crushed-gravel or crushed-rock surfacing where shown on the drawings or as directed. Mineral aggregate for crushed-gravel or

crushed-rock surfacing, water, and soil binder, if required, shall be furnished by the Contractor.

b. Materials. - The source of supply of each of the materials furnishe the Contractor shall be subject to approval of the Engineer before the delivery is started. Only approved materials conforming to the requirements of these specifications shall be used in the work. All materials proposed for use may be inspected or tested at any time during their preparation and use. If, after trial, it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources.

No material which, after approval, has in any way become unfit for use shall be used in the work. ASTM D 1241, type I, gradation C, surface-course materials shall be used, except that a minimum of 8 percent shall pass the No. 200 sieve in lieu of the minimum percentage shown in Table 1 of ASTM D 1241 for gradation C, and the material passing the No. 40 sieve shall have a maximum liquid limit not greater than 25 and a plasticity index not less than 4 nor greater than 9 in lieu of the limits specified for fine aggregate.

TABLE 4C
GRADATION REQUIREMENTS CRUSHED ROCK SURFACING

	Weight Percent Passing Square Mesh Sieves Type I
Sieve Size (Square Openings)	Gradation C
2-in. (50-mm)	...
1-in. (25.0-mm)	100
3/8-in. (9.5-mm)	50 to 85
No. 4 (4.75-mm)	35 to 65
No. 10 (2.00-mm)	25 to 50
No. 40 (425-μm)	15 to 30
No. 200 (75-μm)	* 8 to 15

* Not as it appears in ASTM D 1241.

c. Quality. - When subjected to the Los Angeles abrasion test ASTM C 131, the aggregate shall have a loss, using grading A, not to exceed 50 percent, by weight, at 500 revolutions. The Engineer may test the aggregate, and the Contractor shall provide such facilities as may be necessary for procuring representative test samples.

d. Placing. - Before surfacing material is placed, the subgrade shall be made to conform to prescribed grades and cross sections by means of blade graders or motor patrols and shall be compacted so that surfacing material, when placed, will not mix with the subgrade material. The surfacing material shall be spread on the prepared subgrade to such depth that, when thoroughly compacted, it will conform to the prescribed grades and dimensions. Depositing and spreading the material shall commence at the point farthest from the point of loading and shall progress continuously without breaks, except as otherwise directed. The material shall be deposited and spread in a layer of uniform thickness and of such depth that

after being compacted the layer will be of the required thickness. All material placed shall be well graded and void of any gravel pockets.

e. Compacting. - Rolling of the material shall commence immediately after it has been mixed as described above. Rollers shall weigh from 7 to 12 tons and shall be of the steel, smooth-wheel type. Rolling shall commence at the outer edges and shall progress toward the center of the roadway. Under no circumstances shall the center of the road be rolled first. Sufficient water to obtain compaction shall be applied during the rolling operations. The base course shall be rolled until it is compacted thoroughly and is true to grade and cross section.

f. Measurement. - Crushed-gravel or crushed-rock surfacing will be measured for payment to the nearest cubic yard to the neat lines of the surfacing shown on the drawings and along the length of roadway actually surfaced.

g. Payment. - Payment for crushed-gravel or crushed-rock surfacing will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of preparing the subgrade; furnishing all materials, including binder and water incorporated with the mineral aggregate, but exclusive of water applied to base course material after the material has been spread on the roadbed; hauling, placing, blading, mixing, and compacting the crushed-gravel or crushed-rock surfacing; and all incidental work connected therewith. Payment for water furnished and applied to base course material after the material has been spread on the roadbed will be made as provided in paragraph 2.1.1.

4.2.4 PIPE CULVERTS

a. General. - The Contractor shall furnish and install culverts of corrugated metal pipe where shown on the drawings.

The lengths of pipes shown on the drawings are only approximate and the actual length of pipe to be used at each culvert site will be fixed according to the existing field conditions at the site and such final lengths will be determined in the field by the Engineer.

b. Corrugated metal pipe. - Corrugated metal pipe shall be fabricated with 2-2/3- by 1/2-inch annular or helical corrugations. Pipe sizes shall be as designated on the drawings.

Galvanized corrugated steel pipe and connecting bands for culverts shall be in accordance with AASHTO M36 or ASTM A 760 Type I.

The Contractor, at it's option, may furnish corrugated aluminum alloy pipe and connecting bands. Aluminum alloy pipe and connecting bands shall be in accordance with AASHTO M196 or ASTM B 745 Type I.

Each culvert shall be constructed of pipe of the same metal. Coupling bands shall have either closed-cell expanded rubber gaskets or rubber O-ring gaskets.

Ends of aluminum alloy pipe which are to be embedded in concrete headwalls shall be bituminous coated.

Pipe sizes and plate thicknesses shall be as designated on the drawings.

c. Excavation and bedding. - When the surface of roadway embankment in which a pipe culvert is to be placed has reached an elevation approximar 1/4 the diameter of the pipe above the prescribed elevation of the inve of the pipe, the embankment material shall be excavated carefully to the established lines and grades to provide a firm and uniform bearing for the entire length of the pipe.

In original ground, the trenches for pipe shall be excavated to a bottom width equal to the diameter of the pipe plus 1 foot and to slopes of 1:1. The trenches in which pipe is to be laid shall be excavated carefully to the established lines and grades to provide a firm and uniform bearing for the entire length of the pipe. Where rock is encountered in the bottom of a trench, the trench shall be excavated to a depth of 6 inches below the grade established for the bottom of the pipe, and this additional excavation shall be backfilled with approved material which shall be tamped thoroughly in place before the pipe is laid. Where the character of the material at any point in the bottom of a trench is such as might cause unequal settlement or provide unequal bearing for the pipe, the unsuitable material shall be removed to such depth as may be directed by the Engineer and the additional excavation shall be backfilled with approved material which shall be tamped thoroughly to ensure an even and unyielding foundation for the pipe.

d. Handling and laying corrugated metal pipe. - The pipe shall be hauled and handled in such a manner as to avoid damaging the zinc coating. Where field cutting is performed or where the galvanized coating is damaged, the coating shall be repaired by application of two coats of zinc-dust chlorinated rubber priming paint, in accordance with the manufacturer's recommendations. Any pipe unit that, in the opinion of the Engineer, is damaged beyond repair in hauling, handling, or otherwise shall be removed from the site of the work and replaced.

The pipe shall be laid to the established lines and grades with the separate sections joined firmly together by means of connecting bands furnished for that purpose, with the outside laps of circumferential seams pointing upgrade, and with the longitudinal seams out of the invert.

e. Backfilling. - As each unit of pipe is laid, sufficient backfill material shall be tamped under and about the pipe to hold it rigidly in place until the joints are completed. After the joints have been completed, the backfilling shall be completed to a depth of 2 feet over the top of a culvert, or to the road subgrade if less than 2 feet of cover is available, to a top width equal to the outside width of the barrel of the culvert and within planes sloping at 1:1 from the edges of such top width to intersections with the original ground surface, surface of excavation for the culvert, or to intersections with the elevation at the bottom of the culvert where the bottom is above the original ground surface.

The material used for backfill, the amount thereof, and the manner of depositing the material shall be subject to approval. Insofar as practicable, backfill material shall be obtained from material moved in excavating for culverts.

The material to be compacted shall be deposited in approximately horizontal layers which shall be not more than 8 inches in thickness prior to compaction and the layers shall be moistened or dried as required. After each layer of material has been conditioned to have the best practicable moisture content for compaction, it shall be thoroughly compacted to the degree of compaction required for adjoining embankments by the use of hand or power tampers or other suitable compacting equipment. Special care shall be taken to ensure thorough compaction of material beneath the

haunches of the culverts. The material shall be brought up uniformly on both sides of the culvert.

Travel of loads up to the design loading of H-20 over the culverts will not be permitted until the backfill and embankment material have been placed to a depth equal to at least 1/8 of the culvert span, limited to a minimum of 1-1/2 feet, over the top of the pipe or such minimum which may be recommended by the pipe manufacturer. This minimum cover requirement is not always adequate during construction when equipment heavier than the design traffic load is routed over or close to the installed culverts. The Contractor shall be responsible for providing the additional cover necessary to avoid damage to the pipes due to construction equipment loads.

f. Measurement and payment. - Measurement, for payment, for furnishing and installing 24 inch corrugated metal pipe will be made to the nearest foot along the centerline at midheight of the pipe, from end to end of the pipe in place and no allowance will be made for lap at joints.

Payment for furnishing and laying 24-inch diameter corrugated metal pipe will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and attaching the connecting bands with gaskets, backfill, excavation, compaction, etc.

SECTION 4.3 - GENERAL CONCRETE REQUIREMENTS

4.3.1 GENERAL

The Contractor shall furnish all materials for use in concrete, including cementitious materials, water, sand, coarse aggregate, and specified admixtures; and shall furnish all reinforcing bars and materials for curing concrete.

4.3.2 SUBMITTALS

Submittals shall be in accordance with this paragraph and paragraphs 4.3.7 and 4.3.4.

a Approval data. - Thirty days prior to placement of concrete, the Contractor shall submit to the Government the name and manufacturer of each cementitious material, admixture, curing compound, and aggregate source. The Government reserves the right to require submission of manufacturer's test data and certification of compliance with specifications, and to require submission of samples of all concrete materials for testing prior to or during use in concrete.

b. Mix design. - The Contractor shall submit each concrete mix design for approval prior to the use of the concrete mix.

4.3.3 MATERIALS

a. Cement. - Portland cement shall meet the requirements of ASTM C 150 for types I and II portland cement except that the maximum percent of tricalcium aluminate allowable in type I cement shall be 15 percent and shall meet the low-alkali and false-set limitations specified therein. The low-alkali limitation for cement may be waived on request if the sand and coarse aggregate do not contain objectionable quantities, as determined by the Engineer, of potentially alkali-reactive particles defined by mortar bar tests and complete petrographic analyses of the proposed aggregate. If the Contractor requests waiver of the low-alkali limitation, he will be

required to submit petrographic analyses satisfactory to the Engineer unless such analyses have been performed by the Bureau of Reclamation. The cement shall be free from lumps and contamination by water and other foreign matter when used in concrete.

b. Pozzolan. - Pozzolan shall meet the requirements of ASTM C 618 for class N, F, or C with the following additional requirements:

(1) The maximum percent of sulfur trioxide shall be 4 percent for classes F and C.

(2) The maximum percent loss on ignition shall be 8 percent for class N and 2.5 percent for classes F and C.

(3) The pozzolanic activity index with lime shall be determined using 2-inch cubes, and the minimum strength at 7 days shall be 900 pounds per square inch.

(4) Unless the Contractor selects aggregates which are not potentially alkali reactive, pozzolan shall be tested for reduction or mortar expansion at 14 days as specified for class N pozzolan under the optional physical requirements in ASTM C 618. However, the cement used in the test shall be low alkali. For the pozzolan to be acceptable, it shall result in an expansion reduction of zero percent or greater when compared to the control test.

(5) Pozzolan shall not decrease the sulfate resistance of concrete. Before a class N pozzolan is used, it shall be shown by test and experience not to detract from sulfate resistance. Before a class F or C pozzolan is used, it will be shown to have an "R" factor less than 2.5. "R" is defined as (C-5)/F where C is the calcium oxide content of the pozzolan in percent, and F is the ferric oxide content in percent, determined in accordance with ASTM C 114.

c. Water. - Water shall conform to ASTM C 94, paragraph 4.1.3.1 (including table 1).

d. Sand and coarse aggregate. - Sand and coarse aggregate shall consist of clean, hard, dense, durable, uncoated rock fragments that are free from injurious amounts of dirt, organic matter, and other deleterious substances. Sand and coarse aggregate shall meet all requirements of ASTM C 33. Coarse aggregate shall conform to ASTM C 33 gradings for either size No. 467 (1-1/2 inches to No. 4 United States Standard sieve) or size No. 57 (1 inch to No. 4).

e. Air-entraining admixture. - The air-entraining admixture shall conform to ASTM C 260: Provided, That air-entraining admixture used with type F or G chemical admixture shall be a neutralized vinsol resin formulation.

f. Chemical admixture. - Chemical admixtures which will introduce more than 1/10 of 1 percent chloride, by weight, of cementitious materials shall not be used in concrete for prestressed concrete, bridge decks, or concrete in which aluminum, galvanized metalwork, or other dissimilar steel is to be embedded.

(1) The Contractor may use water-reducing or water-reducing, set-controlling chemical admixtures which conform to ASTM C 494, type A, D, F, or G.

(2) The Contractor may use chemical admixtures for producing flowing concrete which conforms to ASTM C 1017 for type 1 or 2.

g. Reinforcing bars. - Reinforcing bars shall be deformed reinforcement bars conforming to ASTM A 615 or A 617, grade 60. Fabric shall be electrically welded-wire fabric conforming to ASTM A 185 or A 497.

h. Curing compound. - Curing compound shall be a liquid membrane-forming compound in accordance with ASTM C 309. Curing compound shall be of uniform consistency and quality within each container and from shipment to shipment.

i. Polyethylene film. - Polyethylene film for curing concrete shall be white in color, shall be 4 mils thick, and shall conform to the requirements of ASTM C 171.

4.3.4 COMPOSITION

Unless otherwise directed, the Contractor shall design the concrete mix in accordance with these specifications. Pozzolan, as specified, is an acceptable partial replacement for cement and if used shall replace 20 percent, by weight, of cement. Mix designs shall provide for the minimum cementitious materials contents listed in Table 4D.

Table 4D. - Minimum cementitious materials content

Nominal maximum size aggregate in concrete	Minimum cementitious materials content without water-reducing admixture	Minimum cementitious materials content with water-reducing admixture
1-1/2 inches	565 lb/yd³	535 lb/yd³
1 inch	620 lb/yd³	585 lb/yd³
3/4 inch	658 lb/yd³	625 lb/yd³

Each mix design shall be submitted to the Engineer for review prior to use of the concrete mix. See paragraph 4.3.2.

The Engineer will test concrete for compliance with specifications and reserves the right to design and adjust the concrete mix proportions.

Air-entraining admixture shall be used in such an amount as will effect the entrainment of from 4 to 6 percent air, by volume, of the concrete as discharged at the placement.

The slump of the concrete shall not exceed 3 inches plus or minus 1 inch when placed, nor 5 inches when first mixed, unless a type 1 or 2 plasticizing chemical admixture is used to produce flowing concrete for an unusual placing condition. Then the slump shall be appropriate for the placing conditions.

Chemical admixtures which conform to ASTM C 494 for type C or E, including calcium chloride, shall not be used in concrete.

4.3.5 BATCHING, MIXING, AND TRANSPORTING

Concrete shall be manufactured and delivered in accordance with ASTM C 94, "Standard Specifications for Ready Mixed Concrete."

When delivered at the jobsite, each batch of concrete shall be accompanied by a batch ticket in accordance with ASTM C 94. The batch ticket shall be delivered to the Engineer's representative at the jobsite as each batch is delivered.

4.3.6 CONCRETE PLACEMENT, CURING, AND PROTECTION

Steel reinforcing bars shall be placed as shown on the drawings. Before reinforcement is placed, the reinforcement shall be cleaned of heavy, flaky rust; loose mill scale; dirt; grease; or other foreign substances. Reinforcement shall be accurately placed and secured in position so that it will not be displaced during the placing of concrete.

Forms shall be used to shape the concrete to the required lines. Exposed unformed surface shall be brought to uniform surfaces and given a reasonably smooth, wood-float or steel-trowel finish as directed.

The temperature of the concrete when it is being placed shall be not more than 90 °F and not less than 50 °F.

The concrete shall be cured with curing compound. Curing compound shall be applied in accordance with the manufacturer's instructions.

The Contractor shall protect all concrete against injury until final acceptance by the Government. The concrete shall be maintained at a temperature not lower than 50 °F for at least 72 hours after it is placed. In addition, the concrete shall be maintained above freezing for the next 72 hours. Where artificial heat is employed, special care shall be taken to vent the heater and to keep the concrete from drying.

4.3.7 REPAIR OF CONCRETE

a. General. - Concrete shall be repaired in accordance with this paragraph, and Bureau of Reclamation "Standard Specifications for Repair of Concrete," dated March 1, 1990.

b. Submittals. - Submittals shall be in accordance with paragraph 1.1.4 and the "Standard Specifications for Repair of Concrete."

c. Method of repair or replacement. - The method of repair or replacement shall be as determined and directed by the Engineer and in accordance with the "Standard Specifications for Repair of Concrete."

d. Cost. - The cost of furnishing all materials and performing all work required in the repair of concrete shall be borne by the Contractor.

4.3.8 PAYMENT

a. Concrete. - Payment for concrete will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of furnishing all materials and performing all work required for concrete construction, including furnishing and placing reinforcing bars and fabric.

The item of the schedule for concrete includes all concrete required under these specifications except for the items listed in subparagraph b. below.

b. Cost. - The cost of the following items of concrete, including cement or cementitious materials as applicable, and reinforcing bars shall be included in the applicable prices bid in the schedule for work where they are required.

(1) Concrete required for fences.

(2) Concrete lining for ditch.

SECTION 4.4 - STRUCTURES

4.4.1 CONSTRUCTION OF STRUCTURES

Cast-in-place concrete for the structures shall conform to the requirements of section 4.3. Pipe and fittings, miscellaneous metalwork, mechanical equipment, and other items forming a part of the structures are provided for elsewhere in these specifications.

The structures shall be built to the lines, grades, and dimensions shown on the drawings. The dimensions of each structure as shown on the drawings will be subject to such modifications as may be found necessary by the Engineer to adapt the structure to the conditions disclosed by the excavation or to meet other conditions. Where the thickness of any portion of a concrete structure is variable, it shall vary uniformly between the dimensions shown. The Contractor shall place and attach to each structure, all timber, metal, and other accessories necessary for its completion, as shown on the drawings.

Exposed edges of concrete shall be protected against damage prior to acceptance of work. Any damage to concrete due to failure of the Contractor to provide adequate protection shall be repaired by the Contractor, at the Contractor's expense prior to acceptance.

The cost of furnishing all materials and performing all work for installing timber, metal, and other accessories for which specific prices are not provided in the schedule shall be included in the applicable prices bid in the schedule for the work to which such items are appurtenant.

SECTION 4.5 - CAP

4.5.1 CAP INSTALLATION

a. General. - The cap shall consist of a geosynthetics portion overlain by earth materials as specified in Division 3 of these specifications. The earth materials within the upper areas of the cap and overlying the geosynthetics portion shall consist of an 18 inch select fill layer, as described in paragraph 3.3.4, and a 6 inch layer of topsoil as described in paragraph 3.3.5, and as shown on drawing 1556-418-13. Within the sloped areas as shown on drawings 1556-418-24 and 1556-418-11, the geosynthetics portion of the cap shall be overlain by a structural fill material as described in paragraph 3.3.3, and a 6 inch layer of topsoil as described in paragraph 3.3.5.

The geosynthetics portion shall consist of a geosynthetic clay liner (GCL) as specified in paragraph 4.5.2 and placed directly on the graded contaminated material. Overlying the GCL shall be a geomembrane liner as specified in paragraph 4.5.3. Overlying the geomembrane shall be a geocomposite drain as specified in paragraph 4.5.4.

All work shall be performed in strict accordance with the geosynthetic manufacturer's recommendations, as shown on the drawings, and as described in these specifications.

b. Interface Friction Testing. - The Contractor shall perform laboratory interface friction tests on all cover system interfaces using GRI GS6. Normal stresses of 2.0, 4.0, and 6.0 psi along with a displacement rate of 0.002 inches per minute shall be used. All cover system soil components shall be compacted to the same moisture-density requirements specified for full scale field placement and saturated prior to shear. All geosynthetics shall be oriented such that the shear force is parallel to the downslope orientation of these components in the field. For cover system component destined for slopes steeper than 4.25 horizontal to 1 vertical, a minimum interface of 17 degrees is required, including a saturated GCL. A minimum of 15 degrees is required between all cover system components for the remainder of the cap, with the exception of saturated GCL placed within areas with slopes less than 7 horizontal to one vertical, which shall require a minimum interface of 7 degrees. These tests shall be performed by a laboratory approved by the Engineer. All results shall be submitted and approved by the Engineer prior to delivery of any cover system component.

c. Cap installment layout drawing. - The Contractor shall submit within 20 days after notice to proceed, a detailed 'cap installment' layout drawing of the cap extents outlining specific zones, including state plane coordinates for all corners of the zones. Each of these zones shall be individually labeled. No less than 5 zones, and no greater than 50 zones will be required.

The extents for the cap installment layout drawing shall include all areas to be covered with capping materials, with the exception of the areas to be covered with structural fill along the combination 2 horizontal and 3 horizontal to 1 vertical slopes as shown on drawing 1556-418-11.

d. Geosynthetic Anchor Trenches. - No specific anchor trench designs are provided. The Contractor shall ensure through its construction methods and as recommended by the geosynthetics manufacturers, that tensile forces are restricted. The anchor trenches (if required) shall be excavated as recommended by the manufacturers of the GCL, textured geomembrane liner, geomembrane liner, TNT geocomposite drain, and geocomposite drain. No more than the amount of trench required for the geosynthetics to be anchored in

one day shall be excavated. No loose soil, rocks or debris shall underlie the geosynthetics in the trench. Leading edges of the trench shall be smooth and even. After placement of the GCL and any other required geosynthetics (e.g. geomembrane, geotextile, geonet, etc), the trench shall be backfilled and compacted with suitable materials in accordance with these specifications.

e. Warranties. - The Contractor shall procure written warranties addressing all geosynthetic clay liner(GCL), geomembrane, and geocomposite drain materials and installation workmanship. Warranty(s) shall be submitted to UDEQ and approved by the Engineer. The warranty(s) shall be transferrable to the property owner(s). The manufacturer's warranty(s) shall state that the installed material(s) meets all requirements of the contract drawings and specifications that under typical local atmospheric conditions and weather aging, the material(s) is/are warranted for 20 years. The installer's warranty(s) shall state that the material(s) field and factory seams (if required) will not fail within 2 years of the installation under similar conditions.

f. Delivery, Storage, and Handling of Geosynthetics. - Geosynthetics, including GCL, geomembrane, and geocomposite drain materials, shall be delivered only after the required submittals have been received and approved by the Engineer. In the event geosynthetics are stored on-site, they shall be kept dry at all times and shall be stored off the ground. Geosynthetics shall be adequately protected from puncture, abrasion, adhesion of individual layers or other damaging circumstances, ultraviolet exposure, excessive heat, precipitation, contamination, from dirt, debris, etc., or any other damaging circumstances. Geosynthetics rolls or panels shall be marked with the following information: a) manufacturer's name, b) product identification, c) lot number, d) roll number, e)roll dimensions and f) date manufactured. The Contractor shall preserve the integrity and readability of all geosynthetic roll labels. Appropriate handling equipment and techniques, as recommended by the manufacturer and approved by the Engineer shall be used. Any geosynthetic damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the Engineer, at no additional cost to the Government.

g. Submittals. -

(1) Cap installment layout drawing. - The Contractor shall submit a cap installment layout drawings as specified above in subparagraph c. of this paragraph.

(2) Cap area completion notice. - Upon completion of a zone, the Contractor shall submit a cap area completion notice to the Engineer, which shall include the zone label and the surveyed square yardage.

(3) Interface friction testing. - Prior to delivery of geosynthetics to the site the Contractor shall submit to the Engineer for approval the results of interface friction testing as described in this paragraph.

h. Measurement and Payment. - Measurement, for payment, of geosynthetic clay liner(GCL)(4.5.2), textured geomembrane liner(4.5.3), and TNT geocomposite drain(4.5.4) materials placed on the 2 horizontal to 1 vertical slope will be made to the nearest square yard of the material measured in place. Overlaps and remnants of these materials listed above and as specified herein and on the drawings, will not be included in the measurement for payment.

Measurement, for payment, of GCL(4.5.2), geomembrane liner(4.5.3), and geocomposite drain(4.5.4) material within the cap installment zones as

specified will be made to the nearest square yard measured in place according to the Contractor's submitted and approved cap installment lay drawing. Overlaps and remnants of these materials listed above and as specified herein and on the drawings, will not be included in the measurement for payment.

Final payment for GCL(4.5.2), textured geomembrane liner(4.5.3), geomembrane liner(4.5.3), TNT geocomposite drain(4.5.4), geocomposite drain(4.5.4) materials will be made at the unit price per square yard bid therefor in the schedule for each bid item, less adjustments for progress payments per square yard previously paid for each bid item. However, final payments for GCL, geomembrane liner, and geocomposite drain materials placed within the cap installment zones as specified will be withheld until completion of the select fill as specified in paragraph 3.3.4 within each cap installment zone. Unit price shall include the cost of furnishing, hauling, and placing each of the above listed materials on all portions of the cap.

GCL, geomembrane liner, and geocomposite drain materials delivered to the site may be included in monthly progress payments for up to 80 percent of the Contractor's cost of procuring the GCL, geomembrane liner, and geocomposite drain materials including delivery, Provided; That (1) the Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material shall be used to perform the contract, (2) it submits a signed invoice including the price per square yard and quantity amounts, and (3) the quantity is approved by the Engineer. No payment will be made for materials not used in the completion of the project.

Measurement and payment for select fill will be as specified in paragraph 3.3.4.

Measurement and payment for topsoil will be as specified in paragraph 3.3.5.

4.5.2 GEOSYNTHETIC CLAY LINER

a. General. - This paragraph includes the requirements for the geosynthetic clay liner (GCL) portion of the cap. The Contractor shall furnish, protect, and install the GCL. At the Contractor's option, it may furnish and install a GCL sodium bentonite blanket meeting these specifications as established in this paragraph, overlain by a separately furnished and installed geomembrane liner as specified in paragraph 4.5.3, or it may utilize an alternative GCL according to GCL Alternative 1 as described below.

b. Material. - The active ingredient of the GCL shall be natural sodium bentonite.

The bentonite shall be encapsulated between two polypropylene textiles. Where placed on slopes greater than 7 horizontal to 1 vertical, the GCL shall be mechanically bonded by needle punch or lock-stitch with high strength polypropylene thread to provide internal shear strength reinforcing. The internal shear reinforcing mechanism shall resist failure due to thread pull-out over long term creep situations.

The bentonite and textiles used to manufacture the GCL shall have the properties as defined in Table 4E. The final GCL product shall have the properties defined in Table 4F.

Table 4E

Property	Test Method	Value	Units
BENTONITE			
Free Swell	USP-NF-XVII	24	ml
Plate Water Absorption	ASTM E946	750	%l
pH	ASTM D 4972	8 to 11	
TEXTILE BACKINGS			
Weight	ASTM D 3776	3.0	oz/square yard
Grab Tensile	ASTM D 4632	90	lb
Mullen Burst	ASTM D 3786	150	lbs/square inch

Table 4F

Property	Test Method	Value	Units	Min. Test Frequency*
Bentonite Content at 20% Moisture Content	Weigh 12" X Roll Width	1.0	lbs/square foot	1/20,000 square feet
Permeability under 5 psi effective confining pressure	ASTM D 5084	$5X10^{-9}$	cm/sec	1/1,000,000 square feet
Overlap Seam Permeability under 5 psi effective confining pressure	ASTM D 5084	$5X10^{-9}$	cm/sec	1/1,000,000 square feet
Hydrated Internal Residual Shear Resistance (min)	ASTM D 5321	15 or 17**	degrees	Periodic

* Values represent Engineer's quality assurance test frequency. Contractor's frequency will depend on Contractor's quality control plan.
**see Paragraph 4.5.1

The bentonite shall be continuously adhered to both geotextiles to ensure that the bentonite will not be displaced during handling, transportation, storage, and installation, including cutting and patching.

The bentonite sealing compound or bentonite granules used to seal penetrations and make repairs shall be made of the same natural sodium bentonite as the GCL and shall be as recommended by the GCL manufacturer.

At the Contractor's option, GCL Alternative 1 as listed below may be used in lieu of the GCL as specified:

GCL Alternative 1. - A GCL geocomposite which utilizes a 20 mil geomembrane in lieu of the geotextiles as specified, Provided: That; the sodium bentonite portion of the GCL as specified is sufficiently adhered to the geomembrane, and meets the same material property and applicable installation requirements, including; free swell, plate water absorption, pH, bentonite content at 20 percent moisture content, confined swell, permeability under 5 psi effective confining pressure, and internal shear resistance; meets the same overlap requirements as specified; the bentonite is encapsulated by the 20 mil geomembrane and a lightweight, heat bonded, non-woven (parasol) geotextile; is applied with the geomembrane side facing toward the contaminated materials; and is approved by the Engineer 30 days prior to delivery on the site. The separately furnished and installed geomembrane as specified in paragraph 4.5.3 is required for this option.

The manufacturer of the GCL shall have a minimum of 5 years of continuous experience in the manufacture of similar GCL products.

c. Surface Preparation. - Surface preparation shall be performed to the requirements of the drawings, this paragraph, and paragraph 3.2.3. The subgrade shall be prepared in a manner consistent with proper subgrade preparation techniques for the installation of geosynthetic materials. The subgrade shall be properly compacted consistent with paragraphs 3.1.1 and 3.2.3 so as not to settle and cause excessive strains in the GCL or other synthetic liner materials. The Contractor shall ensure that rutting or ravelling is not caused by installation equipment. The Contractor shall ensure that the subgrade has been rolled to provide a smooth surface which is free of debris, roots, or angular stones larger than 3/4 inch.

The surface of the subgrade to a minimum depth of 3 inches shall be dry.

The subgrade surface shall be observed daily by the Engineer and the Contractor to evaluate the surface condition. Any damage to the subgrade caused by the Contractor's operations shall be repaired at no additional cost to the Government. Immediately prior to GCL placement, the Engineer and Contractor shall certify in writing that the surface on which the GCL is to be placed is acceptable.

Final approval of all subgrades will be made by the Engineer.

d. Deployment. - The GCL shall be placed with minimum handling. Any portion of the GCL damaged during installation shall be removed or repaired, at the Engineer's discretion and as specified herein. Only those panels/sheets that can be anchored/ballasted and covered completely by the geomembrane the same day shall be deployed. Any equipment used shall not damage the GCL. No vehicular traffic will be allowed directly on the GCL.

The Contractor shall require the GCL manufacturer to furnish the services of a competent, factory trained, field technical representative to supervise installation of the GCL. The Engineer may excuse the manufacturer's representative, Provided, That; it is determined by the Engineer that the Contractor's or installer's personnel are competent in the installation; the manufacturer submits in writing, its approval of the personnel; and warranties the GCL as installed. However, the manufacturer's representative, if excused, shall be available at the site within 36 hours if required by the Engineer.

All equipment, tools, and machines used in performance of the work shall be subject to approval prior to commencement of work by the Engineer. This

equipment shall be maintained in satisfactory working conditions at all times.

All personnel working on the GCL shall not smoke or wear shoes that could puncture or otherwise damage the GCL.

The method used to unroll the panels/sheets shall not scratch, crimp or excessively elongate the GCL and shall not detrimentally rut the subgrade soil. The method used to place the panels/sheets shall prevent wrinkles. All panels/sheets shall be oriented so as to minimize the number of horizontal seams on slopes. All GCL panels/sheets shall be shingled, with the up-gradient panel/sheets overlying any lower panels/sheets. Adequate ballast (e.g., sand bags) shall be placed on the GCL to prevent uplift by wind without damaging the GCL.

GCL shall be placed only when the temperature is above 35 degrees Fahrenheit and rising. In no case shall the GCL be installed or left exposed in wet weather conditions (e.g., rain, snow, hail). In the event the sodium bentonite within the GCL becomes hydrated prior to the complete covering by the geomembrane, the GCL shall be removed, disposed of, and replaced at the expense of the Contractor.

e. Overlaps. The GCL shall be overlapped a minimum distance of 6 inches. The manufacturer shall provide match lines on the GCL to aid the installers in achieving this overlap. In general, no horizontal seams will be allowed on slopes. For GCL's requiring granular bentonite at the seams, the amount applied will be at the rate and quantity recommended by the manufacturer.

At all slope transitions, the underlying overlap shall be a minimum of 2.5 feet.

f. Defects and Repairs. -

(1) Identification. - Immediately prior to covering the GCL, all seams and non-seam areas shall be visually inspected by the Engineer for defects, holes, or damage due to detrimental weather conditions or construction activities. The surface of the GCL shall be brushed, or blown by the Contractor if the amount of dust, mud, or other foreign material inhibits inspection or functioning of the overlying material.

(2) Repair Procedures. - For defective GCL areas, the defective area shall be overlaid with a patch of the same material extending at least 1 foot beyond the flaw or damaged area. The Contractor shall ensure by either sewing or other approved method, that the GCL repair section will not migrate under any circumstances.

g. Delivery, Storage, and Handling. -

(1) Packing and Shipping. - GCL shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers. GCL rolls shall be marked or tagged with the following information: (1) Manufacturer's name; (2) Product identification; (3) Roll number; (4) Roll dimensions; and (5) Roll weight.

(2) Storage and Protection. - The Contractor shall provide on-site storage area for GCL rolls from time of delivery until installed. After mobilization, the Contractor shall store and protect GCL from dirt, water, ultraviolet light exposure, and other sources of damage. The Contractor shall preserve the integrity and readability of GCL roll labels.

h. Submittal. - At least 30 days prior to delivery to the site the Contractor shall submit to the Engineer the following:

(1) Manufacturer's qualifications, Quality Control Manual, and product literature which displays the manufacturers ability to produce the geocomposite material as specified. Manufacturer's material property certifications certifying the product meets specifications shall also accompany each shipment.

(2) GCL and geotextile property test specifications.

(3) Name of testing laboratory.

(4) One square foot sample.

i. Measurement and Payment. - Measurement and payment, of geosynthetic clay liner(GCL) will be as specified in paragraph 4.5.1.

4.5.3 GEOMEMBRANE LINER.

a. General. - The Contractor shall furnish, and install, the geomembrane liner and materials incident thereto, and the geomembrane liner with roughened surface texture (textured) and materials incident thereto. The Contractor has the option to select the geomembrane liner material from the options as listed below in subparagraph c. of this paragraph. Geomembrane liner work shall conform to the requirements and specifications presented in this paragraph.

b. Manufacturer and installer qualifications. - The Contractor shall submit to the Engineer the name and address of the geomembrane manufacturer and the name and address of the panel fabricator, if different from the manufacturer.

(1) Manufacturer. - The geomembrane manufacturer shall have experience in the manufacture of the geomembrane as specified herein. Experience shall include completed facilities totaling at least 10,000,000 square feet of the Contractor's selected geomembrane.

The Contractor shall provide to the Engineer a list of facilities completed/provided by the manufacturer. Each entry in the list shall specify the name and purpose of the facility, location, geomembrane thicknesses, total square footage of installation, date of installation, owner, project manager, designer, fabricator (if any), and the installer, as well as the name and telephone number of the contact at the facility who can discuss the project.

(2) Installer. - The geomembrane installer's previous experience with the Contractor's selected geomembrane shall consist of least three separate and satisfactory installations totalling at least 5,000,000 square feet.

The Contractor shall provide to the Engineer a list of facilities completed by the installer. Each entry in the list shall specify the name and purpose of the facility, location, geomembrane thicknesses, total square footage of installation, date of installation, owner, project manager, designer, fabricator (if any), and the installer, as well as the name and telephone number of the contact at the facility who can discuss the project.

The Contractor shall provide to the Engineer resume's, including dates and duration of employment and pertinent experience, and

information which shall demonstrate that the installer's onsite personnel have the qualifications required as listed below:

Onsite Geomembrane Installation Supervisor/Field Engineer. - The installation supervisor/field engineer shall have installed or supervised the installation and seaming of a minimum of 2,000,000 square feet of the Contractor's selected geomembrane.

Onsite Geomembrane Master Welder/Seamer. - The master welder/seamer shall have completed within the last 5 years, a minimum of 2,000,000 square feet of the Contractor's selected geomembrane, using the type of seaming apparatus proposed for use on this project. The master welder/seamer may also be the installation supervisor/field engineer.

Other Onsite Geomembrane Welders. - Other welders that will be performing seaming operations on this project shall have seamed, within the past 3 years, a minimum of 100,000 square feet of the Contractor's selected geomembrane.

c. Materials. - The Contractor shall select a non-reinforced geomembrane which meets all specification requirements. The materials used to manufacture geomembrane sheets shall be 100 percent domestic, first-quality raw materials using no more than 2 percent recycled ingredients that originate from the same formulation and the same production lot and which are clean and free of any foreign contaminants. The options, listed below as GL Option A and GL Option B, are:

GL Option A. - GL Option A utilizes a polyethylene geomembrane liner. Resin used in manufacturing polyethylene geomembranes shall have a broad molecular weight distribution, a density of less than 0.920 g/cc, and no more than 6 percent of a higher density resin added which is a carrier for the required 2 to 3 percent carbon black. Textured materials shall contain no more than 7 percent by weight of carbon black and additives. The manufacturer shall provide certification that the raw materials meet or exceed these requirements along with a copy of the quality control certificates.

All sheets and factory seams shall conform to the minimum physical requirements listed in NSF STANDARD 54 for the appropriate material, this specification, and Table 4G as follows. Test values shown in Table 4G, except when specified as minimum or maximum, are typical test values. For materials not included in NSF STANDARDS 54, manufacturer's property specifications shall be substituted.

TABLE 4G - POLYETHYLENE GEOMEMBRANE BARRIER LINER PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE Smooth Geomembrane	TEST VALU Textured Geomembrane
Thickness, mils (nominal)	----------	40	40
Thickness, mils (minimum)	ASTM D 1593	36	36
Density(g/cc) (maximum)	ASTM D 792/1505	0.930	0.930
Tensile Strength at Break, lbs/in	ASTM D 638	126	84
Elongation at Break, %	ASTM D 638	800	400
Multi-axial Tensile Strain, percent, (minimum)	GRI-GM4	20	20
Tear Resistance, lbs.	ASTM D 1004 DIE C	25	25
Puncture Resistance, lbs.	FTMS 101C 2065.1	62	62
Environmental Stress Crack, hours, (minimum)	ASTM D 1693	1500	1500
Low Temperature Brittleness, degrees F, max	ASTM D 746	-50	-50
Seam Shear Strength, lbs./in width, (minimum)	ASTM D 4437	65	65
Seam Peel Adhesion, lbs./in width, (minimum)	ASTM D 4437	50	50

The sheets shall be non-reinforced and uniform in color, thickness, and surface texture. The sheets shall be free of and resistant to fungal or bacterial attack. No fatty acid residues, epoxy, or secondary plastizers shall be used. The sheets shall be free of cuts, abrasions, holes, blisters, contaminants, and other imperfections.

The sheets shall be manufactured in as wide as sheet as possible to minimize factory and field seams and shall be produced in the United States. Where possible, manufactured sheets shall be factory seamed into maximum sized panels so as to minimize field seaming. All factory seaming shall be by methods approved by the geomembrane barrier liner manufacturer. All seams shall meet the minimum shear and peel strength requirements shown in Table 4G. All factory seams shall extend to the end of the sheet so that no unbonded edges greater than 1/8 inch wide are present (top side only).

Polyethylene geomembrane barrier liner shown on the drawings as "textured" shall meet the same specifications as described in this paragraph and shall have the physical properties listed in Table 4G. All polyethylene sheets shall be textured on both faces and aligned on the slope to achieve maximum frictional resistance. The textured surface features shall consist of polymers similar and compatible to that of the base material.

(1) Polyethylene seams. - Polyethylene geomembranes shall be seamed by hot wedge methods. Extrusion welding shall only be allowed for patching and seaming around appurtenances.

If seam overlap grinding is required, the procedure used shall not damage the geomembrane. Grinding marks shall be oriented perpendicular to the seam direction and no marks shall appear beyond 1/4 inch of the extrudate after placement. The depth of the grinding marks shall be no greater than 10 percent of the sheet thickness. Where extrusion fillet welds are temporarily terminated long enough to cool, they shall be ground prior to applying new extrudate over the existing seam.

Test seams shall be made each day prior to production seaming, whenever there is a change in seaming personnel or seaming equipment and at least once every four hours, by each seamer and seaming equipment used that day. One sample shall be obtained from each test seam. This sample shall be at least 36 inches long by 20 inches wide with the seam centered lengthwise. Ten random specimens 1 inch wide shall be cut from the sample. The Contractor shall field test 5 seam specimens for shear strength and 5 seam specimens for peel adhesion using an approved quantitative tensiometer. Jaw separation speed shall be 2 inches per minute. Where necessary, accelerated curing of the test strip seams made by chemical fusion methods, shall be conducted in accordance with GRI GM7. To be acceptable, four out of five replicate test specimens shall meet specified seam strength requirements. If the field tests fail to meet these requirements, the entire operation shall be repeated. If the additional test seam fails, the seaming apparatus or seamer shall not be accepted or used for seaming until the deficiencies are corrected by the Contractor and two successful test seams are achieved.

Solvents, or chemical cleaning agents shall be stored separately away from the panels/sheets and only spill-resistant containers shall be used while working on the geomembrane.

GL Option B. - GL Option B utilizes a 30 mil Polyvinyl Chloride (PVC) geomembrane liner. The PVC geomembrane shall be suitably formulated from domestic, virgin, PVC resin. Plasticizers, stabilizers, and biocides shall be used so as to impart durability and resist migration, mildew, and bacterial degradation. The use of water-soluble compounding ingredients is prohibited. PVC geomembrane liner shall have a dull, matte finish on both sides, and be free of holes, pinholes, blisters, and other defects, and contaminants of any kind including foreign inclusions and nondisbursed raw ingredients. PVC geomembrane liner material shall conform to the minimum material properties requirements of NSF Standard 54, including factory seam requirements.

The sheets shall be manufactured in as wide as sheet as possible to minimize factory and field seams and shall be produced in the United States. Where possible, manufactured sheets shall be factory seamed into maximum sized panels so as to minimize field seaming. Factory seams shall be lap-type seams, with minimum lap of 1/2 inch, shall produce sealed edges on both sides of the seam and shall be of any of the commercially recognized types listed in NSF Standard 54 except tape seams. Factory seams shall comply with the minimum requirements of NSF Standard 54.

PVC geomembrane barrier liner shown on the drawings as "textured" shall meet the same specifications as described for this option. All

textured PVC sheets shall be textured (embossed or file finished) on one side only with the placement of the textured side facing the GCL.

Solvents, or chemical cleaning agents shall be stored separately away from the panels/sheets and only spill-resistant containers shall be used while working on the geomembrane.

d. Surface Preparation. - The subgrade surface shall be observed daily by the Engineer and the Contractor to evaluate the surface condition. Any damage to the subgrade shall be repaired at no additional cost to the Government. Final approval of all subgrades will be made by the Engineer.

e. Panel/Sheet Deployment. - The geomembrane shall be placed with minimum handling. Any portion of the geomembrane damaged during installation shall be removed or repaired, at the Engineer's discretion and as specified herein. Only those panels/sheets that can be anchored/ballasted and seamed together the same day shall be deployed. Any equipment used shall not damage the geomembrane. No vehicular traffic will be allowed directly on the geomembrane.

All personnel working on the geomembrane shall not smoke or wear shoes that could puncture or otherwise damage the geomembrane.

The method used to unroll the panels/sheets shall not scratch, crimp or excessively elongate the geomembrane and shall not detrimentally rut the subgrade soil as determined by the Engineer. The method used to place the panels/sheets shall minimize wrinkles. However, the Contractor, the geomembrane manufacturer, and installer shall coordinate efforts to provide the proper amount of slack in the deployed geomembrane so as to compensate for contraction due to local temperature extremes. All panels/sheets shall be oriented so as to minimize the number of horizontal seams on slopes. Adequate ballast (e.g., sand bags) shall be placed on the geomembrane to prevent uplift by wind without damaging the geomembrane.

Geomembrane deployment shall not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing water, or during high winds. Where weather conditions are marginal for seaming, as determined by the Engineer, test seams, as described in this paragraph shall be made with the Engineer present to decide of production seaming will proceed or continue.

A minimum of one sample per 100,000 square feet shall be sent to the Contractor's separate and independent laboratory for thickness measurements in accordance with ASTM D 1593. Panels/sheets whose mil thickness falls below the specified minimum value shall be rejected and replaced at no additional cost to the Government.

f. Field Seaming. - Test seams shall be made on test strips of geomembrane to verify that seaming conditions are adequate. They shall be made at a location selected by the Engineer in the area to be seamed and in contact with the subgrade.

All panels/sheets shall be overlapped a minimum of 4 inches. Seams shall be oriented parallel to the line of maximum slope and with the fewest possible number of wrinkles. Where seams can only be oriented across the slope, the upper panel shall be lapped over the lower panel. In corners and odd-shaped geometric locations, the number of field seams shall be minimized. Seaming shall extend to the outside edge of panel/sheets to be placed in anchor and/or drainage trenches.

Seaming shall not be conducted in the presence of standing water and/or soft subgrades as determined by the Engineer. All wet surfaces shall be

thoroughly dried and all soft subgrades compacted and approved by the Contractor and Engineer prior to seaming. The seam area shall be cleaned of all dust, dirt, and foreign material prior to and during seaming.

g. Field sampling and Testing

(1) Non-destructive Field Seam Testing. - All field seams shall be non-destructively tested over their full length using test equipment and procedures described in the Contractor's Quality Control Plan as approved by the Engineer. Seam testing shall be performed as the seaming work progresses. Any seams which fail shall be documented and repaired in accordance with these specifications.

(2) Destructive Field Seam Testing. - A minimum of one destructive test sample per 500 feet of field seam length shall be obtained at locations specified by the Engineer. Sample locations will not be identified prior to seaming. The samples shall be a minimum of 12 inches wide by 48 inches long with the seam centered lengthwise. Each sample shall be cut into three equal pieces with one piece given to the Contractor's separate and independent laboratory, and the remaining two pieces given to the Engineer for quality assurance testing and permanent record. Each sample shall be numbered and cross referenced to a field log which identifies: (1) panel/sheet number, (2)seam number, (3) top sheet, (4)date and time cut, (5) ambient temperature, (6) seaming unit designation, (7) name of seamer, and (8) seaming apparatus temperatures and pressures (where applicable). A minimum of four 1-inch wide replicate specimens shall be cut from the Contractor's sample. A minimum of 2 samples shall be tested for shear strength and 2 for peel adhesion using an approved field quantitative tensiometer. Jaw separation speed shall be 2 inches per minute. Both tracks of a double wedge seam shall be tested for peel adhesion. To be acceptable, all replicate test specimens shall meet the specified seam strength requirements. If the field tests pass, 5 specimens shall be tested at the Contractor's separate laboratory for shear strength and 5 for peel adhesion in accordance with ASTM D 4437. Both tracks of a double wedge seam shall be tested for peel adhesion. To be acceptable, 4 out of 5 replicated test specimens shall meet specified seam strength requirements. If the field or laboratory tests fail, the seam shall be repaired in accordance with subparagraph h below. In addition, all destructive seam sample holes shall be repaired the same day as cut. Certified test results on all field seams shall be submitted to and approved by the Engineer prior to the acceptance of the seam.

h. Defects and Repairs -

(1) Identification. - Immediately prior to covering the geomembrane, all seams and non-seam areas will be visually inspected by the Engineer for defects, holes, or damage due to detrimental weather conditions or construction activities. At the Engineer's discretion, the surface of the geomembrane shall be brushed, blown, or washed by the Contractor if the amount of dust, mud, or other foreign material inhibits inspection or functioning of the overlying material.

(2) Evaluation. - At the Engineer's discretion, each suspect location shall be non-destructively tested using methods approved by the Engineer. Each location that fails non-destructive testing shall be repaired and re-tested by the Contractor until it passes. Final acceptance of all seam and non-seam areas will be made by the Engineer.

(3) Repair Procedures. - For defective seams, the defective area may be overlaid with a strip of new material and seamed (cap stripped). Alternatively, the seaming path shall be retraced to an intermedia' location (at 10 feet minimum each side of the failed seam location. At each location a 12 inch by 12 inch minimum size seam sample shall be taken for 2 additional shear strength and 2 additional peel adhesion tests using an approved quantitative field tensiometer. If these field tests pass, then the remaining seam sample portion shall be sent to the Contractor's separate and independent laboratory for 2 shear strength and 2 peel adhesion tests in accordance with ASTM D 4437. If these laboratory tests pass, then the seam shall be cap stripped between that location and the original failed location. If field or laboratory tests fail, then the process is repeated. After cap stripping, the entire cap stripped seam shall be non-destructively tested using methods approved by the Engineer. Certified test results on all repaired seams shall be submitted to and approved by the Engineer prior to covering the seamed areas.

Tears, holes, blisters, and areas with undispersed raw materials or foreign material contamination shall be repaired by patches. Patches shall have rounded corners, be made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of the defects. Minor localized flows shall be repaired by spot welding or seaming as determined by the Engineer. All repairs shall be non-destructively tested using methods approved by the Engineer. The Engineer may also elect to perform a destructive seam test on a suspect area.

i. Installation Completion. - Upon completion and acceptance of the geomembrane in an area, the geomembrane shall be covered with the required materials within 5 days of acceptance in accordance with the drawings and paragraph 3.3.4. Folding over of geomembranes wrinkles will not be allowed prior to or during cover soil placement.

j. Submittal. - At least 30 days prior to delivery to the site the Contractor shall submit to the Engineer the following:

(1) Manufacturer's and installer's qualifications, Quality Control Manual, and product literature which displays the manufacturers ability to produce the geomembrane material as specified.

(2) Geomembrane property test specifications.

(3) Name of testing laboratory.

(4) One square foot sample.

k. Measurement and Payment. - Measurement and payment, of textured geomembrane liner and geomembrane liner will be as specified in paragraph 4.5.1.

4.5.4 GEOCOMPOSITE DRAIN

a. General. - This paragraph includes the requirements for the geocomposite drain and TNT (Textile-Net-Textile) geocomposite drain portions of the cap. The Contractor shall furnish, protect, and install the geocomposite drain(s). The term geocomposite drain shall be defined as a geonet as specified overlain by a heat bonded non-woven geotextile as specified, and shall be installed with the geonet side towards the geomembrane as shown on the drawings. The term TNT (Textile-Net-Textile) geocomposite is defined as a geonet as specified and heat bonded on both

sides by non-woven geotextile as specified, and shall be installed on the slope areas as shown on drawings 1556-418-24 and 1556-418-11.

The term geocomposite drain within this paragraph, unless specifically referred to differently, shall apply to both the geocomposite drain as described and TNT geocomposite drain as described.

b. Geonet properties. - The manufactured geonet shall conform to the property requirements listed in Table 4H and shall be free of defects including tears, nodules or other manufacturing defects which may affect its serviceability. The geonet shall be heat bonded with ply adhesion meeting the requirements of ASTM F904 (1) on both sides with geotextile as specified in this paragraph on the slope sections overlying the textured geomembrane as shown on the drawings and is referred herein as TNT geocomposite drain, and (2) on one side with geotextile as specified in this paragraph for the remainder of the cap and is herein referred as geocomposite drain.

Table 4H - GEONET PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE
Polymer Density, minimum	ASTM D-1505	0.930 g/cm^3
Polymer Melt Index, maximum	ASTM D-1238	<1.0 g/10 min
Carbon Black Content	ASTM D-4218	2-3%
Wide Width Tensile Strength, minimum	ASTM D-4595	23 lbs./inch
Thickness, nominal	ASTM D-1777	0.20 inches @ 2 kPa loading

c. Geotextile properties. - The Contractor shall select a geotextile which meets all specification requirements and is chemically compatible with all contact materials. The geotextile shall be a non-woven pervious sheet of polymeric yarn as defined by ASTM D-123. The geotextile fiber shall consist of long-chain polymers composed of at least 85 percent by weight of polypropylene, polyester, polyethylene, nylon, or polyvinylidene-chlorine. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration by ultra-violet and heat exposure. The fabric shall be fixed so that the yarns will retain their relative position with respect to each other. The edges of the fabric shall be finished to prevent the outer yarn from pulling away from the fabric. The geotextile physical properties shall equal or exceed the minimum values listed in Table 4I. Test values shown are minimum average roll values.

Table 4I - GEOTEXTILE PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE
AOS (U. S. Sieve)	D-4751	70-100
Permittivity (1/sec)	D-4491	1.0
Porosity, % (non-woven only)	------	30
Mullen Burst, psi	D-3786	130
Puncture, lbs.	D-4833	25
Grab Tensile, lbs.	D-4632	80
Trapezoidal Tear, lbs.	D-4533	25
Ultraviolet Degradation @150 hours	D-4355	70% Strength retained

d. Transmissivity. - The minimum transmissivity required for the geocomposite is 6.5 gallons per minute per foot as measured by ASTM D 4716. The minimum transmissivity required for the TNT geocomposite is 4.0 gallons per minute per foot as measured by ASTM D 4716. Transmissivity shall be measured using water at 20°C (68°F) with a maximum gradient of 1 under a normal pressure of 400 psf.

e. Manufacturing, Sampling, and Testing. - The geocomposite drain shall be randomly sampled and tested in accordance with the manufacturer's approved Quality Control Manual. One transmissivity test shall be performed in accordance with the requirements specified in subparagraph d. above. In addition, one 24 inch by 24 inch minimum size sample, along with appropriate identification, shall be provided to the Engineer for quality assurance testing and permanent record of actual furnished material. Samples not meeting the requirements specified in Table 4H and Table 4I - will result in rejection of the applicable rolls.

f. Surface preparation. - Prior to placement of the geocomposite drain, the surface of the geomembrane shall be cleaned of all soil, rock, and other debris.

g. Placement. - The Contractor shall deploy the geocomposite drain carefully such that the geonet and underlying materials are not damaged. All faulty or damaged geocomposite drain shall be replaced or repaired as specified herein.

The geocomposite drain shall be unrolled downslope keeping the net in slight tension to minimize wrinkles and folds. The geocomposite drain shall be maintained free of dirt, mud, or any other foreign materials at all times during construction. Rolls which are contaminated with these materials shall be cleaned or replaced by the Contractor at no additional cost to the Government.

Adequate loading (e.g. sandbags) shall be placed to prevent uplift by wind.

Adjacent rolls shall be overlapped a minimum of 6 inches. Fasteners, as recommended by the manufacturer and approved by the Engineer, shall be used to join adjacent rolls. Metallic fasteners will not be allowed. Fasteners shall be spaced a maximum of 5 feet along downslope roll overlaps and a maximum of 2 feet along cross slope roll overlaps. Fasteners shall be of

contrasting color from the geonet to facilitate visual inspection. Geocomposite drain shall not be welded to geomembranes.

In the corners of side slopes, where overlaps between rolls of nets are staggered, an extra layer of geocomposite drain shall be installed from the top to the bottom of the slope. When more than one layer geocomposite drain is required, joints shall be staggered. Stacked geocomposite layers shall always be laid in the same direction to maintain transmissivity requirements.

h. Repairs. - Holes or tears in the geocomposite drain shall be repaired by placing a patch of geocomposite extending a minimum of 2 feet beyond the edges of the hole or tear. Approved fasteners, spaced every 6 inches around the patch, shall be used to fasten the patch to the original roll.

i. Penetrations. - Geocomposite drain penetration details shall be as recommended by the geocomposite drain manufacturer and as approved by the Engineer.

j. Final Cover. - Upon completion and acceptance of the geocomposite drain in an area, the geocomposites shall be covered with the required materials within 5 days of acceptance in accordance with paragraph 3.3.4.

k. Submittals. - At least 30 days prior to delivery to the site the Contractor shall submit to the Engineer the following:

(1) Manufacturer's qualifications, Quality Control Manual, and product literature which displays the manufacturers ability to produce the geocomposite drain material as specified.

(2) Geonet and Geotextile property test specifications.

(3) Name of testing laboratory.

(4) One square foot sample of each type of geocomposite drain.

l. Measurement and Payment. - Measurement and payment, of geocomposite drain and TNT geocomposite drain will be as specified in paragraph 4.5.1.

SECTION 4.6 - MONITORING WELLS

4.6.1 MONITORING WELLS

a. General. - The Contractor shall furnish all equipment, materials, and labor required to complete the monitoring well installations as described in these specifications and shown on the drawings. All monitoring wells shall be installed in the presence of the Engineer in the locations shown on drawing 1556-418-29. Monitoring wells shall be installed during the daylight hours only.

The monitoring well installations include:

1. Furnishing materials and equipment for monitoring well installations.

2. Drilling holes for monitoring well installations.

3. Installing monitoring wells and dedicated pumps.

4. Developing wells and disposing of development water.

5. Documentation of monitoring well installation.

b. Materials. - The Contractor shall furnish all materials and equipment for monitoring well installations as shown on drawing 1556-418-29 and as provided below.

(1) Well screen. - PVC continuous slot wire wrap screen manufacture by Johnson Screen, under the trade name PVC VEE-WIRE Screen, or equal, shall be used having the following characteristics:

(a) Screen is made of white PVC Type 1, Grade 1 material as described in ASTM F 480 and ASTM D 1784, Class 12454B.

(b) 5.75-inch inside diameter, 10 feet in length.

(c) Slot size shall be determined by the Contractor. The well screen shall have a slot size selected to retain 90-100% of the filter pack material specified in this paragraph.

(2) Well casing. - The well casing shall be thread flush coupled to the top of the well screen having the following characteristics:

(a) Schedule 80 PVC pipe in accordance with ASTM F480 and D 1784, Class 12454B..

(b) Ten-foot sections with 6-inch inside diameter.

(c) 1 foot blank end, 6-inch inside diameter PVC sections.

(d) Square threaded flush joints.

(e) NSF PVC cap.

(3) Dedicated well pumps. - The Contractor shall provide one dedicated bladder type pump or equivalent for each monitoring well installed. The pump shall have the following characteristics:

(a) Shall be capable of pumping water for purging/sampling.

(b) Shall be compatible with site conditions, ground water quality, and well design as recommended by the manufacturer.

(c) Shall be designed for low flow sampling at a rate of 0.1 liter per minute.

The Contractor shall provide all necessary fittings, hoses, caps and other materials required for installation and operation of the pumps including for external power sources and controllers.

(4) Protective pipe and locking cap assemblies. - Monitoring wells shall each be protected by a 10-inch-inside-diameter, schedule 40, galvanized steel pipe, 6 feet in length, threaded on both ends. A plain, 11-inch, galvanized standard pipe cap and galvanized locking bar shall be furnished as shown on drawing 1556-418-29. Caps shall have padlock acceptable to the engineer. The steel casing shall have a 1/4-inch diameter vent hole and drain drilled above the ground surface.

(5) Backfill Materials. -

(a) Graded sand. - Graded sand for filter pack in the monitoring well screened interval shall be a washed silica sand that is chemically inert. The Contractor shall determine the appropriate filter pack size based on gradation sieve analysis of the formation in the screened interval. The filter pack grain size shall be determined by multiplying the 70 percent retained grain size of the formation materials by a factor of 4. Alternative sizes for the filter pack and screen may be used with approval of the Engineer.

(b) Bentonite. - Bentonite products shall be as manufactured by American Colloid Co., Water/Mineral Division, One North Arlington, 1500 West Shure Drive, Arlington Heights IL 60004, or equal, having the following characteristics:

1. Minimum purity of 90 percent montmorillonite clay free of additives that may effect groundwater quality.

2. Moisture content no more than 10 percent as packaged.

3. One-half-inch diameter pellets with minimum dry-bulk density of 75 pounds per cubic foot.

4. Powdered bentonite with minimum 70 percent dry particle size finer than 200 mesh with minimum dry-bulk density of 54 pounds per cubic foot.

(c) Concrete sand. - Concrete sand shall conform to the requirements of paragraph 4.3.3.

(d) Cement-bentonite plug. - The cement-bentonite plug shall be mixed at a ratio of 28 percent bentonite by volume. The bentonite shall be a fine-grained powdered bentonite. Water shall be mixed in a 1:1 ratio with the cement.

(6) Other materials. - Where materials or equipment required to complete monitoring well installations are not specifically described or covered by these specifications, the Contractor shall furnish materials or equipment of the most suitable grade for the purpose intended, acceptable to the Engineer.

c. Drilling, general. - The Contractor shall comply with the requirements of this paragraph for all drill work required for groundwater monitoring wells. Locations of groundwater monitoring wells are shown on drawing 1556-418-29.

The Contractor shall maintain a clean, open drill hole prior to and during the installation of the monitoring wells.

A method of drilling shall be used that allows continuous sampling. The minimum diameter of open annulus available for installation, at the time of installation, at any point in the hole, shall be 4-inches.

Foam and joint compounds for drill rods will not be allowed. All drill tools, temporary casing, or any equipment that is to be used downhole shall be cleaned using a steam cleaner, high pressure water jet, detergent wash, or other methods approved by the Engineer prior to each individual downhole use.

d. Drill-hole completion and cleanout. - Following drilling of the hole to the required depth, the Contractor shall clean all material from within the temporary casing, if used, and to the bottom of the hole.

Following the drill hole cleanout, the Contractor shall verify the total depth of the hole by lowering a measuring probe to the hole bottom in the presence of the Engineer.

e. Installation. - Installation of monitoring wells shall include:

(1) Installing monitoring wells.

(2) Grouting monitoring wells.

(3) Completion of monitoring wells.

(4) Performance testing of each installation.

(5) Developing wells and disposing of development water.

(6) Documentation of monitoring well installation.

The well casing and well screen will be tested by the Engineer for obstructions by probing methods prior to backfilling around and above the well screen. If the well casing or well screen is found to be obstructed or broken anywhere over its length, it shall be removed and replaced by, and at the expense of, the Contractor. With an undamaged and unobstructed well screen and well casing in the hole, and with the top of the well casing at the proper elevation, the hole shall be backfilled as shown on drawing 1556-418-29. All backfill material shall be tremied into place to prevent bridging of the materials. The bentonite pellets shall be placed, saturated with potable water and allowed to cure in accordance with the manufacturer's recommendations.

All monitoring well installations, development and documentation shall be in accordance with "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells", EPA, March 1991.

To prevent foreign material entry, temporary covers shall remain in place on well casing and temporary casing sections at all times except when removing, adding, or grouting sections, or when measurements or surveys are being taken.

f. Testing of each installation. - After the protective pipe assembly is installed, the monitoring wells will be tested again by the Engineer for obstruction by probing methods. If the well casing or well screen is found to be obstructed any where over its length, it shall be removed and replaced by, and at the expense of, the Contractor. If unobstructed, installation of the monitoring wells will be deemed satisfactory.

g. Well development. - The Contractor shall develop all monitoring wells after completion of the installation. Well development shall be in accordance with "Standard Operating Procedure for Well Development", U.S. EPA Region VIII, June, 1994, or later versions. Water from well development shall be disposed of by the Contractor in accordance with all applicable Federal, State and Local regulations. The Contractor shall document all well development activities.

h. Documentation. - The Contractor shall document well design, lithologic descriptions and testing, well installation methods, diagrams of installed wells, and well development activities in accordance with EPA's "Handbook

of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells", March 1991.

i. Completion of monitoring wells. - When well casing installations have reached the final embankment elevation, each installation shall be protected by a protective pipe with locking cap assembly as shown on drawing 1556-418-29.

j. Submittals. - Submittals shall be in accordance with this paragraph and paragraph 1.1.4.

The Contractor shall submit 30 days prior to monitoring well installation to the Engineer for approval methods of monitoring well drilling, installation, development and water disposal, and documentation.

The Contractor shall submit as-builts of the monitoring well installations within 2 working days after each installation is completed.

k. Measurement and payment. - Measurement for payment, for monitoring wells will be by the linear foot of hole in accordance with these specifications.

Payment for monitoring wells will be made at the unit price per linear foot bid therefor in the schedule and will include all costs, labor, materials and equipment necessary for drilling, drill mobilization, drill setup, drill teardown, supplies, pumps, temporary casing, installation, development, development water disposal and documenting of the monitoring wells.

SECTION 4.7 - IRRIGATION DITCH

4.7.1 IRRIGATION DITCH RECONSTRUCTION

a. General. - Irrigation ditch shall be reconstructed to the lines and grades as shown on the drawing 1556-418-18. The existing ditch will be concrete lined or piped as shown on drawing 1556-418-18. Reconstruction of the ditch shall include excavation, backfill and final grading of ditch, concrete lining of the ditch and associated concrete work, flexible membrane liner and gravel fill under the concrete lining, concrete drop structure, 4 inch drainage pipe, excavation and backfill of 24 inch pipe, manholes, removing existing abandoned 6 inch steel pipe and connecting the 24 inch pipe to an existing manhole.

The irrigation ditch provides water deliveries to property owners during the year between April 15 and October 15. Ground surface runoff is also collected by the ditch. The Contractor shall comply with paragraph 1.3.4 and shall be responsible for the removal of all water necessary to perform the lining of the ditch and pipe laying.

The ditch shall be backfilled to bring the surface to the required lines and grades.

b. Concrete lining. - The Contractor shall furnish and install concrete lining as shown on drawing 1556-418-16. Concrete for the concrete lining shall be in accordance with section 4.3. Welded wire fabric shall be in accordance with ASTM A-185.

c. Twenty-four inch pipe. - The Contractor shall furnish and install high density polyethylene pipe with corrugated exterior and smooth interior that meets the requirements of AASHTO M-294 and ASTM F-667. The pipe shall be

installed per the pipe manufacturer's recommendations and the following minimum criteria:

Minimum cover under H-20 live load is 12 inches to top of subgrade.

Minimum compaction for pipe subject to H-20 live load is 90% per AASHTO M-180.

Minimum quality soil type in pipe zone is Class III.

Pipe shall not be placed directly on rock or other rigid materials.

d. Four inch pipe. - The Contractor shall furnish and install schedule 80 PVC pipe and fittings that meets the requirements of ASTM F480 and ASTM D1784, Class 12454B. Slotted pipe shall have six rows of 0.020 inch slots, with 59 slots per foot. Select gravel should be 3/8 inch maximum pea gravel surrounding the slotted pipe and placed a minimum of 2 inches above the pipe crown. Installation of the pipe shall be in accordance with ASTM F481 and with requirements by the manufacturer.

e. Flexible membrane liner. - Furnish and install 80 mil high density polyethylene geomembrane liner with the physical properties listed below. Seaming of the geomembrane liner shall be in accordance with paragraph 4.5.4 or manufacturer's recommendations.

Physical properties of the geomembrane liner:

Thickness - ASTM D1593	80 mils
Tensile Strength - ASTM D638	190 units
Tear Resistance - ASTM D1004C	60 lb
Puncture Resistance - FTMS 101C	100 lb
Resistance Soil Burial - ASTM D3083	90 %
Factory Seam Strength(Shear) - ASTM D4545 6.1.2	160 lb
Factory Seam Strength(Peel) - ASTM D4545 6.1.1	95 lb

Geomembrane pipe sleeve shall be used to pass the 4 inch drainage pipe through the geomembrane and shall be as recommended by the geomembrane manufacturer. Gravel base material placed over the liner shall meet size No. 6 AASHTO gradation as specified in paragraph 3.3.6.

Final grading for placement of the flexible membrane liner shall provide an area that is smooth and free of debris and rock that will puncture the liner.

f. Concrete drop structure. - Precast concrete drop structure shall meet the requirements of ASTM 858-83. Installation of the drop structure shall meet ASTM C891-90. Waterstop shall be SYNKO-FLEX preformed plastic adhesive waterstop or equal. Expansion joints shall be Neoprene Open Cellular expanded elastomeric(Everlast Gaskets) or equal. Expansion joints shall be 1/2 inch thick and the width of the concrete lining.

g. Measurement and payment. - Measurement for payment, for furnishing and installing concrete lined ditch will be made along the centerline of the ditch.

Payment for furnishing and installing concrete lined ditch will be made at the unit price per linear foot bid therefore in the schedule, which shall include the cost of concrete, forming and reinforcement, concrete waterstop and expansion joints, gravel base material, select gravel, flexible membrane liner, 4 inch PVC pipe, slide gate, safety racks, and of removal

of existing check structure, excavation, backfill, final grading, and removal of water.

Measurement for payment, for furnishing and installing 24 inch pipe will be made along the centerline of the pipe and fittings in place and from center to center of intersecting lines, with no allowance being made for laps at joints.

Payment for furnishing and installing 24 inch pipe will be made at the unit price per linear foot bid therefore in the schedule, which unit price shall include the cost of furnishing pipe, excavation, backfill and compaction. laying and joining the pipe, placing and connecting all fittings, dewatering and removal of water for pipe, furnishing and installing concrete drop structure, grating, and installing pipe connections to structures.

SECTION 4.8 - MANHOLES

4.8.1 MANHOLES

a. General. - The Contractor shall furnish and install concrete manholes of the required depth and constructed in accordance with these specifications and details and dimensions shown on the drawings. The concrete manhole installation shall include the concrete manhole section, covers, and dustpans; and inlet and outlet connections.

(1) Materials.

(a) Manhole sections. - Precast manhole sections shall conform to the requirements of ASTM C-478 for circular manholes.

(b) Steps. - Manholes shall be equipped with manhole steps and shall be polypropylene coated steel steps. They shall be cast or mortared securely into the walls of all manholes and spaced on 12 inch centers.

(c) Frames and covers. - Frames and covers shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated in all essentials of design or to Federal Specification RR-F-621, type as suitable for the application, circular, with pick holes. The frames and covers shall have a combined weight of not less than 400 pounds and shall conform to ASTM A48, Class 20B. Ductile iron for frames and covers shall conform to ASTM A 536. The manhole frame shall be fitted with a dustpan.

(2) Installation. - Excavation is considered unclassified. No allowance will be made for variation of materials encountered. If excavation extends below the bottom of the concrete manhole base, it shall be backfilled up to the required grade with granular material, with a maximum gradation of 3/4 inch and less than 5 percent passing the No. 200 sieve.

The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent pipe section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of manhole will permit. The invert channels shall be formed directly in the concrete or shall be constructed by laying full section pipe through the manhole and removing the top half after the surrounding concrete has hardened. The floor of the manhole outside the channel shall slope toward the channels not less than 1

inch per foot. The entire surface of the manhole invert, including channels and shelves, shall be trowled to a smooth dense surface.

Pipe connections shall be made to the manhole using water stops, standard o-rings joints, specials manhole coupling, or shall be in accordance with the manufactures recommendation. The Contractor's proposed method of connection, list of materials selected and specials required, shall be submitted and approved prior to purchase and installation.

Joints between the manhole sections shall be sealed using concrete grout and round rubber gaskets in accordance with ASTM C-361 or the joint shall be sealed using "Ram-Nek" flexible gaskets, or an approved equal.

Backfill material shall be a minimum quality of ASTM type III soil.

b. Measurement and payment. - Measurement, for payment for manholes will be of the depth of manholes installed measured from the top of the cover to the invert of the outlet pipe. All measurements will be to the nearest foot.

Payment for furnishing and installing circular manholes will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and installing the manhole complete as shown on the drawings, including the cost of furnishing concrete and reinforcement, of making connections to the pipes, of furnishing and installing cast iron frame and covers, dustpans, ladder steps, and of excavation, backfill and compaction of backfill.

SECTION 4.9 - INTERCEPTOR TRENCH

4.9.1 INTERCEPTOR TRENCH

a. General. - The Contractor shall furnish all material for and shall construct interceptor trench as shown on drawings 1556-418-7 and 1556-418-19.

The pipe shall be laid to lines and grades as established in the drawings. If actual field conditions vary, the pipe shall be laid to lines and grades established by the Engineer. No portion of the drain system shall be placed with adverse slopes. End plugs or stoppers shall be placed on the upper ends of the drains. A suitable temporary end plug or end cover shall be placed on pipe ends during shutdown periods.

The discharge ends of outfall drains shall be covered with stainless steel or noncorrosive screen of approximately 1/4-inch mesh or other suitable device for preventing animals from entering the pipe.

The pipe shall be hauled and handled in such a manner as to avoid damage to the pipe and coating. The Contractor shall not use rope, cable, or chain slings for handling the pipe, but may use canvas slings not less than 12 inches in width.

All excavated materials from the interceptor trench shall be considered contaminated materials and shall be relocated to reside under the cap.

b. Materials. -

(1) Pipe, fittings, and couplings. - The pipe, fittings, and couplings shall meet the following specifications:

(a) Perforated corrugated poly-ethylene pipe. - Pipe shall conform to AASHTO designation M 252, Class 1 for Ype CP tubing.

(b) End plugs and stoppers. - End plugs or stoppers shall be suitable and manufactured specifically for use with 6 inch pipe.

(c) Pipe dimensions. - The sizes shown on the drawings for the pipe and fittings are the nominal inside diameters of the pipe.

(d) Work requirements. - The pipe and fittings shall be free of foreign inclusions and visible defects as defined herein. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining or connecting.

(2) Capillary materials. - The bedding materials shall be furnished by the Contractor, and shall conform to the specifications established in paragraph 3.3.6.

(3) Backfill material. - The material used for backfill above the capillary material shall be common backfill as described in paragraph 3.3.2.

(4) Manhole. - Manhole shall be as specified in Section 4.7 and drawing 1556-418-19.

c. Constructing drains. -

(1) General. - Excavation for the drain trenches shall be in accordance with paragraph 3.1.1, and drawing 1556-418-7.

Where additional excavation for pipe trenches is directed in accordance with paragraph 3.1.1, such additional excavated volume shall be refilled and compacted in accordance with paragraph 3.1.1.

(2) Perforated drains. - A minimum 3-inch-thick layer of capillary material shall be tamped in place on the bottom surface of the trench. The graded gravel or crushed rock shall then be placed over the sand bedding and shall be shaped and tamped to provide equal bearing under the lower half of the pipe.

The pipe shall be laid and joined together so that the perforations are symmetrical about the vertical centerline and below the horizontal centerline.

End plugs or stoppers shall be cemented in place on the upper ends of the drains. The pipe shall be covered with the minimum thickness of bedding materials as shown on the drawings. The bedding materials shall be carefully placed and tamped about the pipe so as not to disturb the pipe and to hold it securely in position while the overlying material is being placed.

The pipe trench shall be kept free of water which might impair pipe-joining operations. The methods of lowering the pipe into the trenches and placing pipe in position shall be such as to prevent getting dirt inside of the pipe and coupling, and to prevent damage to the pipe. Before and during assembly of a joint, all parts shall be free of mud, ice, oil, or grease.

The joining of pipe sections shall be made with materials, fittings, and couplings consistent with the type of pipe used. The pipe sections shall be fitted together according to the manufacturers specifications and as approved by the Engineer.

As each unit of pipe is laid, sufficient capillary material shall be tamped about the pipe to hold it rigidly in place until the joints are completed.

After the joints are completed, the capillary material shall be placed and compacted to the finished ground surface as directed by the Engineer. The capillary material shall be placed carefully on each side of the pipe simultaneously in such a manner as to prevent disturbing or damaging the pipe and joints.

d. Measurement and payment. - Measurement for payment, for furnishing and placing 6-inch-diameter perforated pipe and 6-inch diameter nonperforated pipe will be made along the centerline of the pipe and fittings in place and from center to center of intersecting lines, with no allowance being made for laps at joints.

Payment for furnishing and placing 6-inch-diameter perforated pipe for interceptor trench drain will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of excavation, backfill, compaction of backfill, furnishing and placing capillary material, furnishing all materials for and preparing and placing bedding material around the pipe, pipe, furnishing all materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers.

Payment for furnishing 6-inch-diameter nonperforated pipe and constructing drain outfalls will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of excavation, backfill, compaction of backfill, preparing the pipe foundation, pipe, furnishing all materials for making joints in pipe, and furnishing and installing outfall structure and the screens or other suitable devices at the ends of the pipe.

SECTION 4.10 - DRAINAGE SYSTEM

4.10.1 DRAINAGE SYSTEM

a. General. - The Contractor shall furnish and install all material for the drainage system as shown on drawings 1556-418-23 and 1556-418-27.

b. Material

(1) Capillary material. - Capillary material shall conform to the specifications in paragraph 3.3.6.

(2) Pipe. - Pipe shall conform to AASHTO designation M 252 for Type C tubing.

(3) Perforated pipe. - Perforated pipe shall conform to AASHTO designation M 252, Class 1 for Type CP tubing.

(4) Course drainage fill. - Course drainage fill shall be hard, durable, and well rounded cobblerock with less than 35 percent wear when tested for resistance to abrasion in conformance to ASTM C535. The course drainage fill shall be screened material with 100 percent passing a 12 inch screen, 70 percent retained on a 8 inch screen, and 100 percent retained on a 6 inch screen.

c. Pipe Dimensions. - The sizes shown on the drawings for the pipe and fittings are the nominal inside diameters of the pipe.

d. Work Requirements. - The pipe and fittings shall be free of foreign inclusions and visible defects as defined herein. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining or connecting.

Cracks, creases, unpigmented or non-uniformly pigmented pipe are not permissible.

e. Pipe installation - Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. The laying of pipe shall proceed upgrade beginning at the lower end of the pipeline. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when the trench conditions or weather is unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Pipe shall be laid to the grades and alinement as indicated. The pipe shall be bedded to the established gradeline. Perforated pipe shall be placed with the perforations down unless otherwise indicated. All pipe in place shall be approved before backfilling. Prior to installing the pipe, the Contractor shall submit the manufacturer's pipe installation recommendations to the Engineer for approval.

A suitable temporary end plug or end cover shall be placed on pipe ends during shutdown periods.

Joints shall be in accordance with the requirements of ASTM F405.

Only fittings supplied or recommended by the pipe manufacturer shall be used.

After pipe for subdrains has been laid, approved by the Engineer, capillary material shall be placed around and over the pipe to the depth indicated.

f. Course drainage fill placement. - The course drainage fill need not be hand placed, but shall be placed and smoothed by moving material into position in such manner as to ensure that the material when in place is stable and without tendency to slide. The method of placement shall be in such a manner as to not appreciably fracture or break the cobbles.

The Contractor shall be responsible for controlling and conducting its operations so as to prevent segregation and provide the best practicable distribution of rock sizes within the fill.

g. Overflow ditches. - Overflow ditches shall be constructed to the lines and grades shown on drawings 1556-418-23 and 1556-418-27. Overflow ditches shall be constructed following the placement of common backfill as required, with the excavated material distributed evenly on both sides of the excavation.

h. Measurement and payment. - Measurement for payment, for furnishing 6-inch-diameter perforated pipe for valley drains, excavation and backfilling trenches, and for furnishing 6-inch-diameter nonperforated pipe and constructing drain outfalls will be made along the centerline of the pipe from end to end of the pipe in place, and no allowance will be made for laps at joints.

Payment for furnishing and placing 6-inch-diameter perforated pipe will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and placing capillary

material, furnishing all materials for and preparing and placing bedding material around the pipe, pipe, furnishing all materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers.

Payment for furnishing and placing 6-inch-diameter nonperforated pipe will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of excavation and backfill, preparing the pipe foundation, pipe, furnishing all materials for making joints in pipe, and furnishing and installing outfall structure and the screens or other suitable devices at the ends of the pipe.

Measurement for payment, for furnishing 6-inch-diameter perforated pipe for toe collector drains, excavation and backfilling trenches will be made along the centerline of the pipe from end to end of the pipe in place, and no allowance will be made for laps at joints.

Payment for furnishing and placing 6-inch-diameter perforated pipe for toe collector drains will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and placing capillary material, furnishing all materials for and preparing and placing bedding material around the pipe, pipe, furnishing all materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers.

Measurement for payment, for furnishing 8-inch-diameter perforated pipe for slope drainage terraces, excavation and backfilling trenches and constructing drain outfalls will be made along the centerline of the pipe from end to end of the pipe in place, and no allowance will be made for laps at joints.

Payment for furnishing and placing 8-inch-diameter perforated pipe for slope drainage terraces will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and placing capillary material, furnishing all materials for a preparing and placing the bedding material around the pipe, pipe, furnishing all materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers. Payment shall not include furnishing and placing course drainage fill.

Measurement for payment, for furnishing 8-inch-diameter perforated pipe for toe ditches, excavation and backfilling trenches and constructing drain outfalls will be made along the centerline of the pipe from end to end of the pipe in place, and no allowance will be made for laps at joints.

Payment for furnishing and placing 8-inch-diameter perforated pipe for toe ditches will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing and placing capillary material, furnishing all materials for and preparing and placing the bedding material around the pipe, pipe, furnishing all materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers. Payment shall not include furnishing and placing course drainage fill.

Measurement for payment, for furnishing 12-inch-diameter nonperforated pipe, excavation and backfilling trenches and constructing drain outfalls will be made along the centerline of the pipe from end to end of the pipe in place, and no allowance will be made for laps at joints.

Payment for furnishing and placing 12-inch-diameter nonperforated pipe will be made at the unit price per linear foot bid therefor in the schedule, which unit price shall include the cost of furnishing all materials for and preparing and placing the bedding material around the pipe, furnishing all

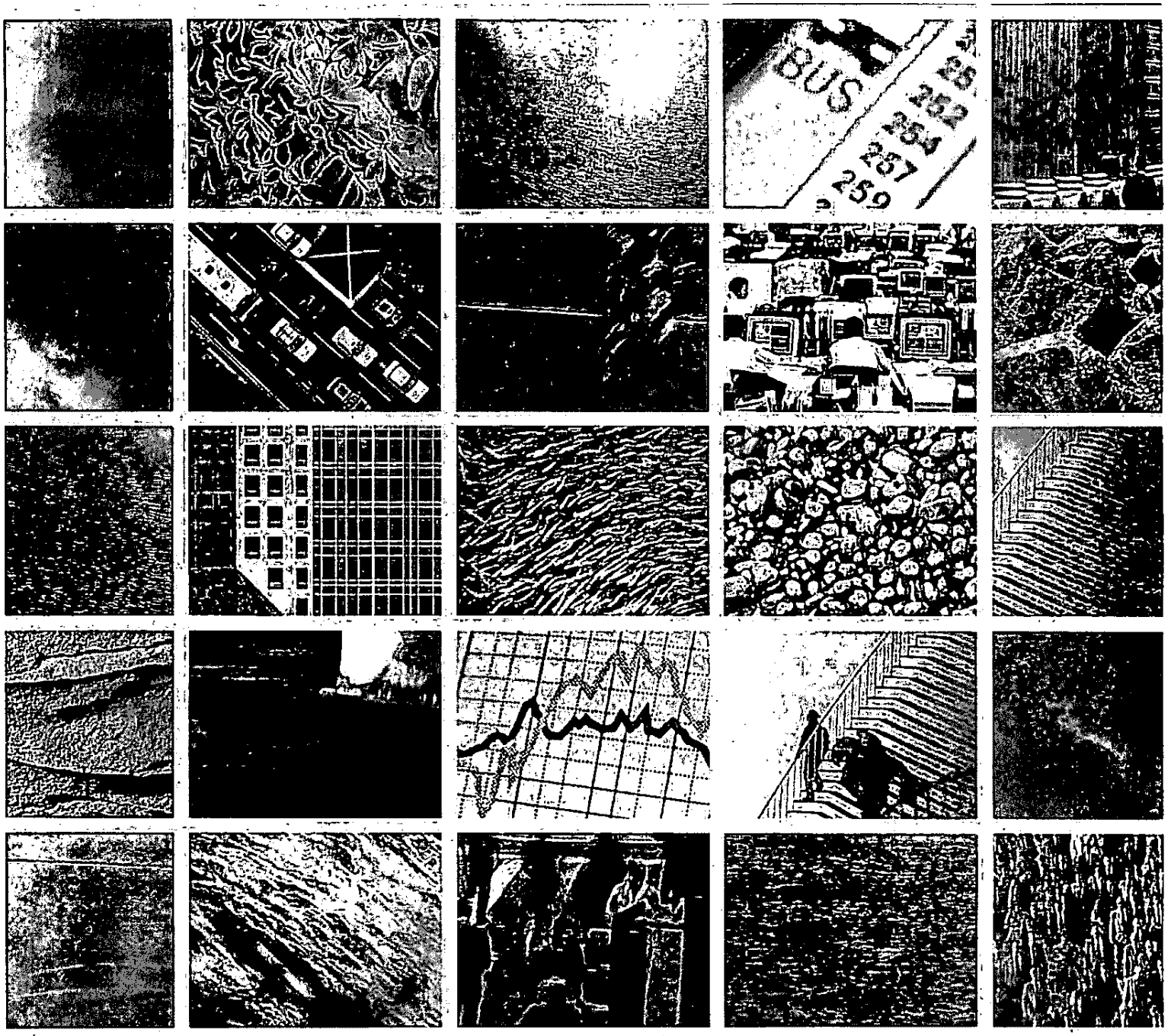
materials for and making joints in the pipe, and furnishing and installing end plugs or stoppers.

Measurement, for payment, of course drainage fill will made to the specified thickness and to the prescribed outlines of the course drainage fill to be placed.

Payment, for furnishing and placing course drainage fill will be made at the unit price per cubic yard bid therefor in the schedule, which unit price shall include the cost of quarrying, selecting, screening, handling, transporting and placing the course drainage fill, and all other operations required to complete the course drainage fill as specified in this paragraph.

Payment, for overflow ditches will be made at the lump sum price bid therefor in the schedule, which lump sum price shall include the cost of all labor and equipment necessary to excavate overflow ditches.

Appendix E
Geotechnical Evaluation Report



Preliminary Geotechnical Evaluation

Sharon Steel Superfund Site - Midvale, Utah

February 2, 2004

Presented to:
Mercury Financial

Environmental Resources Management
102 West 500 South, Suite 650
Salt Lake City, Utah 84101
(801) 595-8400
www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

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February 2, 2004

Mr. Ben Magelsen
Mercury Financial Group
4530 North Windsor Drive
Provo, Utah 84604

Dear Mr. Magelsen:

ERM-Rocky Mountain, Inc. (ERM) has prepared this Geotechnical Evaluation Report for Mercury Financial to describe geotechnical conditions at the Sharon Steel Superfund Site relative to potential redevelopment of the property for various residential, commercial and light industrial purposes. This letter report presents the following information in the order listed below.

- **Summary of Findings and Recommendations**, which presents the major findings from ERM's preliminary evaluation
- **Background**, which presents a brief summary of site conditions relevant to the geotechnical evaluation
- **Scope of Work**, which describes the scope of ERM's evaluation
- **Geotechnical Evaluation**, which presents the details of our engineering evaluation
- **Conclusions**, which summarizes the additional geotechnical work that should be done in preparation for site redevelopment

SUMMARY OF FINDINGS AND RECOMMENDATIONS

- Areas northeast of the tailings pile reportedly contain old building foundations and basements that may require further investigation prior to site development. Identification of the old building footings and basements will enable construction contractors to incorporate these findings into their expected demolition (if needed) and redevelopment costs.

- The south side of the tailings pile was used as a fill repository; a smaller area on the north side of the pile also served as a repository.

The materials placed in these areas will likely have different geotechnical characteristics than the remaining area of the tailings. Therefore, geotechnical investigations for site development will include some additional soil borings and sampling in these areas.

- Engineering analysis by the U.S. Bureau of Reclamation showed that the expected placement of fill materials and structural loads on the closed tailings will not pose a detrimental impact to the protective cover over the tailings as long as the loads are about 3,000 pounds per square foot, which is approximately equal to 30 feet of common fill.

- The ground water level in the wetland area and low-land near the Jordan River may influence the drainage and construction requirements for structures in these areas because excavations will likely extend into the shallow ground water.

- Slope stability analysis performed by the Bureau of Reclamation in 1993 (BOR) showed the completed slopes to be stable, except under an earthquake load that induces liquefaction of the saturated tailings. A revised slope stability analysis should be performed following an updated geotechnical investigation of current site conditions. The updated analysis should include assessment of redevelopment loads at the top of the slope.

- The allowable bearing capacities for capped areas of the site are expected to range from about 2,800 to 3,800 psf, which are suitable for the types of structures planned for the site. The factor of safety against bearing failure is a function of the structural load and foundation dimensions, which can be adjusted to fit within this allowable range.

- The potential settlement induced by adding 5 to 30 feet of fill soil onto the capped area may range from 0.05 to 0.39 feet. This is much less than the deformation expected from the remediation loads that were placed in 1997. Differential settlement is not expected to pose significant development problems, as long as structures are not placed across different sub-base materials (e.g., tailings and native soil).

- Redevelopment activities will need to account for the presence of a 1400-foot-long interceptor trench located along the eastern side of the tailings pile, outside the capped area.

BACKGROUND

The Sharon Steel Superfund site covers approximately 260 acres that was historically used for ore milling, and smelting of lead, copper, zinc, and other metal sulfides. The milling operations were conducted from as early as 1906 until 1971; smelting ceased in the late 1950s. Over 10 million tons of mill tailings containing concentrations of lead, arsenic, cadmium, chromium, copper, and zinc were deposited on the site. Windblown mill tailings were also deposited over several hundred acres of residential property in Midvale.

The site was listed on the CERCLA National Priorities List (NPL) in 1990, due to the presence elevated heavy metals such as lead and arsenic in the windblown tailings and ground water. A CERCLA Remedial Investigation/Feasibility Study (RI/FS) was performed, and the U.S. Environmental Protection Agency (EPA) issued the final ROD for the site in 1993. The following cleanup activities were completed by either the EPA or UDEQ in accordance with the ROD:

- Fencing the site and stabilizing the banks of the Jordan River
- Demolition of old mill buildings
- Excavation of tailings and contaminated soil from the mill and wetland areas
- Backfilling mill and wetland areas with clean fill
- Restoration of the wetlands
- Consolidation of tailings and contaminated site soil in the area of the former tailings ponds and subsequent regarding and capping
- Installation of a ground water interception trench
- Installation of ground water monitoring wells along the perimeter of the site

During remedial engineering, some limited planning for redevelopment and reuse of the site was considered. The Bureau of Reclamation

(BOR), which performed much of the remedial engineering and construction oversight, identified possible redevelopment of the land for use as a golf course. However, no specific land use plan was prepared in connection with the on-site closure activities. In recent years, the City of Midvale, EPA, and the Utah Department of Environmental Quality (UDEQ) have sought opportunities with the current owner of the property to find a third party that may want to redevelop the property in its remediated condition.

We understand that you and your partners (i.e., the Development Group) are considering redevelopment of the land as a mixed use community, which may include uses such as regional commercial, office/commercial, business park/industrial, and a variety of residential uses (e.g., high, medium-high, medium, and low density). The community will include numerous parks and open spaces, and will likely include a neighborhood town center.

ERM was retained by the Development Group to assess the potential for redevelopment of the land as described above from a geotechnical perspective, i.e., soil conditions, foundation bearing capacity, settlement potential, slope stability, and other factors. This report summarizes our preliminary geotechnical evaluation for the site.

SCOPE OF WORK

The scope of ERM's evaluation was described in our Proposal No. 03-204, dated June 24, 2003. The scope of work consisted of the following three tasks.

1) Gathering of records for the Sharon Steel Site that describes the characteristics of the soil, wastes, and liner construction materials.

2) Geotechnical evaluation of the site including slope stability, bearing capacity, and settlement calculations relative to planned development of the site.

3) Preparation of a report describing the data gathering and evaluation processes and results, plus recommendations.

GEOTECHNICAL EVALUATION

The site soil and tailings characteristics (i.e., geotechnical properties) used to perform this preliminary evaluation were obtained from previous engineering studies performed by the EPA, its contractors, and the BOR. An inventory of geotechnical records reviewed by ERM is included with this report as Attachment 1. The geotechnical conditions pertaining to the site are described in the paragraphs below.

Historical Building Foundations

The Remedial Action Report prepared by the BOR (March 1999), identified areas outside the tailings pile footprint that reportedly contained the remnants of historical mill and smelter buildings. Most of these buildings were located in the northeast corner of the property. The original above-ground structures were removed by EPA, under an emergency response action. However, the foundations and basements of these structures remain on site. During remediation activities, the foundations of some of these buildings were temporarily uncovered, their locations were surveyed, and clean soil was placed back over them. The survey results pertaining to these historical structures are shown on the "Record Drawing" included with this report as Attachment 2.

During redevelopment of the site, the presence of these historical, below-grade structures will need to be considered. New structures will either need to be placed on sufficient fill to bridge across the old concrete structures, or the old structures will need to be removed to facilitate site grading and construction of new buildings. The lateral extents and depths of these buried structures should be confirmed in the field to help construction contractors incorporate these findings into their expected demolition (if needed) and redevelopment costs.

CERCLA Repositories

The Technical Specifications for site remediation defined two repositories for placement of affected soil and tailings prior to capping. These areas were referred to as the South and North Repositories. The approximate locations of these repositories are shown on the drawing in Attachment 3. The specifications note that the repositories were to receive excavated tailings and contaminated soil from site areas closest

to each repository. These materials were to be placed in a controlled manner, which included spreading the materials in horizontal lifts between 8 and 12 inches thick, and compacting the materials to at least 92 percent of the laboratory density (assumed to be Standard Proctor Test).

The results of soil placement and field compaction are typically recorded and summarized in a project completion report. However, ERM has not been able to find a report of this type that demonstrates that these specifications were met. The BOR Remedial Action Report (1999) refers to a "Final Construction Quality Control Report;" however, a project representative at the BOR could only locate an incomplete, draft, electronic file of this document, which was apparently never completed.

ERM discussed the placement of materials in the repositories with Mr. Mark Day, who was the UDEQ engineer that oversaw the construction work on behalf of the State. Mr. Day indicated that the materials were generally placed in the repositories as described in the specifications. He noted that only small amounts of vegetative matter were placed in the repositories, and no large debris was placed beneath the cap that may have resulted in large void spaces.

Based on the specifications and input from Mr. Day, ERM expects that the materials placed in the repositories will likely have different geotechnical characteristics than other areas of the tailings. The repository material may have greater strength characteristics, if they were placed as controlled fill; or they may be weaker because they have not been in place for as long as some of the original tailings. Therefore, future geotechnical investigations for site redevelopment should include some additional soil borings and sampling in the areas of these repositories to confirm site conditions.

Protection of Cap

During redevelopment, the loads placed on the cap must not be too excessive that they damage the geosynthetic materials comprising the cap. It is expected that some additional fill material will be placed over the existing two feet of cover soil, and that building footings may be placed both above and through the liner in various areas. All footings placed above the liner should be a minimum of two feet above the

geosynthetic materials, and any penetrations through the liner will require ties to preclude rainwater from entering the contained tailings.

A technical paper prepared by Mr. Michael Christianson of the BOR (Christianson, 2001) indicated that the minimum crush strength of the geonet drainage layer was designed to support up to 30 feet of overlying soil. Hence, the expected placement of fill materials and structural loads on the tailings pile is not expected to pose a detrimental impact to the cap as long as the loads are less than approximately 3,000 pounds per square foot (psf) (assuming a conservatively low soil unit weight of 100 pounds per cubic foot [pcf]). The actual crush strength (i.e., compressive strength at yield) for geonet materials similar to that specified for this site is about 20,000 psf; however, the in-plane flow rate of the geonet can be reduced at lesser pressures.

Ground Water Management

The site ground water levels may influence site development in low-lying areas, such as around the wetlands. The water table elevation on the south side of the site is approximately equal to the water level in the Jordan River and wetlands. Hence, redevelopment in the low-lying areas will either require imported fill to build up the area around the wetland, or dewatering of excavations and drains for structures below the water table.

The presence of residual water within the mill tailings covered by the multi-layer cap may also affect redevelopment. The current thickness of the saturated tailings is unknown. At the time of closure, the water level within the tailings was reported to be about two feet thick, according to the BOR's "Liquefaction Potential and Slope Stability" report (BOR, 1993). However, the thickness of the saturated tailings may have been greater in other areas of the site according to other sources. The thickness of the saturated tailings can influence the potential for consolidation settlement, as described later in this report. The geotechnical investigations to be performed for redevelopment should assess the current water level within the capped tailings.

Slope Stability

Slope stability analysis was performed by the BOR for various static and dynamic loadings (BOR 1993). Four specific conditions were

evaluated for the most critical slope relative to placement of materials on the tailings pond for closure. The calculated factor of safety (FS) for each scenario is also shown; FS values greater than one suggest a stable condition, while FS values less than one suggest instability.

1) Static conditions - FS=2.0

2) Static with heavy equipment load on edge of slope - FS=1.8

3) Earthquake load without liquefaction - FS=1.4

4) Earthquake load with liquefaction - FS=0.64 to 0.97

The 3H:1V slopes that were modeled by the BOR were determined to be stable under all scenarios except for that of liquefaction. The site was determined by the BOR to be susceptible to liquefaction, which would result in a slope failure with a failure plane occurring approximately 60 feet back from the top of slope. Hence, a set back of 60 feet has been recommended by the BOR for any redevelopment of the site. Also, the 150-foot set-back at the toe of the slope along the Jordan River was established to preclude impacts to the Jordan River, if a sufficient earthquake occurred to cause liquefaction. These set backs should be observed unless new data are obtained and a new stability analysis performed that shows that the off-sets may be modified.

Upon re-evaluation of the saturated tailings during the redevelopment investigations, the slope stability model may be re-evaluated for potential failure due to liquefaction. The slope stability model should also be checked based on the additional loads to be placed near the top of the slopes as a result of redevelopment. A new slope stability analysis was not performed as part of this evaluation, as the information presented by the BOR is sufficient to demonstrate that the slopes are generally adequate to allow redevelopment, as long as the off-set conditions are observed.

Soil Bearing Capacity

The ultimate bearing capacities for typical strip- and spread-footings have been calculated by ERM for the cover soil overlying the cap and the recompacted tailings beneath the cap. The range of ultimate bearing capacities for the strip footings is 6,400 to 8,500 psf, and the range for

spread footings is 6,800 to 9,600 psf. The ultimate bearing capacity is a function of the size and shape of the footing and the characteristics of the soil above and below the footing. We have assumed that the base of the footings will be at least three feet below the ground surface to protect against frost heave. ERM's calculations are presented in Attachment 4. Typical precautions should be made to prevent the percolation of rainwater beneath the footings.

The recommended factor of safety for bearing capacity calculations is 2 to 3, and is based on the level of safety desired. The lower end of this range is typically adequate for residential structures. Using an average FS of 2.5, the allowable bearing capacities may range from about 2,500 to 3,400 psf for strip footings, and 2,700 to 3,800 psf for spread footings. These bearing capacities are generally sufficient for the types of structures proposed for the capped areas of the site.

The potential building loads and pressures for one through four story structures are show on Table 1 below for various structure types proposed for the site.

Table 1 - Maximum Loads Expected from Proposed Structures

Structure Description	*Column Load (int/ext)*	*Continuous Wall Load*	*Floor Slabs on Grade*
One Story			
Commercial	50/25 k	2.5 k/ft	150 psf
Residential	20 k	1.5 k/ft	100 psf
Two Story			
Commercial	210/110 k	4.0 k/ft	150 psf
Residential	45 k	2.5 k/ft	100 psf
Three Story			
Commercial	370/220 k	4.0 k/ft	150 psf
Four Story			
Commercial	590/325 k	4.0 k/ft	150 psf

Assumptions:

Commercial Buildings: (30'-0" x 30'-0" bays, Composite steel fame @ floors and open web Joist @ roof)

Dead Load:	Floor	80 psf
	Roof	20 psf
Live Loads:	Floor	80 psf (office)+ 20 psf (partitions)
	Roof	30 psf (Snow)
Walls (Metal Studs Brick Veneer -16'-0" height Story)		
	1 story	2.5 kips
	2-4 story	4.0 kips

Residential (20'-0" x 20'-0" max bays, Wood framing @ floors and roof)

Dead Load:	Floor	20 psf
	Roof	15 psf
Live Loads:	Floor	40 psf + 10 psf (int. partitions)
	Roof	30 psf (Snow)
Walls (Wood Studs w/ Stucco-10'-0" height Story)		
	1 story	1.5 kips
	2 story	2.5 kips

Also, in regard to bearing capacity strength, Mr. Mark Day noted that the rounded nature of the tailings particles is such that in a confined state the tailings can demonstrate reasonable strength and bearing capacity; however, when they are not confined, they tend to move around like stacked marbles. Hence, it is recommended that structural footings be founded on materials above the cap to the extent possible, as installation of footings on the tailings may cause movement of the rounded tailings particles.

Soil Settlement

ERM has estimated the potential amount of settlement that may occur in the tailings and underlying saturated soil as a result of site redevelopment. There are two primary types of settlement that may occur: 1) elastic deformation or collapse of air-filled voids, which occurs almost immediately after a load is placed on the soil; and 2) consolidation settlement, which occurs over a longer period of time as pore water pressure is relieved from fine-grained soils (silts/clays). This latter type of consolidation settlement can be detrimental to infrastructure development because it can cause structural damage over one or more years. Hence, we focused our attention on this type of settlement. ERM's settlement calculations are presented in Attachment 5.

We have estimated the consolidation settlement from the original remediation load placed on the tailings and native clay in 1997 to be as much as 0.65 to 0.94 feet. It is unknown whether this consolidation has actually occurred, as no survey monitoring has been performed to

observe cap settlement. It is also unknown whether consolidation from the remediation loading is complete or still occurring.

The additional settlement that may occur from placement of more fill above the tailings has been estimated to range from 0.05 to 0.39 feet, depending on the saturated thickness of the tailings and the amount of fill material placed above the cap. Table 2 summarizes the calculated settlement amounts that may occur under a combination of conditions.

Table 2 - Range of Settlement Amounts Due to Redevelopment Loads

Thickness of fill placed above existing cap	*Assume 2-feet of saturated tailings*	*Assume 10-feet of saturated tailings*
5 feet	0.05 feet	0.08 feet
10 feet	0.10 feet	0.15 feet
20 feet	0.19 feet	0.28 feet
30 feet	0.26 feet	0.39 feet

Because it is unlikely that more than 10 feet of soil will be placed anywhere on the cap, the potential settlement that may occur due to redevelopment is very low compared with the amount produced from the original remediation activities. Also, because the calculated settlements are relatively small compared with the overall thickness of the unsaturated tailings and compacted fill, consolidation settlement is not expected to preclude development on the cap. Refinement of these calculations can be performed following a geotechnical investigation and measurement of actual water levels in the tailings.

In regard to structural loads, the placement buildings on the cap is not expected to result in consolidation settlement, because the 30- to 60-foot thickness of the unsaturated tailings will attenuate the small footing loads such that they will have little if any influence on consolidation. Settlement beneath building footings is expected to occur soon after the loads are applied as the unsaturated voids collapse (if any) under the weight of the new loads. Differential settlement, for similar reasons, is not expected to preclude redevelopment nor require excessive measures to protect the structures.

Other Protective Measures

Redevelopment activities will need to account for the presence of a 1400-foot-long interceptor trench located along the eastern side of the tailings pile, outside the capped area. The interceptor trench contains a 30-mil PVC liner on the downgradient side and a perforated pipe near the trench base. This trench intercepts shallow ground water flowing from east to west on the east side of the site, and diverts it to the wetland area on the south side. Excavations and other development activities will need to be performed in a manner that does not penetrate this feature. The approximate location and dimensions of this trench are shown on the drawings in Attachment 6.

CONCLUSIONS

Based on the findings of this preliminary geotechnical evaluation, we do not anticipate any geotechnical conditions that would create an unreasonable financially burden to redevelopment of the property as planned by your group. Also, we do not expect site conditions to require excessive measures to prepare the structural footings (e.g., piles or thick structural fills). We have identified some areas where additional information is needed, such as where old mill building foundations still exist. You may want to work around these areas to create open space rather than remove the old footings and basements.

It is noted that this evaluation is considered preliminary, as the findings are based entirely on geotechnical data and field observations made by other parties. However, the data used appear to be reasonable. Based on the preliminary calculations and factors of safety used in our evaluation, there would have to be significant deviations from the existing data before redevelopment would become problematic. If deviations are discovered, they would most likely be in isolated areas where the development plans could be adjusted to compensate for these conditions.

As we have discussed, we recommend that as you move forward with redevelopment, and the design concepts become solid, that we perform a design-phase geotechnical investigation to verify the conditions described herein, and collect soil and tailing samples for further testing. A site map showing potential locations for 12 soil borings is included

with this report as Figure 1. These new data will be used to refine the geotechnical calculations for use by the structural engineers for building design. Given the current data, the geotechnical parameters for structural design will likely be similar to those for other developments in this area of the Salt Lake Valley.

We expect that this information will be helpful as you plan toward redevelopment of the Sharon Steel Site. If you have any questions, please contact us at (801)595-8400.

ERM Rocky Mountain, Inc.

David S. Wilson, P.E., P.G.
Principal

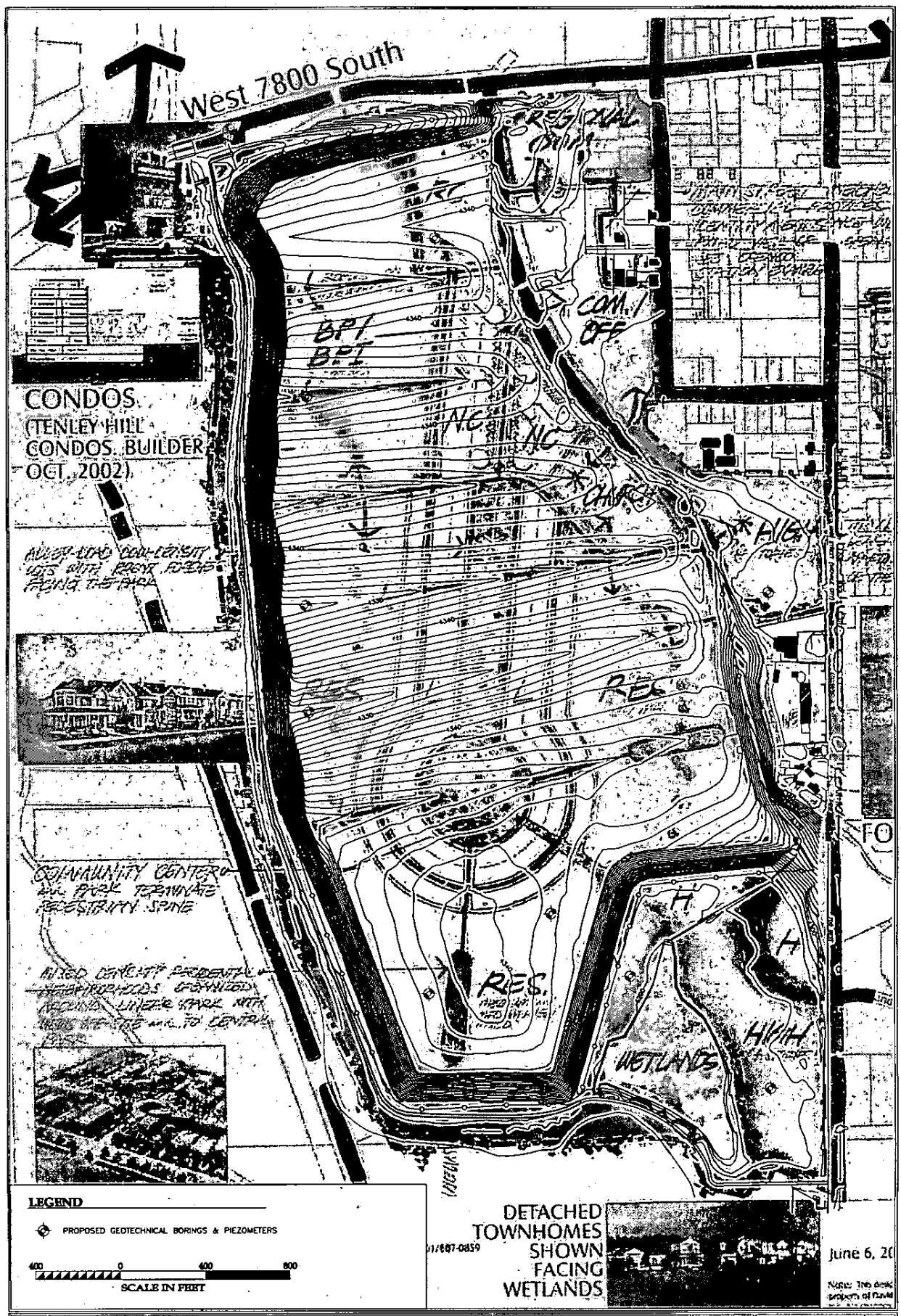


FIGURE	DESIGNED / DRAWN / CHECKED / DATE / TIME	DSW / RJB
1		

MERCURY FINANCIAL GROUP
FORMER SHARON STEEL SUPERFUND

PROPOSED GEOTECHNICAL BORINGS & PIEZOMETERS
SHARON STEEL SITE, MIDVALE, UTAH

Environmental Resources Management
102 West 500 South
Suite 320
Salt Lake City, Utah 84101-2534
ERM (801) 595-8400

N W E S

REVISION DESCRIPTION	DATE

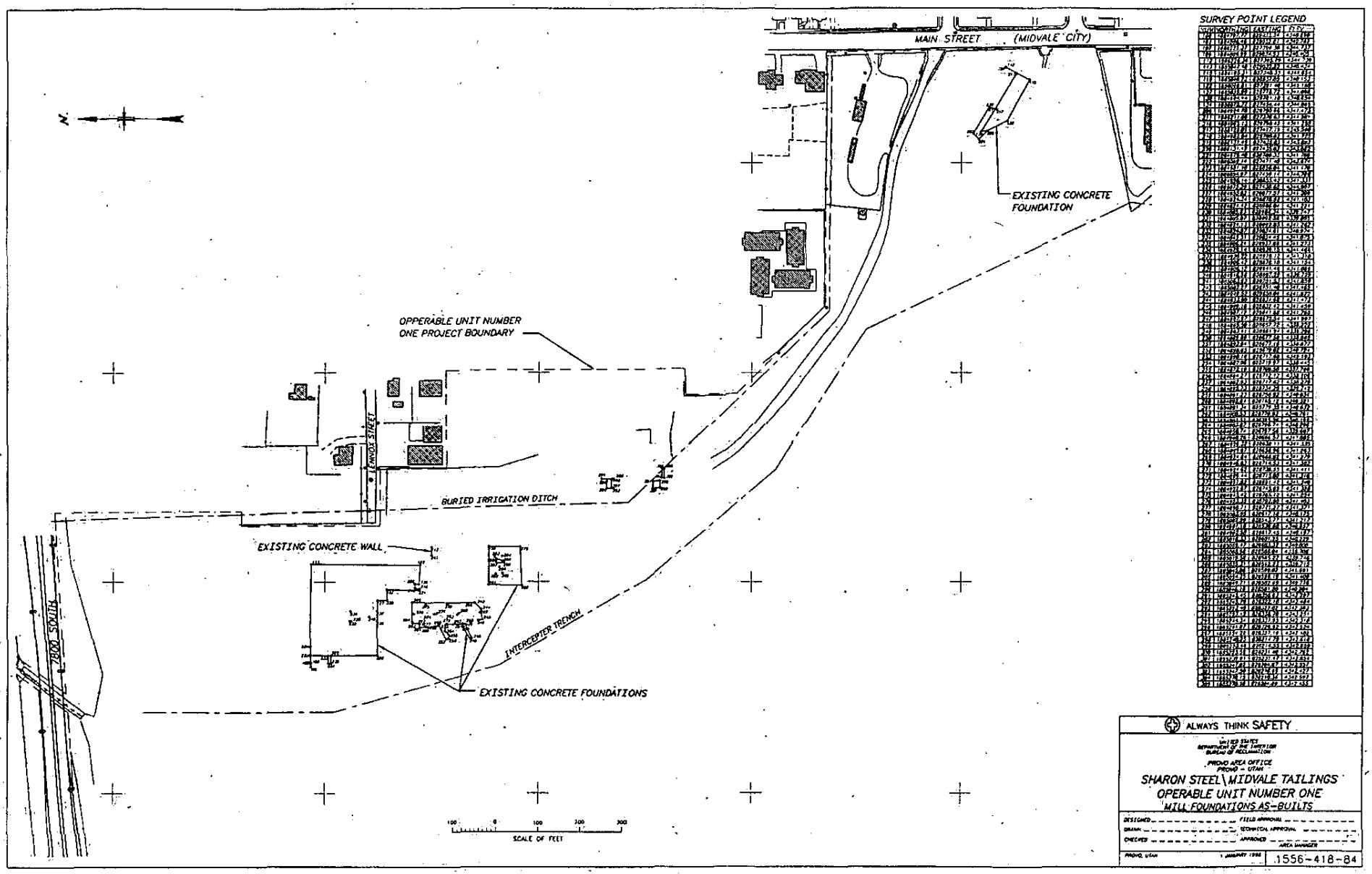
• POOR COPY •
CO. RECORDER

Attachment 1
List of Reference Documents

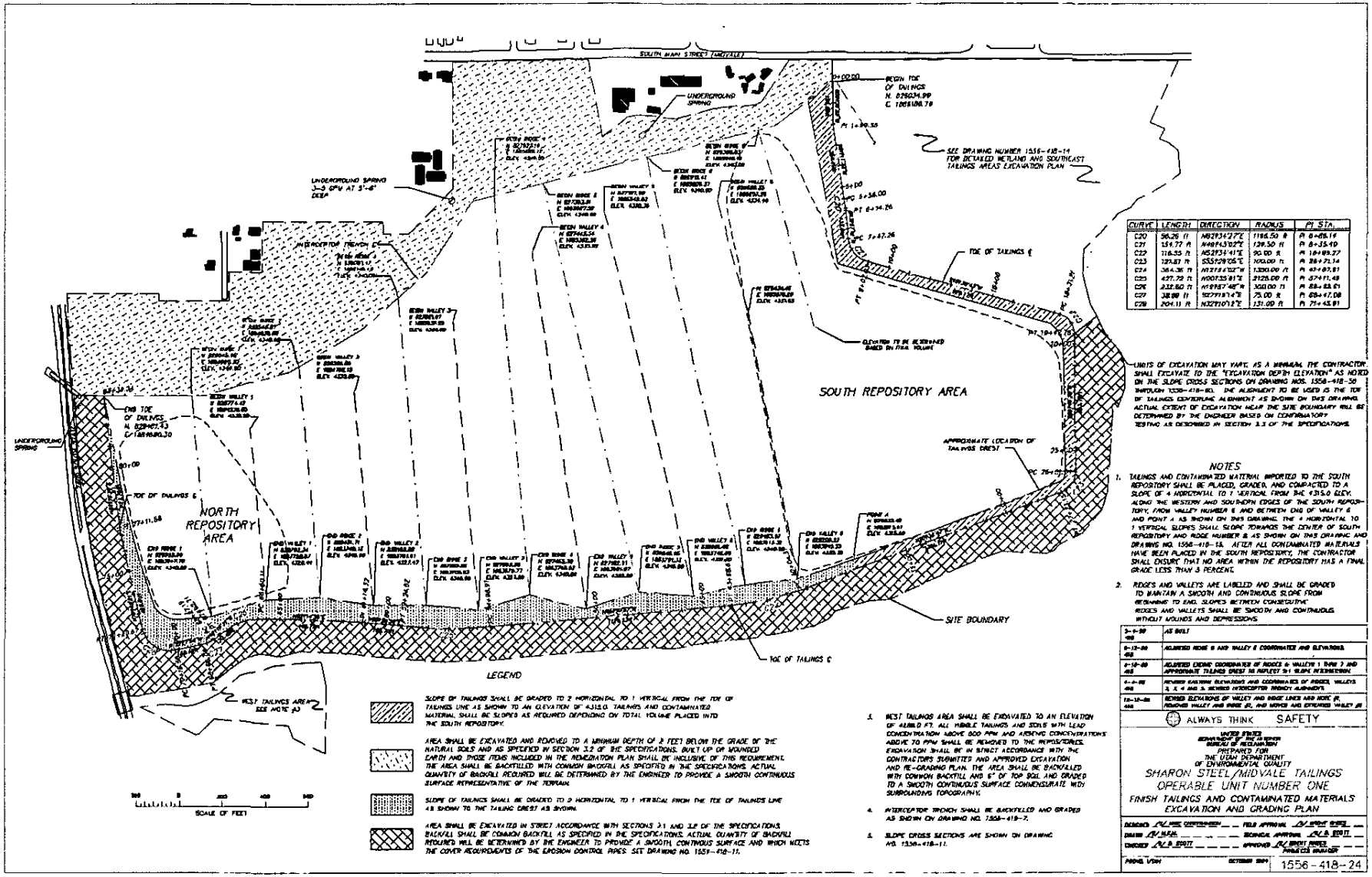
List of References
Preliminary Geotechnical Evaluation
Sharon Steel Superfund Site

- CDM, July 14, 1989, Final FS Report for OU#1 of Sharon Steel Site.
- U.S. Bureau of Reclamation, Oct. 2001, Operation, Maintenance, and Monitoring Manual for Sharon Steel Superfund Site OU1.
- EPA, December 1993, Final Decision Summary (ROD).
- AMEC Earth & Environmental, Inc., November 16, 2000, Draft - Summary of Findings, Preliminary Geotechnical Study, Proposed Development - Sharon Steel/Midvale Tailings Site OU1.
- U.S. Bureau of Reclamation, February 1993, Preliminary Liquefaction Potential and Slope Stability of Sharon Steel/Midvale Tailings Site.
- Field Investigation and Sampling Plan - Sharon Steel Corp./Midvale Tailings Site RI/FS (1-86 Rev).
- U.S. Bureau of Reclamation, no date, Boring logs and geotechnical data.
- Geotechnical Fabrics Report, December 2000, GFR Specifier's Guide 2001, Volume 18, number 9.
- Christianson, Michael K., August 30, 2001, Design and Construction of Earthfill/Geosythetic Cap and Slope Stabilization at Sharon Steel/Midvale Tailings Superfund Site.
- U.S. Bureau of Reclamation, March 1999, Remedial Action Report for Sharon Steel/Midvale Tailings Operable Unit No. 1.

Attachment 2
Survey of Historical Building Locations



Attachment 3
Drawing of On-Site Repository Locations



CURVE	LENGTH	DIRECTION	RADIUS	PI STA.
C20	56.26 ft	N82°34'27"E	1166.50 ft	PI 0+85.14
C21	134.77 ft	N48°43'02"E	129.50 ft	PI 0+35.40
C22	116.55 ft	N52°34'41"E	90.00 ft	PI 1+89.27
C23	123.83 ft	S55°59'05"E	100.00 ft	PI 3+71.34
C24	384.36 ft	N17°54'02"W	1,350.00 ft	PI 4+67.81
C25	477.72 ft	N00°55'31"E	2125.00 ft	PI 5+71.48
C26	233.50 ft	N19°57'48"W	300.00 ft	PI 8+63.61
C27	38.89 ft	S52°19'14"E	75.00 ft	PI 6+47.08
C28	204.11 ft	N32°10'12"E	131.00 ft	PI 7+45.91

3-1-99 MB	AS BUILT
8-13-98 MB	ADJUSTED RIDGE 8 AND VALLEY 8 COORDINATES AND ELEVATIONS
6-12-98 MB	ADJUSTED CHEMS COORDINATES OF RIDGES 6 VALLEYS 1 THRU 7 AND APPROXIMATE TAILINGS CREST TO REFLECT 3:1 SLOPE INTERSECTION.
4-6-98 MB	REVISED EXISTING ELEVATIONS AND COORDINATES OF RIDGES, VALLEYS 3, 4, 5 AND 6. REVISED INTERCEPTOR TRENCH ALIGNMENT.
12-12-96 MB	REVISED ELEVATIONS OF VALLEY AND RIDGE LINES AND NOTE #5. REMOVED VALLEY AND RIDGE #7, AND MOVED AND EXTENDED VALLEY #8

DESIGN JV MIKE CHRISTENSEN — FIELD APPROVAL JV BRENT BIRGE
DRAWN JV M.E.H. — TECHNICAL APPROVAL JV R. SCOTT
CHECKED JV R. SCOTT — APPROVED JV BRENT BIRGE PROJECT MANAGER
PROJECT NUMBER 1556 OCTOBER 1996

Attachment 4
Bearing Capacity Calculations

ERM

Project Sharon Steel | Project No. 0038001.0 | Sheet 1 of 4
Subject Bearing Capacity | By D. Wilson | Date 8-5-03
Checked by J. KRAUS | Date 8/10/03

Purpose - Calculate ultimate bearing capacity (q_{ult}) for near surface soils at site under typical footings for one to two story residential & commercial structures.

Method - Ultimate bearing capacity of shallow footings with concentric loads per "Naval Facilities Engineering Command - Design Manual" March 1973 p. 7-11.2 (attached)

Assumptions - Consider two soil types using strength data from Bureau of Reclamation study, "Liquifaction Potential and Slope Stability of Sharon Steel / Midvale Tailings Site," February 1993, and cover soil strength estimates from Technical Specifications BOR Req. No. RA-5048.

Cover Soil on Cap

SM, SW, SM, SC, CL
PI < 12

$\gamma \sim 105$ lb/cf
$\phi = 28°$
$C = 0$ (assume)

Use Terzaghi & Peck Fig. 11.13 (attached)

Recompacted Tailings (below cap)

SM

$\gamma = 110$ lb/cf
$\phi = 30°$
$C = 150$ psf (assume 0)

ERM

Project _____ Project No. _____ Sheet 2 of 4

Subject _____ By _____ Date _____

_____ Checked by _____ Date _____

Footing dimensions:

Wall Footings (width) 1', 1.5', 2'

Spread Footings (width) 2', 3', 4'

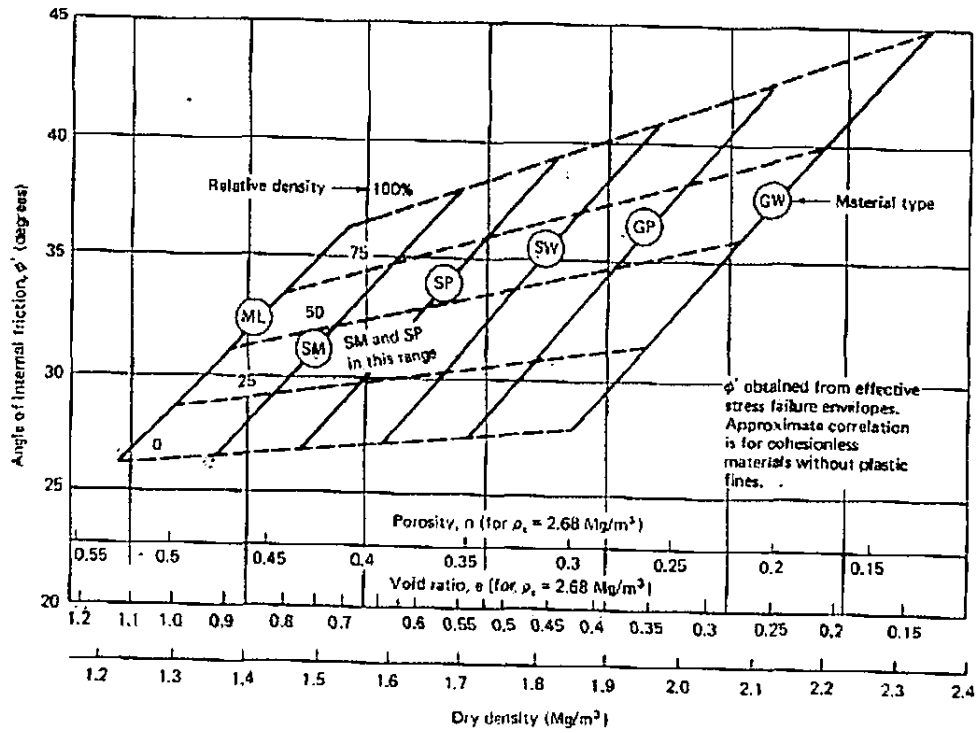


Fig. 11.13 Correlations between the effective friction angle in triaxial compression and the dry density, relative density, and soil classification (after U.S. Navy, 1971).

Calculations - See Spreadsheets

Strip: $q_{ult} = \gamma D N_q + \frac{\gamma B N_\gamma}{2}$ (C=0)

Spread: $q_{ult} = \gamma D N_q + .4 \gamma B N_\gamma$ (C=0)

Bearing Capacity Calculations
Define q(ult) per attached Figure 11-1

Cover Soil on Cap
Phi = 28 degrees

Soil Data

Density =	105	pcf
D =	3	feet
Nq =	18	
Ny =	13	
Assume C = 0		

Strip Footing

Width (B in feet)	q(ult) in pcf (rounded)
1.0	6,400
1.5	6,700
2.0	7,000

Spread Footing

Width (B in feet)	q(ult) in pcf (rounded)
2.0	6,800
3.0	7,300
4.0	7,900

Recompacted Tailings (below cap)
Phi = 30 degrees

Density =	110	pcf
D =	3	feet
Nq =	20	
Ny =	17	
Assume C = 0		

Strip Footing

Width (B in feet)	q(ult) in pcf (rounded)
1.0	7,500
1.5	8,000
2.0	8,500

Spread Footing

Width (B in feet)	q(ult) in pcf (rounded)
2.0	8,100
3.0	8,800
4.0	9,600

ERM

Project _____ Project No. _____ Sheet 4 of 4

Subject _____ By _____ Date _____

_____ Checked by _____ Date _____

Conclusion:

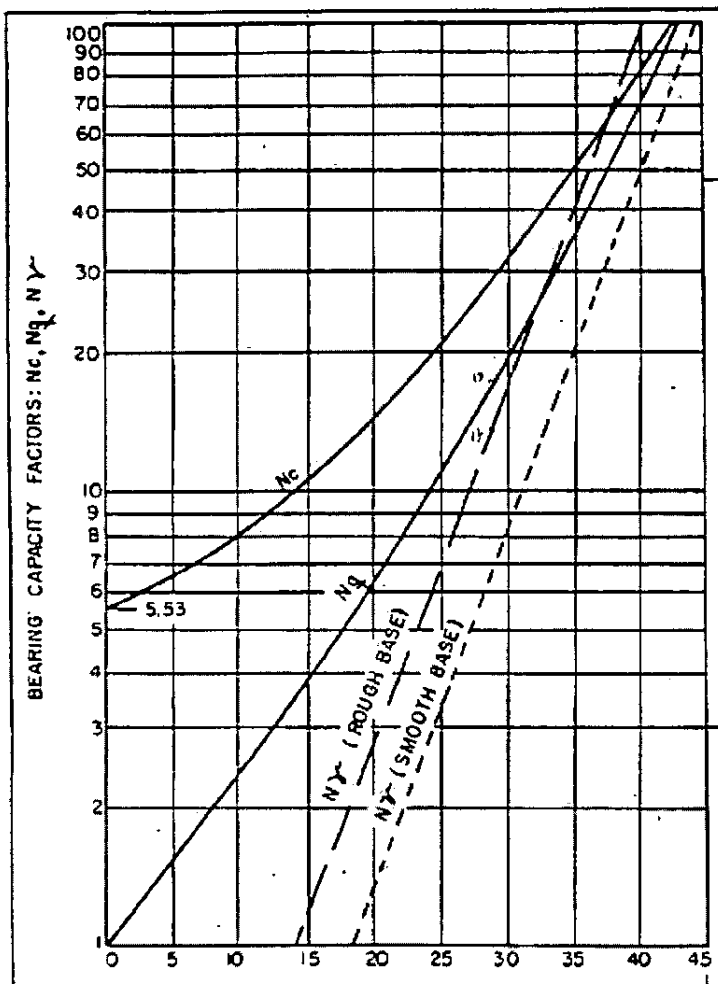
Expected strip footings result in q_{all} from 6400 to 8500 psf. Spread footings result in q_{all} from 6800 to 9600 psf.

Recommended Factors of Safety should range from 2 to 3, which yield allowable values ranging as follows (FS = 2.5):

q_{all} = 2,560 to 3,400 (strip)

q_{all} = 2,720 to 3,840 (spread)

These values are within the typical range of loadings for 1 to 2 story buildings planned for the site.



ULTIMATE BEARING CAPACITY = q_{ult}

CONTINUOUS FOOTING; GENERAL CASE

$q_{ult} = q' + q''$

q' = PORTION OF BEARING CAPACITY ASSUMING WEIGHTLESS FOUNDATION SOIL

q'' = PORTION OF BEARING CAPACITY FROM WEIGHT OF FOUNDATION SOIL

$q' = cN_c + \gamma D N_q$

$q'' = \gamma \frac{B}{2} N_\gamma$

$q_{ult} = cN_c + \gamma D N_q + \frac{\gamma B}{2} N_\gamma$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = cN_c(1.3\frac{B}{L}) + \gamma D N_q + 0.4\gamma B N_\gamma$

CIRCULAR FOOTING: RADIUS = R

$q_{ult} = 1.3 cN_c + \gamma D N_q + 0.6\gamma R N_\gamma$

FOR COHESIONLESS FOUNDATION SOILS (c = 0)

CONTINUOUS FOOTING:

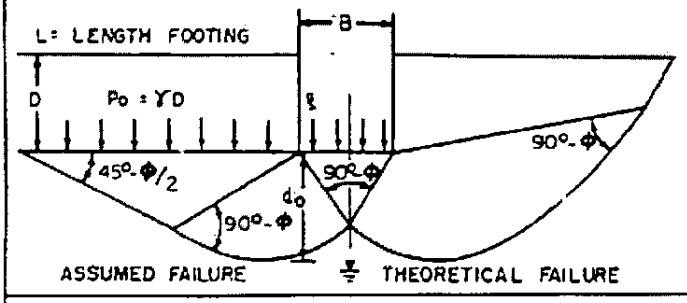
$q_{ult} = \gamma D N_q + \frac{\gamma B}{2} N_\gamma$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = \gamma D N_q + 0.4\gamma B N_\gamma$

CIRCULAR FOOTING:

$q_{ult} = \gamma D N_q + 0.6\gamma R N_\gamma$



FOR COHESIVE FOUNDATION SOILS (ϕ = 0)

CONTINUOUS FOOTING:

$q_{ult} = cN_c + \gamma D$

SQUARE OR RECTANGULAR FOOTING:

$q_{ult} = cN_c(1 + .3\frac{B}{L}) + \gamma D$

CIRCULAR FOOTING:

$q_{ult} = 1.3 cN_c + \gamma D$

ASSUMED CONDITIONS:

1. $D \leq B$
2. SOIL IS UNIFORM TO DEPTH $d_o > B$
3. WATER LEVEL LOWER THAN d_o BELOW BASE OF FOOTING.
4. VERTICAL LOAD CONCENTRIC.
5. FRICTION AND ADHESION ON VERTICAL SIDES OF FOOTING ARE NEGLECTED.
6. FOUNDATION SOIL WITH PROPERTIES c, ϕ, γ

FIGURE 11-1
Ultimate Bearing Capacity of Shallow Footings With Concentric Loads

Attachment 5
Settlement Calculations

ERM

Project Sharon Steel | Project No. 10238001.0 | Sheet 1 of 3
Subject Settlement Calculations | By D. Wilson | Date 8.5.03
Checked by | Date

Purpose - Estimate deflections (settlement) of ground surface due to additional loading on top of capped area of site.

Method - Consolidation Settlement Analysis per "Naval Facilities Engineering Command Design Manual March 1977, p. 7.6-2 (attached)

Total settlement includes elastic deformation that may occur relatively instantaneous upon grading and placement of loads, plus consolidation settlement. Because the elastic loading of unsaturated soil will occur quickly and not cause redevelopment problems, hence, only the longer term consolidation settlement is considered detrimental and is estimated here in.

Assumptions

Soil property data and cross sections taken from Bureau of Reclamation (BOR), "Liquifaction Potential and Slope Stability of Sharon Steel". See attached cross section & soil data.

Calculations address consolidation due to remedial activities in 1997, plus new loads from redevelopment.

ERM

Project _____ Project No. _____ Sheet 2 of 3

Subject _____ By _____ Date _____

_____ Checked by _____ Date _____

Because the saturated tailings and native clay soil have only been loaded for about 5 years by the movement of soil for remediation, the saturated soil is expected to be in an "underconsolidated" state. Consolidation may still be occurring due to this initial loading of 20 to 30 feet of material in some locations.

Estimated Soil data have been obtained from site information and estimates from geotechnical literature (especially the coef. of Consolidation C_c & initial void ratio e_o. No estimate of the rate of consolidation has been made at this time.

Saturated Tailings

γ = 92 lb/ft (ρ=1.4)

Rel. Density ~ 40%

SM - CM

e_o = 0.85 to 0.8

C_c = 0.15

Native Clay

γ = 81 lb/ft

CH

e_o = 0.9 to 0.85

C_c = 0.5

See typical C_c & e_o values from attached references. No actual data available for tailings.

ERM

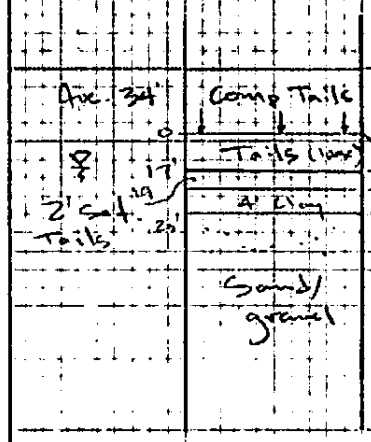
Project _____ Project No. _____ Sheet 3 of 3

Subject _____ By _____ Date _____

_____ Checked by _____ Date _____

Calculations - Pictures below show effective stress profiles for addition of compacted tailings during 1997, and for proposed new loading for redevelopment. Calculations of settlement are shown on spreadsheets.

Initial loading for Remediation



Δp = 34' x 110 pcf = 3740 psf

σ = 17' x 85 pcf = 1445 psf

σ_o = 2' x (92 - 62.4) = 59 psf

1445 + 59 = 1504 psf

σ_o = 4' x (81 - 62.4) = 74 psf

1504 + 74 = 1578 psf

Final Loading - Done on spreadsheets - now includes remediation load as preconsolidation and adds redevelopment soil 5', 10', 20', and 30'

Conclusions

Original Remediation loads may result in settlement of 0.05 to 0.94 feet

Added new loads (5' to 30' soil) may result in additional consolidation of 0.05 to 0.39 feet.

Settlement Calculations
Estimate settlement due to consolidation of saturated tailings/clay due to original remediation activities and new fill for redevelopment

Consolidation due to Remediation Loading
Effective Stress Profile and Consolidation Calculations (Sat. Tails 2 feet)

Soil Profile Date

Soil Description	Unit Wt. (pcf)	Thickness (ft)
New Fill Soil	110	Varies (5, 10, 20, 30)
Compacted Tails	110	34 (ave.)
Uncompacted Tails	85	17 (ave. 12 to 22 feet)
Saturated Tails	92	2 (may be as much as 10 feet)
Native clay	81	4 (ave.)
Sand/gravel		

	Base Stress (psf)	Mid-layer Stress (psf)	Cc	eo
Compacted Tails (new load)	3,740			
Uncompacted Tails	1,445			
Saturated Tails	1,504	1,475	0.15	0.85
Native clay	1,579	1,541	0.5	0.9
Sand/gravel				

Consolidation Calculation

dH (tail) =	0.09	feet
dH (clay) =	0.56	feet
dH (total) =	0.65	feet

Consolidation due to Remediation Loading
Effective Stress Profile and Consolidation Calculations (Sat. Tails 10 feet)

Soil Profile Date

Soil Description	Unit Wt. (pcf)	Thickness (ft)
New Fill Soil	110	Varies (5, 10, 20, 30)
Compacted Tails	110	34 (ave.)
Uncompacted Tails	85	17 (ave. 12 to 22 feet)
Saturated Tails	92	10 (may be as much as 10 feet)
Native clay	81	4 (ave.)
Sand/gravel		

	Base Stress (psf)	Mid-layer Stress (psf)	Cc	eo
Compacted Tails (new load)	3,740			
Uncompacted Tails	1,445			
Saturated Tails	1,741	1,593	0.15	0.85
Native clay	1,815	1,778	0.5	0.9
Sand/gravel				

Consolidation Calculation

dH (tail) =	0.43	feet
dH (clay) =	0.52	feet
dH (total) =	0.94	feet

Consolidation due to Redevelopment
Effective Stress Profile and Consolidation Calculations (Sat. Tails 2 feet)

Soil Profile Date

Soil Description	Unit Wt. (pcf)	Thickness (ft)
New Fill Soil	110	Varies (5, 10, 20, 30)
Compacted Tails	110	34 (ave.)
Uncompacted Tails	85	17 (ave. 12 to 22 feet)
Saturated Tails	92	2 (may be as much as 10 feet)
Native clay	81	4 (ave.)
Sand/gravel		

		Base Stress (psf)	Mid-layer Stress (psf)	Cc	eo
New Fill (5')	5	550			
New Fill (10')	10	1100			
New Fill (20')	20	2200			
New Fill (30')	30	3300			
Compacted Tails		3,740			
Uncompacted Tails		5,185			
Saturated Tails		5,244	5,215	0.15	0.8
Native clay		5,319	5,281	0.5	0.85
Sand/gravel					

Consolidation Calculation

Soil Overburden (5')		
dH (tail) =	0.01	feet
dH (clay) =	0.05	feet
dH (total) =	0.05	feet
Soil Overburden (10')		
dH (tail) =	0.01	feet
dH (clay) =	0.09	feet
dH (total) =	0.10	feet
Soil Overburden (20')		
dH (tail) =	0.03	feet
dH (clay) =	0.16	feet
dH (total) =	0.19	feet
Soil Overburden (30')		
dH (tail) =	0.04	feet
dH (clay) =	0.23	feet
dH (total) =	0.26	feet

Consolidation due to Redevelopment
Effective Stress Profile and Consolidation Calculations (Sat. Tails 10 feet)

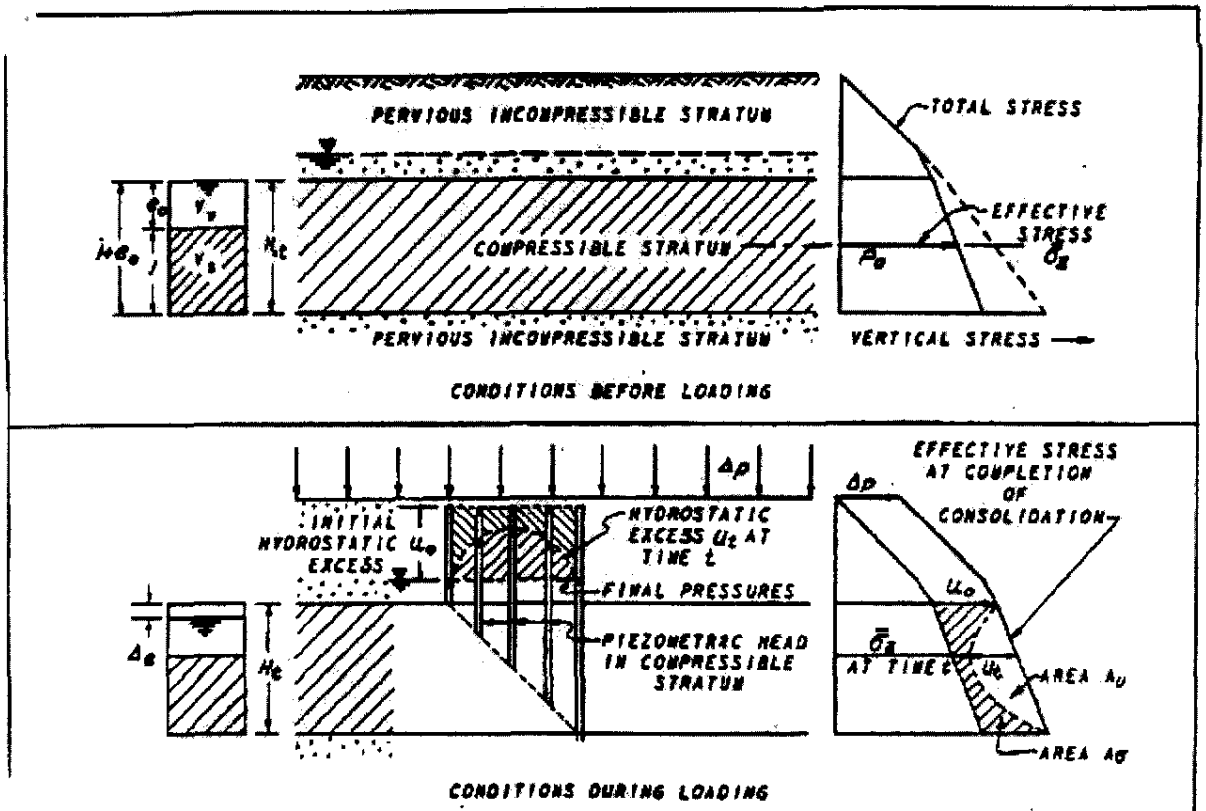
Soil Profile Date

Soil Description	Unit Wt. (pcf)	Thickness (ft)
New Fill Soil	110	Varies (5, 10, 20, 30)
Compacted Tails	110	34 (ave.)
Uncompacted Tails	85	17 (ave. 12 to 22 feet)
Saturated Tails	92	10 (may be as much as 10 feet)
Native clay	81	4 (ave.)
Sand/gravel		

		Base Stress (psf)	Mid-layer Stress (psf)	Cc	eo
New Fill (5')	5	550			
New Fill (10')	10	1100			
New Fill (20')	20	2200			
New Fill (30')	30	3300			
Compacted Tails		3,740			
Uncompacted Tails		5,185			
Saturated Tails		5,481	5,333	0.15	0.8
Native clay		5,555	5,518	0.5	0.85
Sand/gravel					

Consolidation Calculation

Soil Overburden (5')		
dH (tail) =	0.04	feet
dH (clay) =	0.04	feet
dH (total) =	0.08	feet
Soil Overburden (10')		
dH (tail) =	0.07	feet
dH (clay) =	0.09	feet
dH (total) =	0.15	feet
Soil Overburden (20')		
dH (tail) =	0.12	feet
dH (clay) =	0.16	feet
dH (total) =	0.28	feet
Soil Overburden (30')		
dH (tail) =	0.17	feet
dH (clay) =	0.22	feet
dH (total) =	0.39	feet



COMPUTATION OF TOTAL SETTLEMENT

ΔH = TOTAL SETTLEMENT FROM PRIMARY CONSOLIDATION PLUS AN AMOUNT OF SECONDARY COMPRESSION.

Δe = DECREASE IN VOID RATIO CORRESPONDING TO A STRESS INCREASE FROM P_o TO $(P_o + \Delta P)$ AT THE MID-HEIGHT OF THE LAYER H_t.

IF Δe IS DETERMINED DIRECTLY ON THE $(e - P)$ CURVE FROM LABORATORY CONSOLIDATION TEST, ΔH IS COMPUTED AS FOLLOWS:

$$\frac{\Delta e}{1+e_o} = \frac{\Delta H}{H_t} \qquad \Delta H = \frac{\Delta e}{1+e_o}(H_t)$$

IF COMPRESSION INDEX C_c IS INTERPRETED FROM A SERIES OF SEMILOGARITHMIC $(e - P)$ CURVES OF CONSOLIDATION TESTS, ΔH IS COMPUTED AS FOLLOWS:

$$\Delta H = \frac{C_c H_t}{1+e_o}\left(\log \frac{P_o + \Delta P}{P_o}\right)$$

ΔH MAY BE COMPUTED FROM a_v THE SLOPE ARITHMETIC $(e - P)$ CURVES IN THE RANGE FROM (P_o) TO $(P_o + \Delta P)$:

$$\Delta H = \frac{a_v \Delta P H_t}{1+e_o} \qquad a_v = \frac{0.434\, C_c}{P_o + \Delta P/2}$$

COMPUTATION OF TIME RATE OF CONSOLIDATION:

$\bar{U}$ = AVERAGE PERCENT OF CONSOLIDATION COMPLETED AT ANY TIME t AND DEPENDS ON THE DEGREE OF DISSIPATION OF THE INITIAL HYDROSTATIC EXCESS PORE WATER PRESSURES u_o.

$\bar{U}$ AT ANY TIME IS MEASURED BY THE DIVISION OF THE AREA UNDER THE INITIAL EXCESS PRESSURE DIAGRAM BETWEEN EFFECTIVE STRESS AND PORE PRESSURE:

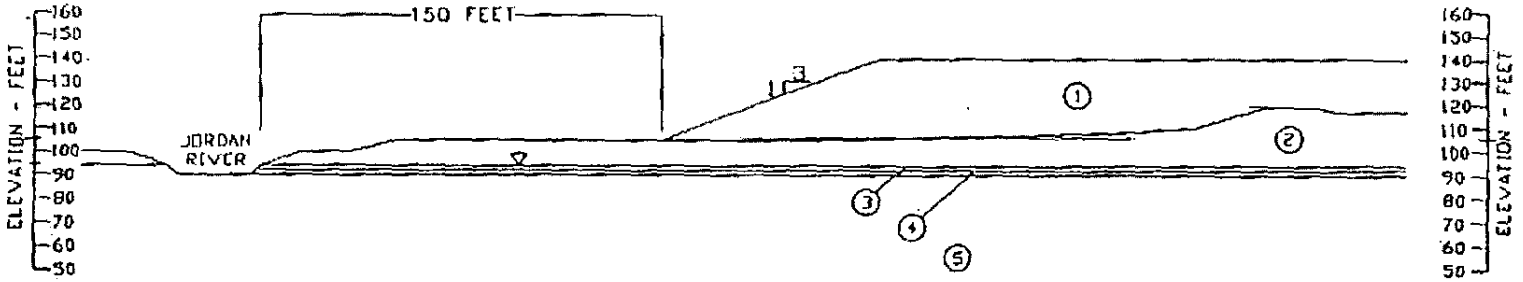
$$\bar{U} = \frac{A_\sigma}{u_o H_t} = \frac{A_\sigma}{A_\sigma + A_u}$$

THIS RELATIONSHIP IS EVALUATED BY THE THEORY OF CONSOLIDATION AND IS EXPRESSED BY THE TIME FACTOR T_v. TO DETERMINE $\bar{U}$ AS A FUNCTION OF TIME FACTOR, USE CURVES OF FIG. 6-8.

$$T_v = \frac{C_v t}{H^2}$$

H = LENGTH OF LONGEST VERTICAL PATH FOR DRAINAGE OF PORE WATER. FOR DRAINAGE TO PERVIOUS LAYERS AT TOP AND BOTTOM OF COMPRESSIBLE STRATUM, $H = H_t/2$.

FIGURE 6-1
Consolidation Settlement Analysis

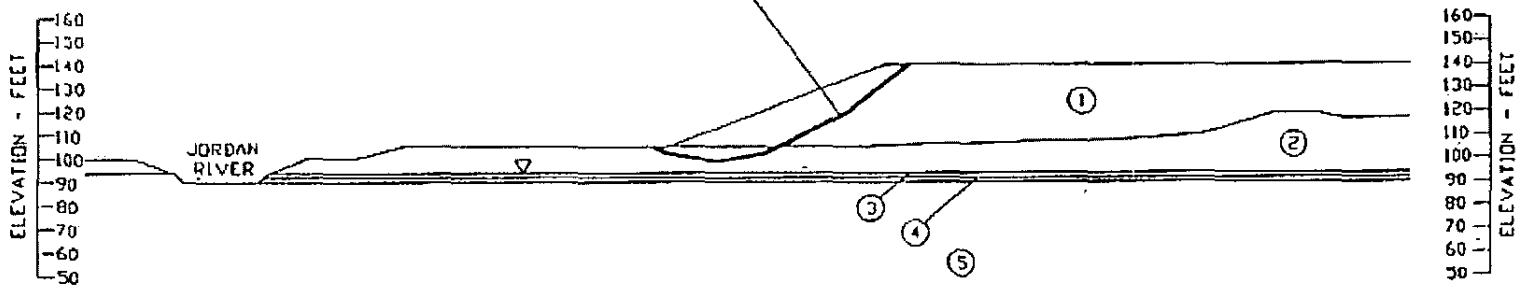


Scale: 1 inch = 75 ft

SOIL TYPE NO.	MATERIAL	
1	OU2 IMPORTED MATERIALS	~34' thick
2	EXISTING OU1 TAILINGS	~12' thick (up to 22')
3	SATURATED OU1 TAILINGS	2'
4	IMPERMEABLE CLAY	4'
5	SAND, GRAVEL, SILT & CLAY	

Prepared by:	SHARON STEEL OU2 REPOSITORY - SITE PROFILE
Date:	
Figure No. 1	

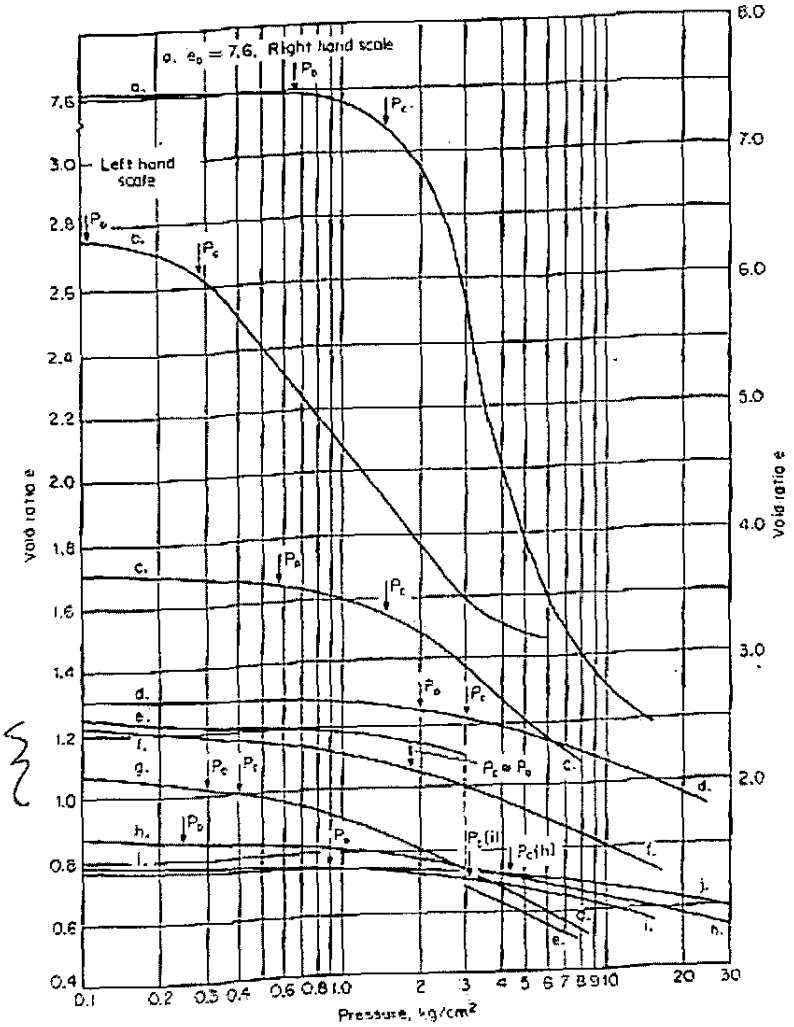
STATIC CONDITION
F.S. = 2.0



Scale: 1 inch = 75 ft

MATERIAL PROPERTIES				
SOIL TYPE NO.	MATERIAL	UNIT WEIGHT (PCF)	FRICTION ANGLE (DEGREES)	COHESION (PSF)
1	OU2 IMPORTED MATERIALS	110	30	150
2	EXISTING OU1 TAILINGS	85	28	100
3	SATURATED OU1 TAILINGS	92	28	100
4	IMPERMEABLE CLAY	81	21	720
5	SAND, GRAVEL, SILT & CLAY	110	30	300

Prepared by:	SHARON STEEL OU2 REPOSITORY – SLOPE STABILITY ANALYSIS
Date:	
Figure No. 2	



Material	γ_d	w	LL	PI
a. Soft silty clay (lacustrine, Mexico)	0.29	300	410	260
b. Soft organic silty clay (alluvium, Brazil)	0.70	92		
c. Soft organic silty clay (backswamp, Georgia)	0.96	65	76	31
d. Stiff clay varve (glaciolacustrine, New York)		46	62	34
e. "Porous" clay (residual, Brazil)	1.05	32	43	16
f. Medium sandy, silty clay (residual gneiss, Brazil)	1.29	38	46	16
g. Soft silty clay (alluvium, Texas)		32	48	33
h. Clayey silt, some fine sand (shallow alluvium, Georgia)	1.46	29	53	24
i. Stiff clay (Beaumont clay, Texas)	1.39	29	61	55
j. Silt varve (glaciolacustrine, New York)				

FIG. 3.87 Typical pressure-void ratio curves for various clay soils.

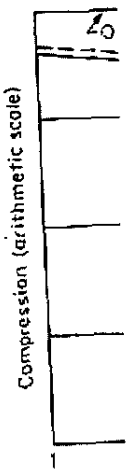


FIG. 3.88

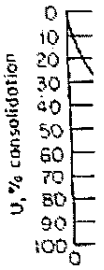


TABLE 8-3 Typical Values of the Compression Index C_c

Soil	C_c
Normally consolidated medium sensitive clays	0.2 to 0.5
Chicago silty clay (CL)	0.15 to 0.3
Boston blue clay (CL)	0.3 to 0.5
Vicksburg buckshot clay (CH)	0.5 to 0.6
Swedish medium sensitive clays (CL-CH)	1 to 3
Canadian Leda clays (CL-CH)	1 to 4
Mexico City clay (MH)	7 to 10
Organic clays (OH)	4 and up
Peats (Pt)	10 to 15
Organic silt and clayey silts (ML-MH)	1.5 to 4.0
San Francisco Bay Mud (CL)	0.4 to 1.2
San Francisco Old Bay clays (CH)	0.7 to 0.9
Bangkok clay (CH)	0.4

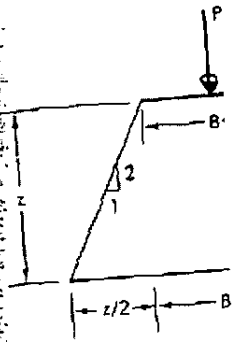
8.12 STRESS DISTRIBUTION

In the previous sections of this chapter when we calculated settlements, the increase in stress $\Delta\sigma$ caused by an applied load was given. In this section, we shall show you how to estimate the stress increase in the soil due to boundary or surface loads.

Suppose a very large area such as a subdivision or shopping mall is to be filled with several metres of select compacted material. In this instance, the loading is *one dimensional*, and the stress increase felt at depth would be 100% of the applied stress at the surface. However, near the edge or end of the filled area you might expect a certain amount of attenuation of stress with depth because no stress is applied beyond the edge. Likewise, with a footing of limited size, the applied stress would dissipate rather rapidly with depth.

One of the simplest methods to compute the distribution of stress with depth for a loaded area is to use the *2 to 1 (2:1) method*. This is an empirical approach based on the assumption that the area over which the load acts increases in a systematic way with depth. Since the same vertical force is spread over an increasingly larger area, the unit stress decreases with depth, as shown in Fig. 8.19. In Fig. 8.19a, a strip or continuous footing is seen in elevation view. At a depth z, the enlarged area of the footing increases by $z/2$ on each side. The width at depth z is then $B + Z$, and the stress σ_z at that depth is

$$\sigma_z = \frac{\text{load}}{(B+z)\times 1} = \frac{\sigma_o(B\times 1)}{(B+z)\times 1} \qquad (8\text{-}22)$$



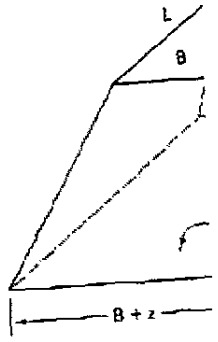


Fig. 8.19 The stress with depth

where σ_o is the surface

By analogy, a re

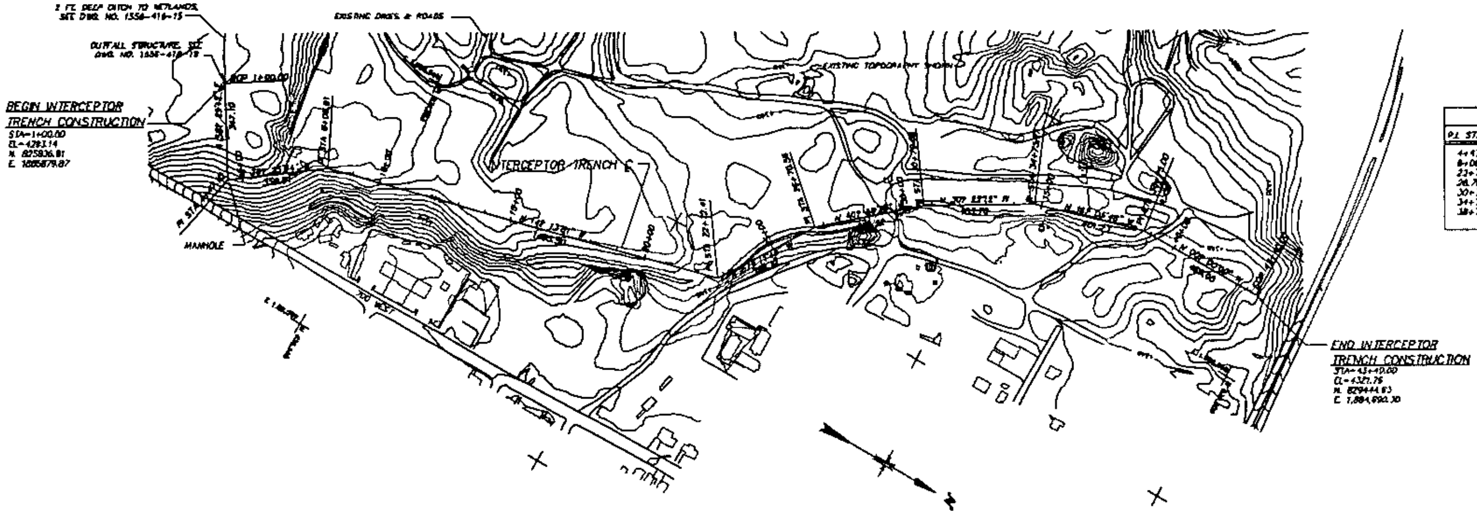
have an area of $(B +$

corresponding stress a

$\Delta\sigma_z =$

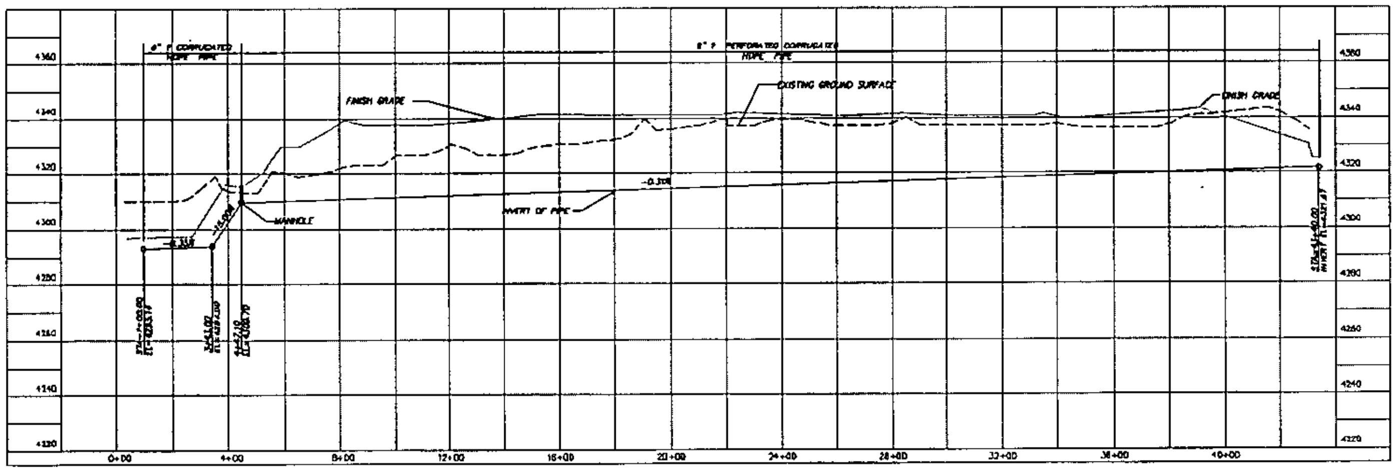
Example 8.17 illustrat

Attachment 6
Existing Interceptor Trench Drawings



INTERCEPTOR TRENCH DATA			
P.I. STATION	NORTHING	EASTING	INV. ELEVATION
4+47.10	820018.5587	1886176.3135	4308.70
8+08.81	828308.0635	1885862.6478	4310.87
22+72.41	827728.5901	1885602.3872	4315.35
26.70.56	827844.2941	1885267.7314	4316.50
30+70.07	828245.8127	1885005.6960	4317.87
34+73.77	828584.1293	1884901.5457	4319.08
38+75.00	828879.8283	1884680.3011	4320.32

SCALE OF FEET



NOTES

1. SEE DRAWING NO. 1556-418-19 FOR INTERCEPTOR TRENCH DETAILS.

AS BUILT

REVISED BEGINNING AND ENDING OF TRENCH, STATIONS, PROFILES AND TRENCH DATA

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FOR THE
STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY

SHARON STEEL/MIDVALE TAILINGS
OPERABLE UNIT NUMBER ONE
INTERCEPTOR TRENCH
PLAN AND PROFILE

PROVO, UTAH

1556-418-7

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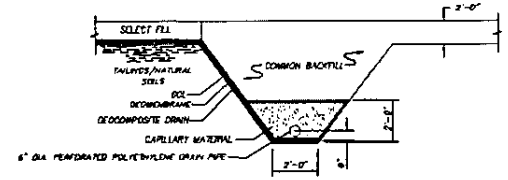
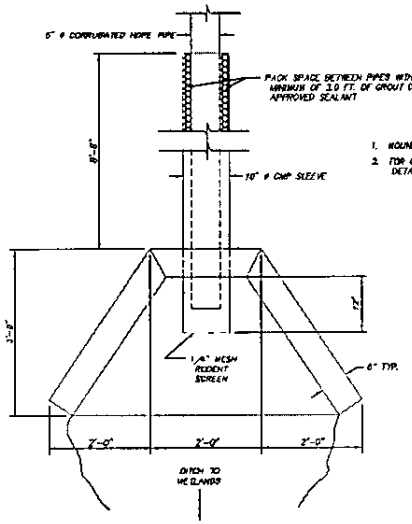


NOTES

1. EXCAVATED MATERIAL WILL BE DISPOSED OF UNDER THE CAP AND REPLACED WITH COMMON BACKFILL AND COMPACTED TO 95% OF PROCTOR IN 1.0 FT. LIFTS.
2. FULLY ENCAPSULATED CAPILLARY MATERIAL MIN GEOCOMPOSITE DRAIN MATERIAL.

NOT TO SCALE

INTERCEPTOR TRENCH



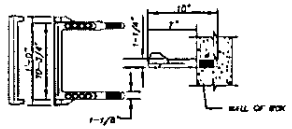
NOTES

1. ROUND COVER SOIL A MINIMUM OF 3.0 FT. OVER PIPES.
2. FOR GENERAL NOTES AND MINIMUM REQUIREMENTS FOR DETAILING REINFORCEMENT, SEE DRAWING NO. 40-D-6263.

NOTE: FOR GENERAL NOTES AND MINIMUM REQUIREMENTS FOR DETAILING REINFORCEMENT, SEE DRAWING NO. 40-D-6263.

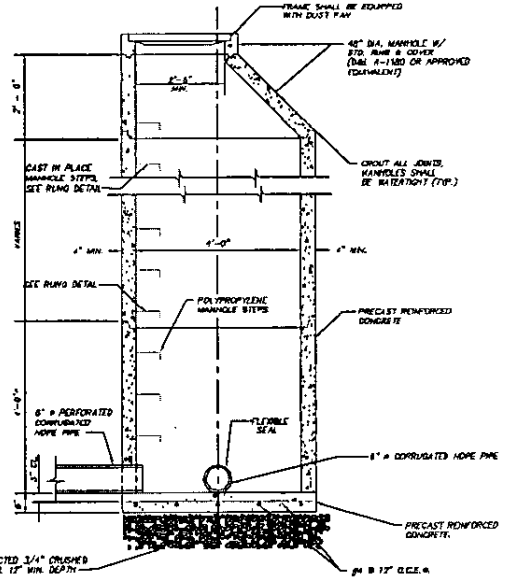
NOT TO SCALE

OUTFALL STRUCTURE TOP VIEW



NOT TO SCALE

RUNG DETAIL



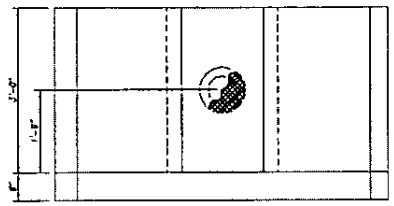
NOTES

1. ADJUST DEPTH OF MANHOLE SECTION IN RELATION TO DEPTH OF COVER.
2. DETAIL IS TYPICAL. MANHOLE BASES SHALL BE FURNISHED TO FIT EACH LOCATION.

NOT TO SCALE

MANHOLE DETAIL (TYPICAL)

INLET STA. 38+52.22, EL. 4309.70



NOT TO SCALE

OUTFALL STRUCTURE END VIEW

ALWAYS THINK SAFETY

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FOR THE
STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY

SHARON STEEL/MIDVALE TAILINGS
OPERABLE UNIT NUMBER ONE

INTERCEPTOR TRENCH DETAILS

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