M037/088

HYDRO-TRIAD, LTD

12136 West Bayaud Avenue, Suite 100
Lakewood, Colorado 80228
Telephone 303/989-8588 *FAX 303/989-9932*

TO: State of Utah
Deptarment of Natural Resource
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114-5801

DATE: December 20, 1996

JOB: Lisbon Valley

ATTENTION: Tom Munson

We are sending you: X Attached ____ Under Separate Cover

Copies	Drawing No.	Description
1		Lisbon Valley Hydrology Memo

These are transmitted as checked below:

____ For Approval X For Your Use

____ As Requested ____ For Review and Comment

Remarks Attached is a copy of HTL's response to the inqueries of the Lisbon Valley hydrology.

Have a wonderful Christmas and best wishes for the New Year.

DIV. OF OIL, GAS & MINING
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By: Troy Thompson

Copy To: 475-004

M037/088

Water Resources

Environmental Studies

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MEMORANDUM

DATE: 20 December, 1996

TO: Pat Gochnour, Gochnour & Associates, Inc.
John Welsh, J. D. Welsh & Associates, Inc.

CC: Tom Munson, Utah Division of OG&M

FROM: Troy Thompson, **HYDRO-TRIAD, LTD**

SUBJECT: Lisbon Valley UDOG&M Inquiries
HTL Project #: 475-004

The following memorandum addresses the inquiries raised by Tom Munson of the Utah Division of Oil, Gas and Mining.

Sediment Ponds and Control

Sediment Pond Construction Details

A row of entrenched and anchored straw or hay bales will serve as the filter media at the outlet of the sediment collection ponds. Construction methods will include the following:

- A trench will be excavated along the length and width of the bale barrier. The minimum depth of excavation for the trench will be 4 inches. The trench will be constructed perpendicular to the direction of flow.

- Bales will be orientated perpendicular to the contours with ends of adjacent bales abutting tightly against one another.

- The bales will be staked in place by wooden stakes or rebar. Each bail will be secured by a minimum of two stakes, driven a minimum of one foot below the invert of the trench.

- The excavated soil will be used as backfill against the barrier after the stakes are in place. Backfilled soils will be built up a minimum of 4 inches against the upstream face to prevent piping.

- Any gaps between bales will be filled in by wedging straw or hay into the openings. Tight joints will be required to insure the water is not allowed to flow freely between the bales.

The length of the barrier will extend far enough such that the base of the external bales are higher than the top of the lowest bales. This arrangement minimizes water flow around the bales. A schematic of a typical sediment pond is shown on Figure 1. Details of the bale installation and a schematic of a typical barrier cross section are shown on Figure 2.

The upstream and downstream slopes leading to and from the bale barrier will be lined with a geogrid and covered with rip rap. This protection will provide added stability to ensure the slopes are not eroded. Placement of the geogrid over the top of the straw/hay bales will reduce the amount of erosion that would occur if the bales are overtopped. The outlet ditch will be lined with rip rap (VL sized) to maintain the downstream channel integrity. The channel downstream of the sediment pond south of the pad will be rip rapped downstream until it meets the natural drainage channel. The channel downstream of the sediment pond east of Sentinel Pit 2 will be rip rapped to the confluence with the main diversion ditch. The channel downstream of the sediment pond east of GTO pit will be rip rapped until it enters a natural drainage path. The location and extent of these channels are presented on Figure 3.

Maintenance Plan

The bale's ability to filter sediment and transmit water deteriorates with time and use. The bales will be inspected a minimum of three times per year. Inspections will be performed once at the beginning of the wet season (end of June), in the middle of the wet season (September) and once at the end of the wet season (beginning of December). Repair or replacement of the bails will occur as necessary based upon inspection findings.

A staff gauge will be installed in each sediment pond. The gauge will be marked to indicate the interface between the dead and live storage. Sediment that has accumulated in the ponds will be removed whenever the sediment level reaches the mark on the staff gauge. Accumulated sediment will also be cleaned out at the beginning of the wet season (end of June) to prepare for the wet season.

Reclamation Plan

The sediment control ponds are temporary structures that will be removed in conjunction with the overall mine reclamation. The sediment ponds will remain

operational until the waste rock dumps have been reclaimed. After vegetation has been established on the waste rock dumps, the bales will be removed and the sediment ponds will be backfilled. The surface will be graded and vegetated.

Size Calculations

The required size for the life storage in the sediment ponds are as follows:

West of Sentinel Pit 1	900CY
South of Pad	675 CY
East of GTO Pit	5000 CY

Note: These numbers are updates for the values previously presented. Hydrologic calculations used to determine the size of each sediment pond are presented in Appendix A.

Diversion Ditch Detail - Sentinel Pit 1

Rip Rap Sizing

Rip rap sizes were determined based upon the method developed by Smith and Murray (Wright Water, 1984). This method incorporates the design fluid velocity, the specific gravity of the rock and the channel slope to ensure that the gravity forces holding the rip rap in place exceed the forces causing the rip rap to move. For Channels 3 and 4, the local slopes will be reduced to 5% and 4.5% respectively in the riprap (downstream) sections of the channels. A Manning's "n" value of 0.04 was used for rip rapped sections (Chow, 1959). Calculations to determine the required rock sizes are presented in Appendix B.

Ditch Confluence

Ditch confluences will be constructed to limit turbulence. The angle created by the confluence of two ditches will be designed with a maximum angle of 45 degrees. Confluences shall be inspected after major storm events for excessive erosion and displaced riprap and repaired if necessary. In situations where a rip rapped channel and a channel without rip rap converge, the channel without rip rap will be rip rapped for 50 feet upstream of the confluence. A schematic showing the confluence of channel sections is presented on Figure 4.

Channel Erosion

Bends in designed channels will be constructed such that the radius of the bend is greater than three times the channel width. This design minimizes turbulence thereby limiting erosive potentials.

Channels will be inspected after major storm events. Areas that may have eroded will be repaired.

Vegetation

Revegetation of the diversion system will be accomplished by hand broadcasting one or more of the following species:

Species	Broadcast Rate (lbs/acre)
Newhy Wheatgrass	3
Small Bernette	2
Intermediate Wheatgrass	2
Piute Orchard Grass	1
Drought tolerant Basin Wild Grass	3
Sandberg Bluegrass	1
Mountain Rye	3
Ephraim Crested Wheatgrass	1

Variations of species and weight (lbs/acre) will be tested during the initial years of construction and operations.

This species list was developed in consultation with Lynn Kunzler, Senior Reclamation Specialist, Utah Department of Natural Resources, Division of Oil, Gas and Mining.

Temporary Lining

In the event that difficulties are incurred establishing the vegetative linings and excessive erosion of the channels is occurring, temporary measures will be taken to limit erosion from the diversion ditches until vegetation can be established. Methods that will be used for temporary relief include:

- Flow barriers constructed in the channels to reduce flow velocities,
- Geotextile or similar covers installed on sections to stabilize sections of the channels, and if necessary
- Placement of temporary rip rap.

Drainage Path Downstream of Sediment Ponds

The outlet channels downstream of the sediment collection ponds will be lined with rip rap to ensure the channel integrity. A more detailed description of the planned channel construction is discussed above in the section "Sediment Pond Construction Detail". The arrangement of the outlet channel is presented on Figure 3.

Alternative Ditch Arrangements - Sentinel Pit 1

Two alternatives have been proposed for the Sentinel Pit. Option 1 includes a lobe at the north end of the pit. Option 2 does not include the northern lobe.

The diversion ditch arrangement for the final design will depend upon which of these alternatives is actually constructed. For this work, ditch arrangements were designed and evaluated for both scenarios. Figure 5 shows the details of the diversion ditch around Sentinel Pit 1 assuming that the northern lobe is constructed. Figure 6 shows the necessary diversion arrangement if the lobe is not constructed.

Data pertaining to the size of the individual ditch segments for both options are presented on Table 1. As shown in the table, the two individual ditch segments from option 2 (design points 14 and 16) have the same size and flow characteristic as the first and last segments for option 1 (design points 14 and 16).

References:

Chow, V. T. Open-Channel Hydraulics, McGraw-Hill Book Company, Inc. 1959.

Wright - McLaughlin Engineers, Urban Storm Drainage, Criteria Manual, 1984.

Attachments:

Table 1 - Sentinel Pit 1 Options, Diversion Ditch Data
Figure 1 - Erosion Bale Installation
Figure 2 - Sediment Pond Schematic
Figure 3 - Diversion System and Sediment Collection Arrangement
Figure 4 - General Confluence Schematic
Figure 5 - Diversion Ditch Arrangement, Option 1, Extended Sentinel Pit 1 Limits
Figure 6 - Diversion Ditch Arrangement, Option 1, Reduced Sentinel Pit 1 Limits
Appendix A - Sediment Pond Sizing Calculations
Appendix B - Rip Rap Sizing Calculations

Table 1

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HYDROLOGICAL DESIGN DATA

DIVERSION DITCH DATA

Option 1 Extended Sentinel Pit 1 Limits

Design Point	Ditch Slope (%)	Drainage Area (acres)	Peak Flow (cfs)	Depth (ft)	Base Width (ft)	Maximum Velocity (fps)
14	0.5	602	253	5.5	8.0	6.3
15	0.5	5115	1155	8.0	8.0	8.2
16	0.5	5734	1295	7.0	8.0	8.6

Option 2 Reduced Sentinel Pit 2 Limits

Design Point	Ditch Slope (%)	Drainage Area (acres)	Peak Flow (cfs)	Depth (ft)	Base Width (ft)	Maximum Velocity (fps)
14	0.5	602	253	5.5	8.0	6.3
16	0.5	5734	1295	7.0	8.0	8.6

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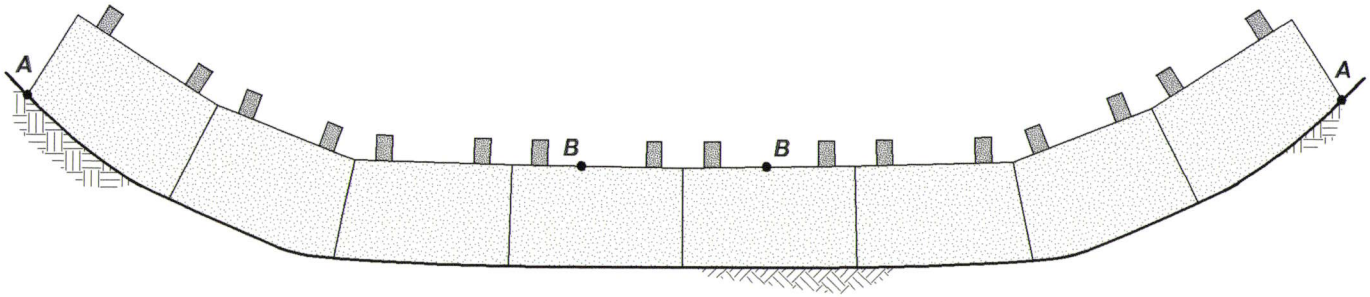
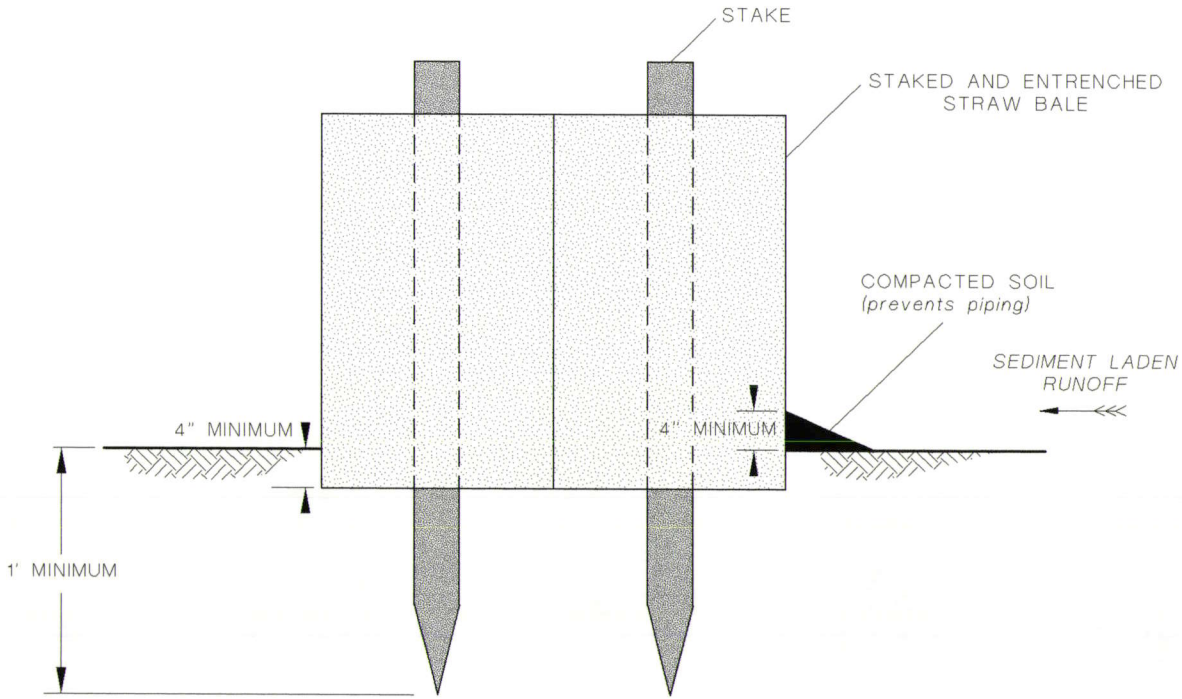


Notes:

1. Base of external bales *(points A)* to be set at a higher elevation than the top of the center bales *(points B)*, to minimize flows around the barrier.

BARRIER CROSS SECTION



CONSTRUCTION DETAILS

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Erosion Bale Installation

December 1996

Figure 1

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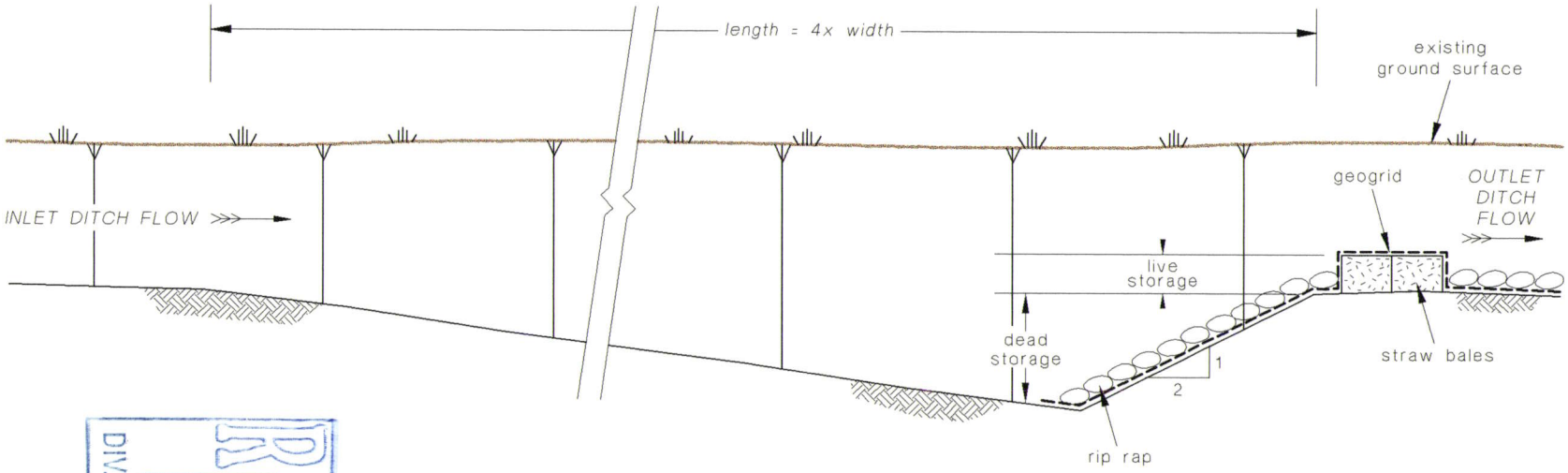

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Sediment Pond

Cross Section Schematic

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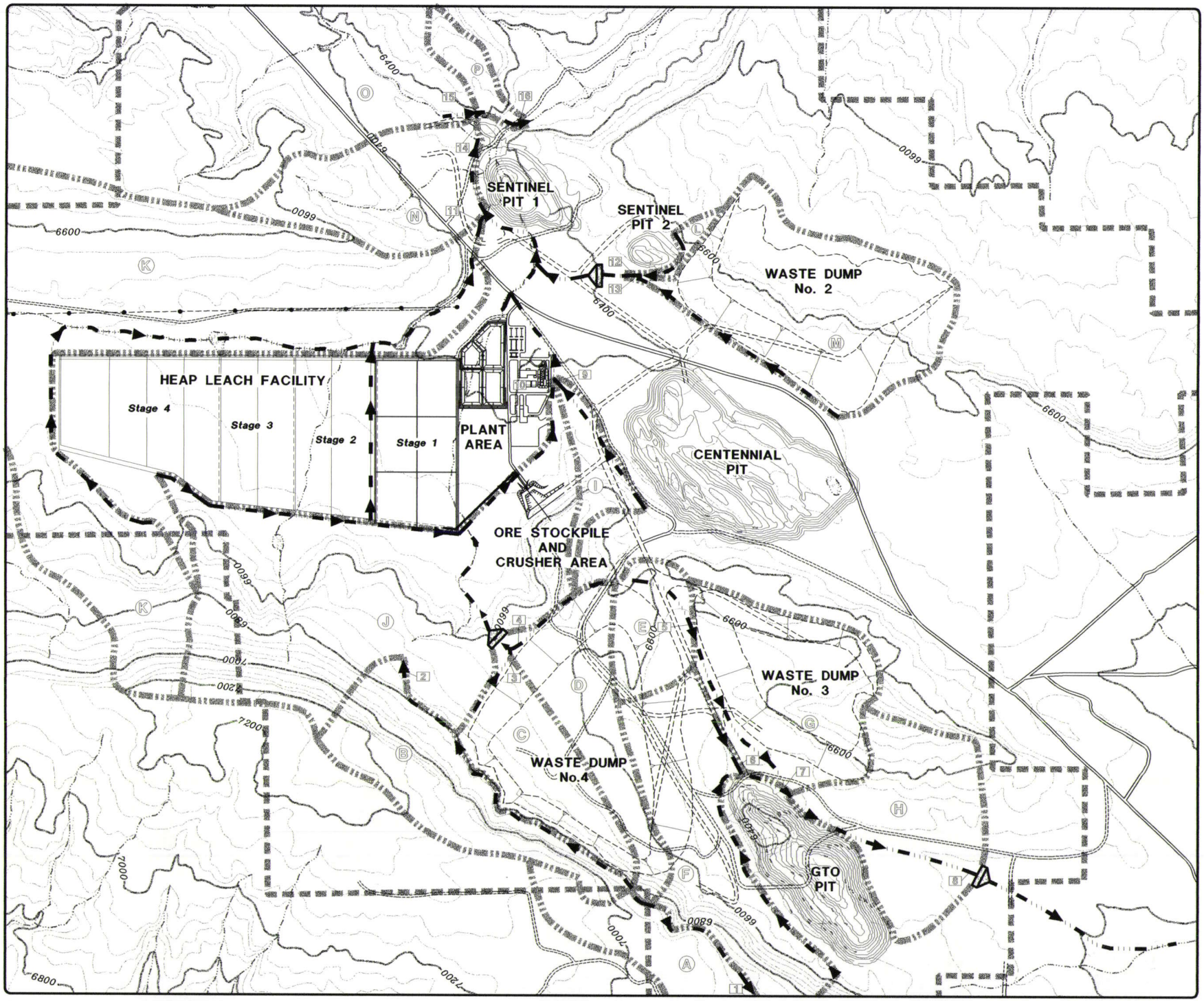
Figure 2

HTL File No. 47596015.dwg



LEGEND

- Property Boundary
- Drainage Boundary
- Diversion Ditch - *flow direction*
- Design Point
- Sub-basin Identification
- Sediment Collection Structure

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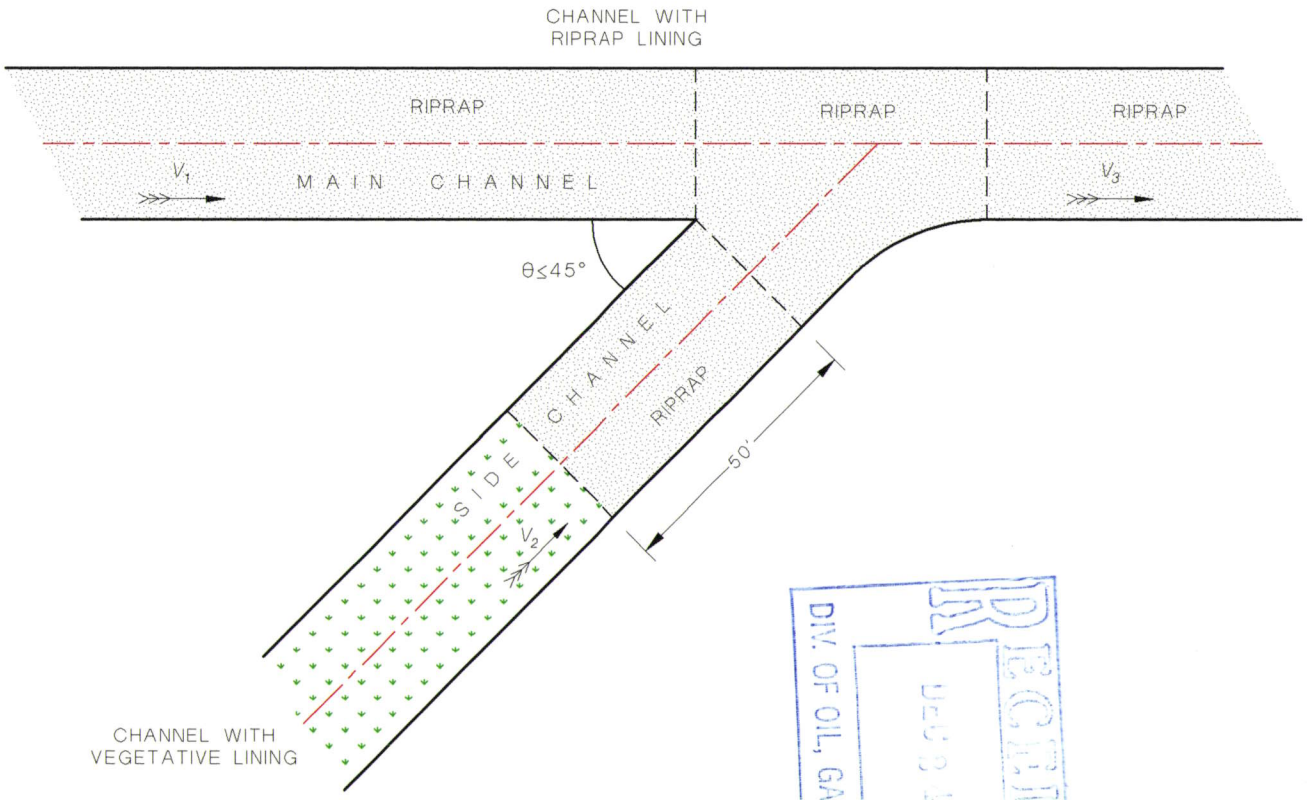
Diversion System and Sediment Collection Arrangement

Base map provided by Shepherd-Miller, Inc.

Figure 3

HTL File No.: 47596014.dwg | Date: 18 December 1996



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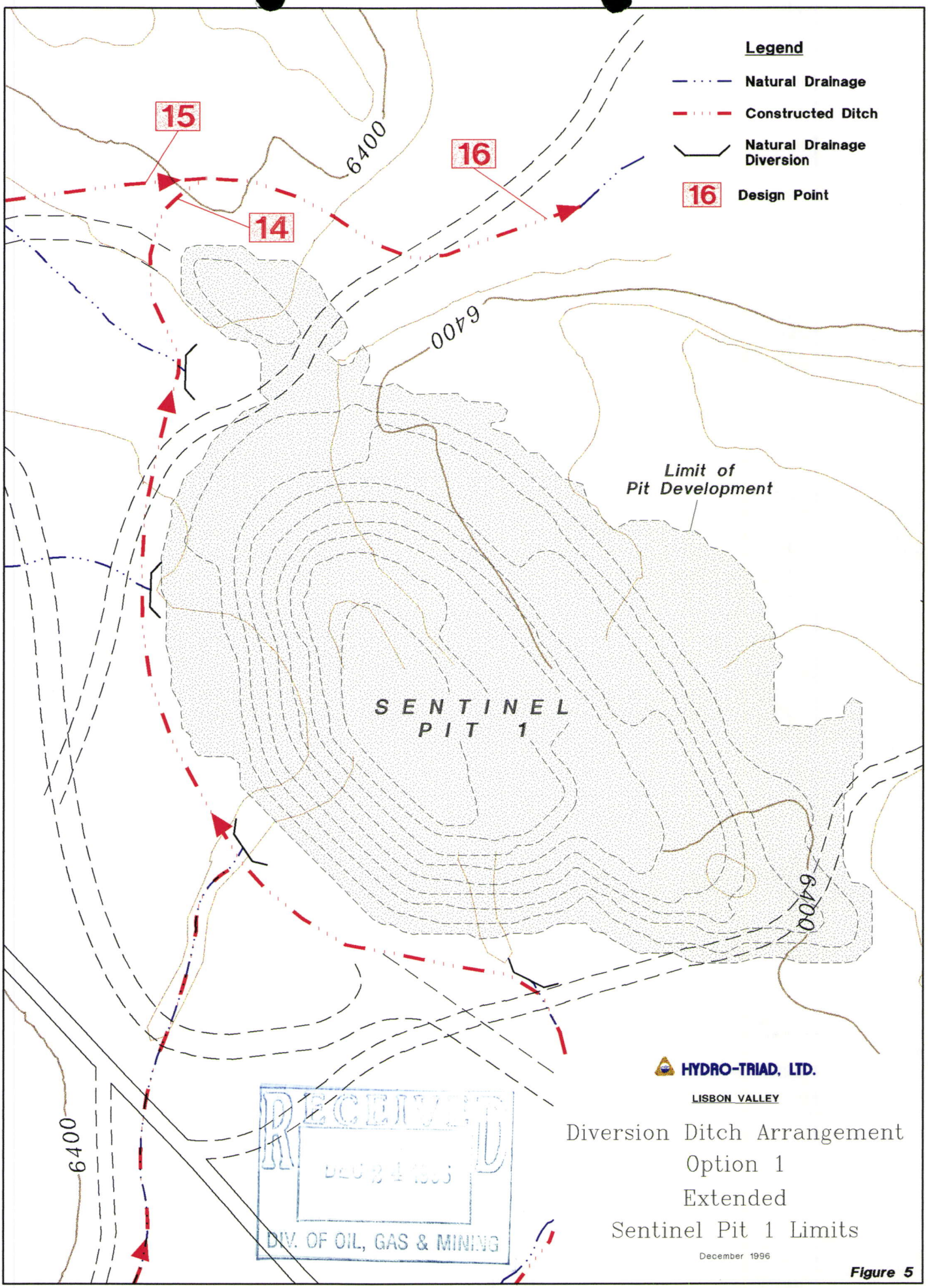
LISBON VALLEY

General
Confluence Schematic

December 1996

Figure 4

HTL File No. 47596016.dwg



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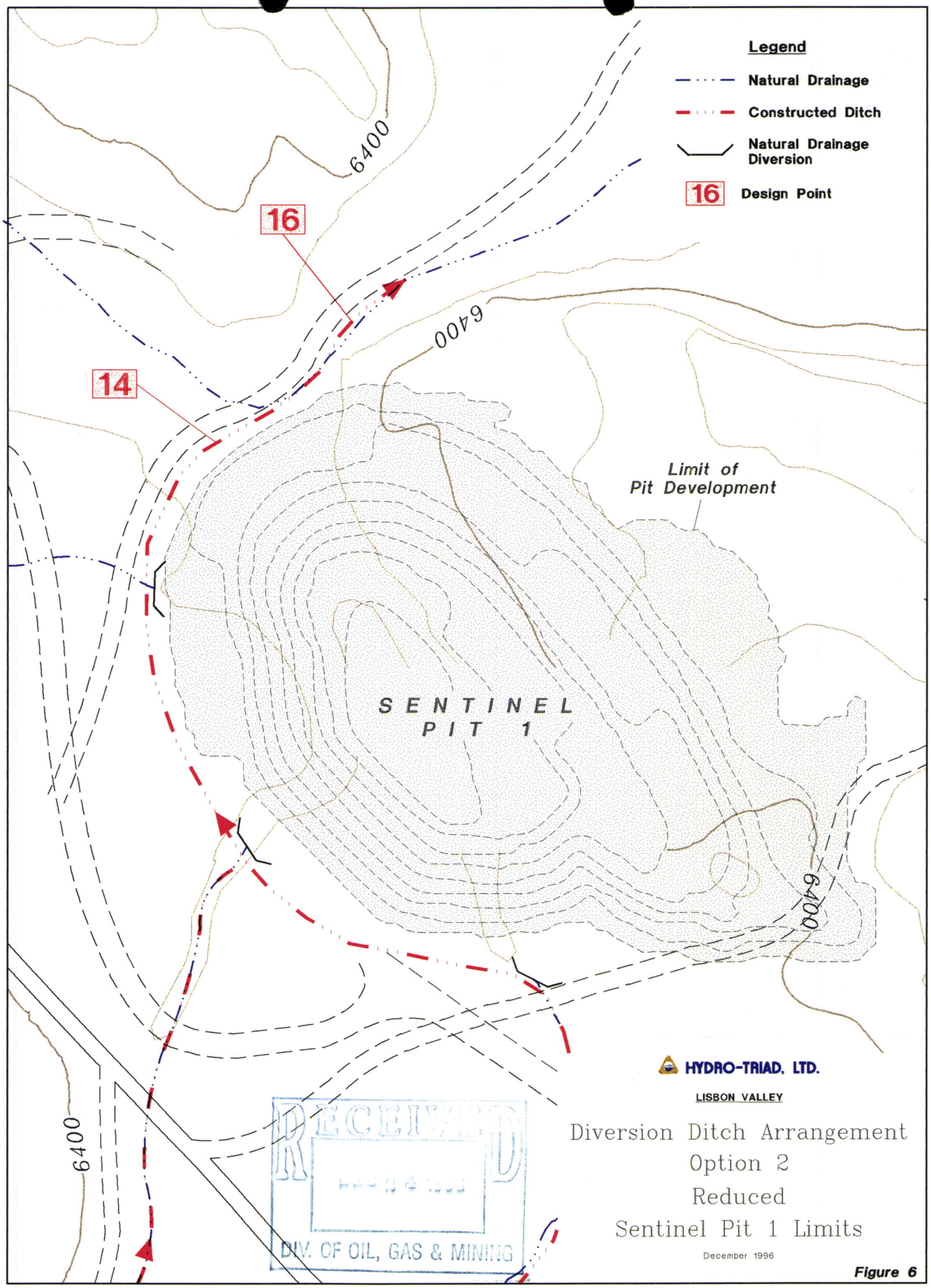

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Appendix A

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Sediment Pond Sizing

Criteria

Storm: 10-yr, 24-hour

Assumptions

25% of waste rock dumps worked at a time. Remainder bypasses basins.

50% of direct precipitation ⟹ runoff

10-yr, 24-hour storm = 1.9" (HTL report)

$1.9'' \times \frac{1 ft}{12''} = 0.158 ft$ of rainfall

At Sentinel Pt #2, contributing areas are "L" + "M"

= 5 + 159 acres = 164 acres = 7,143,840 ft^2

25% of area = 1,785,960 ft^2

Runoff volume = 1,785,960 ft^2 × 0.158 ft × 0.5

V_{ro} = 141,090 ft^3 = 5200 CY

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By: _____

South of Pad

Contributing Subbasins are "C" & "D"

72 + 77 acres = 149 acres

$149 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} = 6{,}490{,}440 \text{ ft}^2$

$V_{RO} = \frac{6{,}490{,}440 \text{ ft}^2}{4} \times \frac{0.158 \text{ ft}}{2} = 128{,}186 \text{ ft}^3$

$= 4700 \text{ CY}$

East of GTD Pit

Contributing Subbasins are "E", "F", "G" & "H"

Areas are 33 + 114 + 107 + 104 acres
E, F & G are waste rock dumps ∴ assume only 75% of area contributes. Assume 100% of H contributes

Area Contributing = $\frac{33 + 114}{4} + 107 + 104$ acres = 167.5 acres

$167.5 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} = 7{,}296{,}300 \text{ ft}^2$

$V_{RO} = 7{,}296{,}300 \text{ ft}^2 \times \frac{0.158 \text{ ft}}{2} = 576{,}400 \text{ ft}^3 = 21{,}300 \text{ CY}$

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CALCULATION SHEET

By: _____ Date: _____ Subject: _____ Job No.: _____

Checked: TB Date: 12/16/96 Sheet No. 3 of 5

Determine Flows Thru Sediment Barriers

Assume 4:1 length to width dimensions
4foot high barrier (bales)
Conductivity ≈ 1 cm/s (Sand-Gravel)
Flow occurs over top of barrier (plugging etc)
Size such that Qout = 150% Qin

SP#2

5200CY = 140,400 ft³ (want Q ≈ 5200×1.5 = 7800 CY/d)

At 4' deep, Surface Area ≈ 35,100 ft²

$4X^2 = 35{,}100$ where X = width ⇒ X = 93 ft

At mean head @ 2', flow thru barrier =

Q = A×V = A×Kdh/dl assume dl = 2'

$Q = 2 \times 93' \times \frac{1\,cm}{s} \cdot \frac{1\,in}{2.54\,cm} \cdot \frac{1\,ft}{12\,in} \times \frac{3600\,s}{1\,h} \times \frac{24\,h}{1\,d} \times \frac{2'}{2'}$

= 527,000 ft³/d = 19,500 CY/d

Can decrease size

Try 50' × 200' × 4' ≈ 1480 CY

$Q = 2 \times 50 \times \frac{1\,in}{2.54\,cm} \cdot \frac{1}{12} \cdot 3600 \times 24 = 283{,}500\,ft^3/d = 10{,}500\,CY$

Try 40' × 160' × 4' ≈ 950 CY

$Q = 2 \times 40 \times \frac{1}{2.54} \times \frac{1}{12} \times 3600 \times 24 = 226{,}800\,ft^3/d = 8{,}400\,CY$

Try 38' × 152' × 4' = 23,100 ft³ ≈ 900 CY

$Q = 2 \times 38 \times \frac{1}{2.54} \times \frac{1}{12} \times 3600 \times 24 = 215{,}400\,ft^3/d = 7980\,CY$ OK

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By: _____

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By: _____ Date: _____ Subject: _____ Job No.: _____

Checked: _____ Date: _____ Sheet No. 1 of 5

South of Pad

4700 CY = Q_{in} ∴ want Q = 7050 CY/d

Try 35' x 190' x 4' = 19600 ft³ = 725 CY

Q = 2 x 35 x 2834 = 198,380 ft³/d = 7300 CY/d

Try 30' x 120' x 4' = 14,400 ft³ = 530 CY

Q = 2 x 30 x 2834 = 170,040 ft³/d = 6300 CY/d

use 35' x 140'

Try 34' x 136' x 4' = 18,496 ft³ = 685 CY

Q = 2 x 34 x 2834 = 192,712 ft³/d = 7100 CY/d

≈ 675 CY

East of GTO Pit

21,300 CY ∴ want Q = 31,950 CY/d

Due to size, assume 6' depth

Try 100 x 400 x 6 = 240,000 ft³ = 8850 CY

Q = 4 x 100 x 2834 = 1,132,000 ft³/d = 42,000 CY/d

Try 80 x 320 x 6 = 153,600 ft³ = 5700 CY

Q = 4 x 80 x 2834 = 906,880 ft³/d = 33,600 CY/d

Try 75 x 300 x 6 = 135,000 ft³ = 5000 CY

Q = 4 x 75 x 2834 = 850,200 ft³/d = 31,500

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SP#2 ≈ 900CY
South of Pad = 675CY
GTD Pit = 5000CY

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CALCULATION SHEET

By: TB Date: 12/16/96 Subject: Rip-Rap Calculations Job No.: 475-001
Checked: [illegible] Date: 12/18/96 [illegible] Sheet No. 1 of 3

Equation 5-4
Urban Drainage Criteria manual

$$d_{50} = \left(\frac{V S^{0.17}}{(S_s - 1)^{0.66}\, 4.5} \right)^2$$

V → Mean Velocity (fps)
S – Slope (feet/feet)
S_s – Specific gravity of rock
d_{50} – Rock size in feet for which 50% of the riprap by weight is smaller

Design Point #3

* $V_{max} = 7.0$ (fps)
$S = 0.05$

$$d_{50} = \left(\frac{(7.0)(0.05)^{0.17}}{(2.5-1)^{0.66}\,(4.5)} \right)^2 = 0.5'$$

$$\frac{V S^{0.17}}{(S_s - 1)^{0.66}} = \frac{(7.0)(0.05)^{0.17}}{(2.5-1)^{0.66}} = 3.2 \ \frac{ft^{1/2}}{s}$$

Rock Type = VL

Design Point #4

* $V_{max} = 6.9$ fps
$S = 0.045$

$$d_{50} = \left(\frac{(6.9)(0.045)^{0.17}}{(2.5-1)^{0.66}\, 4.5} \right)^2 = 0.5'$$

$$\frac{V S^{0.17}}{(S_s - 1)^{0.66}} = \frac{(6.9)(0.045)^{0.17}}{(2.5-1)^{0.66}} = 3.1 \ \frac{ft^{1/2}}{s}$$

Rock Type = VL

Design Point #8

$V_{max} = 5.7$ fps
$S = 0.006$

$$d_{50} = \left(\frac{(5.7)(0.006)^{0.17}}{(2.5-1)^{0.66}\,(4.5)} \right)^2 = 0.16'$$

$$\frac{V S^{0.17}}{(S-1)^{0.66}} = \frac{(5.7)(0.006)^{0.17}}{(2.5-1)^{0.66}} = 1.8$$

Rock Type = VL

* Riprap sections of each channel will have reduced slopes of 5% (Design Point 3) and 4.5% (Design Point 4).

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Design Point #10

$V_{max} = 6.5$ fps
$S = 0.005$

$$d_{50} = \left(\frac{(6.5)(0.005)^{0.17}}{(2.5-1)^{0.66}\,(4.5)}\right)^2 = 0.20'$$

$$\frac{VS^{0.17}}{(S-1)^{0.66}} = \frac{(6.5)(0.005)^{0.17}}{(2.5-1)^{0.66}} = 2.0$$

Rock Type = VL

Design Point #11

$V_{max} = 5.9$
$S = 0.006$

$$d_{50} = \left(\frac{(5.9)(0.006)^{0.17}}{(2.5-1)^{0.66}\,(4.5)}\right)^2 = 0.17'$$

$$\frac{VS^{0.17}}{(S-1)^{0.66}} = \frac{(5.9)(0.006)^{0.17}}{(2.5-1)^{0.66}} = 1.9$$

Rock Type = VL

Design Point #13

$V_{max} = 5.6$
$S = 0.006$

$$d_{50} = \left(\frac{(5.6)(0.006)^{0.17}}{(2.5-1)^{0.66}\,(4.5)}\right)^2 = 0.16'$$

$$\frac{VS^{0.17}}{(S-1)^{0.66}} = \frac{(5.6)(0.006)^{0.17}}{(2.5-1)^{0.66}} = 1.8$$

Rock Type = VL

Design Point #14

$V_{max} = 6.3$
$S = 0.005$

$$d_{50} = \left(\frac{(6.3)(0.005)^{0.17}}{(2.5-1)^{0.66}\,(4.5)}\right)^2 = 0.19'$$

$$\frac{VS^{0.17}}{(S-1)^{0.66}} = \frac{(6.3)(0.005)^{0.17}}{(2.5-1)^{0.66}} = 2.0$$

Rock Type = UL

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CALCULATION SHEET

By: TB Date: 12/17/96 Subject: Riprap Calculations Job No.: 475-001
Checked: Date: Lisbon Valley Sheet No. 3 of 3

Revisions: By: Date:

Design Point #15

$V_{max} = 8.2$ fps
$S = 0.005$

$$d_{50} = \left(\frac{(8.2)(0.005)^{0.17}}{(2.5-1)^{0.66}(4.5)}\right)^2 = 0.32'$$

$$\frac{VS^{0.17}}{(S_s-1)^{0.66}} = \frac{(8.2)(0.005)^{0.17}}{(2.5-1)^{0.66}}$$

$$= 2.5$$

Rock Type = VL

Design Point #16

$V_{max} = 8.6$
$S = 0.005$

$$d_{50} = \left(\frac{(8.6)(0.005)^{0.17}}{(2.5-1)^{0.66}(4.5)}\right)^2 = 0.35'$$

$$\frac{VS^{0.17}}{(S_s-1)^{0.66}} = \frac{(8.6)(0.005)^{0.17}}{(2.5-1)^{0.66}}$$

$$= 2.7$$

Rock Type = VL

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