ATTACHMENT OP-7

Specifications for Storage Ponds

TECHNICAL SPECIFICATIONS

Section TS-1 General Requirements

TS 1.1 Summary Of Work

The Work under this contract includes construction of two lined evaporation ponds which includes installation of embankment raises, installation of double ponds with leak detection systems.

The site is located east of the Proposed Lost Creek Plant. Site location maps are provided in the Drawings.

TS 1.2 General Description Of Work

1.2.1 Location

Ponds 1&2 Reservoirs are located in the E1/2, Section 18, T25N, R92W, in Sweetwater County, Wyoming.

1.2.2 Statement Of Work

The work to be performed is shown on the Drawings and described in these specifications. The Work includes, but is not limited to, the following components:

- Site preparation which includes clearing and grubbing, topsoil and subsoil removal and stockpiling;
- Excavation of key cut;
- Construction of embankments;
- Installation of geomembrane and collections system for double lining with leak detection.

1.2.3 List Of Drawings

Included with these specification are the following drawings:

Drawing Number	Title
0802.100	Index, Legend and General Notes
0802.101	Overall Site Plan
0802.102	Embankment Plan
0802.103	Embankment Details
0802.104	Leak Detection Details

TS 1.3 Equipment, Materials, and Labor

The Contractor shall furnish all supervision, personnel, labor, materials, Plant, machinery, tools, equipment, repairs, maintenance and service, and all other facilities and incidentals necessary for the execution and completion of the Work. The Owner shall provide fresh water for soil compaction and dust abatement. The Contractor shall be responsible for all pumping, hauling and dispensing of such water.

TS 1.4 On-Site Material Definitions

For purposes of these specifications, other than payment, materials of earthwork and construction are defined as follows:

A. TOPSOIL

Surficial soil material selectively salvaged and stockpiled for use in reclamation. The depth of topsoil to be salvaged at any particular location shall be directed by the Engineer.

B. SUBSOIL

Soil material beneath topsoil selectively salvaged and stockpiled for use in reclamation. The depth of subsoil to be salvaged shall be directed by the Engineer.

C. UNSUITABLE MATERIAL

Material excavated or removed from the borrow areas, foundation or embankments which is not suitable for embankment fill or foundation. The Engineer shall determine if excavated material is unsuitable.

D. FILL MATERIAL

Material from the borrow excavation which is suitable for embankment construction. The Engineer shall determine if excavated material is suitable for fill material.

TS 1.5 Standard Of Construction

The Work covered by these specifications will be completed in such a manner as to meet the requirements of all applicable federal, state, and local laws, regulations and ordinances, and to conform to modern practices for this type of work.

TS 1.6 Environmental

The Contractor shall insure that no contamination of topsoil, water, and air occurs from oil, fuel, or other fluid spills; from vehicle emissions; or from garbage, waste, or other debris.

The Contractor shall service all equipment in designated areas, and maintain all equipment to prevent leakage of oil, fuel or other fluids; and to prevent unacceptable levels of emissions.

The Contractor shall provide approved sanitary facilities on-site and these facilities shall be properly maintained.

The Contractor shall collect, remove, and properly dispose of all trash, garbage, debris, used oil, and other waste materials off-site at an approved disposal area.

The Contractor shall comply with all State of Wyoming Department of Environmental Quality rules and regulations during construction, including, but not limited to, the handling and storage of fuel, oil, and other liquids.

The Contractor shall keep all access roads and work areas wetted, as directed by the Engineer, to abate fugitive dust.

TS 1.7 Field Engineering

The Engineer will provide initial slope stakes for the embankment raises and will stake topsoil stripping limits and depths. The Engineer will also determine the suitability of borrow material depth.

TS 1.8 OSHA Requirements

The Contractor shall be required to obtain a contractor identification number from the U.S. Office of Safety and Heath Administration (OSHA) and shall assume sole responsibility for compliance with OSHA requirements.

Section TS-2 Mobilization and Demobilization

TS 2.1 Scope

The Work in this Section comprises the Contractor's establishment on Site of all the temporary accommodation, Plant and equipment necessary for the successful completion of the Work and shall include, but not necessarily be limited to the following:

(1) Assemble all necessary Plant and transport to Site.

(2) Establish the Contractor's maintenance facilities, temporary workshops, temporary office accommodation and sanitation facilities.

(3) Provide the Engineer’s temporary office accommodations.

(4) Provide temporary accommodation for the Contractor's personnel.

(5) Maintain Plant and services for the duration of the Work.

(6) All things required to move onto the Site for execution of the Work.

(7) On completion of the Work remove all Plant from the Site, and restore the Site to a clean and tidy condition to the satisfaction of the Engineer.

TS 2.2 Execution

2.2.1 Mobilization

The Contractor shall mobilize on the Site, sufficient labor, materials, and equipment to allow commencement of the Work, and shall bring on to the Site, as and when necessary, any additional equipment, labor and materials which may be required to complete the Work as scheduled.

2.2.2 Contractor’s Workshops, Stores and Offices

The Contractor shall either transport mobile units or erect, in the area designated on the Drawings or indicated by the Engineer, adequate workshops, offices and other buildings and structures for the completion of the Work. Such workshops and offices, etc., shall be maintained in a neat and tidy condition throughout the duration of the Work to the satisfaction of the Engineer.

2.3.3 Sanitation

The Contractor shall provide and maintain adequate sanitary facilities for his personnel at the Site, including his offices and temporary accommodation and Engineer's office in compliance with local health regulations and to the satisfaction of the Engineer.

2.2.4 Construction Roads

All temporary construction roads which the Contractor may require to complete the Work shall be constructed at the Contractor's expense.

The location of any temporary roads, or portions thereof, on the Site shall be subject to the Engineer's approval.

The Contractor's construction roads shall be available for use by others having permission from the Engineer to carry out work on the Site.

2.2.5 Drainage

Adequate drainage facilities in the form of ditches, culverts or other conduits shall be installed as necessary to maintain temporary construction access roads. These temporary drainage facilities shall be constructed to the satisfaction of the Engineer.

2.2.6 Demobilization

Upon completion of the Work, the Contractor shall remove all Plant from the Site, restore all damaged roads, and remove all haul roads not authorized by the Owner, and shall leave the Site in workman-like condition, to the satisfaction of the Engineer.

TS 2.3 Measurement and Payment

2.3.1 Mobilization

Payment shall be full compensation for Mobilization and shall be limited to an amount not greater than seven percent of the total contract price.

2.3.2 Demobilization

Payment shall be full compensation for Demobilization and shall be limited to an amount not greater than three percent of the total contract price.

PAY ITEMS	PAY UNIT
2-1 Mobilization	LS
2-2 Demobilization	LS

Section TS-3 Earthwork

TS 3.1 Scope

The Work in this Section covers stripping of all topsoil, subsoil, the construction of the downstream embankment raise, installation of the cutoff trench and construction of access roads. The Work shall include the necessary manpower and equipment to construct the embankments from material designated as borrow material on the Drawings or as approved by the Engineer.

TS 3.2 Products/Materials/Equipment

3.2.1 Soils

The following soil types shall be encountered during the Work:

- Topsoil - Topsoil shall be determined using WDEQ-LQD Guideline 1 standards and as shown in Appendix D7 of the Permit to Mine. Stockpiling and protection will also follow WDEQ-LQD Guideline 1 standards.

- Subsoil - Subsoil shall be considered the three feet of soil below the topsoil unless otherwise determined by the Engineer.

- Fill Material-Downstream Embankment - Fill material shall be that material suitable for embankment construction. This material shall be a sand with clay lenses from the Designated Borrow Areas. and from the Interior Borrow Area.

- Road Base Material - Road Base Material shall consist of gravely material imported to the site from a suitable quarry as approved by the Engineer.

3.2.2 Compaction Equipment

The Contractor shall provide sufficient compaction equipment of the types and sizes specified herein as is necessary for compaction of the various fill materials. If the Contractor wishes to use alternative equipment, he shall submit to the Engineer for approval complete details of such equipment and the methods proposed for its use. The Engineer's approval of the use of alternative equipment will be dependent upon the contractor's successful demonstration of the equipment. Suitable test fills will be constructed to the satisfaction of the Engineer. Alternative equipment will compact the fill materials to a density not less than that which would be produced by the equipment and number of coverages specified herein.

Compaction equipment, which includes the following, shall be maintained in good working condition at all times to ensure that the amount of compaction obtained is a maximum for the equipment. The Contractor shall immediately make adjustments to the equipment to achieve this end when necessary.

Smooth Drum Vibratory Roller

Smooth drum vibratory rollers shall be equipped with a suitable cleaning device to prevent the accumulation of material on the drum during rolling. Each roller shall have a total static weight of not less that 20,000 pounds at the drum when the roller is standing on level ground. The drum shall be not less than 60 inches in diameter and 78 inches in width. The vibration frequency of the roller drum during operation shall be between 1100 and 1500 vibrations per minute and the centrifugal force developed by the roller at 1250 vibrations per minute shall not be less than 38,000 pounds. The smooth drum roller compactor shall also contain a timing device for indicating actual roller operating time.

Sheepsfoot Roller

The Contractor may be required to compact the fill with a sheepsfoot roller.

The sheepsfoot roller shall be a self-propelled, fully-ballasted, standard sheepsfoot design developing 6000 lbs. in weigh per liner foot of width at rest on level ground, or equivalent as approved by the Engineer. The sheepsfoot roller machine shall be equipped with a timing device which will indicate actual roller operating time.

Special Compactors

Special compactors shall be used to compact materials which, in the opinion of the Engineer, cannot be compacted properly by the specified sheepsfoot or vibratory rollers because of location or accessibility.

The Contractor shall adopt special compaction measures such as hand-held vibratory compactors or other methods approved by the Engineer to compact fill in trenches, around structures and in other confined areas which are not accessible to the larger vibratory roller or sheepsfoot roller. Such compaction shall consist of not less than 4 coverages of the compaction equipment.

Before commencing work with the proposed compaction equipment, the Contractor will provide the Engineer with a list of each piece of equipment to be used, together with the Manufacturer's specification.

3.2.3 Moisture Conditioning of Soil

In areas requiring moisture conditioning, the Contractor will apply clean water to the borrow area and use a heavy duty discing unit to thoroughly blend the soil producing an even mixture of soil and water.

TS 3.3 Execution

3.3.1 Topsoil/Subsoil Stripping

Topsoil and subsoil shall be removed from the borrow areas.

During all phases of topsoil and subsoil removal, the Contractor shall use extreme caution to avoid a conflict with or contact or damage to existing utilities, overhead or buried, such as gas or oil lines, power lines, poles, cased wells, or other appurtenances. The Contractor shall be responsible for location of, and any damage to, existing utilities during construction activities. Cost of utility location and damage repair shall be solely borne by the Contractor.

Stockpile slopes shall not be steeper than 5h:1v (horizontal:vertical) unless otherwise directed by the Engineer.

3.3.3 Key Cut Installation

A key cut shall be installed under the entire embankment. The key cut shall be a minimum of five feet deep, bottom width of 10 feet and 2:1 (h:v) side slopes. Material from the cutoff trench is suitable embankment fill.

3.3.4 Foundation Preparation

The foundation material shall be over excavated by three to four feet. Unsuitable material as determined by the Engineer shall be put aside for possible embankment fill material. The remaining material shall be placed back in the foundation in six inch minimum lifts. Each lift shall be compacted to 95% of the Modified Proctor Density as determined by ASTM 1557 D and to within plus or minus two percent of the optimum moisture as determined by ASTM 1557 D and must have a permeability of less than 10^{-7} cm/sec as determined by ASTM 2434. The foundation shall be constructed to the exact lines and grades as determined by the Engineer.

3.3.5 Fill Placement

The Contractor should expect cold weather conditions during a portion of this project. This will require the fill area to be scarified at the beginning of each working shift to insure additional lifts are not placed on frozen surfaces.

All material used for fill shall be loaded and hauled to the placement site, dumped in layers no greater than eight inches, spread and leveled, moisture conditioned if required, and compacted to form a dense integral fill as required by the Engineer. The Contractor shall at all times exercise care to avoid segregation of the material being placed and shall, if required by the Engineer, remove all pockets of segregated or undesirable material and replace it with material which matches the surrounding material. All material in excess of one foot in diameter shall be removed from the fill material either prior to its being placed or after it is dumped and spread but before the compaction operations are started.

For most construction conditions, the fill is to be constructed in near horizontal layers with each layer being completed over the full length and breadth of the embankment before placement of subsequent layers. Each layer shall be constructed only with materials meeting the specified requirements and shall be free from lenses, pockets and layers of materials which are substantially different in gradation from the surrounding material, as determined by the Engineer.

The Contractor shall spread, level and compact the material to ninety percent (90%) of the Modified Density (ASTM D 1557). The Contractor shall control the routing of the scrapers to achieve the specified compaction where practical. In areas where this cannot be accomplished, the embankment shall be rolled with four (4) passes from a vibratory roller or as approved by the Engineer.

Except in areas approved by the Engineer, where space is limited or as otherwise specified, fill shall be placed by routing the hauling and spreading units approximately parallel to the axis of fill. Where impractical limits exist, the hauling units shall be so routed that they do not follow in the same paths but spread their traveled paths evenly over the surface of the fill.

Materials requiring moisture control shall be moisture conditioned in the borrow areas, as required by the Engineer. Moisture conditioning is the operation required to increase or decrease the moisture content of material to within specified limits.

If materials require moisture conditioning, the Contractor shall employ whatever method and equipment are necessary to condition the material to the moisture content designated by the Engineer. The Contractor shall adopt all measures necessary to achieve a moisture content within plus two percent (2%) or minus two percent (2%) of the optimum moisture content, and the moisture shall be distributed uniformly throughout each layer of material being placed, immediately prior to compaction. The Contractor shall adopt whatever measures are necessary to ensure that the designated moisture content is preserved after compaction, until the succeeding layer is placed.

Should the surface of the fill become rutted or uneven subsequent to compaction, it shall be re-leveled and re-compacted, by and at the expense of the Contractor, before the next layer of fill is placed.

If the surface of the fill becomes too dry or hard to permit suitable bonding with the subsequent layer, the material shall be loosened by scarifying or disk harrowing, moistened and re-compacted before an additional lift is placed.

All particles of dimensions such that they interfere with compaction in the layer thicknesses specified, as determined by the Engineer, shall be removed, either prior to or during compaction as specified.

The rolling pattern of all construction joints shall be such that the full number of roller passes required in one side of the construction joint extends completely across the joint.

3.3.6 Compaction Procedures

The Contractor's procedures for compaction of fill shall be subject to the approval of the Engineer. Compaction of each layer of fill shall proceed in a systematic, orderly and continuous manner approved by the Engineer, such as to ensure that all of each layer receives the compaction specified. The compaction shall be carried out by routing the compaction equipment parallel to the axis of the embankment or fill, except that where such routing is impractical such as in roller turning areas, in areas adjacent to foundations or at the lower elevations of the fill, in areas adjacent to pipework and where otherwise required by the Engineer, the compaction equipment may be routed in any direction approved by the Engineer.

For compaction by the vibratory roller, one coverage shall consist of one pass of the roller. A minimum overlap of 12 inches shall be maintained between the surfaces traversed by adjacent passes of the roller drum. During compaction the roller shall be propelled at 2 miles per hour or such lesser speed as may be determined by the Engineer. The power of the motor driving the vibrator shall be sufficient to maintain the specified frequency and centrifugal force under the most adverse conditions which may be encountered during the compaction of the fill. Propulsion equipment for the roller shall be adequate to propel the roller at speeds up to 4 mph.

3.3.7 Road Base Material

Road Base Material shall be placed on the top surface of all embankments and final access roads. The road base shall be placed a minimum of six inches thick and shall be compacted by using a roller compactor or by wheel rolling with loaded scrapers.

3.3.8 Quality Control

The Contractor shall give the Engineer full cooperation in sample taking or making tests and shall render such assistance as is necessary to enable sampling and testing to be carried out expeditiously. Each lift of embankment or other type fill will need

to be approved by the Engineer prior to placement of further fill. The Contractor shall allow sufficient time for the Engineer to carry out the required test work in order to determine the acceptability of each lift. The making of such tests by the Engineer or the time taken to interpret their results shall not constitute grounds for a claim by the Contractor for additional compensation or an extension of time.

The Engineer will take samples of fill materials and perform gradation and moisture content tests and will carry out field density tests on the compacted fill and other tests that he considers necessary to ascertain that the fill being placed or already placed meets the specified requirements. The results of the tests carried out by the Engineer will be final and conclusive in determining compliance with the Technical Specifications.

Tests carried out by the Engineer will be performed in accordance with the principles and methods prescribed by the American Society for Testing and Materials (ASTM) and other such recognized authorities. The following quality control testing is anticipated:

Tests on Fill Material Prior to Compaction

Tests for gradation and moisture content where applicable will be made by the Engineer. Samples of fill materials will be taken from test pits after spreading and prior to compaction. Sampling will be at frequencies sufficient to ensure that the placement of fill material is in full compliance with the Specification.

Tests on Fill After Compaction

The Engineer will conduct density and other tests on the fill compacted in place. Samples of the fill for related laboratory testing will be taken at such frequency the Engineer considers necessary for the proper evaluation of the properties of the compacted fill materials.

TS 3.4 Measurement and Payment

3.4.1 Measurement for Payment

Topsoil

Measurement for payment for Topsoil shall be based on volumes determined by the number of scraper loads multiplied by the rated capacity of the scraper.

Foundation Preparation

Measurement for payment for Foundation Preparation shall be the net volume of over excavation and replacement of foundation material as determined by survey prior and after foundation preparation.

Embankment Fill

Measurement for payment for Embankment Fill will be made of the net volume in cubic yards of fill placed with scrapers as determined by survey prior to and after completion of the embankment construction.

The surveys shall be performed by the Engineer. The Contractor may have his representative present during field or office work related to the surveys and may obtain copies of field notes, drawings, or calculations to the extent sufficient to verify the calculations.

Key Cut

The key cut shall be considered subsidiary to Embankment Fill and will not be paid separately.

3.4.2 Payment

Topsoil Removal

Payment for topsoil removal shall be for compensation for excavating, hauling and stockpiling the topsoil. Payment will be based on the contracted unit cost per cubic yard of material removed.

Foundation Preparation

Payment shall be full compensation for removing, replacing, moisture conditioning and compacting of foundation material. Payment for foundation preparation sahll be based on the contract unit cost per cubic yard of material removed for foundation preparation.

Fill Material

Payment shall be full compensation for ripping, hauling, placing, spreading, shaping, moisture conditioning, and compacting the material. Payment for embankment fill shall be based on the contract unit cost per cubic yard for both downstream embankment and upstream embankment regardless of the source of borrow material.

No separate measurement or payment will be made for moisture conditioning the soil nor other equipment to obtain the specified moisture and density. The cost of moisture conditioning and compacting shall be included in the unit price for the various earthwork items.

PAY ITEMS	PAY UNIT
3-1 Topsoil Removal	CY
3-2 Subsoil Removal	CY
3-3 Foundation Preparation	CY
3-4 Embankment Fill	CY

Section TS-4 Double Liner w/ Leak Detection

TS 4.1 Scope

Work in this Section covers all Work associated with the installation of the double pond liner with a leak detection system.

Work shall include all labor, material and equipment necessary to perform site preparation to install the liner and leak detection.

The Work consists of installing one layer of liner, placing collection system and placing top layer of liner.

TS 4.2 Products/Equipment

4.1.1 Geomembrane

The impermeable liner shall be a polypropylene geomembrane, manufactured by Lange Containment Systems, Inc. and supplied by Geotech Industrial Supplies, Casper, WY, at telephone number 307-472-0084 or approved equivalent. The geomembrane shall conform to the following values and test methods:

Property	Test Method	Value	Qualifier
Gauge		.048 mil	
Plies		1	
Thickness (min.)	ASTM D 751	41 mil	MIN
Breaking Strength	ASTM D-751	225lbf	MIN
Low Temp Flax °F	ASTM D-2136	-40	
Puncture Resistance	FTMS 101C	350 lbs	MIN
Tear Strengh	ASTM D-5884	55 lbf	MIN
Dim Stability	ASTM D-1204	1.0 %	MAX
Hydrostatic Resistivity	ASTM D-751	70%	MARV
Ply Adhesion	ASTM D-431	20 lbs/in	MIN
Water Absorption	ASTM D-4632	203 lbs	MARV
ESCR Env Stress Check Resistance		Not affected by ESC	
UV Resistance	ASTM G-26	Pass	

Typical Fabricated Seam Properties			
Bonded seam strength Adhesive	ASTM D 751	200	MIN
Peel Adhesion	ASTM D-431	20 or FTB	MIN

4.2.2 Sand

The sand and fine gravel used to cover the drain pipe shall meet the following gradation:

Sieve Designation	Percent Passing
3/8	100
200	<5

4.2.3 Pipe

The leak detection system shall use 4 inch perforated PVC Schedule 40 pipe.

4.2.4 Sump

The sump shall be 24"x24"x24" heavy duty reinforces plastic sump box manufactured by Zurn Industries, Inc. or approved equal.

4.2.4 Alarm System

The Alarm System shall be composed of the following products manufactured by Netmon, Inc. or approved equals:

- Sensorhawk 2-Port Base Unit SH2
- Sensorhawk Smart Liquid Detection Sensor SH-LD-12
- Sensorhawk Smart Siren/Strobe Sensor SH-STR-00

4.2.5 Sump Pump

Any 1/6 HP approved 110V submersible pump with high and low level detectors shall be acceptable for this project.

4.2.6 Flow Meter

A flow meter with totalizer as approved by the Engineer shall be install in the discharge line.

TS 4.3 Execution

4.3.1 Site Preparation

The bottom of the pond shall be graded as smooth as practicable prior to laying geomembrane.

4.3.2 Geomembrane (Bottom Layer)

The geomembrane shall be installed to the lines and grades as shown on the Drawings.

The geomembrane shall be placed in accordance with manufactured specification. A factory representative shall be on site to supervise and direct the welding of seams.

4.3.3 Leak Detection Collection Pipe with Sand Cover

The perforated pipe shall be placed as shown in the drawings. The pipe is place in a herringbone pattern leading to a central non-perforated drainage pipe going down the center. At each arm of the herringbone pattern is placed, sand shall be placed over the pipe to a nominal thickness of 12 inches.

Factory supplied boots shall be used where pipe penetrates the liner.

4.3.4 Leak Detection Alarm, Sump and Pumpback system.

The alarm, sump and pumpback system including flow meter shall be installed as shown in the Drawings. The control panels controlling the alarm and incoming power shall me mounted on a pole as shown in the drawings and installed to the manufactures specifications.

4.3.4 Geomembrane (Top Layer)

The top layer of geomembrane shall be placed to the lines and grades as shown on the drawings.

The geomembrane shall be placed in accordance with manufactured specification. A factory representative shall be on site to supervise and direct the welding of seams.

Construction Quality Control - Field Quality Control seam testing involves both non-destructive and destructive testing. The non-destructive testing is primarily centered around determination of "water tightness"; whereas destructive testing is based on ASTM D 882 and ASTM D 413 test methods.

Each seam must be checked visually for uniformity of width and surface continuity. Proper fusion chemical application visually changes the surface appearance. Usually the installer will use an air lance or blunt - end pick to check for voids or gaps under the overlapping geomembrane.

When unbonded areas are located, they can sometimes be repaired by inserting more chemical fusion agent into the opening and applying pressure. If that is not satisfactory, a round or oval patch must be placed over them with at least 6 inches of geomembrane extending on all sides.

Any area of the geomembrane sheets where puncture holes are observed must be patched as above, with at least 6 inches of geomembrane extending beyond the affected areas.

Note that with the above items, it is not practical to use a seaming board or slip sheet beneath the geomembrane. However, a piece of the liner material can be used for added support under the liner, if needed, even if the hole must be enlarged to insert the piece before the patch is made. This added piece is left in place. In either situation, additional care should be used to ensure a proper bond.

TS 4.4 Measurement and Payment

4.4.1 Measurement for Payment

Geomembrane - The measurement for payment for placed geomembrane shall be the net square yards of geomembrane placed.

Perforated PVC Pipe - The measurement for payment for placed perforated PVC pipe shall be the lineal feet of placed pipe.

Non - Perforated PVC Pipe - The measurement for payment for placed PVC pipe shall be the lineal feet of placed pipe.

Sand - The measurement for sand shall be the placed be the placed cubic yards of sand placed.

Leak Detection Alarm, Sump and Pumpback System - the measurement for payment for the leak detection shall be the successful installation of all the components of the system.

4.4.2 Payment

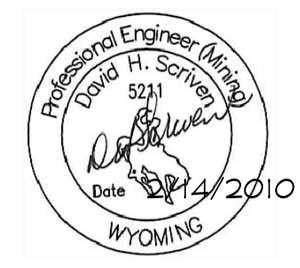
Payment for the double geomembrane liner with leak detection shall be full compensation for the work and be made at the contract price and for those item listed

below. Site preparation shall be considered subsidiary to the placement of geomembrane.

PAY ITEMS		**PAY UNITS**
4-1	Geomembrane	SY
4-2	4 in Perforated Pipe	LF
4-3	Sand	CY
4-4	Leak Detection Alarm, Etc.	LS

Ponds 1 & 2 Reservoir Construction Drawings

Lost Creek ISR, LLC
Casper, Wyoming, USA



WESTERN STATES MINING CONSULTANTS, P.C.
6911 Casper Mountain Road • Casper, Wyoming 82601 • (307) 266-9117

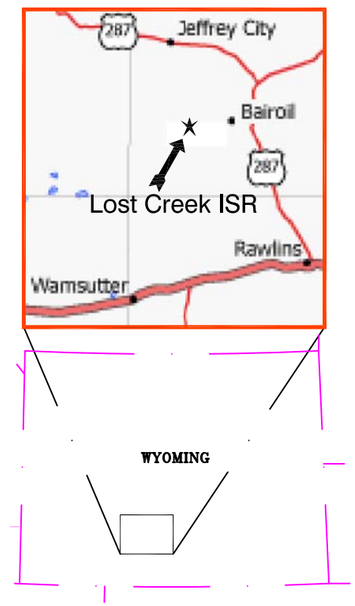
Project No. 0802

April 2008

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

INDEX OF DRAWINGS

Drawing No.	Title
0802.100	Index, Legend & General Notes
0802.100	Overall Site Plan
0802.101	Embamkment Plan
0802.103	Embankment Details
0802.104	Liner and Leak Detection Details



INDEX MAP

NTS

LEGEND

- Existing ground surface or bottom of excavation
- Groundwater table
- 6520 Existing grade elevation
- Slope
- 3:1 3 horizontal to 1 vertical slope
- Section number / 00802.000 / Drawing No. where section is shown or called out
- W.S. Water surface

UNIFIED SOIL CLASSIFICATION SYSTEM

- Gravels; include GP, GM and GC
- Clean sands; include SW and Sp
- Clayey sands and silts; include SM, SC and ML
- Clays; include CL and CH
- Borrow Area

ABBREVIATIONS

PWPC	Process water collection pond	MH	Manhole
LCRS	Leachate collection and removal system	ID	Inside diameter
		OD	Outside diameter
CMP	Corrugated metal pipe	NFWE	No free water encountered
HDPE	High density polyethylene		
PVC	Polyvinyl Chloride	Nom.	Nominal
CPT	Corrugated polyethylene tubing	SDR	Standard dimensional ratio
NTS	Not to Scale		
Typ.	Typical		
El.	Elevation		
Req'd	Required		
Dia.	Diameter		
Sch.	Schedule		
℄	Center line		
Perf.	Perforated		

Lost Creek ISR, LLC
Englewood, Colorado, USA

Engineered By:

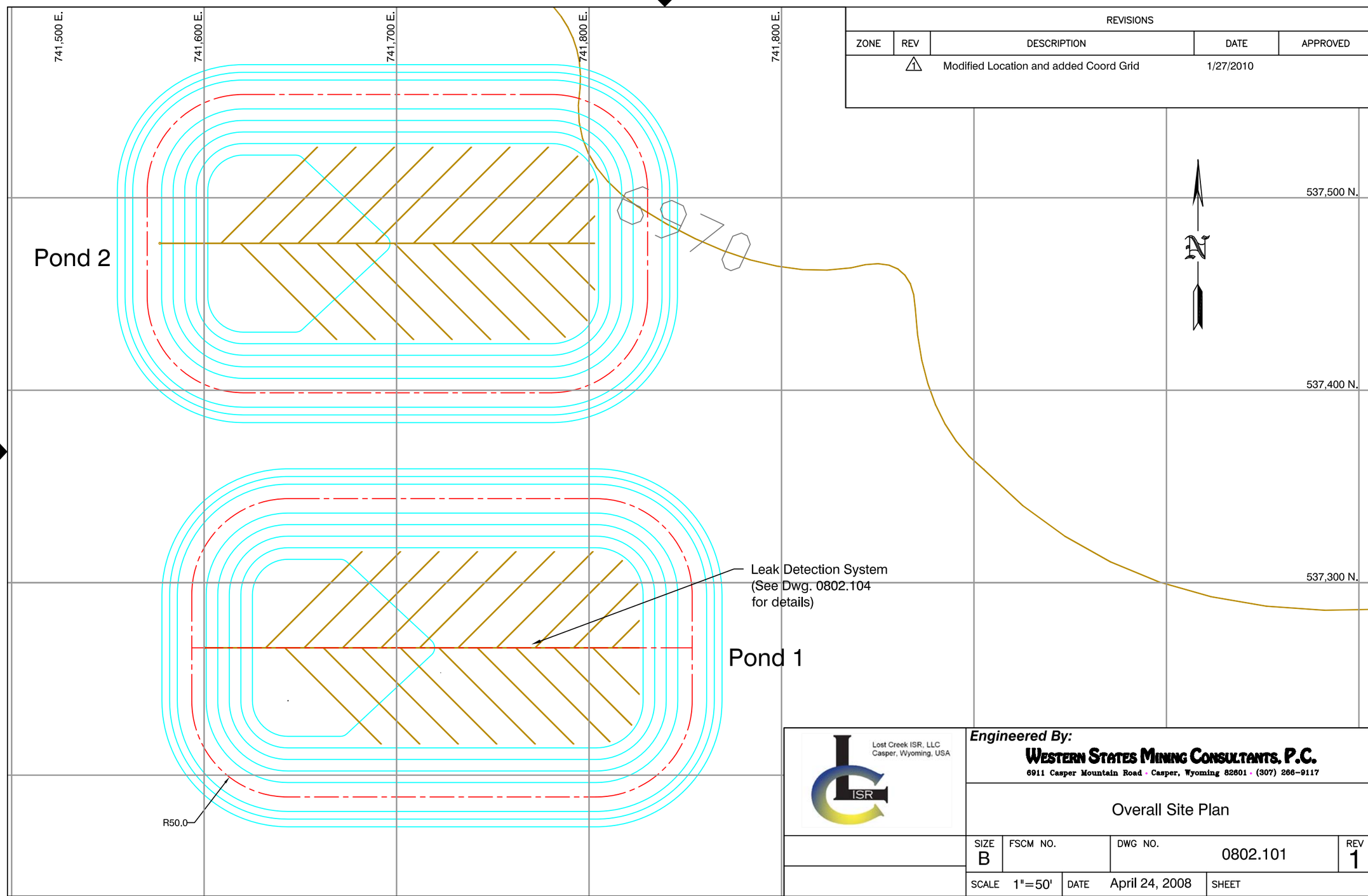
WESTERN STATES MINING CONSULTANTS, P.C.

6911 Casper Mountain Road • Casper, Wyoming 82601 • (307) 266-9117

Index, Legend and General Notes

SIZE	FSCM NO.	DWG NO.	REV
B		0802.100	
SCALE	DATE April 24, 2008	SHEET	

FNAME REVDATE USER



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	1	Modified Location and added Coord Grid	1/27/2010	

Lost Creek ISR, LLC
Casper, Wyoming, USA

Engineered By:

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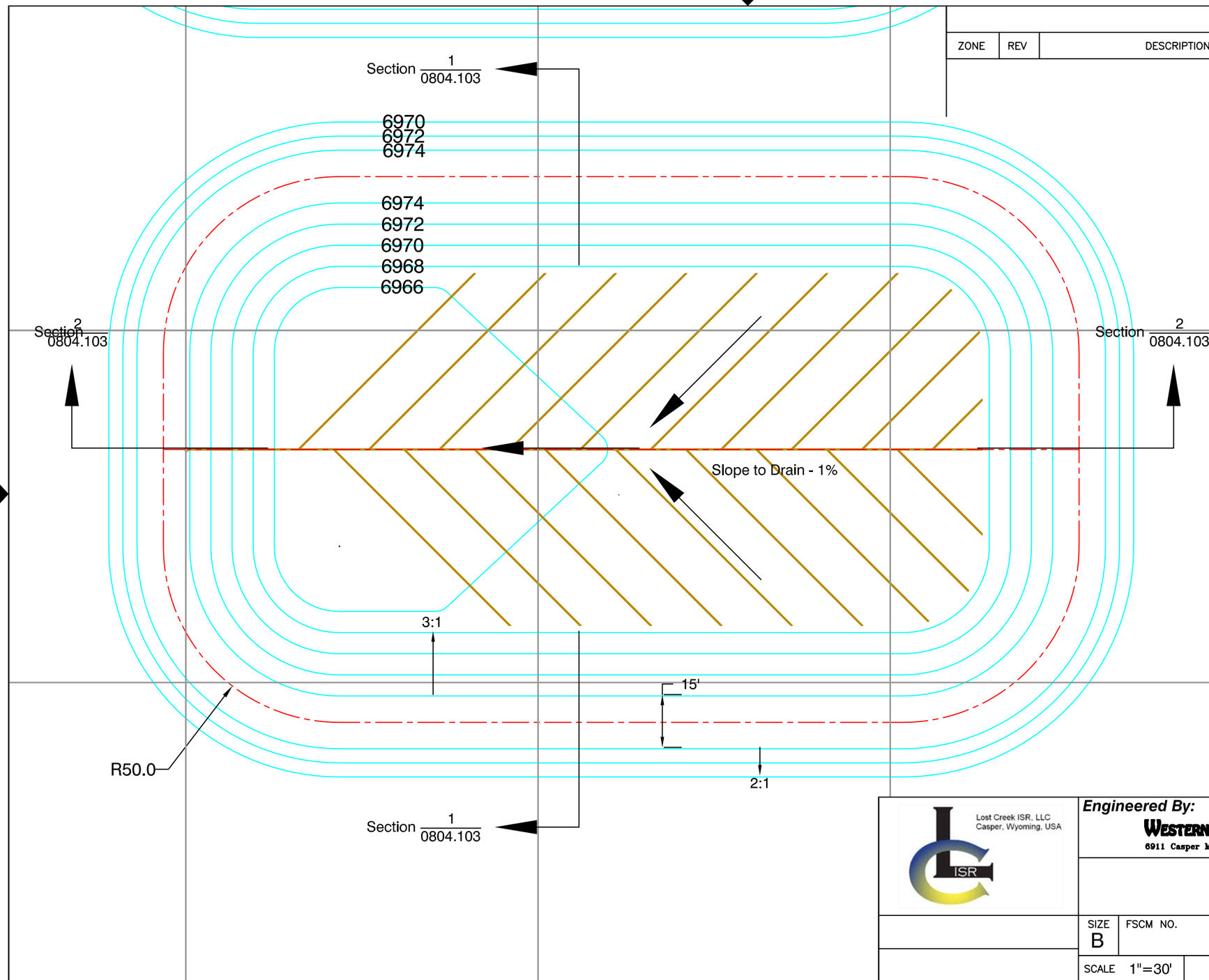
Overall Site Plan

SIZE	FSCM NO.	DWG NO.	REV
B		0802.101	1

SCALE	1"=50'	DATE	April 24, 2008	SHEET

USER REVDATE FNAME



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Lost Creek ISR, LLC
Casper, Wyoming, USA

Engineered By:

WESTERN STATES MINING CONSULTANTS, P.C.

6911 Casper Mountain Road · Casper, Wyoming 82601 · (307) 266-9117

Embankment Plan

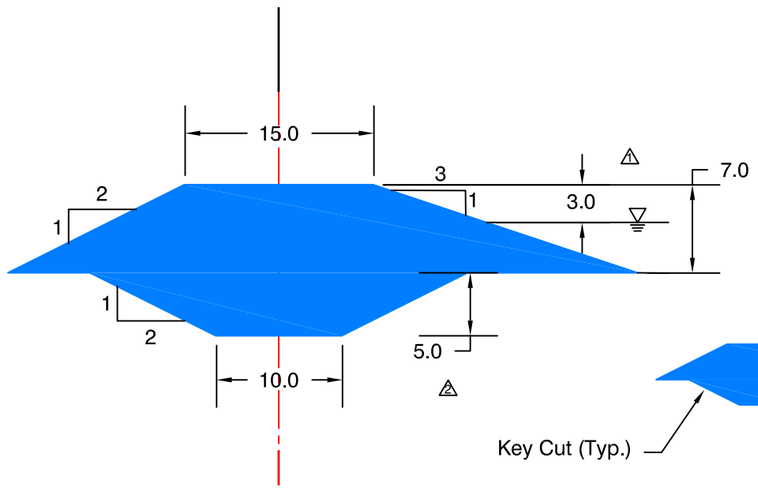
SIZE	FSCM NO.	DWG NO.	REV
B		0802.102	
SCALE 1"=30'	April 24, 2008	SHEET	

FNAME

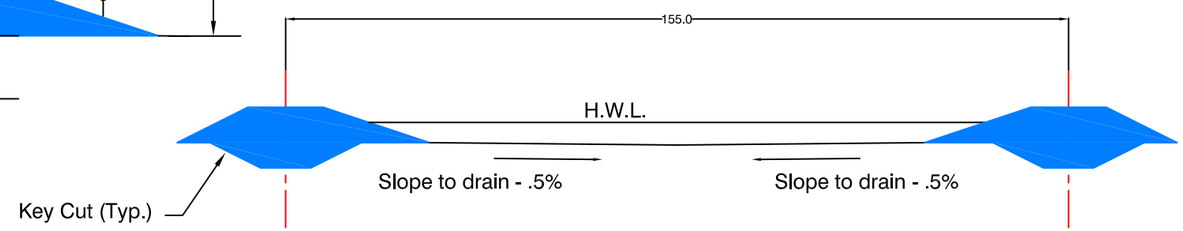
REVDATE

USER

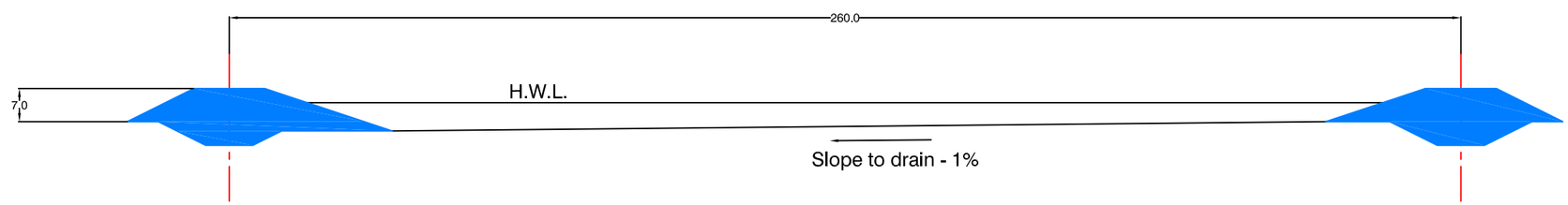
REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	1	Changed dim font for freeboard and added dim for depth	7/17/09	DHS
	2	Added dim. for Key Cut depth	4/7/10	DHS



Embankment Detail
(Typ.)
NTS



Section $\frac{1}{0804.102}$



Section $\frac{2}{0804.102}$

Lost Creek ISR, LLC
Casper, Wyoming, USA

Engineered By:

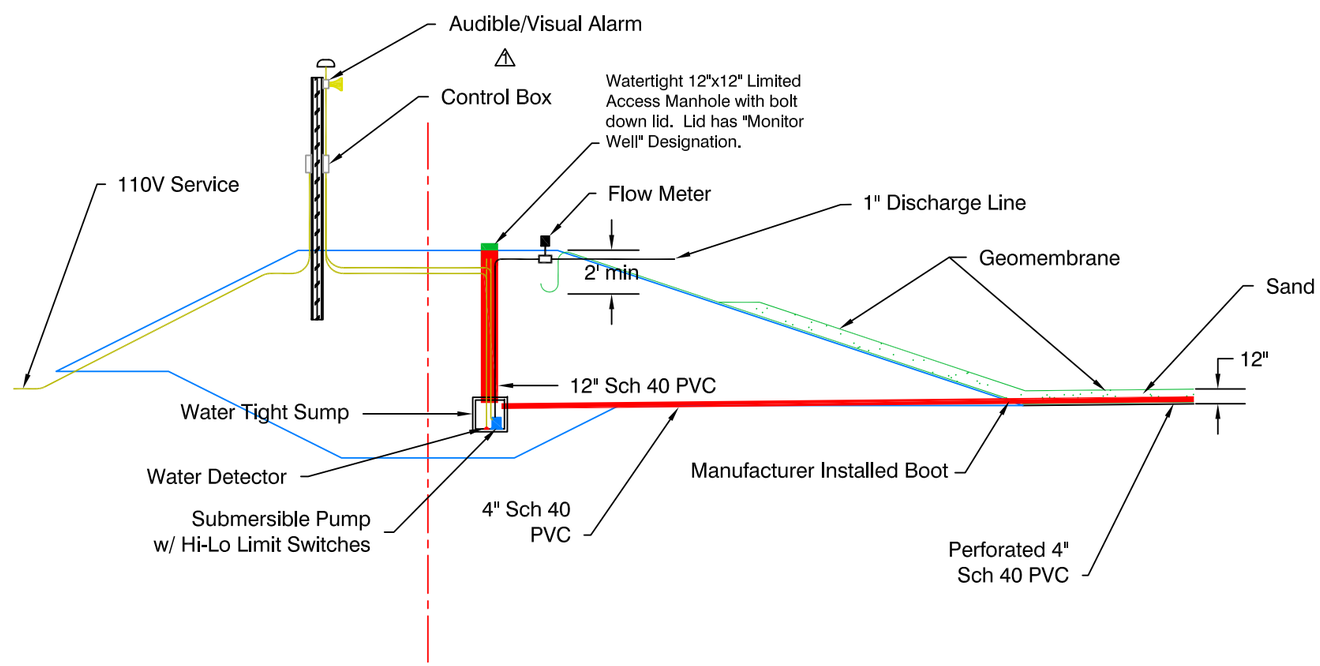
WESTERN STATES MINING CONSULTANTS, P.C.
6911 Casper Mountain Road • Casper, Wyoming 82601 • (307) 266-9117

Embankment Details

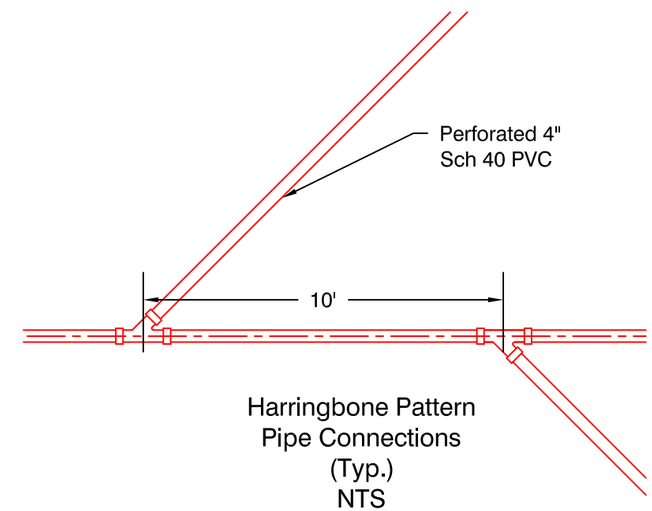
SIZE	FSCM NO.	DWG NO.	REV
B		0802.103	2
SCALE 1"=30'	April 24, 2008	SHEET	

FNAME
REVDATE
USER

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	1	Leak Detection, Alarm System & Pump Back	12/23/2009	DHS



Double Geomembrane Liner
w/ Leak Detection
NTS



Harringbone Pattern
Pipe Connections
(Typ.)
NTS

Lost Creek ISR, LLC
Casper, Wyoming, USA

Engineered By:
WESTERN STATES MINING CONSULTANTS, P.C.
6911 Casper Mountain Road • Casper, Wyoming 82601 • (307) 266-9117

Leak Detection Details

SIZE	FSCM NO.	DWG NO.	REV
B		0802.104	1
SCALE NTS	April 24, 2008	SHEET	

FNAME
REVDATE
USER

Design Report

Ponds 1 &2

Submitted to:

Lost Creek ISR, LLC

5880 Enterprise Dr., Suite 200
Casper, WY 82609

Prepared by:

Western States Mining Consultants, P.C

6911 Casper Mountain Road
Casper, WY 82601

January, 2009
Project Number: 00802

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Appendix A - Slope Stability Analysis
Appendix B - Geotechnical Report

Design Report
Ponds 1 & 2

1.0 Introduction

Western States Mining Consultants, P.C. (WSMC) has complete the design of a two holding ponds at the Lost Creek ISR project in Carbon County, Wyoming. Both ponds are identical and are adjacent to one another

Both ponds are approximately 155 feet wide and 260 feet long and have a capacity of approximately 2.3 acre-ft each.

Included in this design report are the following:

- Stability analyses of the embankment,
- Freeboard calculations,
- Slope protection recommendations, and the
- Geotechnical Report.

2.0 Stability Analysis and Settlement

Stability Analysis

Slope stability analyses were performed on embankment cross-section determined to be the most critical. Embankment slopes are 3:1 (h:v) for the upstream slope and 2:1 (h:v) for the downstream slope.

The material properties for the slope stability analyses were obtained from historical values used in similar projects and compared to drilling logs. They are presented in Table 1, Material Properties.

Table 1
Material Properties

Material Type	Cohesion (pcf)	Friction Angle	Unit Weight (pcf)
Fill Material	300	15	115
Native Soils	300	15	110
Bedrock	600	30	150

The computer program STABR was used to generate the slope stability analyses. The program uses the Modified Bishop Method developed by LeFebvre in 1971 to determine minimum factors of safety. Specific input requirements of the program include material properties (listed above), . surface profiles and phreatic surface profiles. Analyses were performed for both the upstream slope and downstream slope at Station 25+00 of the Phase 2 modification. The analyses included both the static and psuedostatic cases. A static safety factor of 1.5 and a psuedostatic safety factor of 1.0 is considered stable for earth filled dams. Results of the analyses are shown in Table 2, Stability Analyses.

Table 2
Stability Analyses - Station 25+00

Slope	Static	Psuedostatic
Downstream	2.128	2.575

All input data and output results of these analyses are included as Appendix A to this report.

Settlement Analysis

The foundations of the ponds will be a very dense clayey sandstone. The bearing strength of this material is about 10 kips (20,000 lbs/ft^2). The ponds are designed to have a maximum water depth of approximately 6 feet. This will apply approximately 374.4 lbs/ft^2. Therefore settlement of the pond is not anticipated with these water volumes.

3.0 Freeboard

The design freeboard must be of sufficient height above the maximum design water level to impound water when it rises above the design water level under the combined action of:

- waves,
- run-up, and
- wind-tide.

Wave height and wind-tide depend on the reservoir configuration; run-up is a function of the steepness and roughness of the design dike slope, the wave length and wave period (Linsley and Franzini, 1964)

The following assumptions were made in calculating the wind-tide, wave height, and run-up for Pond 1 Reservoir:

- Wind Velocity, Vw = 80 mph
- Fetch (length of water surface in miles), F = 0.05 miles
- Average depth of pond, d = 6 feet

The following calculations were based on the above assumptions:

<u>Wind Tide (Zs)</u>

$Zs = Vw^2F/1400d = 80^2 \times 0.05/(1400 \times 6) = 0.038$ *feet*

<u>Wave Height (Zw)</u>

Significant wave height (13% exceeding) , Zw

$Zw = 0.034\ Vw^{1.06}F^{0.47} = 0.034 \times 80^{1.06} \times 0.038^{0.41} = 0.932$ *feet*

<u>Design</u>

Design wave height (4% exceeding) , Z'

$Z' = 1.67\ Zw = 1.67 \times 0.932 = 1.55$ *feet*

Run-up

Assume 3:1 slope (moderately smooth slope)

Wave Period (tw)

$tw = 0.46\ Vw^{0.44} F^{0.28} = 0.46 \times 80^{0.44} \times .05^{0.28} = 1.37$

Wave length (lw)

$lw = 5.12\ tw^2 = 9.57$

Zw = 0.07 (from Linsley and Franzini, pg 167)

Run-up, Zr/Zw = 1.2 (Interpolated)

Zr = 1.2 x 0.932= 1.12 feet

Freeboard

Freeboard = Wind-tide + wave height (<4%) + run-up

= Zs + Z' + Zr = 0.04 +1.55 + 1.12 = 2.71

Use 3 feet

4.0 Slope Protection

Upstream Slope Protection - The upstream slopes of earth filled dams must be protected against destructive wave action. The liner will provide all the required slope protection. No other measures are anticipated for these facilities.

Downstream Slope Protection - The downstream slope of the embankment will covered with topsoil and vegetation.

5.0 Geotechnical Report

The geotechnical report prepared by Inberg-Miller Engineers. The report in its entirety is shown as Appendix B of this report. Inberg-Miller drilled 12 borings. Boring B2 is the closest to the proposed pond location and that is the one used for the aforementioned analyses.

Liquefaction Potential

The liquefaction potential appears to be low for the soils surrounding the ponds. Soil used for pond construction and the foundation of the ponds have a low potential for the following reasons:

- The fines in the soils are greater than 15 percent, typically in the 25 - 30% range.
- The soils in the area are typically very dry. Usually less then 10%.
- The soil penetration resistance is high with typical blowcounts of greater than 50 blows per foot.

Permeability of Foundation

Sample were taken from the foundation material to determine the permeability of the foundation. The samples were re-compacted to 95% of their maximum density as determined by the Modified Proctor Analysis (ASTM D1557). Falling head permeability testing methods were used.

The results of the testing are as shown is Table 3, Permeability Testing, is as follows:

Table 3
Permeability Testing

Sample ID	Sample Depth, (ft)	gd max (pcf)	target remolded gd (pcf), M%	Permeability (cm/sec)
Pond 1	4 to 5	125	118.8,11	3.85 E-7
Pond 1	6 to 7	121.5	115.4,11.5	5.46 E-7
Pond 1	7 to 8	125	118.8,9.5	8.52 E-8
Pond 2	4 to 5	123	116.9,11	4.26 E-6
Pond 2	6 to 7	115	109.3,16	9.57 E-7
Pond 2	7 to 8	125	118.8,11	3.42 E-5

The results show that three to four feet of material will need to be removed from the pond, blended and replaced in six inch layers compacted to 95% of the Modified Proctor to result in an acceptable permeability of 10^{-7} cm/sec.

Appendix A

Input file - Typical Cross-section Downstream - Static Case

Typ XS DS s 2:1

```
0 0 11 4 1 0  0.0 0.0
55.9    0       5
55.9    7
-10     9       9       9       9       9       10      40
0       9       9       9       9       9       10      40
17.9    3       3       3       3       9       10      40
23.4    1.19    1.19    1.19    1.19    9       10      40
26.9    0       0       0       0       10.8    10.8    40
29.4    0       0       0       0       12      12      40
39.4    0       0       0       0       12      12      40
41.9    0       0       0       0       10.8    10.8    40
49.4    3.8     3.8     3.8     3.8     7.1     10      40
55.9    7.1     7.1     7.1     7.1     7.1     10      40
100     7.1     7.1     7.1     7.1     7.1     10      40
 1   300   15   115
 2   300  15   110
 3   600   30   150
-10     3
0       3
17.9    3
23.4    7
26.9    9
29.4    10
39.4    13
41.9    14
49.4    15
55.9    15
100     15
 0
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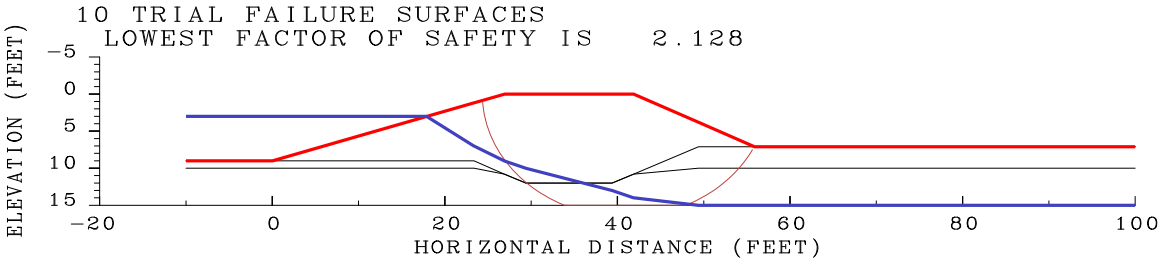


Typ XS DS s 2:1

Output file - Typical Cross-section Downstream - Static Case

Typ XS DS s 2:1

CONTROL DATA

NUMBER OF SPECIFIED CENTERS 0
NUMBER OF DEPTH LIMITING TANGENTS 0
NUMBER OF VERTICAL SECTIONS 11
NUMBER OF SOIL LAYER BOUNDARIES 4
NUMBER OF PORE PRESSURE LINES 1
NUMBER OF POINTS DEFINING COHESION PROFILE 0

SEISMIC COEFFICIENT S1,S2 = .00 .00

SEARCH STARTS AT CENTER (55.9, .0),WITH FINAL GRID OF 5.0

ALL CIRCLES PASS THROUGH THE POINT (55.9, 7.0)

GEOMETRY

SECTIONS	-10.0	.0	17.9	23.4	26.9	29.4	39.4	41.9	49.4	55.9	100.0
T. CRACKS	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
W IN CRACK	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 1	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 2	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 3	9.0	9.0	9.0	9.0	10.8	12.0	12.0	10.8	7.1	7.1	7.1
BOUNDARY 4	10.0	10.0	10.0	10.0	10.8	12.0	12.0	10.8	10.0	10.0	10.0

SOIL PROPERTIES

LAYER	COHESION	FRICTI0H ANGLE	DENSITY
1	300.0	15.0	115.0
2	300.0	15.0	110.0
3	600.0	30.0	150.0

PORE PRESSURE DATA

COORDINATES OF EQUI-PRESSURE LINES

SECTIONS	-10.0	.0	17.9	23.4	26.9	29.4	39.4	41.9	49.4	55.9	100.0
LINE 1	3.0	3.0	3.0	7.0	9.0	10.0	13.0	14.0	15.0	15.0	15.0

VALUES OF PRESSURE ON EQUI-PRESSURE LINES

LINE	PRESSURE
1	.0

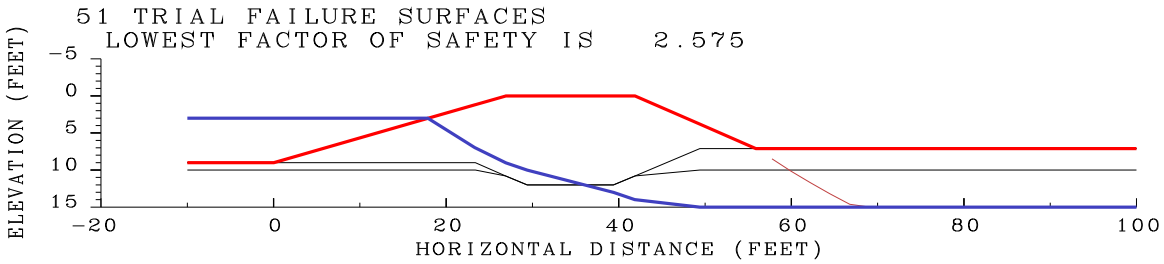
NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	7.0	7.0	55.9	.0	15.215	15.199
2	12.2	12.2	65.9	.0	**********	
				BISHOPS SOLU. DID NOT CONVERGE IN 21 ITERATIONS		
3	12.2	12.2	45.9	.0	2.582	
				BISHOPS SOLU. DID NOT CONVERGE IN 21 ITERATIONS		
4	21.2	21.2	35.9	.0	3.046	2.103
5	9.7	19.7	45.9	-10.0	6.012	5.764
6	8.6	8.6	50.9	.0	6.506	6.276
7	16.6	16.6	40.9	.0	2.128	1.491
8	21.2	21.2	35.9	.0	3.046	2.103
9	14.2	19.2	40.9	-5.0	2.577	2.128
10	18.3	23.3	35.9	-5.0	3.126	2.467
11	10.6	15.6	45.9	-5.0	4.459	4.115

F.S. MINIMUM= 2.128 FOR THE CIRCLE OF CENTER (40.9, .0)

Input file - Typical Cross-section Downstream - Psuedostatic Case

Typ XS DS p 2:1

```
0 0 11 4 1 0  0.1 0.1
55.9    0       5
55.9    7
-10     9       9       9       9       9       10      40
0       9       9       9       9       9       10      40
17.9    3       3       3       3       9       10      40
23.4    1.19    1.19    1.19    1.19    9       10      40
26.9    0       0       0       0       10.8    10.8    40
29.4    0       0       0       0       12      12      40
39.4    0       0       0       0       12      12      40
41.9    0       0       0       0       10.8    10.8    40
49.4    3.8     3.8     3.8     3.8     7.1     10      40
55.9    7.1     7.1     7.1     7.1     7.1     10      40
100     7.1     7.1     7.1     7.1     7.1     10      40
 1   300   15   115
 2   300  15   110
 3   600   30   150
-10     3
0       3
17.9    3
23.4    7
26.9    9
29.4    10
39.4    13
41.9    14
49.4    15
55.9    15
100     15
 0
```



Typ XS DS p 2:1

Output file - Typical Cross-section Downstream - Psuedostatic Case

BISHOP MODIFIED,LEFEBVRE 1971

Typ XS DS p 2:1

CONTROL DATA

NUMBER OF SPECIFIED CENTERS 0
NUMBER OF DEPTH LIMITING TANGENTS 0
NUMBER OF VERTICAL SECTIONS 11
NUMBER OF SOIL LAYER BOUNDARIES 4
NUMBER OF PORE PRESSURE LINES 1
NUMBER OF POINTS DEFINING COHESION PROFILE 0

SEISMIC COEFFICIENT S1,S2 = .10 .10

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T. CRACKS	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
W IN CRACK	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 1	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 2	9.0	9.0	3.0	1.2	.0	.0	.0	.0	3.8	7.1	7.1
BOUNDARY 3	9.0	9.0	9.0	9.0	10.8	12.0	12.0	10.8	7.1	7.1	7.1
BOUNDARY 4	10.0	10.0	10.0	10.0	10.8	12.0	12.0	10.8	10.0	10.0	10.0

SOIL PROPERTIES

LAYER	COHESION	FRICTI0H ANGLE	DENSITY
1	300.0	15.0	115.0
2	300.0	15.0	110.0
3	600.0	30.0	150.0

PORE PRESSURE DATA

COORDINATES OF EQUI-PRESSURE LINES

SECTIONS	-10.0	.0	17.9	23.4	26.9	29.4	39.4	41.9	49.4	55.9	100.0
LINE 1	3.0	3.0	3.0	7.0	9.0	10.0	13.0	14.0	15.0	15.0	15.0

VALUES OF PRESSURE ON EQUI-PRESSURE LINES

LINE	PRESSURE
1	.0

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	FS(BISHOP)	FS(OMS)
1	7.0	7.0	55.9	.0	12.687	12.698
2	12.2	12.2	65.9	.0	10.898	9.991
3	21.2	21.2	75.9	.0	5.028	4.003
4	30.8	30.8	85.9	.0	4.820	3.434
5	35.7	35.7	90.9	.0	6.443	4.733
6	35.1	30.1	85.9	5.0	7.458	4.513
7	26.0	26.0	80.9	.0	4.413	3.240
8	30.1	25.1	80.9	5.0	6.795	3.780
9	21.2	21.2	75.9	.0	5.028	4.003
10	22.7	27.7	80.9	-5.0	3.741	3.020
11	27.3	32.3	85.9	-5.0	3.794	2.912
12	18.3	23.3	75.9	-5.0	4.667	4.014
13	20.2	30.2	80.9	-10.0	3.545	3.043
14	24.5	34.5	85.9	-10.0	3.330	2.708
15	28.9	38.9	90.9	-10.0	3.649	2.871
16	27.3	32.3	85.9	-5.0	3.794	2.912
17	22.2	37.2	85.9	-15.0	3.141	2.678
18	26.3	41.3	90.9	-15.0	3.213	2.629
19	18.3	33.3	80.9	-15.0	3.590	3.218
20	20.4	40.4	85.9	-20.0	3.111	2.752
21	24.2	44.2	90.9	-20.0	2.998	2.543
22	28.3	48.3	95.9	-20.0	3.224	2.650
23	26.3	41.3	90.9	-15.0	3.213	2.629
24	22.4	47.4	90.9	-25.0	2.913	2.549
25	26.2	51.2	95.9	-25.0	2.968	2.509
26	18.9	43.9	85.9	-25.0	3.180	2.894
27	20.9	50.9	90.9	-30.0	2.910	2.613
28	24.5	54.5	95.9	-30.0	2.836	2.460
29	28.3	58.3	100.9	-30.0	3.004	2.533
30	26.2	51.2	95.9	-25.0	2.968	2.509
31	23.0	58.0	95.9	-35.0	2.782	2.469
32	26.6	61.6	100.9	-35.0	2.827	2.435
33	19.7	54.7	90.9	-35.0	2.964	2.717
34	21.7	61.7	95.9	-40.0	2.780	2.515
35	25.1	65.1	100.9	-40.0	2.730	2.398
36	28.6	68.6	105.9	-40.0	2.863	2.452
37	26.6	61.6	100.9	-35.0	2.827	2.435
38	23.8	68.8	100.9	-45.0	2.686	2.402
39	27.1	72.1	105.9	-45.0	2.726	2.375
40	20.6	65.6	95.9	-45.0	2.816	2.591
41	22.6	72.6	100.9	-50.0	2.679	2.434
42	25.8	75.8	105.9	-50.0	2.647	2.343
43	29.2	79.2	110.9	-50.0	2.757	2.386

44	27.1	72.1	105.9	-45.0	2.726	2.375
45	24.6	79.6	105.9	-55.0	2.606	2.341
46	27.9	82.9	110.9	-55.0	2.645	2.321
47	21.6	76.6	100.9	-55.0	2.701	2.488
48	23.6	83.6	105.9	-60.0	2.594	2.362
49	26.7	86.7	110.9	-60.0	2.575	2.290
50	29.9	89.9	115.9	-60.0	2.672	2.327
51	27.9	82.9	110.9	-55.0	2.645	2.321

Appendix B