

APPENDIX F

TECHNICAL SPECIFICATIONS

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TECHNICAL SPECIFICATIONS
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Mine Waste Cleanup Bureau
DEQ CONTRACT NO. 407053**

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*Standard Specifications for Abandoned Mine Reclamation Construction, 1991 Edition

** Forest Service Specifications for Construction of Roads and Bridges, 1982 Edition

SECTION 100: GENERAL PROVISIONS

SECTION 101.00: ABBREVIATIONS

Whenever in these Specifications or in other Contract Documents, the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows. Reference to a specific standard or specification shall mean the latest edition or amendment in effect on the date of Invitation to Bid.

AA--Aluminum Association
AAN--American Association of Nurserymen
AASHTO--American Association of State Highway and Transportation Officials
ACI--American Concrete Institute
AGC--Associated General Contractors of America
AI--Asphalt Institute
AIA--American Institute of Architects
AISC--American Institute of Steel Construction
AISI--American Iron and Steel Institute
AITC--American Institute of Timber Construction
ANSI--American National Standards Institute
APA--American Plywood Association
API--America Petroleum Institute
ASA--American Society of Agronomy, Inc.
ASCE--American Society of Civil Engineers
ASHRAE--American Society of Heating, Refrigerating and Air Conditioning Engineers
ASLA--American Society of Landscape Architects
ASME--American Society of Mechanical Engineers
ASPA--American Sod Producers Association
ASTM--American Society for Testing and Material
AWPA--American Wood Preservers Association
AWS--American Welding Society
CLFMI--Chain Link Fence Manufacturers Institute
CRSI--Concrete Reinforcing Steel Institute
CS--Commercial Standard issued by U.S. Department of Commerce
DEMA--Diesel Engine Manufacturers Association
EJMA--Expansion Joint Manufacturers Association
EPA--Environmental Protection Agency
FED. SPEC. or FS--Federal Specifications
FHWA--Federal Highway Administration
FPR--Federal Procurement Regulations System
FSS--Federal Specifications and Standards
GSA--General Services Administration
IEEE--Institute of Electrical and Electronic Engineers
IES--Illuminating Engineering Society
IMSA--International Municipal Signal Association
ITE--Institute of Traffic Engineers
MCA--Montana Code Annotated
MDOH--Montana Department of Highways
MIL--Military Specifications
MSHA--Mine Safety and Health Administration
MUTCD--Manual on Uniform Traffic Control Devices
NBFU--National Board of Fire Underwriters
NBS--National Bureau of Standards
NEC--National Electric Code
NEMA--National Electrical Manufacturers Association

NESC--National Electrical Safety Code
NFPA--(Fire)--National Fire Protection Association
NFPA--(Forest)--National Forest Products Association
NSWMA--National Solid Wastes Management Association
NWMA--National Woodwork Manufacturers Association
OSHA--Occupational Safety and Health Act
PCA--Portland Cement Association
PCI--Prestressed Concrete Institute
PS--Product Standard issued by the U.S. Department of Commerce
RIS--Redwood Inspection Service
SAE--Society of Automotive Engineers
SDI--(Deck)--Steel Deck Institute
SDI--(Door)--Steel Door Institute
SJI--Steel Joist Institute
SMACNA--Sheet Metal and Air Conditioning Contractors' National
Association
SSPC--Steel Structures Painting Council
SSSA--Soil Science Society of America, Inc.
TAS--Technical Aid Series
UL--Underwriter's Laboratories, Inc.
USASI--United States of America Standards Institute
USDA--United States Department of Agriculture
WASHTO--Western Association of State Highway Transportation Officials
WCLIB--West Coast Lumber Inspection Bureau
WWPA--Western Wood Products Association

SUBSECTION 140 00: CONTRACTOR QUALITY CONTROL

140.01 GENERAL

A. QUALITY CONTROL PLAN

Furnish for approval by Engineer, the Contractor Quality Control (CQC) Plan within 10 calendar days after receipt of Notice to Proceed. The CQC Plan shall identify personnel, procedures, instructions, records and forms to be used. For failure to submit an acceptable CQC Plan within the time herein prescribed, Engineer may refuse to allow construction to start until such time as an acceptable final CQC Plan is submitted.

The CQC Plan shall include, at a minimum, the following:

1. Description of QC organization, including a chart showing lines of authority and acknowledgment that Contractor's QC staff shall report to the Project Manager.
2. Name, qualifications, duties, responsibilities, and authorities of each person assigned a CQC function.
3. Copy of a statement signed by an authorized official of Contractor's firm, which describes the responsibilities and delegates the authorities of CQC Manager.
4. Procedures for scheduling and managing submittals, including those of subcontractors, off-site fabricators, suppliers, and purchasing agents.
5. Control testing procedures for each specific test. (Testing laboratories must be approved in writing by Owner.)
6. Reporting procedures including proposed reporting formats.

Acceptance of the CQC Plan by Engineer is required prior to the start of construction. Satisfactory implementation during the construction of the CQC Plan is required.

After acceptance of the CQC Plan by the Engineer, Contractor shall notify Engineer in writing of any proposed changes. Proposed changes are subject to acceptance by the Engineer.

B. QUALITY CONTROL ORGANIZATION

CQC Manager shall be responsible for overall management of the CQC and have the authority to act in all CQC matters for Contractor. The CQC Manager shall be an approved, qualified hazardous materials removal operator or comparable individual to ensure compliance with the Contract Documents, Drawings, Special Provisions and Technical Specifications. This person shall demonstrate ability to perform the duties required to the satisfaction of Engineer and shall be physically at the project site whenever Work is in progress and will be in charge of Contractor's QC program. All Contractor's submittals for approval shall be reviewed and modified or corrected as needed by the CQC Manager and approved correct prior to forwarding of such submittals to the Engineer.

The personnel of the CQC staff shall be fully qualified by experience and technical training to perform their assigned responsibilities and shall be hired by and Work for Contractor.

C. SUBMITTALS

Submittals shall be as specified in the Special Provisions. CQC Organization shall be responsible for certifying that all submittals are in compliance with contract requirements.

140.02 MATERIALS (NOT USED)

140.03 EXECUTION

A. CONTRACTOR QUALITY CONTROL

1. Contractor QC is the means by which Contractor is assured that the Work complies with the requirements of the Contract Documents, Drawings, Special Provisions and Technical Specifications. The controls shall be adequate to cover all construction operations, including both on-site and off-site operations, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of inspection for all definitive features of Work as follows:
 - a. Preparatory Inspection: This shall be performed prior to beginning any definable feature of Work. It shall include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work has been completed and a physical examination of materials, equipment, and sample Work to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand.
 - b. Initial Inspection: This shall be performed as soon as a representative portion of the particular feature of Work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions, and dimensional requirements.
 - c. Follow-Up Inspection: These shall be performed daily to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of Work. Such inspection shall be made a matter of record in the CQC documentation as required in the following sections. Final follow-up inspections shall be conducted and deficiencies corrected prior to the addition of new features of Work.

B. TESTING PROCEDURES

1. Test Procedures: Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. Procure the services of an industry-recognized testing laboratory or he/she may establish an approved testing laboratory at the project site. A list of tests which Contractor understands he/she is to perform shall be furnished as part of the CQC Plan to Engineer. The list shall give the test name, specification paragraph containing the test requirements and the personnel and laboratory responsible for each type of test. Perform the following activities, record and provide the following data:
 - a. Verify that testing procedures comply with contract requirements.
 - b. Verify that facilities and testing equipment are available and comply with testing standards.
 - c. Verify that test instrument calibration data are checked against certified standards.
 - d. Verify that recording forms, including all of the test documentation requirements, have been prepared.

C. COMPLETION INSPECTION

At the completion of all Work or any increment thereof, the CQC Manager shall conduct a completion inspection of the Work and develop a "punch list" of items which do not conform to the approved Drawings, Special Provisions and Technical Specifications. Such a list shall be included in the CQC documentation, as required below, and shall include the estimated date by which the deficiencies will be corrected. The CQC Manager or his/her staff shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify Engineer. The completion inspection and any deficiency corrections required by this paragraph will be accomplished within the time stated for completion of the entire Work.

D. DOCUMENTATION

1. Maintain current records of QC operations, activities, and tests performed including the work of suppliers and subcontractors. These records shall be on an acceptable form and indicate a description of trades working on the project, the numbers of personnel working, the weather conditions encountered, any delays encountered, and acknowledgment of deficiencies noted along with the corrective actions taken on current and previous deficiencies. In addition, these records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:
 - a. Type and number of control activities and tests involved.
 - b. Results of control activities or tests.
 - c. Nature of defects, causes for rejection, etc.
 - d. Proposed corrective action(s).
 - e. Corrective actions taken.
2. These records shall cover both conforming and defective or deficient features and shall include a statement that supplies and materials incorporated in the Work comply with the requirements of the contract. Legible copies of these records shall be furnished to Engineer daily.

E. NOTIFICATION OF NON-COMPLIANCE

Engineer will notify Contractor of any non-compliance with the forgoing requirements. After receipt of such notice, immediately take corrective action. Such notice, when delivered to Contractor or his/her representative at the site of the Work, shall be deemed sufficient for the purpose of notification. If Contractor fails or refuses to comply promptly, Owner may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or claim for excess costs or damages by Contractor.

END OF SUBSECTION 140

SECTION 200: EARTHWORK

SUBSECTION 201.00: CLEARING AND GRUBBING

201.01 GENERAL

- A. DESCRIPTION - This work shall consist of clearing, grubbing, removing, burning, burying, and otherwise disposing of vegetation and debris within the clearing limits as designated on the Drawings and by the Engineer. Vegetation and objects designated to remain shall be preserved free from injury and defacement.

If any evidence of aboriginal activity or occupation is encountered, the Contractor shall immediately stop work and notify the Engineer, who shall contact the proper state authorities for an assessment of the significance of the resource.

The work shall be classified as follows:

1. Clearing. Clearing shall consist of the felling of trees and disposal of stumps, brush, windfalls, logs, limbs, sticks, piles of sawdust, rubbish, debris, vegetation, and other objectionable matter existing within the clearing limits or that interfere with excavation and embankment.
2. Grubbing. Grubbing shall consist of the removal and disposal of roots, stumps, stubs, rock, roots, debris, and other objectionable matter from the grubbing limits.
3. Clearing and Grubbing. Clearing and grubbing shall consist of performing both clearing and grubbing as set forth above.
4. Disposal. Disposal shall consist of removing, burning, burying, or otherwise disposing of the refuse accumulations from clearing, grubbing, or clearing and grubbing operations. The refuse resulting from these operations shall be disposed of in the same manner as debris described in Subsection 502.00, Debris and Structure Removal.

201.02 MATERIALS

Not applicable.

201.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - Clearing, grubbing, or clearing and grubbing shall be done at times and in a manner that the surrounding vegetation, adjacent property, and anything designated to remain shall not be damaged. Dragging, piling, disposing of debris, and other work that may be injurious to vegetation shall be confined to areas that carry no vegetation or that will be covered by embankments or disturbed by excavations.

Vegetation adjacent to streams, ponds, or lakes shall be preserved and protected from injury unless the vegetation conflicts with construction operations and is designated by the Engineer to be removed. If any vegetation designated to be preserved becomes damaged or destroyed by the Contractor, it shall be replaced to the satisfaction of the Engineer at no cost to the Owner.

The Engineer will designate trees, shrubs, plants, or other objects that are to remain. The Contractor shall preserve all objects so designated.

The Contractor shall not injure trees, shrubbery, vines, plants, grasses, and other vegetation growing outside of the slope limits of excavation and embankment. The Contractor shall paint all cut or scarred surfaces of trees or shrubs selected for retention. The paint shall be an approved asphaltum base paint prepared especially for tree surgery.

Where scour is likely to occur, resulting from clearing or grubbing conducted in advance of excavation work, temporary erosion control setting basins shall be constructed prior to any scour occurring.

B. CLEARING - All areas within the neat lines of cut or fill areas shall constitute the clearing limits.

Unless specifically designated to be saved, all trees, stumps, brush, windfalls, logs, and other objectionable matter occurring within clearing limits shall be cut off and disposed of. All stumps within the clearing limits and all trees, the stumps of which are not to be grubbed, shall be cut not more than the diameter of the stump, and in any instance not more than 12 inches, above the ground.

The refuse resulting from the clearing operation shall be removed, as specified in Subsection 502.00, Debris and Structure Removal, to a location designated by the Engineer, or, if no site is specified, then the Contractor shall secure a waste site. The Contractor shall not burn on the site unless he has obtained permission as specified in Subsection 502.00, Debris and Structure Removal. In all cases, the authority to burn shall not relieve the Contractor in any way from damages which may result from his operations. In no case shall any material be left on the project, shoved onto abutting private properties, or be buried in embankments or trenches on the project.

C. GRUBBING - All areas within the neat lines of cuts, and all areas to be covered by embankments less than 3 feet in height shall constitute the grubbing limits.

All stumps, roots, logs, or other timber more than 3 inches in diameter, and all brush, matted roots, rock, and other debris within the grubbing limits not suitable for roadway foundation shall be pulled or otherwise removed to a depth of not less than 6 inches below the original ground or 12 inches below roadway subgrade.

All material resulting from the grubbing operations shall be disposed of as specified in Subsection 502.00, Debris and Structure Removal. All depressions below subgrade, or below the final surface of the ground resulting from the grubbing operations shall be backfilled with suitable material as specified in the Subsection 202.00, Excavation and Embankment.

D. CLEARING AND GRUBBING - Clearing and grubbing shall be done in accordance with the provisions of B and C above.

SUBSECTION 202.00: EXCAVATION AND EMBANKMENT

202.01 GENERAL

- A. **DESCRIPTION** - All excavation, embankment, and grading work shall be in accordance with these Specifications and in accordance with the lines, grades, and elevations shown on the Drawings or as established by the Engineer.
1. **Excavation**. This work shall consist of performing all operations necessary to excavate, grade, and satisfactorily dispose of all materials encountered during excavation at the areas designated on the Drawings. The work shall include roadway excavation, structure excavation, excavation of mine workings, ditch or channel excavation, any general unclassified excavation, and all other excavation not covered under other subsections of these Standard Specifications.
 2. **Embankment**. This work shall consist of performing all operations necessary to prepare, backfill, compact, and grade all areas requiring embankment or fill as shown on the Drawings. The work shall include roadway embankment, structure embankment, dike embankment, backfilling mine workings and depressions, cut and fill terracing, and all other backfilling or embankment not covered under other subsections of these Standard Specifications.
- B. **SUBMITTALS** - The Contractor shall provide the following submittals in accordance with the Supplementary Conditions:
- * Moisture-density characteristics using AASHTO T-99 for embankment or backfill material and excavated subgrades. As material types change during construction, additional moisture-density characteristics may be required by the Contractor or Engineer.
 - * Backfill imported from an off-site source shall be tested and submitted, including source location, gradation, and moisture-density characteristics.
- C. **REFERENCE STANDARDS** - Maximum density shall be determined by AASHTO T-99 and is defined as the maximum dry weight in pounds per cubic foot obtained when a material is mixed with different percentages of water and compacted in a standard manner. The percentage of water at which maximum density is obtained is termed the optimum moisture content.

The percent compaction is defined as the density of the compacted layer expressed as a percentage of the maximum density of the material when tested in accordance with these Specifications.

The percentage of compaction is computed by the formula:

$$\text{Percent compaction} = \frac{\text{Field Density}}{\text{Maximum Density}} \times 100$$

202.02 MATERIALS

- A. **ON-SITE MATERIALS** - Suitable materials for embankments and backfill shall be taken from designated excavation areas. Stumps, trees, rubbish, vegetation, frozen lumps, or other unsuitable materials shall not be placed in embankments. Large rock will only be considered suitable if it does not adversely affect the requirements for compaction.

- B. ROADWAY MATERIALS - Requirements for roadway materials are specified under Section 800, Surfacing - Aggregate, Base Courses, and Pavement of the Standard Specifications.
- C. IMPORTED MATERIALS - Imported backfill materials shall meet the requirements specified in Section 202.02-A above and shall be approved by the Engineer prior to delivery of the material to the project. All areas used as a material source or for stockpiling shall be reclaimed by the Contractor at his cost unless such areas are designated as Approved Areas of Disturbance as defined in the Supplementary Conditions.

202.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - All excavation and embankment shall be considered unclassified and shall consist of the removal or disposal of any and all material encountered regardless of type or nature obtained within the construction limits designated on the Drawings.

All suitable materials removed from excavation shall be used insofar as possible for backfill and in embankments.

- B. SITE PREPARATION - All areas scheduled for excavation and embankment shall be cleared and grubbed in accordance with Subsection 201.00, Clearing and Grubbing.

Prior to excavation and embankment work, all suitable topsoil and subsoil in the scheduled work areas shall be salvaged in accordance with Subsection 310.00, Cover Soil.

- C. LINE AND GRADE CONTROL - Prior to excavation, backfill, grading, and embankment operations, the Contractor shall perform all necessary surveys for control of line and grade and establish stable and protected monuments for reference throughout the construction period. A sufficient number of such monuments shall be provided throughout the work to permit verification of the work within the tolerances specified.

- D. EXCAVATION

1. General. The Contractor shall utilize excavating equipment appropriate for the work being performed. The method of excavation shall be the Contractor's responsibility. All methods and equipment used shall result in finished work meeting the construction tolerances specified. No work shall be performed beyond the construction limits without prior written approval from the adjoining landowners and the Engineer.
2. Dewatering. Ground water encountered during excavation shall be removed to avoid interfering with any construction activity. The cost of dewatering operations shall be merged with and considered part of the excavation cost.
3. Shoring, Sheet piling, and Bracing. The Contractor shall do all shoring, bracing, and tight sheet piling required to prevent caving and to protect his workmen, in accordance with the Occupational Safety and Health Regulation Requirements, and to protect adjacent property and structures. No separate payment shall be made for these items and the cost thereof shall be considered part of the excavation cost unless otherwise shown or specified for the project.
4. Surplus and Waste Material. During excavation, where the ground foundation for embankments is composed of muck or other unstable materials, such materials shall be removed to the depth shown on the Drawings or as determined in the field by the Engineer and satisfactorily disposed. All holes created by removal of soft or unstable material shall be backfilled as specified for "Embankment". Backfill shall be obtained

from the most select material encountered in excavation and shall be paid for only as is "Unclassified Excavation", unless otherwise approved in writing.

All excavated material not used as mentioned above shall be used for embankment backfill or shall be wasted and disposed of by the Contractor at an approved disposal site. Finding disposal areas, placing waste material in these areas, and final leveling and cleanup of these disposal areas to the satisfaction of the property owner involved shall be entirely the Contractor's responsibility.

When unsuitable material or debris is encountered during excavation, it shall be overexcavated until removed or until 1 foot below the established grade. Suitable material shall then be placed and compacted to bring the area to grade.

5. Maintenance of Subgrade and Drainage. During excavation, the subgrade shall be maintained in such a condition that it will be well drained at all times. Side ditches emptying from cuts to embankments shall be constructed to avoid damage by erosion.

If it is necessary in the prosecution of the work to interrupt existing surface drainage, temporary drainage facilities shall be provided and maintained at the Contractor's expense until permanent drainage facilities are completed. The Contractor shall be responsible for, and shall take all necessary precautions to protect and preserve any and all existing subsurface drains, conduits, utilities, and other underground structures or parts thereof which may be affected by the construction, and which in the opinion of the Engineer may be properly continued in use without any change. The Contractor shall, at his own expense, repair all damage to facilities or structures which results from any of his operations or his negligence.

Erosion checks shall be constructed perpendicular to ditches and as detailed on the Drawings.

E. STRUCTURE EXCAVATION

1. All Structures. Excavation adjacent to existing structures shall not commence until authorized by the Engineer.

Excavations for structures or structure footings shall be to the lines and grades or elevations shown on the Drawings. They shall be of sufficient size to permit the construction of structures or structure footings. The elevations of the bottoms of footings, as shown on the Drawings, shall be considered as approximate.

Boulders, wood, and any other unsuitable materials encountered in the excavation shall be removed and disposed of at an approved disposal site.

The Contractor shall notify the Engineer when each excavation is complete. Footings shall not be placed without first notifying the Engineer.

Excavations over 5 feet deep, except in solid rock, shall have side slopes of 1 to 1 or flatter, depending upon conditions at the individual site and in accordance with OSHA regulations. When the laying back of excavation slopes is precluded, supporting systems shall be used to retain the sides of excavations greater than 5 feet deep. Sides of excavations less than 5 feet deep shall also be effectively protected when hazardous ground movement may be expected.

Where concrete is to be placed on any excavated surface, special care shall be taken

not to disturb the bottom of the excavation more than necessary. When the excavation is at the required depth, all water shall be pumped out for cleaning the foundation bed for inspection. All loose and disintegrated rock and thin strata shall be removed. All seams or crevices in rock strata shall be cleaned out and filled with concrete mortar. When the foundation material is soft or otherwise unsuitable, the unsuitable material shall be removed and the area shall be backfilled with approved compacted, granular material.

When foundation piles are used, the excavation of each pit shall be completed before the piles are driven. Foundation backfill shall be placed after the piles are driven. After the driving is completed, all loose and displaced material shall be removed, leaving a smooth, solid bed to receive the footing.

2. Cofferdams. Watertight cofferdams or cribs shall be used wherever waterbearing strata are encountered above the elevation of the bottom of the excavation. For this purpose, a cofferdam or crib is defined as an enclosed single- or double-wall braced structure with walls sheeted with timber, concrete or steel, and which shall extend well below the bottom of the excavation when practical. Earthen or rockfill dikes, dams, or embankments are not considered cribs or cofferdams for this purpose.

The design and construction of supporting systems, if used, shall be the responsibility of the Contractor in accordance with the following provisions. The Contractor shall submit 5 sets of drawings showing the proposed method of cofferdam or crib construction and 5 copies of the design calculations, fully annotated and referenced. The design calculations and drawings submitted shall bear the signature and seal of a State of Montana registered Professional Engineer.

Supporting systems shall be designed to withstand the expected loads and pressures, including surcharge, water and earth, which may occur during the period for which they are used. Surcharge, earth, and water pressure diagrams, and the method of supporting system analysis and design, shall meet accepted engineering practice. For new materials, the allowable working stresses of the materials shall be as recommended by the manufacturer for the construction conditions encountered. For used materials or when manufacturer's recommendations are not available or applicable, the allowable working stresses shall be as specified in AASHTO's "Standard Specifications for Highway Bridges".

In general, the interior dimensions of cofferdams shall be sufficient to give clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs that are tilted or moved internally during the process of sinking shall be righted or enlarged to provide the necessary clearance.

When conditions make it impracticable to dewater the foundation before placing a footing, a concrete foundation seal with dimensions as necessary to resist uplift pressures shall be constructed. The concrete for the seal shall be placed as shown on the Drawings. The foundation shall then be dewatered and the footing placed. When weighted cribs are employed and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib to the foundation seal. When a foundation seal is placed under water, the cofferdam shall be vented or ported at low water level.

Cofferdams shall be constructed to protect green concrete against damage from sudden rising of water levels and to prevent damage to the foundation by erosion.

Timber or bracing that extends into substructure masonry shall not be left in cofferdams or cribs.

Pumping from the interior of any foundation enclosure shall be done in a manner that will not carry concrete materials away.

All pumping required during the placing of concrete, or for a period of at least 24 hours thereafter, shall utilize a suitable sump located outside the concrete forms. Pumping to dewater a sealed cofferdam shall not start until the seal has set sufficiently to withstand the hydrostatic pressure.

Cofferdams or cribs, and all sheeting and bracing shall be removed after completion of the substructure. Removal shall not disturb or mar finished masonry.

F. EMBANKMENT

1. Foundation Preparation. Site preparation including topsoil salvage work shall conform to the requirements as specified herein.

After topsoil stripping, all areas which will be receiving fill shall be scarified to a depth of 6 inches, watered, and compacted in conjunction with the first lift of new fill. When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankment, the slope of the original hillside, or old fill respectively, shall be benched or stepped by cutting into it horizontally, for a minimum distance of 12 inches. These measures will provide a secure bond between the new and existing materials. Each bench shall be cut as close to the one below as the slope of the ground will permit. Materials thus cut out of the benches shall be incorporated into the new fill. Costs for constructing the benches shall be included in the price for the work performed herein, and no additional compensation will be allowed.

2. Placement. Embankment and backfill materials shall not be placed until the required excavation and foundation preparation have been completed and the foundation has been inspected and approved by the Engineer. Fill materials shall not be placed upon frozen surfaces, nor shall it contain snow, ice or frozen materials.

Embankment shall be constructed of materials excavated on-site or borrowed materials from approved sources. Embankment shall be placed to the lines and grades indicated in uniform layers as required to obtain the specified compaction throughout the embankment. Each layer of embankment shall be completed, leveled, compacted, and tested, if required, before the succeeding layer is placed. The embankment surface is to be kept level and uniform at all times.

Embankment material shall not be excessively dry or wet when placed. If necessary, the Contractor shall manipulate the material as required to assure that compaction will be performed at or near the optimum moisture content given in the moisture-density curve. Jetting or ponding of the backfill materials will not be allowed.

The site shall be adequately dewatered prior to placing any embankment or attempting compaction such that ground water is not intruding into the material.

If it should become necessary because of weather or other conditions to suspend grading operations, the entire area worked upon shall be bladed until smooth, free of depressions and ruts, and crowned so no water can collect or be impounded.

Areas inaccessible to rollers shall be compacted by hand or mechanical tampers or other means until the density conforms to adjacent embankment, compacted in accordance with these Specifications.

Whenever the surface of a proposed cut or the site of an embankment is frozen or is covered with snow or ice sufficient to impair the stability of the work, the frozen earth material and snow and ice must be removed at no cost to the Owner. Work of this nature shall be completed at least 300 feet in advance of the excavation and placing of the embankment material. Frozen excavation or that lying under a blanket of snow of such extent as to preclude its placement in the embankment will be considered cause for suspending grading operations.

Embankment constructed during the winter shall be refinished to grade, cross-section, and compaction requirements after the frost is out of the ground and the embankment is in suitable condition for work.

3. Structure Embankment. Adjacent to structures, backfill materials shall be placed in a manner which will prevent damage to the structures and allow the structures to assume the loads from fill gradually and uniformly. The height of the fill adjacent to a structure shall be increased at approximately the same rate on all sides of the structure. The maximum size of rock fragments in backfill adjacent to the structure shall be 2 inches.

Backfill materials shall not be placed and compacted against any structure for a minimum period of 14 days after the placement of concrete, or until 90% of design strength has been attained through testing.

- G. REMOVAL AND PLACEMENT OF DEFECTIVE FILL - Embankment and backfill materials not conforming to the density and moisture requirements shall be reworked until the requirements are achieved or removed and replaced by acceptable fill. The replacement fill, foundations, abutment and fill surfaces upon which it is placed shall conform to all requirements of specifications for Foundation Preparation, Placement, Moisture and Density Requirements contained herein.

- H. MOISTURE AND DENSITY REQUIREMENTS - Each layer of embankment and backfill material shall be compacted until the in-place density exceeds 85% of its maximum dry density. In no case will compaction be less than that of adjacent undisturbed material. For roadway and structure embankments, compaction shall be 95% of maximum. For excavation cuts, compaction shall be equal to or greater than that of the adjacent undisturbed material. Cost of compaction, rolling, and watering is incidental to the earthwork bid item listed on the Bid Form.

Water required shall be sufficient to obtain optimum moisture content plus or minus a minimum 3% as determined by AASHTO T-99, ASTM D 698, Standard Proctor Method A, B, C, or D, as applicable. The Engineer may periodically measure the degree of compaction (field density) during embankment construction. Measurements will be based on optimum moisture and maximum density curves submitted.

Field or in-place density refers to the dry density expressed in pounds per cubic foot of a layer of compacted material in place at the site as determined by a sample representative of the compacted layer. The field density shall be determined in accordance with AASHTO T-147, AASHTO T-181, ASTM D 1556, or ASTM D 2167.

- I. HAUL - When constructing embankments or wasting, the cost of hauling shall be included in the Contract unit price bid for earthwork item on the Bid Form.

- J. FINE GRADING - After the earthwork has been substantially completed and after all underground utilities, drainage facilities, etc. have been installed or adjusted to grade, the embankment shall be brought to the lines, grades, and cross-sections shown on the Drawings, and compacted to the required density.

The Contractor shall increase heights above grade and increase widths as necessary to allow for settlement, consolidation, or compaction. Side slopes shall be finished to a reasonable uniform but rough surface that blends to the contours of surrounding undisturbed ground. Smooth surfaces shall be scarified perpendicular to the slope of the ground.

- K. TOPSOILING AND CLEANUP - After fine grading work is accepted, salvaged topsoil shall be replaced to cover those areas to be seeded as designated on the Drawings and according to Subsection 310.00, Cover Soil.

The Contractor shall remove all tools, equipment, excess materials, debris, etc. from the vicinity of the work.

SUBSECTION 203.00: PROVIDING AND/OR STOCKPILING BACKFILL MATERIALS

203.01 GENERAL

- A. **DESCRIPTION** - This work shall consist of furnishing, producing and hauling backfill materials including specified additives in accordance with these Specifications. An area on site for stockpiling backfill material may be utilized, upon approval of the Engineer. Materials at the source of supply are subject to the Engineer's approval before delivery of the materials to the project.
- B. **RECLAMATION REQUIREMENTS** - All areas used by the Contractor as a material source shall be reclaimed by the Contractor in accordance with an approved Reclamation Plan. The Reclamation Plan shall provide for a finished materials pit site that blends with the adjacent landscape.

The Contractor shall comply with the pertinent statutes relating to open cut mining (Title 82, CH. 4, Part 4); hard rock mining (Title 82, CH. 4, Part 3); water quality (Title 72, CH. 5); stream bank preservation (Title 87, CH. 5, Part 5 and Title 75, CH. 5); and all other Federal, State and local statutes that apply.

Final responsibility for administration of the Open Cut Mining Act and the Hard Rock Mining Act rests with the Department of State Lands. Therefore, all reclamation plans and reclamation work are subject to review and approval by personnel of the Department of State Lands. The Contractor shall comply with all directives and instructions issued by the Department of State Lands with regard to reclamation work.

The Contractor shall furnish the Engineer with copies of all authorizations, plans/and or permits necessary to comply with this provision.

No extra compensation will be considered or allowed by reason of the conditions of this provision, as it shall be considered necessary and incidental to the completion of the work.

203.02 MATERIALS

All backfill shall be as specified in the pertinent subsection or Special Provisions. The Contractor shall provide all testing required, at no cost to the Owner, for approval of any materials source prior to delivery of the materials to the site. Such testing shall be done by an approved testing laboratory. Gradation analysis, moisture-density relationship, and specific gravity tests are required.

203.03 CONSTRUCTION REQUIREMENTS

The source pit and storage area shall be cleared of weeds, roots, stumps, rocks and other contaminating matter. The cleared matter shall be disposed of or leveled in accordance with Subsection 502.00, Debris and Structure Removal, and Subsection 220.00, Waste Pile Disposal, or otherwise described in the Special Provisions. Sites shall occupy a minimum area.

Equipment or methods that cause segregation, degradation or contamination of the material shall not be used, when delivering materials from the source pit or storage area.

SUBSECTION 206.00: HAUL

206.01 GENERAL

- A. DESCRIPTION - This work shall consist of loading and hauling material excavated from its original location to its final location in the work. It shall include dumping hauled material in a location that will facilitate placement under the Waste Pile Disposal work item, watering for dust control, and the installation and removal of temporary facilities such as fence, culverts, access/haul roads, etc. The work shall also include all signing and traffic control, including flagmen if necessary. This work also applies to hauling of cover soil and other miscellaneous excavated materials, where necessary.

The material which shall be loaded and hauled is that material which is excavated as spoils material in Subsection 220.00, Waste Pile Disposal.

- B. SUBMITTALS - The following submittals for haul will be required in accordance with the Supplementary Conditions:
- * A Traffic Control Plan as specified in the Supplementary Conditions.
 - * Specifications, layout, and location of weighing equipment.
 - * Sample weigh ticket to be used.
 - * Certified empty weights and identifying number for each haul vehicle to be used.

206.02 MATERIALS

Materials for this item are covered under Construction Requirements.

206.03 CONSTRUCTION REQUIREMENTS

- A. HAUL - All materials to be hauled shall be removed from their original location and placed in trucks or other suitable equipment capable of transporting the material without spillage. All vehicles shall travel on the designated haul routes in such a manner as to minimize damage to the surrounding vegetated areas.

Haul routes shall be those designated on the Drawings. Proposed haul routes not shown on the Drawings must be approved in writing by the Engineer prior to construction.

- B. WEIGHING - All material to be hauled shall be weighed if weighing is required by the Bid Form and/or Special Provisions for basis of measurement and payment. The Contractor shall provide and erect a scale suitable for weighing entire haul vehicles or axles thereof to an accurate weight of 0.5% of the total weight. The Contractor shall furnish a competent scale tender and provide certified weigh tickets for each load. The scale and weighing operation shall be easily verifiable for accuracy by the Engineer. The Contractor shall also furnish six 50-lb. weights for scale calibration.

SUBSECTION 210.00: TRENCH EXCAVATION AND BACKFILL

210.01 GENERAL

- A. DESCRIPTION - This section covers excavation, trenching, and backfilling for pipelines and appurtenances, complete. This item shall consist of all necessary clearing, grubbing, and site preparation; removal and disposal of debris; handling and storage of materials to be used for fill and backfill; all necessary bracing, shoring, and protection; pumping and dewatering as necessary; all backfill; preparation of subgrades; and final grading, dressing, and cleanup of the site.
- B. STRIPPING - When crossing existing or prospective cultivated areas, gravel streets or other developed surfaces, the Contractor shall strip the cover material to full depth at the existing surfacing. This surfacing shall be stockpiled and placed back over the trench after backfilling to the extent that it is acceptable and usable for that purpose. Topsoil shall be removed to full depth of the topsoil, or to a maximum depth of 12 inches, whichever is less.
- C. EXISTING UTILITIES AND PRIVATE PROPERTY - The Contractor is reminded of the utility notification, identification, preservation, and repair requirements in the Supplementary Conditions.
- D. SUBMITTALS - The following submittals are required in accordance with the Supplementary Conditions:
- * Gradation(s) of bedding materials.
 - * Standard Proctor, including moisture density curve for backfill and bedding materials.
 - * Atterberg Limits for bedding materials.
 - * Blasting plan and related information (see Section 210.03-A5) for blasting operations.
- E. REFERENCE STANDARDS - Standard Proctor Density, where referenced herein, shall refer to AASHTO T-99. Other standards shall be as noted herein.

210.02 MATERIALS

- A. GENERAL. Materials for trench excavation consist of Type 1 Pipe Bedding, Type 2 Pipe Bedding, and backfill material.
- B. TYPE 1 PIPE BEDDING - Type 1 pipe bedding shall consist of the material 6 inches under, around, and 6 inches over the pipe. The bedding material under the pipe and up to the spring line of the pipe shall consist of imported sand, sandy gravel, or fine gravel having a maximum size of 3/4-inch, uniformly graded, and having a maximum plasticity of 6 as determined by AASHTO T89 and T90.
- Bedding material from the spring line to 6 inches over the pipe shall consist of select earth, sand, or fine gravel free from clods, lumps of frozen material, or stones larger than 1 1/2 inches in their maximum dimension. Where wet or otherwise unstable conditions exist, the material in this zone shall be free draining, nonplastic material. Where suitable material is available in the material excavated from the trench, the Contractor may procure the select material by screening, sifting, or manually sorting the material removed from the trench.
- C. TYPE 2 PIPE BEDDING - The Type 2 bedding material shall consist of suitable granular material having a maximum size of 3 inches and shall be graded so 25% to 60% passes a No. 4 sieve, not more than 12% passing a No. 200 sieve, and shall have a maximum plasticity index of 6.

- D. BACKFILL MATERIAL - Backfill material shall consist of all suitable material, or material made suitable, that was removed in the excavation, unless otherwise specified. Backfill material shall be free of boulders, timbers, tree trunks and branches, concrete debris, and other deleterious materials that will prevent proper placement and compaction. From 1 foot above the top of pipe to 6 inches below the ground surface, or to the subgrade elevation for streets or paved surfaces, material containing stones up to 8 inches in the greatest dimension may be used.

210.03 CONSTRUCTION REQUIREMENTS

A. TRENCH EXCAVATION

1. General. All excavation, trenching and shoring, and the like, under this Contract shall be performed in a manner that meets with the OSHA and Department of Labor, Safety, and Health Regulations for Construction.

The Contractor shall excavate as necessary at the locations shown on the drawings, staked in the field, or otherwise specified for the installation of pipelines. Excavations shall be made at each location by one of the two methods specified herein - either Type 1 or as Type 2 trench excavation. Type 1 trench excavation will be used in most areas. Type 2 will be used when space limitations or other conditions dictate. Areas of Type 1 and Type 2 trench excavation are designated on the Drawings or described in the Special Provisions. However, the Contractor shall have the option of performing the opposite type excavation in any area, providing this option results in equal or less cost to the Owner.

Whether trench excavation is by Type 1 or Type 2, the Contractor shall take precautions and protect all adjoining private and public property and facilities, including underground and overhead utilities, driveways, structures, and fences. Any disturbed or damaged facilities will be suitably restored or replaced at no cost to the Owner or Landowner.

During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Excavated materials shall be piled on one side of the trench only. Surface drainage of adjoining areas shall be unobstructed.

All excavated materials not required or suitable for backfill shall be removed from the site and wasted in accordance with Subsection 220.00, Waste Pile Disposal.

Grading shall be done as may be necessary to prevent surface water from flowing into excavations, and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in unbackfilled trenches until after the pipe has been placed, tested, and covered with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be relaid at no additional cost to the Owner.

The bottom of the trenches shall be accurately graded to the line and grade shown on the drawings. Bedding material shall provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bedding has been graded, and shall be only of such length, depth, and width as required for properly making the particular type joint. Unauthorized overdepths shall be backfilled with bedding material at the Contractor's expense.

There will be no differentiation between common and rock trench excavation, except when listed as separate items on the Bid Form. Excavation shall include the removal and subsequent handling of all earth, gravel, rock, or other material encountered regardless of the type, character, composition, or condition of the material.

2. Type 1 Trench Excavation. Excavation performed as Type 1 will not be shored or sheathed. The sides of all trenches greater than 5 feet in depth shall be sloped back to preclude collapse, in accordance with OSHA Regulations (Table P-1, Section 1926-652), and as shown on Standard Drawing 210.01, Utility Trench. In no case shall trench walls above the 5 feet level be sloped steeper than a 1-foot rise per 1-foot horizontal (1:1), except for rock excavation.
3. Type 2 Trench Excavation. Excavation performed and paid for as Type 2 shall be adequately shored and sheathed in accordance with the minimum requirements of OSHA Regulations, and as shown on Table P-2, Section 1926-652, and as indicated on Standard Drawing 210.01, Utility Trench.

Portable trench boxes or sliding trench shields may be used for performing Type 2 excavation in lieu of a shoring system provided they comply with OSHA regulations.

4. Trench Dimensions.

- a. Width. The width of the trench shall be such to provide adequate working room for men to install and join the pipe in the specified manner. The width of that portion of the trench (a) from the existing ground surface to the bottom of the trench for Type 2 Trench Excavation and Backfill or (b) from the bottom of the trench to a maximum of 5 feet above the bottom of the trench for Type 1 Trench Excavation, shall be as follows:
 - (1) A minimum of 3 feet 6 inches for pipe sizes 12 inches and under.
 - (2) A minimum of 2 feet 0 inches plus the outside diameter for pipe sizes greater than 12 inches.
- b. Depth of Trench. Trench depth shall be as required for the invert grade or pipe bury shown on the Drawings or specified elsewhere, plus an additional 4 inches for Type 1 Pipe Bedding. Care shall be taken not to excavate below the required depth. If ledge rock, boulders, or large stones are encountered at the bottom of the trench, excavating shall be carried a minimum of 6 inches below the bottom of the pipe for backfilling with Type 1 bedding.

When soft or unstable material is encountered at the subgrade which will not uniformly support the pipe, such material shall be excavated to an additional depth as determined by the Engineer and backfilled with Type 2 Bedding Material.

5. Blasting. The Contractor shall furnish the submittal information to the Engineer prior to commencing blasting operations as noted in Section 20, Use of Explosives, in the Supplementary Conditions.

When blasting rock in trenches, the Contractor shall cover the area to be shot with earth backfill or approved blasting mats that will prevent the scattering of rock fragments

outside the excavation. Prior to blasting, the Contractor shall station men and provide signals of danger in suitable places to warn people and stop vehicles. The Contractor will be responsible for all damage to property and injury to persons resulting from blasting or accidental explosions that may occur in connection with his use of explosives.

6. Equipment. The use of trench digging machinery will be permitted except in places where its operation will cause damage to existing structures or features; in which case hand methods shall be employed.

Any equipment operating on tracks, which is to be used on pavement, shall be equipped with suitable pads to prevent damage to the pavement. All pavement damaged during construction by the Contractor's equipment shall be restored to its original condition by the Contractor. No compensation will be allowed for pavement replacement other than as specified elsewhere.

7. Dewatering. Where ground water is encountered in excavation, it shall be removed to avoid interfering with pipe laying and other construction operations. The cost of dewatering operations will not be paid for as a separate item, but shall be merged with and considered a part of the excavation cost.
8. Shoring, Sheeting, and Bracing. The Contractor shall do all shoring, bracing, and tight sheeting required to prevent caving and to protect his workmen, in accordance with Occupational Safety and Health Regulation requirements, and to protect adjacent property and structures. No extra payment shall be made for these items. The cost thereof shall be considered a part of the cost for Type 2 Trench Excavation.
9. Excavation for Appurtenances. Excavations for manholes, hydrants, structures, and other appurtenances shall be sufficient to leave 12 inches minimum and 24 inches maximum clearance on all sides. The depth, provisions for removing water and other applicable portions of these specifications shall apply to excavation for appurtenances.

B. TRENCH BACKFILL

1. General. All trenches shall be backfilled immediately after grade, alignment, and jointing of the pipe has been inspected and approved by the Engineer. Leakage tests, pressure tests, or tests for alignment and grade shall be performed after backfill. If any test fails, the Contractor shall be responsible for work required to correct the defects at no additional cost to the Owner.
2. Pipe Bedding.
 - a. Type 1 Pipe Bedding. Bedding material 6 inches under and around the pipe to 6 inches above the top of the pipe shall be placed by hand in maximum layers of 6 inches and thoroughly compacted by tamping. Special care shall be taken to assure complete compaction under the haunches of the pipe. Backfill material shall be placed in the trench for its full width on each side simultaneously. Compaction of Type 1 Pipe Bedding shall be not less than 90% of the maximum density.

Water settling of this portion of the trench will not be allowed, and the addition of water shall be limited to that required for optimum moisture for maximum compaction of the material.

- b. Type 2 Pipe Bedding. Type 2 bedding material shall be used to replace soft, spongy, or other unsuitable material encountered in trench bottom, to the depth necessary to support the pipe as determined by the Engineer.

3. Trench Backfill.

- a. General. After the select pipe bedding material has been placed and compacted as specified above, the remainder of the trench backfilling shall be done.

Trench backfill from the top of the pipe bedding material to ground surface or to the subgrade of street surfacing is separated into two classifications. Type A trench backfill refers to compacted backfill in streets or paved areas, while Type B backfill is designated for field, borrow pits, unimproved streets or other unsurfaced areas where special compaction of the trench backfill is not required. Locations of the types of backfill required shall be as shown on the Drawings or as designated in the Special Provisions.

- b. Type A Trench Backfill. Materials used for bedding and backfill shall be carefully deposited in layers suitable to the equipment used for compaction, wetted to optimum moisture content, and compacted to at least 95% of maximum Standard Proctor Density.

The upper 6 inches layer forming the subgrade for pavement which is to be replaced shall be compacted to a density of at least 97% of maximum Standard Proctor Density.

Compaction by flooding will not be permitted. Wherever the trenches have not been properly filled, or if settlement occurs, they shall be re-opened to the depth required for proper compaction and refilled and recompactd at no cost to the Owner.

For graveled streets, the backfill shall be completed by blading the stripped gravel back over the trench.

- c. Type B Trench Backfill. Materials used for Type B Trench Backfill shall not require special compaction. However, the material shall be placed in layers to achieve a density approximately equal to the density of the existing soil.

The Contractor may be required to mound excess earth over the top of the trench so that a depression will not be formed after the trench settles. In cultivated areas, the stripped topsoil shall be placed uniformly over the backfilled trench. The topsoil shall not be compacted but shall be graded to provide a smooth surface conforming to the adjoining ground surfaces.

- 4. Backfilling for Appurtenances. Backfill around appurtenances shall be deposited in such a manner as not to disturb the appurtenance from its proper alignment, and compacted to the finished grade. Backfill material, compaction, and backfill procedures shall conform to the requirements of the related Type A or Type B backfill as specified for trenches.

- 5. Backfill Above Original Ground for Minimum Cover Requirements. Where shown on the Drawings, the Contractor shall provide embankment over the pipe above the original ground surface to a height which will satisfy the minimum depth of cover requirements.

Such embankment shall be constructed to the cross section shown on the Drawings. No additional compensation will be paid for embankment unless shown as a specific item on the Bid Form.

6. Testing. Field density tests of the compacted fill will be run on each lift. These tests will be performed by the Engineer at the Owner's expense to insure that the specified density is being obtained. The cost of re-tests after failed test may be charged to the Contractor.

- C. TRENCH MAINTENANCE - The Contractor shall, for a period of 1 year after completion and final acceptance of the work, maintain, and repair any trench settlement which may occur and shall make suitable repairs to any pavement, sidewalks, or other structures, which may become damaged as a result of backfill settlement.

If the Contractor elects to perform such maintenance and repairs by subcontract with the Owner or with others, he shall furnish the Owner a copy of such subcontract or authorization as evidence of his faithful intention to perform the work.

In any case the Contractor shall furnish a written statement of the method of maintenance he proposes to use. Final acceptance and payment will not be made without such statement.

- D. CONTRACTOR'S SAFETY RESPONSIBILITIES - Whether utilizing Type 1 or Type 2 trench excavation, the Contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring, and blasting operations to conform to OSHA regulations.

- E. TRAFFIC CONTROL AND WARNING DEVICES - The Contractor shall construct the project in such a manner as to minimize the interruption of the use of roads, highways or streets involved and shall provide for emergency runs at all times.

As specified in Subsection 550.00, Traffic Control, the Contractor is responsible for providing adequate barricades of high visibility design, flares, lanterns, signs, flag persons, and pre-warning devices to alert the public, motorists, and pedestrians of hazardous conditions in accordance with the latest issue of the Manual of Uniform Traffic Control Devices for Streets and Highways published by the Department of Transportation.

- F. CLEANUP - As work progresses, that portion of the work completed shall be cleared of debris and brought to the finished grade. Upon completion of the work, the entire site shall be cleared of all debris and ground surfaces shall be finished to smooth, uniform slopes and shall present a neat and workmanlike appearance. All rocks brought to the ground surface by excavation or backfilling operations shall be removed.

- G. TIME OF OPEN TRENCHES - The Contractor will be required to conduct his work so that trenches will remain open a minimum possible time.

No trench excavation shall begin until approved compaction equipment is at the site where the excavating is to take place. All backfill and compacting shall be completed in all trenching and structural excavations within a maximum distance of 500 feet behind the end of newly installed pipe and the maximum distance between the newly installed pipe and the excavator shall be 200'. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling and compacting crew, the maximum allowable open ditch at any time will be 700'. The maximum distance behind the end of the new pipe shall be 1,500 feet for gravel replacement or for base placement or pavement replacement.

Certain conditions, as provided in the Special Provisions, may necessitate the closing of certain sections of trench prior to daily, weekend or holiday shutdown.

SUBSECTION 220.00: WASTE PILE DISPOSAL

220.00 GENERAL

- A. **DESCRIPTION** - This work shall consist of excavating and regrading all waste materials from previous mining operations as designated on the Drawings and by the Engineer and disposing of waste materials in designated areas. It shall include topsoil salvage and replacement, regrading of suitable materials, preparing disposal and deposition areas where excavated materials are to be placed including clearing and grubbing, and hauling of spoils material to deposition areas unless the material is specifically identified to be moved under Subsection 206.00, Haul. Also included in the work is placing spoils, extinguishing burning material, compacting, watering, and resloping and serration of the excavated slopes and embankments. The work shall also include the installation and removal of any temporary facilities such as fence, culverts, access/haul roads, etc. necessary to dispose of waste piles.
- B. **SUBMITTALS** - The following submittals will be required in accordance with the Supplementary Conditions:
- * Moisture-density characteristics using AASHTO T-99 for spoils material from piles indicated by the Engineer.
 - * The details, anticipated sequence, and schedule for those areas where spoils material is to be removed from, in, around, or on the banks of a stream channel.
 - * The details, anticipated sequence, and schedule for those areas where spoils material is hauled to a spoils deposition area.
 - * The details, anticipated sequence, and schedule for those mine sites where spoils material shall be disposed of by stowing methods.
- C. **REFERENCE STANDARDS** - Standard Proctor Density, where referenced herein, shall refer to AASHTO T-99. Other standards shall be as noted herein.

220.02 MATERIALS

Materials for this item are covered under Construction Requirements.

220.03 CONSTRUCTION REQUIREMENTS

- A. **SITE PREPARATION** - All trees, brush, stumps, trash, and other objectionable matter shall be removed and disposed of from all areas to be excavated and from all designated disposal and deposition areas prior to any topsoil salvage work taking place. The Contractor shall protect all structures and/or vegetation, including trees, that are specifically identified for protection in the Drawings, specifications, or by the Engineer from being severely impacted by the execution of the work.
- Disposal shall be in such a manner as to be consistent with all state, county, and municipal regulations regarding health, safety, and public welfare. Debris disposal shall be in accordance with Subsection 502.00, Debris and Structure Removal.
- B. **TOPSOIL SALVAGE** - All topsoil and other suitable surface soil, from areas which will be excavated and from disposal areas upon which excavated materials will be placed, shall be salvaged and either stockpiled or spread over previously prepared areas as specified in Subsection 310.00, Cover Soil.

Topsoil materials stripped and salvaged from the areas described herein shall be removed in an operation separate from other excavation and shall be free of stones, junk, debris, and other deleterious substances.

- C. EXCAVATION - Excavation shall be unclassified and shall consist of the excavation of any and all materials encountered in areas designated on the Drawings or by the Engineer in the field regardless of type or nature.

The material to be excavated is that material piled upon the natural ground as a result of previous mining activities and the portion of original ground at the interface of the waste materials and the original ground which may be unsuitable for supporting new vegetation.

The areas disturbed by this operation shall be limited to the areas of waste materials, areas of the disposal sites, roadways between the sites and the small area adjacent thereto as necessary to accomplish the work. Trees and shrubs shall not be removed unless prior approval is obtained from the Owner or his representative.

Any material encountered in the excavation that cannot be disposed of at the designated site shall be hauled to an approved waste disposal site. No additional compensation will be allowed for such work.

- D. EMBANKMENT - Embankment shall consist of placing, extinguishing all burning materials encountered, and compacting excavated mine waste materials in the disposal areas as designated on the Drawings and by the Engineer.

Stumps, trees, timbers, rubbish, trash, vegetation, and any other biodegradable materials encountered in the excavation shall not be placed in the embankment. All such materials shall be disposed of as debris.

After topsoil stripping, all areas scheduled for fill shall be scarified to a depth of 6 inches and watered prior to placement of new materials. When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankment, the slope of the original hillside, or old fill respectively, shall be benched or stepped by cutting into it horizontally for a minimum distance of 12 inches. These measures will provide a secure bond between the new and existing material. Each bench shall be cut as close to the one below as the slope of the ground will permit. Materials thus cut out of the benches shall be incorporated into the new fill. Costs for constructing the benches shall be included in the price for the work performed herein, and no additional compensation will be allowed.

Embankment materials shall be placed in horizontal layers approximately 12 inches in loose thickness as required for proper compaction and shall be compacted as specified before the next layer is placed. Effective equipment shall be used in each lift to obtain uniform thickness prior to compaction. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Construction equipment shall be routed uniformly over the entire surface of each layer in order to insure compaction.

- E. DENSITY REQUIREMENTS - After each layer of excavated materials has been properly placed, watered, mixed, and evenly spread, it shall be uniformly compacted. Compaction shall be sufficient to create a density equal to or greater than the material density prior to excavation from the pile but in no case less than 85% of optimum. Determination of in-situ density of materials to be excavated and completed embankment layers shall be made by approved ASTM methods for the materials encountered.

If adequate compaction cannot be attained with conventional earth moving equipment, then it shall be accomplished by using multiple-wheeled, pneumatic-tired rollers, equivalent rollers, or tampers.

- F. SHAPING AND SLOPES - After all excavation is complete, the disturbed excavated areas shall be shaped to the contours shown on the Drawings, indicated in the Specifications, and as field determined by the Engineer. The surface of disturbed areas shall be finished to a reasonably uniform but rough surface. Smooth surfaces shall be scarified to a depth of 6 inches perpendicular to the slope of the ground.

Mounding of backfill materials shall be completed prior to topsoil replacement in order to provide drainage away from the spoils deposition area. All drainage pockets shall be eliminated. All ditches and drainage ways which are disturbed by the excavation of materials or placement of embankments shall be rerouted in a stable configuration such that the water flowing therein will reach its original destination, or one suitable to the Engineer.

- G. EXTINGUISHING BURNING MATERIALS - When excavated material contains burning coal wastes or residues from the burning process, it must be completely extinguished prior to placement and compaction. When such materials are encountered, they shall be spread atop an unvegetated area and thoroughly watered until extinguished. The Contractor will provide control of any runoff water per the Supplementary Conditions and prevent any spread of fire to adjacent combustible materials including non-burning coal wastes. After extinguished, materials may be placed and compacted. Compaction or equipment rolling are not an acceptable method for extinguishing burning materials.

- H. TOPSOIL REPLACEMENT - After all other operations are completed, all available topsoil material salvaged previously shall be spread to the depth specified over the embankments and cut sections in accordance with Subsection 310.00, Cover Soil, and left with a rough surface texture without drainage pockets. The entire area shall be cleaned of all surface rubble and debris and left with a neat appearance prior to seeding.

Section 299 - Composite Road Construction

DESCRIPTION

299.01
Work

This work shall consist of clearing and grubbing, excavation and embankment, and erosion control. Clearing and grubbing shall include treatment of merchantable timber, and disposal of construction slash, including all designated trees. Excavation and embankment shall include borrow, drainage excavation, shaping the roadway, including approaches, turnarounds, ditches and drainage dips, and disposal of all excavated material, regardless of its nature. Erosion control, when specified, consists of furnishing and placing required seed, fertilizer, mulch and tackifier. Construction of the roadway shall be in conformance with the dimensions SHOWN ON THE DRAWINGS and DESIGNATED on the ground.

MATERIALS

299.02
Requirement

Materials shall meet the following requirements:

(a) Seed shall meet the requirements of Federal Specification JJJ-S-181 and shall have been tested within the past 6 months.

Seed shall be certified to meet state requirements for containment of noxious or undesirable plant seeds.

(b) Mulch shall be grass, hay, or grain straw in an air dry condition or wood cellulose fiber. Mulch shall be free of noxious weeds, mold, or materials injurious to plant growth.

(c) Fertilizer shall be a standard commercial grade furnished in sealed containers with name, weight, and contents clearly marked.

(d) Tackifier shall be emulsified asphalt Grade SS-1, SS-1h, CSS-1, or CSS-1h or as SHOWN ON THE DRAWINGS.

CONSTRUCTION

299.03
Clearing & Disposal

All trees, snags, downed timber, brush, and stumps within the clearing limits shall be removed and disposed of by:

(a) Decking or removing timber meeting utilization standards as SHOWN ON THE DRAWINGS.

(b) Decking unmerchantable timber as SHOWN ON THE DRAWINGS.

(c) Treating the construction slash larger than 3 inches in diameter and 3 feet in length by one or more of the following methods as SHOWN ON DRAWINGS:

Method A. Incorporating construction slash in the embankment.

Method B. Windrowing construction slash outside the clearing limits. When slash is windrowed, it shall be placed approximately parallel to the roadway outside the toe of the fill slope.

Method C. Scattering construction slash outside the clearing limits.

Method D. Piling for future disposal.

(d) Construction slash less than 3 inches in diameter and 3 feet in length may be incorporated into embankments so long as the material is distributed so that it does not result in concentrations or matting.

Slash shall not be deposited in stream courses.

Fire-dangerous dead trees or unstable live trees, DESIGNATED by the Engineer within 200 feet slope distance of the centerline of roads shall be felled and disposed of in accordance with (a), (b), or (c) unless there is agreement that removal would cause unnecessary damage to residual timber or roads.

299.04
Pioneering

Pioneering operations shall not undercut the final back slope, deposit material outside the roadway limits, or restrict drainage.

299.05
Grubbing

Grubbing limits shall be as SHOWN ON THE DRAWINGS. Stumps outside the grubbing limits may remain, but shall be cut no higher than 12 inches above the original ground measured on the uphill side unless otherwise SHOWN ON THE DRAWINGS.

299.06
Excavation &
Embankment

The roadway shall be constructed to conform to the typical sections SHOWN ON THE DRAWINGS. Embankment may be placed by side casting and end dumping.

The location and requirements for use of borrow material and any requirements for the removal and disposition of unsuitable or excess material will be as SHOWN ON THE DRAWINGS.

Rocks too large to be incorporated in the embankment shall be placed outside the traveled way on the downhill side, so that they will not roll, obstruct drainage, or hinder the use and the maintenance of the roadbed.

To facilitate seeding, slopes shall be left in a roughened condition.

Unless otherwise SHOWN ON THE DRAWINGS, the roadbed shall be shaped and finished to that ordinarily accomplished by a crawler tractor with dozer blade to provide drainage of surface water. Individual rocks, within the roadbed, shall not protrude over 4 inches above the subgrade. A motor grader finish is not required.

Unless otherwise SHOWN ON THE DRAWINGS, the traveled way width shall not exceed the specified dimension by more than 2 feet.

299.07
Erosion Control

Seasonal limitations for seeding are SHOWN ON THE DRAWINGS. The seeding shall not be accomplished during windy weather, nor when the ground is excessively wet, nor when the ground is frozen. The methods and rates of application, and types of seed, fertilizer, mulch, and tackifier shall be as SHOWN ON THE DRAWINGS. Materials shall be applied uniformly to the areas to be treated.

**SECTION 300: SOIL PREPARATION, AMENDMENTS,
AND SEEDING**

SUBSECTION 308: MANURE APPLICATION

308.01 GENERAL

- A. **DESCRIPTION** - Cattle manure application shall consist of furnishing, applying, and incorporating this soil amendment at locations and rates designated on the Drawings and in the Special Provisions.
- B. **SUBMITTALS** - The Contractor shall provide to the Engineer the following submittals in accordance with the Supplementary Conditions:
 - * Location of Supplier.
 - * Stockpiling and handling plan in the project area.
 - * Manure analysis including: water content, type percentage, percent straw, and percent grass stalks and seed heads.
 - * Proposed manure application and incorporation methods and equipment.
 - * Scale tickets for each load of manure delivered to and removed from the site.

308.02 MATERIALS

- A. **APPLICABLE FORMS OF MANURE** - Cattle manure shall be the preferred manure type. Only 20% (dry weight basis) of other animal manure types will be acceptable. Straw bedding material mixed into the manure is acceptable, but it shall not constitute more than 20% (weight basis) of the dry weight. The presence of grass stalks and seed heads in manure shall not exceed 5% (dry weight basis) of the manure mass. The manure shall not contain rock.
- B. **APPLICATION RATE** - Application rate shall be as specified in the Special Provisions. The water content of the manure must be determined from each Supplier. The field application rate shall be on a dry weight basis. The amount of water will be deducted in calculating the application rate.

308.03 CONSTRUCTION REQUIREMENTS

- A. **STOCKPILING MANURE** - Prior to stockpiling manure on-site, the Contractor shall develop an acceptable stockpiling plan. The plan shall include the location of the stockpile and adequate measures to prevent contamination of underlying and adjacent soils and prevent air or water pollution.
- B. **SITE GRADING** - Prior to placement of the manure, all areas shall be graded to approximately restore the original contour of the ground or to produce a contour that will blend with contours of adjacent areas. This shall include grading erosion channels in devegetated areas which are to receive manure.
- C. **MANURE APPLICATION** - Manure shall be applied with standard agricultural manure spreaders or other approved application equipment.

For a specified application rate, the Contractor shall apply the amendment in a uniform manner across the landscape. Localized manure application thicker than 10 inches will be unacceptable.

Under no circumstances shall the Contractor apply manure during wind conditions strong enough to displace material onto adjacent sites. The Engineer may halt application during such conditions.

- D. MANURE INCORPORATION - Following amendment application, the soil shall be ripped to the 16 to 18-inch depth at 12-inch centers. A D5 dozer, 16 G grader or comparable unit pulling 5 shanks is recommended. The soil shall then be tilled to a depth of 12 inches with a disc, rototiller, moldboard plow or chisel plow. A double gang offset disc with a minimum disc diameter of 32 inches having cone-shaped discs at a maximum spacing width of 9 inches and self-adjusting scrapers is recommended. Multiple tilling equipment passes may be required to achieve adequate incorporation. Adequate incorporation, as determined by the Engineer, will be complete and uniform mixing of the manure and soil to a depth of 12 inches.

Following amendment incorporation, all surface areas shall be pitted with a Dammer-Diker or comparable apparatus if specified in the Special Provisions.

All tillage procedures shall be completed within 48 hours of amendment application.

SUBSECTION 310: COVER SOIL

310.01 GENERAL

A. DESCRIPTION - Topsoil (A Horizon Material) and subsoil (B Horizon Material) shall be called cover soil after it has been excavated and shall be used to cover all areas to be seeded.

1. Salvage and Replace On-Site Cover Soil Source. This work consists of site development, excavating, stockpiling, hauling, depositing, spreading, and preparing for seeding all topsoil and subsoil material to be used as cover soil. Area(s) for topsoil and subsoil salvage will be designated on the Drawings and in the field by the Engineer.
2. Provide Imported Cover Soil. This work item includes performing all operations required for furnishing, excavating, hauling, stockpiling, spreading, and seedbed preparation of approved cover soil material from a site which is outside the project limits specified herein or shown on the plans. Imported cover soil sources will be either designated on the Drawings or determined by the Contractor as described in the Special Provisions. Imported Cover Soil, if used, will be listed as a separate bid item on the Bid Form.

B. SUBMITTALS - The Contractor shall provide the following submittals in accordance with the Supplementary Conditions:

- * For imported cover soil sources determined by the Contractor, the exact intended cover soil source site location, including detailed mapping.
- * For imported cover soil sources determined by the Contractor, the Contractor shall be required to secure at least 3 soil samples from the source area. The Engineer will be present during soil sampling, will determine sampling locations and depths, and will approve samples to be sent for analysis.
- * Each of the above 3 soil samples shall be analyzed by an approved laboratory for the following parameters:

Texture class and particle size; pH; saturation percent; conductivity (EC) in mmhos/cm; organic matter %; NO₃ - nitrogen; available phosphorus (P) and available potassium (K); total arsenic, cadmium, copper, lead, manganese and zinc.

The above parameters shall be analyzed using USDA classification and test methods as described in ASA/SSSA Monograph No. 9, Methods of Soil Analysis, Parts 1-2, most recent edition, except for lead and arsenic which shall be analyzed using EPA SW-846, Method 6010.

Additionally, analyses of the exchangeable sodium percentage (ESP) and acid-base account (ABA) parameters shall be done, as determined by the Engineer, in the following situations. ESP shall be analyzed when pH is greater than 8.0; or when EC is greater than 2.0 and mean annual precipitation is less than 19 inches; or where sodic soils are known to exist. ESP shall be analyzed using methods described in the above-referenced ASA/SSSA Monograph No. 9. ABA shall be analyzed where the soil source is in known mineralized areas and the method used to determine ABA shall be as described in EPA-600/2-78-054. Additional soil parameters may be required by the Special Provisions. All soil sampling and analysis costs will be included in the price for importing topsoil as covered in the Special Provisions. Cover soil work shall not begin until test results of the soil samples are known.

310.02 MATERIALS

- A. ON-SITE AND IMPORTED COVER SOIL (DESIGNATED SOURCE) - Topsoil and subsoil shall be excavated to depths determined by the Engineer from areas designated on the plans. The suitable topsoil and subsoil used as cover soil shall be reasonably free of trash, rocks, hard lumps of soil, stumps, or brush. Noxious weeds shall be pulled and disposed of properly before topsoil stripping. Suitable cover soil shall contain sod or soils with large amounts of humus and other organic materials to promote plant growth. Cover soil suitability will be determined by the Engineer. Suitable soil salvaged shall be stockpiled from unsuitable soil and shall be stored in a manner to prevent erosion or contamination.
- B. IMPORTED COVER SOIL (CONTRACTOR SOURCE) - Topsoil to be used as cover soil shall be fertile, friable material of an organic composition and characterized as loam, sandy loam, sandy clay loam, clay loam, silty clay loam, or silt loam in accordance with the USDA Soil Conservation Service textural classification. Topsoil material shall be reasonably free of trash, rocks, hard lumps of soil, stumps, and brush. The Contractor's proposed topsoil source shall not contain any "noxious weeds". If noxious weeds are found on the topsoil source site, the topsoil will be rejected and not used on the project. Clay textured soils with more than 40% clay shall be unsuitable. Topsoil shall meet the following requirements:

TABLE OF TOPSOIL GRADATION REQUIREMENTS

| Fraction | Particle Size (mm) | Max. % of Soil (-10 Mesh) Fraction |
|----------|--------------------|---------------------------------------|
| Sand | 0.05 - 2.0 | 70 |
| Silt | 0.002 - 0.05 | 70 |
| Clay | Less than 0.0023 | 40 |
| Gravel | Larger than 2.0 | *Max % of total sample |

- * A maximum of 20% of the total soil sample is allowable; however, any quantity greater than 10% will not be included in the basis for payment.

The soil pH shall be between 5.5 and 8.0, except that the maximum limit may be extended to 8.5 if the ESP is less than 10. The soil ESP shall not be greater than 15%. Soil saturation percent will be less than 85% and greater than 25%.

The soil shall have an EC less than 4 mmhos/cm. The organic content of the topsoil shall be within a range of values not less than 1% and not greater than 20%. The ABA shall indicate that no acid-forming materials are present. NO₃, P, and K will be used by the Engineer to verify fertilizer rates. Fertilizer rates specified in the Special Provisions may be changed by the Engineer after receipt of the NO₃, P, and K analyses.

The maximum concentrations of total metals in the top soil shall not exceed the following levels:

| | |
|-----------|-----------------------------------|
| Arsenic | 30 milligrams per kilogram (ppm) |
| Cadmium | 4 milligrams per kilogram (ppm) |
| Copper | 100 milligrams per kilogram (ppm) |
| Lead | 100 milligrams per kilogram (ppm) |
| Manganese | 250 milligrams per kilogram (ppm) |
| Zinc | 250 milligrams per kilogram (ppm) |

310.03 CONSTRUCTION REQUIREMENTS

A. SOIL SALVAGE (DESIGNATED SOURCE SITE).

1. Site Development. Site development performed by the Contractor will include clearing and grubbing as necessary to prepare the soil borrow area for topsoil and subsoil salvage. Clearing and grubbing consists of removing and disposing of trees, stumps, brush, roots, rock, logs, timber, debris, and other objectionable material as determined by the Engineer. The refuse resulting from this operation shall be removed and disposed of as are debris described in Subsection 502.00, Debris and Structure Removal.
2. Topsoil and Subsoil Excavation. Where practical as determined by the Engineer, topsoil and subsoil shall be excavated and salvaged from the borrow area in separate operations. The first lift, comprised of existing topsoil, shall be stripped. The second lift, comprised of underlying subsoil, shall then be stripped separately. The exact depths of excavation shall be site specific as determined by the Engineer.

First lift topsoil and second lift subsoil shall be stockpiled in separate piles and shall be located where they will not impair drainage. Stockpiles shall be shaped and smoothed to facilitate measurement of the piles. Where possible, topsoil and subsoil shall be hauled directly to the prepared areas to be covered.

Materials excavated and stockpiled as described herein shall be removed in an operation separate from other excavation. Care shall be exercised to avoid the incorporation of any deleterious subsoils during this work.

- B. PROVIDE COVER SOIL (CONTRACTOR SOURCE) - For cover soil imported from a Contractor-determined topsoil source, the Contractor shall make arrangements for obtaining the soil. The Contractor shall pay all costs involved, including royalties and other costs for developing the source, including borrow site reclamation. These costs shall be included in the bid and no additional charges shall be made to the Owner.
- C. COVER SOIL PLACEMENT (ALL SOURCES) - Cover soil shall not be placed until the areas to be covered have been properly prepared and all construction work in the area has been completed and approved by the Engineer, including lime application. All slopes to receive cover soil shall have a rough surface. Smooth slopes shall be scarified parallel to the contour to facilitate holding cover soil in place.

Ordinary sod or soil containing grass roots shall be broken up before being placed. Broken up sod or soil shall be capable of passing a 2-inch sieve opening.

Cover soil material shall be placed on areas to be covered as the soil occurred naturally, with subsoil (second lift) material placed first and underneath the topsoil (first lift) material. The Engineer will determine the amount of soil to be left at the borrow area for borrow area reclamation.

After the cover soil has been spread, all large clods, hard lumps, rocks, and large roots over 6 inches in diameter; litter; or other foreign material (exposed iron, timbers, etc.) shall be raked up, removed from the seeding areas, and disposed of properly. The cover soil shall be brought to a friable condition to an average depth of 4 inches, or to the depth specified in the Special Provisions or Drawings.

- D. SITE RECLAMATION - After topsoil and subsoil removal, the Contractor shall grade the soil borrow site to existing contours and to provide positive drainage. The Contractor shall replace stockpiled cover soil to the borrow area. The borrow area shall be prepared for seeding, mulching, and fertilizing as are other areas receiving cover soil.

SUBSECTION 320.00 FERTILIZER AND SEEDING

320.01 GENERAL

A. DESCRIPTION. This work shall consist of ground surface preparation; furnishing, applying and incorporating fertilizer into the soil; executing Summer Erosion Control Procedures (if necessary); furnishing and planting seed; mowing; tracking; and cleanup. The work includes permanent seeding.

B. CERTIFICATIONS.

1. Indigenous Seed. Defined by Section 80-5-120(14), MCA:

"Indigenous seeds" means the seeds of those plants that are naturally adapted to an area where the intended use is for revegetation of disturbed sites. These species include grasses, forbs, shrubs and legumes."

The Contractor must supply the Engineer with all seed tags and a certification from the supplier stating that the seed complies with the Federal Seed Act and the Montana Seed Laws (Sections 80-5-120 through 80-5-144, MCA).

2. Fertilizer. Fertilizer shall be delivered in standard size bags of the manufacturer showing weight analysis and manufacturer's name, or in bulk quantities accompanied with written certifications from the manufacturer stating that the fertilizer supplied complies with applicable specifications.

320.02 MATERIALS

A. INDIGENOUS SEED. All seed shall comply with and be labeled in accordance with the Montana Seed Law. Section 80-5-123(1), MCA, requires that each container of indigenous seeds sold in this state for sowing purposes must bear a conspicuous, unaltered label or tag, plainly written or printed in English. Bulk sales must be accompanied by the required label information which must be given to the seed purchaser. The following information must be included on a label:

- (a) name and address of seed labeler;
- (b) lot number identification;
- (c) germination rate and date of germination test or a notation of the year for which the seed was packaged for sale;
- (d) state or country of origin; and,
- (e) seed kind or variety.

In addition to the required label information listed above, and any information required by rule established by the Department of Agriculture, the following information shall either be included on the label or provided to the Owner:

- (a) the statement "Labeled only for reclamation purposes";
- (b) the common name, genus, species and subspecies, when applicable, including the name of each kind of seed present in excess of 5%. When two or more kinds of seed are named on the label the label shall specify the percentage of each. When only one kind of seed is present in excess of 5% and no variety name or type designation is shown, the percentage must apply to seed of the kind named. If the name of the variety is given, the name may be associated with the name of the kind. The percentage in this case may be shown as "pure seed" and must apply only to the seed of the variety named;

- (c) the approximate percentage of viable seed, together with the date of test. When labeling mixtures, the percentage viability of each kind shall be stated;
- (d) the approximate percentage by weight of pure seed, meaning the freedom of seed from inert matter and from other seeds;
- (e) the approximate percentage by weight of sand, dirt, broken seeds, sticks, chaff and other inert matter;
- (f) the approximate total percentage by weight of other seeds;
- (g) the name and approximate number of each kind of species of prohibited and restricted noxious weed seeds occurring per pound of seed; and
- (h) the full name and address of the person, firm or corporation selling the seed.

As listed in Section 80-5-134(1), MCA of the Montana Seed Law, seed shall contain no "PROHIBITED" noxious weed seed. The seed shall contain no "RESTRICTED" noxious weed seed in excess of the maximum numbers per pound as specified by Section 80-5-134, MCA, ARM 4.12.3011 or as specified by the appropriate County Weed Board, whichever is more stringent.

The number of seed allowed per pound, for all other noxious weed seeds shown on the "restricted list" will be zero.

Seed shall be grown in the North American continent above 41 degrees north latitude. Known varieties whose origin is above the 41st parallel but grown below are acceptable. All seed shall be a standard grade adapted to Montana conditions. Seed which has become wet, moldy or otherwise damaged will not be accepted.

Calculations of pure "live seed" may be made on the basis of either a germination test or a tertrazolium test in addition to the purity analysis. Seed shall be applied on a pure "live seed" basis. The quantity of pure "live seed" in a 100 lb. container shall be determined by the formula: 100 multiplied by germination percentage and this product multiplied by the purity percentage. (For example, if the seed is 85% pure and tests 90% germination, then a 100 lb. container would contain 76.5 lbs. of pure "live seed.")

When legumes are seeded, inoculants specified by the Special Provisions shall be used.

B. FERTILIZER. Fertilizer shall be a soluble commercial carrier of available plant food element or combination thereof. The fertilizer to be used on the project shall supply the quantities of available chemical elements stipulated in the Special Provisions or on the Drawings. The fertilizer shall be in uniform composition and in good condition for application by suitable equipment. It shall be labeled with the manufacturer's guaranteed analysis as governed by applicable fertilizer laws. Any fertilizer which becomes contaminated or damaged, making it unsuitable for use, will not be accepted.

C. WATER. Water used for seeding shall be of irrigation quality and free of impurities that would be detrimental to plant growth.

320.03 CONSTRUCTION METHODS

A. GENERAL. Areas to be seeded and fertilized shall be completed, in reasonable conformity, to specified line and grade prior to seeding and fertilizing and approved by the Engineer.

Slopes and areas finished during the period of October 15 through April 30 or May 20, depending on seeding zone, shall be topsoiled and permanently seeded within this time period. The Contractor must obtain Engineer's permission to commence topsoil placement and seeding operations. Slopes and areas finished during the period May 1 through October 14 shall be topsoiled, and mulched or otherwise treated as specified in the Special Provisions. The permanent seeding of these areas shall then commence during the fall at a time approved by the

Engineer. The Contractor shall be required to either mulch or otherwise treat in accordance with the Summer Erosion Control Procedure or permanently seed any topsoil area within 15 days of topsoil placement. Application rates for permanent seeding are shown in the Special Provisions.

Seeding of the finished slopes shall require repeated seeding operations until approved by the Owner, and shall not be construed to mean that the required finishing, topsoiling, fertilizing, mulching, Summer Erosion Control Procedure (if necessary), and seeding may be done only once at the convenience of the Contractor. Any additional move-in required will not be paid for separately as the cost thereof shall be absorbed in the Contract unit price for seeding, fertilizing and mulching.

It is necessary, insofar as practicable and feasible, as determined by the Engineer, that the seedbed surface, at the time of application of seeds, not be excessively wet, snow-covered, or frozen and be reasonably free of large lumps, clods, and impervious crusts of dirt; that there be no appreciable areas of loose soils which can feasibly be compacted; that the surface, to a depth of approximately 4", not be so tightly compacted that seed cannot begin growth. The Contractor shall treat such areas, as required by the Engineer, to attain, as nearly as practicable, the condition described.

If seeding is hampered due to standing vegetation, the vegetation shall then be mowed and left lay after seeding. Mowing shall be done, where terrain permits, with equipment using a cutting blade which rotates in a plane parallel to the ground. Whether alive or dead, the vegetation shall be removed if it will prevent good seeding practice.

Excessively tight or compacted soils shall be loosened to the minimum depth of 4 inches. Discing, harrowing, or tilling shall be done at right angles to the natural flow of water on the slopes, unless otherwise approved by the Engineer. Compaction of the soil when required shall be performed by equipment which will produce a uniform rough textured surface ready for seeding and mulching. Compacting of loose soils may be required by the Engineer.

Existing structures and facilities shall be adequately protected and any damage done by the Contractor shall be repaired or adjusted to the satisfaction of the Engineer.

B. APPLICATION OF FERTILIZER. Fertilizer shall be applied to the accepted seedbed surface at the rate as specified in the Special Provisions. Mechanical or hydraulic methods of application are acceptable so long as a uniform application at the specified rate is accomplished. Fertilizer shall not be applied within 5 days of the time of spoils material lime application if no topsoil covers spoils material. Fertilizer shall be applied prior to seeding. The application method is subject to approval by the Engineer.

The fertilizer shall be incorporated into the soil by discing, raking, or shallow plowing to the full depth of the topsoil or to a maximum depth of 6 inches, whichever is less. Exceptions will be made for seed drills that are capable of incorporating fertilizer and seed directly into the seedbed. In no instance shall subsoil be incorporated into the seedbed as a result of this operation. Fertilizer shall be incorporated with equipment operated at right angles to the slope of the land.

If the Contractor is required to perform the Summer Erosion Control Procedure, fertilization will be completed at the time of permanent seeding. The application methods and methods for incorporating the fertilizer into the seedbed shall be specified herein.

C. SEED DISTRIBUTION

1. General. Seed shall be applied to the conditioned seedbed no longer than 48 hours after the seedbed has been conditioned. The method of seeding will be as called for in the Special Provisions.

Broadcast or hydraulic seeding methods shall not be used during adverse weather as determined by the Engineer.

The applied seed, regardless of the method of application, shall not be covered by a soil thickness greater than ½ inch in depth.

The basic rate of seed application will be described in the Special Provisions.

2. Seeding by Drill. Seeding equipment used for applying grass seed must be designed, modified or equipped to regulate the application rate and planting depth of grass seed. If equipment for sowing cover crop seed is not equipped with press wheels, the seed shall be compacted with a cultipacker immediately after the ground has been drilled. Seed must be uniformly distributed in the drill hopper during the drilling operation. Acceptable drills are: custom seeders, furrow drills, disc drills, no till drills or other drills approved by the Owner. All grass establishment equipment shall be operated normal to the slope drainage.

Planting depth shall be regulated by depth bands or coulters. The drill box shall be partitioned by dividers no more than 24 inches apart, in order to provide for more even distribution on sloping areas. A drill shall be no wider than the width of the area over which it is to operate.

The rows of planted seed shall be a maximum of 8 inches apart and shall be at right angles to the natural slopes.

3. Broadcast Seeding. Seeding by hand or mechanical broadcasting will be permitted on areas inaccessible to drills or impractical to seed by other prescribed methods. Broadcast seeding requires the approval of the Engineer.
4. Hydraulic Seeding. Hydraulic seeding equipment may be used. The seeding Special Provisions will indicate which slopes require hydraulic seed coverage. Seed and mulch will be applied in separate and distinct operations except for the following:

When using the hydraulic seeding method, the Contractor must provide 1 pound of wood fiber or organic mulch per each 3 gallons of water in the hydraulic seeder as a cushion against seed damage. The mulch used as a cushion may be part of the total required mulch with the remainder applied after the seed is in place.

When hydraulically applying mulch in a separate operation, the Contractor may mix the seed with the fertilizer if his hydraulic seeding equipment is capable of uniformly mixing water, fertilizer and seed – in that order – and power blowing or spraying the mixture uniformly over the seedbed. THIS OPTION MAY ONLY BE APPLIED ON SLOPES STEEPER THAN 2:1. After blending, the slurry shall be applied to the seedbed within 45 minutes after the seed has been added to the water/fertilizer mixture. If the slurry cannot be applied within the specified 45 minutes, it shall be fortified, at no cost to the Owner, with the correct ratio of seed to the remaining slurry and a new 45-minute time frame established for applying the fortified mixture.

The Contractor will be required to use extension hoses to reach the extremities of slopes.

The Contractor shall remove any equipment tracks on the seedbed prior to final mulching. The Contractor shall use a rake, small harrow, or other acceptable means to remove the tracks.

- D. TRACKING. All seeded and fertilized areas may or may not require tracking as noted in the Special Provisions. Tracking shall be accomplished using a tracked vehicle equipped with grousers sufficient to groove the surface to at least ½ inch. The tracking vehicle shall be operated

so as to completely cover the surface with grouser marks. All grousers marks shall run perpendicular to the natural slopes. The tracking vehicle shall be operated alternatively between forward and reverse on each pass to eliminate damage to the seedbed resulting from 180 degree skid turns.

If the area is seeded by hydraulic methods, tracking of the slopes shall be done at such time when the surface has had sufficient time to dry. The length of time established will be at the discretion of the Engineer.

C. SEEDING DATES

1. Western Seeding Zone. The following counties shall comprise the Western Seeding Zone and seeding shall be permitted from October 15 through May 20.

| | |
|----------|----------|
| Flathead | Mineral |
| Granite | Missoula |
| Lake | Ravalli |
| Lincoln | Sanders |

2. Eastern Seeding Zone. All counties not included in the Western Seeding Zone shall be included within this zone. Seeding shall be permitted from October 15 through April 30.

SUBSECTION 330.00: MULCH

330.01 GENERAL

- A. DESCRIPTION - This work shall consist of covering and processing specified seeded areas with a mulch of the stipulated materials.
- B. SUBMITTALS - The following submittals are required in accordance with the Supplementary Conditions:
 - * Manufacturer's specifications and material content for mulch products.
 - * Manufacturer's recommended application methods and rate.

330.02 MATERIALS

- A. GENERAL - Mulching materials used on the project shall be those stipulated in the Special Provisions or stipulated as items in the Bid Form and described hereafter.
 - 1. On projects which require a specific mulch, that type will be shown on the Bid item, i.e., "Vegetative Mulch" or "Wood Fiber Mulch", and the type specified will be the only type accepted for use.
 - 2. On projects which can be mulched equally well by any one of several types, the Bid item will be "Mulch" and the Special Provisions will specify the types acceptable. The Contractor will have the option of selecting which one of the specified types he will use. However, once selected, only one type of mulch will be used throughout the project.
- B. VEGETATIVE MULCH - This type of mulch material shall be composed of grass hay, wheat straw, rye straw, or barley straw, in that order of preference.
 - 1. Grass Hay. This type of mulch material shall be composed primarily of perennial grasses at least 10 inches. The grass hay mulch shall contain greater than 70% grass by weight and shall not contain greater than 10% alfalfa, crested wheatgrass or yellow sweet clover. Grass hay is subject to the Engineer's approval and must be "Montana Noxious Weed Seed Free Hay" provided by a certified supplier.
 - 2. Straw. This type of mulch material shall be clean grain straw, at least 10 inches, shall be "Montana Noxious Weed Seed Free" straw and shall not contain greater than 5% cereal seed by weight, i.e., seed heads. Written confirmation from a certified supplier will be required.

Chopped or ground material is not acceptable. The mulch material is not acceptable if it is musty, moldy or rotted, or if it contains seedbearing stalks of noxious weeds. It shall be free of stones, dirt, roots, stumps or other foreign material.

- C. FABRICATED MULCH - Fabricated mulch acceptable to the Owner shall be made of jute, burlap or kraft paper string. It shall be a material made and commonly used for the purpose of preventing erosion of soil surfaces.
- D. FABRICATED NETTING - Fabricated netting shall be made up of jute, burlap, kraft paper string or similar products. It may be made up on the project or prefabricated. The material must be approved prior to use, and if required, samples submitted. It shall be installed as determined by the Engineer.
- E. WOOD FIBER MULCH - Wood fiber mulch shall consist of specially prepared wood fibers and

shall be processed in such a manner that it will not contain any growth or germination inhibiting factors. Fiber shall not be produced from recycled material such as sawdust, paper, cardboard, or residue from pulp and paper plants. The fiber shall be dyed an appropriate color to facilitate visual metering during application. The mulch shall be of such a consistency that after being combined in a slurry tank with water and other approved additives, the fibers in the material will be uniformly suspended to form a homogeneous slurry. During application the material shall produce a mat-like net covering the grass seed. Wood fiber shall be supplied in packages. Each package shall be marked by the manufacturer to show the air-dry weight content. All mulch material must be acceptable to the Owner. If requested by the Owner, the Contractor shall submit a signed statement certifying that the material furnished has been laboratory and field tested and that it meets requirements and intents specified. Wood fiber mulch shall be as manufactured by Weyerhaeuser Company or approved equal.

- F. PAPER FIBER MULCH - Paper fiber mulch shall consist of waste paper, containing at a minimum 85% by weight cellulose fiber. The material may not contain any germination- or growth-inhibiting factors nor particles of metal, plastic, or non-biodegradable materials. Organic matter (oven dry) as determined by ASTM D-586 shall be at least 95%, and pH range shall be between 5.5 and 7.5.

The fiber must be dyed with a non-toxic green tracer or non-toxic green dye may be added when slurring with water. When slurried with water and fertilizer, the mulch shall remain in uniform, homogeneous suspension while agitated.

When applied by hydraulic means to the ground surface, the paper fiber mulch must form a strong moisture-retaining mat capable of holding seed in contact with the soil without smothering the seed.

Mulch must be supplied (dry) in individual packages, each clearly marked to show the air-dry weight and contents. In the packaged form, mulch moisture cannot exceed 15% by weight.

Paper fiber mulch shall be as manufactured by Thermoguard Co., or approved equal.

- G. ORGANIC MULCH - Organic mulch shall be a neutral pH organic produce formulated from grass/straw by-products, and shall be processed specifically for mulching purposes. Processing shall be in such a manner that the organic mulch not contain stalks or seeds of noxious weeds or grasses, or any growth or germination inhibiting factors. To facilitate visual metering during application, a non-toxic water soluble green colored dye shall be added to the water. The mulch shall be of such a consistency that after being combined in a slurry tank with water, dye and other approved additives, the mulch material will be uniformly suspended to form a homogeneous slurry. Upon application the material shall produce a mat-like net covering the grass seed. Organic mulch shall be supplied in packages. Each package shall be marked by the manufacturer to show the air-dry weight content. All mulch material must be acceptable to the Owner. If requested by the Owner, the Contractor shall submit a signed statement certifying that the material furnished has been laboratory and field tested and that it meets requirements and intents specified.
- H. TACKIFIER - Tackifier shall be a biodegradable organic formulation processed specifically for the adhesive binding of mulch. The tackifier shall uniformly disperse when mixed with water and not be detrimental to the homogeneous properties of the mulch slurry. Any tackifier which has been moisture damaged or damaged by other means will not be acceptable. Tackifier may be added either during the manufacturing of the mulch or incorporated during mulch application.

Organic soil and mulch tackifier for use in hydraulically planting of grass seeds, flowers, or

woody tree seeds, or stolon, either alone or in combination with fertilizer, wood fiber mulch and other approved additives, shall consist of specifically blended compatible hydrocolloids. Starch-based tackifiers are unacceptable.

The soil and mulch tackifier shall be supplied in easily disposable packages containing 5, 20, or 40 pounds of material having an equilibrium air-dry moisture content at time of manufacture of 8%, plus or minus 2%, with a minimum water-holding capacity of 6 1/2 times by weight of dry material.

The organic soil and mulch tackifier shall have the additional characteristics of hydrating and dispersing in circulating water to form a homogeneous slurry and remain in such a state in the hydraulic mulching unit, or adequate equal, with the specified, or other approved materials.

Soil and mulch tackifier shall be applied at a minimum rate of 40 pounds per acre on slopes 2:1 or flatter, or at 80 pounds per acre, or more on slopes steeper than 2:1, or at manufacturer's recommendations, approved by the Engineer.

When applied, the organic soil and mulch tackifier shall form a loose chain-like protective film, but not a plant inhibiting membrane, which will allow moisture to percolate into the underlying soil, while helping "stick" seeds, fertilizer and other specified materials to the soil surface during germination and initial seedling growth, after which the organic soil and mulch tackifier shall breakdown by microbial action.

330.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - Mulch, when required, must be applied to seeded areas not more than 24 hours after seeding regardless of the type used. The Contractor does not mulch within 24 hours after seeding, the Contractor may be required to re-seed the project at no additional cost to the Owner. Mulch shall not be applied in the presence of free surface water, but may be applied upon damp ground. Mulch shall not be applied to snow-covered ground surfaces.

Mulch shall not be applied to areas having a substantial vegetative growth, such as grasses, weeds and grains. Areas not to be mulched shall be determined by the Engineer. Mulching shall not be done during adverse weather conditions or when wind prevents uniform distribution. Application, if after seeding, shall be in a manner to not seriously disturb the seedbed surface. All roadway structures and facilities shall be protected and kept undamaged from application of bituminous material and other operations. Any such material deposited on such structures or facilities shall be removed, at the expense of the Contractor, to the satisfaction of the Engineer.

Additional mulching may be required in accordance with summer erosion control procedures as noted in the Special Provisions.

The Contractor shall remove any equipment tracks on the seedbed prior to final mulching. The Contractor shall use a rake, small harrow or other acceptable means to remove the tracks.

- B. APPLICATION OF VEGETATIVE MULCH - Vegetative mulch shall be applied after seeding and fertilizing is completed unless otherwise specified in the Special Provisions. The mulch shall be applied in a uniform manner by a mulch spreader, at the rate specified in the Special Provisions or Drawings. The mulch spreader shall be designed specifically for this type of work. The vegetative material shall be fed into the mechanical mulch spreader at an even, uniform rate.

When asphalt or a tackifying agent is used as a binder for vegetative mulch, it shall be applied

at the rate specified in the Special Provisions or Drawings. It shall be evenly distributed over the vegetative material as it emerges from the blower discharge or it may be hydraulically applied directly following mulch application. Uneven distribution, caused by inadequately powered or improperly adjusted equipment, poor workmanship, erratic material feed or discharge, or similar causes within the Contractor's control, shall be corrected. The quantity of asphalt or tackifying agent specified is subject to increase or decrease as determined in the field by the Engineer.

Straw or native hay shall be uniformly spread at the rate specified on the Drawings, or in the Special Provisions. Unless otherwise specified by the Engineer, straw or hay shall be anchored into the seedbed by using a mulch crimper. Straw or hay shall have a minimum length of 10 inches and shall be pliable. If straw breaks during crimping, it shall be sprinkled with water, not soaked, to facilitate placement.

The mulch crimper, specifically designed for this type of work, shall have round, flat (not angled), notched blades of these approximate dimensions: 1/4-inch thick by 18 inches in diameter and spaced 8 inches apart. The crimper shall have sufficient weight to force the vegetative mulch a minimum of 3 inches into the soil and shall be equipped with disc scrapers. Mulch crimping shall be done on all slopes capable of being safely traversed by a tracked vehicle. All mulch crimping shall be done perpendicular to the flowline of the slope.

- C. APPLICATION OF FABRICATED MULCH AND FABRICATED NETTING - Fabricated mulch shall be laid on the areas specified on the Drawings or designated by the Owner and securely fastened to the ground by wire staples, wooden pegs, or other satisfactory devices.
- D. APPLICATION OF WOOD FIBER MULCH, OR ORGANIC MULCH - Wood fiber mulch or organic mulch shall be applied by means of hydraulic equipment which utilizes water as the carrying agent. A continuous agitator action, that keeps the mulching material and approved additives in uniform suspension, must be maintained throughout the distribution cycle. The pump pressure shall be capable of maintaining a continuous non-fluctuating stream of slurry. The slurry distribution lines shall be large enough to prevent stoppage.

The discharge line shall be equipped with a set of hydraulic spray nozzles which will provide an even distribution of the mulch slurry to the seedbed. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow, or other causes.

The Contractor shall start at the top of the slope and work downward. If necessary, he may be required to use extension hoses to reach the extremities of slopes.

- E. FINISHING - Prior to final acceptance of the project, the Contractor shall immediately remulch any area from which the original mulch may have been washed or blown. If the original seedbed and seeding is damaged due to the displacement of the mulching material, the seedbed shall be repaired and reseeded before remulching. The operations described in this paragraph shall be at the Contractor's expense if the damage is due to his negligence.

SUBSECTION 340.00: EROSION CONTROL MAT

340.01 GENERAL

- A. **DESCRIPTION** - This work item shall consist of furnishing, placing, and stapling erosion control mat to the ground surface on the slopes designated by the Engineer and as shown on the Drawings.
- B. **SUBMITTALS** - The Contractor shall provide the following submittals in accordance with the Supplementary Conditions:
 - * One-square-foot sample of each type of mat and sample staple.
 - * Manufacturer's catalog cuts and material specifications for the erosion control mat and staples.
 - * Installation manuals.

340.02 MATERIALS

- A. **EROSION CONTROL MAT** - The erosion control mat shall be curled wood excelsior or straw with photodegradable extruded plastic mesh or woven jute fabric. Erosion control mats shall be furnished in continuous rolls of 30-feet or greater with a minimum width of 4 feet. The erosion control mat shall be as manufactured by North American Green, American Excelsior Company, Belton Industries, or approved equal. Mat type and grade (model) shall be as specified in the Special Provisions.
- B. **STAPLES** - Staples shall be made of wire, 0.091-inch in diameter or greater and have a "U" shape with legs 6 to 8 inches in length and a 1 to 2-inch crown. On slopes steeper than 3:1, staples shall have at least 8 inches legs.

340.03 CONSTRUCTION REQUIREMENTS

- A. **GENERAL** - The area to be covered with the erosion control mat shall be as shown on the Drawings and areas designated by the Engineer. The area to be covered shall be properly prepared, fertilized, seeded, and approved by the Engineer before the mat is applied. Those areas to which the mat is to be applied shall not be mulched unless otherwise specified in the Special Provisions.

Erosion control mat may be placed either perpendicular or normal to the slope and shall be "trenched in" at the uphill end of the mat as shown on the Drawings and according to the manufacturer's recommendations. Additional trenching and backfilling of mat may be required to insure adequate stability. The mat shall be stapled on 2-foot centers in trench bottoms.

When the erosion control mat is unrolled, the finer mesh size side or fiber side of the mat will be placed in contact with the soil (not applicable to woven jute fabric). The mat will not be stretched and will lay loosely on the soil surface to achieve maximum contact with the soil. Mat edges shall be butted snugly against each other and stapled. Ends shall be overlapped, and end joints shall be staggered as recommended by the manufacturer. Staples shall be placed according to manufacturer's recommendations, as shown on the Drawings and additionally as requested by the Engineer. Wire staples shall be driven into the ground for the full length of the legs.

Mat installation, if after seeding, shall be in a manner as to not seriously disturb the seedbed

surface. If the seedbed is seriously disturbed, the Engineer may require re-preparing the seedbed and reseeding at no additional cost to the Owner.

SECTION 400: MINE RECLAMATION

SUBSECTION 410.00: CLOSE MINE OPENINGS

410.01 GENERAL

- A. DESCRIPTION - This work item shall consist of permanently closing all mine openings at the locations shown on the Drawings. Any opening basically in a vertical plane will be considered as a shaft and any open basically in a horizontal plane will be considered as an adit.

Work on a horizontal opening where the riprap material is buried by backfill material will be called "adit closure"; work on a horizontal opening where the riprap material is not buried by backfill material will be called "adit seal". Adit seal closures will be without a soil cement seal unless described otherwise in the Special Provisions or Drawings. Shaft closures will be with or without a concrete plug and/or with riprap as called for on the Drawings or in the Special Provisions.

- C. CONDITIONS - The site conditions vary at each mine opening and the Contractor shall carefully evaluate the amount of work necessary to close each opening.
- C. SUBMITTALS - The Contractor shall provide information on the material to be used for shaft closures per the submittal requirements for those material subsections of these Specifications.

410.02 MATERIALS

- A. RIPRAP – Riprap used to close or seal mine openings shall be hand-laid and random riprap as described in Subsection 530.00, Riprap.
- B. SOIL CEMENT – Soil cement materials for adit seal shall conform to the requirements of Subsection 341.00, Soil – Cement Embankment. Backing materials used to form the backing for the soil cement seal shall be mine spoils or other material approved by the Engineer.
- C. OTHER BACKFILL MATERIALS – All other suitable materials adjacent to the mine openings shall be used as backfill material, but this material shall not interfere with the placement of the riprap closure. Materials below adits shall be pushed up into the openings insofar as possible.
- D. CONCRETE SHAFT PLUG – Concrete for constructing a concrete shaft plug shall be Type C-3000 as defined in Subsection 710.00, Structural Concrete.

410.03 CONSTRUCTION REQUIREMENTS

- A. SITE PREPARATION – All exposed timbers, ties, brush, trees, trash, and other combustible materials found in the mine opening work area shall be disposed of as specified in Subsection 502, Debris and Structure Removal. In no case will such materials be placed within the mine opening or in the mine.

Metal, steel pipe, rails, concrete, and other like structural material found in the mine opening shall be broken down and buried in the opening or removed in accordance with Subsection 502.00, Debris and Structure Removal.

Adits shall be opened with a backhoe or other suitable equipment to a point where the depth of the roof over the opening is a minimum of 5 feet thick for an adit closure and 3 feet thick for an adit seal.

Entrance preparation for soil-cemented adit seals will involve removal of loose disturbed material in the area where the seal will be placed and as shown on the Drawings. It will consist of prying loose rock from the roof and sidewalls as well as cleanup of all materials on the floor down to undisturbed soil or rock.

Any portion of an entrance structure that would be exposed after the closure and reclamation of the opening shall be removed to a minimum of 1 foot below the finished ground surface. The limits of the closure work shall be determined by the Engineer prior to commencing with the closure work.

- B. TOPSOIL SALVAGE – All topsoil and other suitable surface soil shall be salvaged from any area to be disturbed by the closure work. Such materials shall be stockpiled or directly place on areas of completed and accepted work specified in Subsection 310.00, Cover Soil.
- C. DRAINAGE – Any mine opening discharging water will require construction of a drainage facility. Details of such facilities are shown on the Drawings.
- D. ADIT CLOSURE – Riprap shall be placed inside and around the adit to provide a permanent and complete blockage of the adit opening as shown on Standard Drawing 410.01, Adit or Exposed Drift Closure. A permanent and complete blockage of the adit opening is considered as filling all of the void space for 3 feet into the adit measured along the roof. This closure may require hand placement of riprap to insure that all of the void space to the top of the adit is filled. The adit cuts or trenches into which the adits open shall be backfilled. The resultant adit closure shall approximately restore the original contour of the ground or produce a contour that will merge with the contour of the adjoined land. Final grading shall result in positive drainage of all surfaces.

E. ADIT SEALS

- 1. Riprap Seal. Riprap shall be placed inside and around the adit in such a way as to provide a permanent and complete blockage of the adit opening as shown on Standard Drawing 410.02, Adit or Exposed Drift Riprap Seal. A permanent and complete blockage of the adit opening is considered as filling of all of the void spaces for 10 feet into the adit measured along the roof. This closure may require hand placement of riprap to insure that all of the void space from the floor to the roof is filled.
- 2. Soil-Cement Seal. After entrance preparation and placement of compacted soil backing, the seal will be placed as shown on the Drawings. The face of the spoil backing shall be thoroughly wetted prior to placing of soil cement.

The soil cement shall be mixed and pneumatically placed in accordance with Subsection 341.00, Soil-Cement Embankment.

The mixture shall be blown against the compacted backing, roof, ribs, and sill and built up to the thickness shown in the Drawings and Special Provisions. The front face shall be shaped to conform to the roof, ribs, and sill at the portal of the adit.

The exposed surface of the soil cement shall be sprayed with curing compound immediately upon completing the placement of the seal.

- F. SHAFT CLOSURE – Shafts shall be backfilled with approved materials in such a way as to provide a permanent and complete blockage of the shaft as shown on Standard Drawing 410.03, Shaft Closure. Complete blockage of the shaft is achieved by filling the entire area across the shaft and the drift below the shaft which is necessary to support backfill. The

material shall be placed to prevent future sloughing from the shaft into the drift. Material conforming to the Random Riprap specification in Subsection 530.00, Riprap, is recommended, but other materials will be considered. Riprap backfill will be required when water is found in the shaft. No materials shall be placed in the shaft that are so large as to cause premature plugging.

Shaft flushing with water may be required by the Special Provisions and as described in Section 424.00, Water Injection and Flooding.

For concrete shaft plug closures, the 2 feet just below the concrete slab shall be moisture conditioned and compacted to obtain a density equal to or greater than the density of the undisturbed shaft walls. The concrete plug shall be placed only after the Engineer has approved the compacted backfill in the shaft. Backfilling of the shaft above the concrete plug shall not be undertaken until a minimum of 7 days have elapsed following the placement of the concrete.

Mounding of backfill material above the surrounding ground will be required as detailed on Standard Drawing 410.04, Typical Shaft with Concrete Closure. Materials used to construct the mound shall be compacted by operating construction equipment uniformly over the shaft. Final grading shall result in positive drainage of all surfaces.

- G. TOPSOIL REPLACEMENT – After all other operations are completed and accepted by the Engineer, all available topsoil previously salvaged shall be spread uniformly over the disturbed areas and left with a rough surface texture without depressions where water will collect. The entire area shall be cleaned of all surface debris and left with a neat appearance.

SUBSECTION 430.00: SUBSIDENCE GRADING AND/OR BACKFILLING

430.01 GENERAL

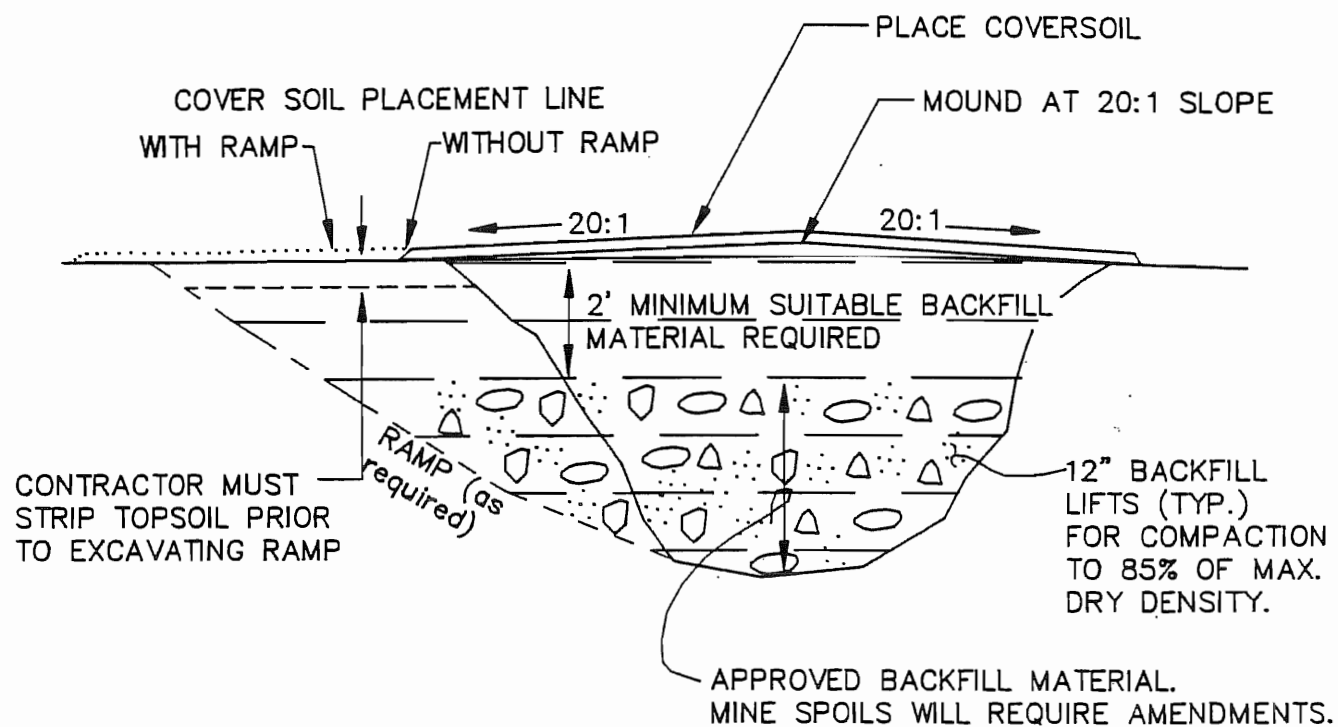
- A. DESCRIPTION - Work on subsidence features shall consist of grading and/or backfilling as described in the Special Provisions or as shown on the Drawings and Standard Drawing 430.01.
1. Subsidence Grading. This work shall consist of grading the designated subsidence areas to provide: 1) positive drainage, 2) slopes with a maximum gradient of 1.5:1, and 3) a more natural surface appearance by blending with adjacent contours.
 2. Subsidence Backfilling. This work shall consist of backfilling existing subsidence holes and other surface depressions as shown on the Drawings. Additional subsidence holes found during the course of the construction project and not shown on the Drawings may also be required to be backfilled as designated by the Engineer. Watering may be required to achieve required compaction.
- B. CONDITIONS - Subsidence features usually indicate collapse of underground mine workings.

430.02 MATERIALS

Subsidence grading materials shall be excavated from within the designated subsidence grading area. Subsidence backfill materials shall be excavated from the designated borrow areas or mining waste piles as shown on the Drawings or as designated by the Engineer. The Contractor shall excavate and place in subsidence areas any and all materials encountered subject to the discretion of the Engineer.

430.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - Subsidence grading and backfilling shall conform to Subsection 202, Excavation and Embankment, and Subsection 502, Debris and Structure Removal. Prior to grading and backfilling, the Contractor shall attempt to induce additional subsidence by partial excavation within and around the perimeter of the subsidence hole.
- B. TOPSOIL SALVAGE - All topsoil and other suitable surface soil shall be salvaged from any area to be disturbed by the closure work. Such materials shall be stockpiled or directly placed on areas of completed and accepted work specified in Subsection 310.00, Cover Soil.
- C. COVER SOIL REPLACEMENT - After all other operations are completed and accepted by the Engineer, all available topsoil previously salvaged shall be spread uniformly over the disturbed areas and left with a rough surface texture without depressions where water will collect. The entire area shall be cleaned of all surface debris and left with a neat appearance.



STATE OF MONTANA
DEPARTMENT OF STATE LANDS

**TYPICAL SUBSIDENCE
BACKFILL DETAIL**

DRAWING No. 430.01

SECTION 500: MISCELLANEOUS SITEWORK

SUBSECTION 501.00: MOBILIZATION

501.01 GENERAL

Mobilization shall consist of preparatory work and operations performed by the Contractor, including, but not limited to, those necessary for the transportation and movement of personnel, equipment, supplies, and incidentals to the project site; for necessary permits; for the establishment of all offices and other facilities necessary for work on the project; for premium on contract bonds, unless a lump sum bid item for contract bond is included in the contract; for insurance for the contract; and for other work and operations that must be performed or costs incurred before beginning work on the various items on the project site. Mobilization costs for subcontracted work shall be considered to be included.

501.02 MATERIALS

As part of mobilization, the Contractor shall provide a safe storage area for material intended for the work until it has been incorporated in the completed project.

501.03 CONSTRUCTION REQUIREMENTS

Not applicable.

501.04 ADDITIONAL MOBILIZATION

Should additional equipment, personnel or materials be requested by the Owner or Engineer which are not included in the Bid Documents, the cost of any additional mobilization shall be negotiated between the Contractor and Owner before any additional mobilization is made.

SUBSECTION 502.00: DEBRIS AND STRUCTURE REMOVAL

502.01 GENERAL

- A. DESCRIPTION - This work shall consist of the disposal of all debris and trash specifically including that from previous mining operations as designated on the Drawings and by the Engineer and the disposal of this debris in designated areas. Debris shall be defined as but not limited to the remains of any manmade objects found within the project limits. Debris removal shall also include the demolition and disposal of existing structures as indicated on the Drawings or designated by the Engineer. Structures shall be defined as but not limited to buildings, foundations, fences, abandoned pipe lines, vent pipes, utility facilities, etc. within the project limits.

Some structures may be required to remain completely undisturbed for historical reasons. Such structures will be designated on the Drawings or by the Engineer.

- B. SUBMITTALS - The following submittals are required in accordance with the Supplementary Conditions:

- * Location of disposal or burning area.
- * Authorized burn permits when burning is used.

502.02 MATERIALS

- A. COVER MATERIAL - Materials used for cover of debris in embankments or subsidence holes shall be as described in Subsection 220.00, Waste Pile Disposal.

502.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - The Contractor shall gather and dispose of all debris, trash, and structures as specified herein. Disposal may consist of burial, burning, salvaging or off-site disposal of debris, trash, and structures.
- B. BURIAL - All non-biodegradable materials such as but not limited to wire, rails, scrap metal, concrete, discarded appliances and vehicles, glass, etc. may be placed in the areas of deepest fill in embankment or subsidence holes as designated by the Engineer, providing the finished work will result in a minimum of 2 feet of cover with suitable backfill material. Crushing of these materials may be required before placing in the burial site.

Burial of large amounts of combustible materials on-site will not be allowed. Burial of small amounts of combustible materials is at the discretion of the Engineer.

- C. BURNING - All combustible materials such as, but not limited to, trees, brush, trash, planks, wooden ties, timbers, etc. may be burned on the project site. Burning of materials will be allowed when authorized in writing by the proper fire and air pollution control authorities, provided that all requirements set forth by such authorities are met. Burning of materials will be allowed only if such burning operations can be performed without damage to on-site or adjacent properties. Proposed burning locations must also be approved in writing by the Engineer prior to burning any materials. Burning will not be allowed in adit cuts or subsidence areas where there exists potential for igniting coal or spoils material.

The Contractor shall maintain adequate fire-fighting equipment at the site at all times during any burning. Shovels, rakes, and a water truck equipped with a pump shall be included in the

fire-fighting equipment. The Contractor may be required to demonstrate the fire-fighting water pump prior to any burning.

Fires shall be guarded at all times and shall be under constant surveillance until completely extinguished.

The Contractor shall be fully responsible for any damages incurred as a result of any burning operations. A copy of all required permits shall be furnished to the Engineer prior to the start of any burning operations.

- D. SALVAGING - The Owner reserves the right to salvage any mining artifacts, historically significant materials, or other materials discovered at the site. The Contractor shall coordinate with the Engineer for the salvage of such material. Any other salvage not designated by the Owner shall become the property of the Contractor and must be removed from the site or disposed of as specified herein.

All materials denoted to be salvaged shall be carefully moved and stockpiled in the areas designated. All salvaged materials shall be in sections or pieces that can be readily transported. Timber and other wood components shall be neatly stacked on skids. Salvaged materials are not to be used by the Contractor in the course of his work.

- E. OFF-SITE DISPOSAL - Any materials which cannot be gathered and disposed of on site by burial, burning or salvaging shall be hauled and disposed of at an approved legal off-site disposal area at no additional cost to the Owner.

SUBSECTION 530.00: RIPRAP

530.01 GENERAL

- A. **DESCRIPTION** - This work item shall consist of furnishing and placing suitable riprap material in areas designated on the Drawings and in the Special Provisions. Riprap shall be obtained off-site unless otherwise indicated on the Drawings, and it shall be the responsibility of the Contractor to locate a suitable material source.

Riprap shall consist of a revetment composed of stone or fragmented rock placed as a protective and erosion-resistant covering on the slopes of embankments, dikes, channels, or streambanks, at culvert inlets and outlets, on bottoms and side slopes of channels, at abutment wings, at structure foundations, around and in mine openings, and in accordance with the lines, grades, and thicknesses shown on the Drawings or established by the Engineer.

- B. **SUBMITTALS** - The following submittals are required in accordance with the Supplementary Conditions:

- * Gradation (by size and weight) and specific gravity for riprap materials.
- * Samples of stone shall be taken in the presence of the Engineer.
- * Riprap source location.

530.02 MATERIALS

- A. **GENERAL** - Stone shall be hard, durable, angular in shape, resistant to weathering and to water action, free from overburden, spoil, shale, structural defects, and organic material, and shall meet the gradation requirements for the class specified. Neither breadth nor thickness of a single stone shall be less than one-third its length. Rounded stone or boulders from a stream bed source will not be accepted. Shale or stone with shale seams is not acceptable. Any stone to be placed in acidic drainages shall be tested by the Contractor with concentrated sulfuric acid and proven non-carbonaceous (non-reactive).
- B. **HAND-LAID RIPRAP** - In the case of hand-laid riprap, each stone or fragment shall not be less than 3 inches thick or contain less than 1/2 cubic foot in volume or weight less than 75 pounds, except for rock spalls. All stones and fragments shall extend through the revetment, with the exception of spalls used to chock the larger stones solidly in position and to substantially fill voids between the major stones.
- C. **RANDOM RIPRAP** - Gradation of random riprap shall be:

| Weight of Stone (lb) | Equivalent Spherical Dia.*(ft) | Percent of Total Weight Smaller than Given Size |
|-------------------------|-----------------------------------|----------------------------------------------------|
| 100 | 1.05 | 100 |
| 60 | .88 | 90 - 70 |
| 25 | .66 | 60 - 40 |
| 2 | .27 | 0 - 10 |

* Based on unit weight of 165 lbs/cubic ft.

- D. **BANK PROTECTION RIPRAP** - The type of material used for bank protection riprap shall be as described in the Special Provisions and/or as shown on the Drawings.

The sizes of material for the different types and thicknesses and the range of gradation shall be as follows:

| Type | 1 | 2 | 3 | 4 |
|-------------------------------------|---------|--------|-------|------------------------------|
| Nominal thickness | 24" | 18" | 12" | 6" course gravel |
| Overall thickness including bedding | 30" | 24" | 18" | As specified on the Drawings |
| Largest rock permissible | 1/4 cy | 1/8 cy | 1 cf | 1/8 cf |
| Smallest rock permissible | 1/10 cf | 1 1/2" | 3/16" | |

530.03 CONSTRUCTION REQUIREMENTS

- A. HAND-LAID RIPRAP - A trench of the design and dimensions shown on the Drawings shall be excavated along the toe of the slope to a stable foundation or carried to a point below scour, but in no case less than 2 feet below the toe of the slope. A course consisting of the largest stone shall be placed in the trench. The angle of repose of the material shall not be less than the angle of the slope to be protected.

The stones shall be placed with their beds at right angles to the slope and, so far as practicable, the larger stones shall be used in the lower courses. They shall be laid in close contact so as to break joints and so placed that each stone will rest on the slope of the embankment and not wholly on the stone beneath it. The spaces between the stones shall be filled with smaller stones or fragments and securely rammed into place. Ends of riprap walls shall be keyed into the earth or embankment slopes a minimum of 24 inches from the outer face of the riprap for the full height of the riprap wall. The finished work shall present an even, tight, and reasonable plane surface varying not more than 3 inches from the general contour of the revetment.

Where hand-laid riprap thickness is not shown on the Drawings, it shall be at least 12 inches measured perpendicular to the slope.

- B. RANDOM AND BANK PROTECTION RIPRAP - The stone, graded so the smaller stone is uniformly distributed, shall be handled or dumped on the designated slopes to form the cross section shown on the Drawings and as determined in the field by the Engineer. The rock shall be manipulated by hand or machine methods sufficiently to secure a regular surface and mass stability. Where the thickness of the riprap is not shown on the Drawings, it shall be at least 18 inches measured perpendicular to the slope. Unless otherwise shown, riprap shall extend from 2 feet below the toe of the slope to the elevation shown on the Drawings.

When riprap is specified for placement around pipe openings, special care shall be taken in placing and handling. Manipulation of individual rocks during placement of riprap shall be required as determined by the Engineer. Pipe that is damaged shall be repaired or replaced at no expense to the Owner.

When riprap is used for adit closure, adit seals and shaft closure, the riprap shall be placed in

such a manner as to provide a permanent and complete blockage of the adit opening. If necessary, the adit opening shall be excavated wider to enable the placement of riprap inside the adit itself to provide a stable base for the closure material.

When bank protection riprap is specified, the inclusion of rock spalls or gravel will be required in a quantity not in excess of that required to fill the voids in the material, as determined by the Engineer. A maximum of 5% of earth, sand, or rock material less than 3/16 inch in size will be permitted. If specified, bank protection riprap shall be bedded on a sand-levelling course atop 6 inches of graded gravel (1 1/2 inches maximum). Filter fabric will be required under riprap where shown or specified, and shall be equal to Mirafi 700X.

SUBSECTION 540.00: PROVIDE WATER

540.01 GENERAL

- A. **DESCRIPTION** - This item shall consist of furnishing and applying water required in all compaction work, hydroseeding and mulching, soil-cement, cement, stowing work, injection work, drilling, grouting, fire control, and dust control all in accordance with the requirements of these Specifications. Unless otherwise specified in the Proposal and Special Provisions, water used in any work will not be measured or paid for but will be considered incidental to and included in payment for other items of the Contract.

540.02 MATERIALS

Water shall be reasonably clean and free from acid, oil, alkali, or vegetable substances and shall not be brackish or salty. The Contractor shall be responsible for obtaining any necessary water rights, permits, and for payment of any royalty costs on the water provided. The source of water to be used shall be indicated to the Engineer prior to use.

540.03 CONSTRUCTION REQUIREMENTS

Water, when required, shall be applied at the locations in the amounts required to properly complete the work. An adequate water supply shall be provided by the Contractor. The equipment used for watering shall be of ample capacity (minimum water holding capacity of 1,000 gallons) and of such design as to assure uniform application of water in the amounts required.

Equipment used for fire control and extinguishing burning waste piles shall be capable of providing a minimum of 100 gpm of water at sufficient pressure to successfully accomplish the work specified. Extension hoses may be required for this work.

In the watering of subgrades and embankments, the Engineer may require the Contractor to apply water in such quantities that the subgrade and embankment shall be compacted at a moisture content in excess of "optimum moisture". When so required, the amount of water required in excess of "optimum moisture" will not be greater than 3%. The Contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition.

The Contractor shall provide watering for dust control during construction and for maintenance of traffic on public roadways and other access roads as required by the Engineer and Air Quality Bureau, Environmental Sciences Division, Montana Department of Health and Environmental Sciences.

SUBSECTION 550.00: TRAFFIC CONTROL

550.00 GENERAL

- A. **DESCRIPTION** - Traffic control shall consist of furnishing, installing, maintaining and relocating necessary traffic signs, barricades, lights, signals, pavement markings, and other traffic control devices necessary to insure the safety of the general public and project personnel. This work shall include flagging for the guidance of traffic through the work zone and the furnishing and application of water for dust control.
- B. **OPERATIONS** - The contractor shall at all times conduct his operations so that there is a minimum interruption in the use of the roads and highways involved.

The contractor shall schedule his operations to keep all roads and streets open to a minimum of one-way traffic during normal working hours during construction. Two-way traffic shall be provided at all times during overnight and weekend periods.

All work shall be done in accordance with the Contract Documents, the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) as published by the U.S. Department of Transportation, the Montana Department of Highways (MDOH) Standard Specifications for Road and Bridge Construction, the Special Provisions, the approved traffic control plan, and as required by the Engineer.

C. **SUBMITTALS**

1. **Traffic Control Plan.** The Contractor shall submit a traffic control plan for any work involving public roadways. All traffic control plans shall be submitted and accepted prior to construction and shall meet the requirements specified herein. The traffic control plan shall include the following as appropriate:

- Itemizing of signing, including: type, size, shape, color, location and MUTCD reference.
- Temporary pavement markings.
- Channelization (cones, barrels, barricades, etc.).
- Flagging, including: personnel numbers, time on location, location.
- Lighting.
- Road closures and time of road closure.
- Special traffic patterns (pilot cars, one-way traffic lanes, detours).
- Signing during non-working hours.

The traffic plan will be subject to review and approval by the Montana Department of Highways for roads under their jurisdiction, by the appropriate county for roads under county jurisdiction, and by any other public entity having jurisdiction over other public roadways (U.S. Forest Service, city, etc.). These approvals will be in addition to that provided by the Engineer in accordance with the Submittals Section. No work may commence until all approvals of the traffic plan have been secured.

550.02 MATERIALS

All traffic control device materials shall be in accordance with MDOH Standard Specifications for Road and Bridge Construction, most current edition.

550.03 CONSTRUCTION REQUIREMENTS

All devices utilized for traffic control shall be in accordance with the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, most current edition.

Before placement of any traffic control for any stage of construction, the Contractor shall have on hand at the project site all traffic control devices required for that construction stage. All traffic control devices necessary for construction shall be properly placed and in operation and approved before any construction is allowed to start. All devices shall be constructed and erected in a workmanlike manner and shall be properly maintained, cleaned, and operated during the entire time they are used. They shall remain in place only as long as they are needed and shall be removed immediately thereafter. Where operations are performed in stages, there shall be in place only those signs that apply to the present stage of construction. Signs that do not apply to the existing conditions shall be covered with opaque material, turned, or removed, so as not to be readable to oncoming traffic.

Construction equipment, vehicles, materials, and debris shall be stored or parked a minimum of 30 feet from the edge of the travelled way or behind guardrail. When it is not feasible to park equipment or store materials a minimum of 30 feet from the edge of the travelled way or behind guardrail, adequate warning devices and protective measures shall be utilized.

All traffic control devices furnished by the Contractor shall remain the property of the Contractor and shall be removed from the project when their use is no longer required. All properly installed traffic control devices shall be replaced by the Contractor when destroyed by traffic.

The Contractor shall schedule his construction operations in a manner which will assure that: 1) the safety and convenience of motorists and pedestrians, and the safety of construction workers, are adequately met at all times; and 2) the project is completed in a manner most beneficial to the project as a whole. Traffic control shall be provided in full compliance with MUTCD during materials hauling and equipment operation or transport along public roadways. No separate payment will be made for traffic control and all costs for traffic control shall be absorbed in other work items included in the Contract bid.

SUBSECTION 563.00: GEOSYNTHETICS

563.01 GENERAL

- A. **DESCRIPTION** – This subsection covers the construction of a geosynthetic lining system as shown on the Drawings and in accordance with the Specifications. The work includes site preparation, furnishing and installing the liner, and any incidental work required.
- B. **SUBMITTALS** – The following information shall be required in accordance with the Supplementary Conditions:
- Shop drawings, including: liner dimensions, mounting details, panel and seam layout.
 - Manufacturer's catalog cuts, product and liner specifications, and liner samples.
 - Manufacturer's certification, installation recommendations, and warranty.
 - Liner seaming methods (factory and field) including cleaning and bonding materials, sealant, methods, and equipment.
 - Shipping, handling, and storage recommendations for uninstalled materials.
 - Name and experience of manufacturer's installation personnel.
 - Schedule of installation activities.
 - Seam testing equipment and methods.
- C. **MANUFACTURER'S QUALIFICATIONS** –
1. **Manufacturer's Experience**. – Geosynthetic liner manufacturers shall have a minimum of 5 years of successful experience in the manufacture and installation of like products.
 2. **Manufacturer's Warranty**. – The geosynthetic liner manufacturer shall provide a Comprehensive warranty on the completed installation. The warranty shall guarantee the system against all defects in materials and workmanship for a period of 5 years from the date of Owner acceptance.

563.02 MATERIALS

- A. **GENERAL** – Geosynthetic liner shall be manufactured from first quality materials that are highly resistant to bacteriological deterioration and certified by the manufacturer as being suitable for the work and as meeting these Specifications. Materials shall be new and the products of recognized, reputable manufacturers. Used, reprocessed, or remanufactured products or materials are not acceptable.
- B. **GEOSYNTHETIC CLAY LINER (GCL)** – The GCL shall consist of natural sodium Bentonite encapsulated between two non-woven polypropylene textiles. For side slopes steeper than 7H:1V, the GCL will be lock-stitched with high strength polypropylene thread to provide internal shear strength reinforcement. The internal shear reinforcing mechanism will resist failure due to thread pull-out over long-term creep situations. The textile will allow sufficient bentonite flow-through such that the permeability of the overlap seams is equal to or less than the permeability of the body of the GCL sheet without the addition of granular or paste bentonite.

The bentonite and textiles used to manufacture the GCL will have with the following properties:

| Property | Units | Test Method | Value |
|-------------------------|-------|-------------|-------|
| BENTONITE | | | |
| Swell Index | MI | ASTM D5890 | 24 |
| Fluid Loss | MI | ASTM D5890 | 18 |
| TEXTILE BACKINGS | | | |
| Weight (non-woven) | oz/sy | ASTM D5261 | 6.0 |

ml = milliliter

oz/sy = once per square yard

The bentonite will be continuously adhered to both geotextiles to ensure that the bentonite will not be displaced during handling, transportation, storage, and installation including cutting, patching and fitting around penetrations.

The final GCL product will have the following properties:

| Property | Units | Test Method | Value | Min. Test Freq. |
|-------------------------------------------------------------------|-------------------------------------|-------------|--------------------|-----------------|
| Bentonite Content @ 0 percent Moisture Content | Lbs./sq.ft. | ASTM D5261 | 0.75 | 1/40,000 sf |
| Grab Strength | Lbs./sq.ft | ASTM D4632 | 150 | 1/200,000sf |
| Peel Strength | Lbs | ASTM D4632 | 15 | 1/40,000sf |
| Index Flux | M ³ /M ² /sec | ASTM D5887 | 1x10 ⁻⁸ | 1/1,000,000sf |
| Permeability under 5psi effective confining pressure | cm/sec | ASTM D5084 | 5x10 ⁻⁹ | 1/1,000,000sf |
| Overlap Seam Permeability under 5psi effective confining pressure | cm/sec | ASTM D5084 | 5x10 ⁻⁹ | 1/1,000,000sf |
| Hydrated Internal Residual Shear Strength | Lbs./sq.ft. | ASTM D5321 | 500 | Periodic |

Lbs=pounds

Cm/sec=centimeters per second

Lbs./sq.ft.=pounds per square foot

M³/m²/sec-cubic meters per square meter per second

Sf=square foot

- C. **BENTONITE GRANULES** – Bentonite will meet the requirements of Subsection 560.02(A) of the Standard Specifications.

| Property | Units | Test Method | Value |
|-------------|-------|-------------|-------|
| Swell Index | MI | ASTM D5890 | 24 |
| Fluid Loss | MI | ASTM D5890 | 18 |

MI=milliliter

- D. **GEOTEXTILE CUSHION** – The geotextile cushion shall be installed directly over the prepared repository subgrade shall be a non-woven, needle-punched geotextile fabricated from polypropylene or polyester resin. Physical properties shall be as follows:

GEOTEXTILE CUSHION PHYSICAL PROPERTIES

| Property | Units | Test Method | Value |
|-----------------------|-------------------------|-------------|---------------|
| Unit Weight | oz/SY | ASTM D3776 | 16 (minimum) |
| Grab Strength | Pounds | ASTM D4632 | 400 (minimum) |
| Puncture Strength | Pounds | ASTM D4833 | 240 (minimum) |
| Trapezoidal Tear | Pounds | ASTM D4533 | 145 (minimum) |
| Apparent Opening Size | US Sieve Number | ASTM D4751 | 100 (minimum) |
| Permittivity | gal/min/ft ² | ASTM D4491 | 50 (minimum) |
| Permeability | cm/sec | ASTM D4491 | 0.2 |
| Thickness | Mils | ASTM D17777 | 115 (minimum) |

- E. **GEOCOMPOSITE** – The geocomposite shall consist of a geonet with a non-woven, needle punched geotextile thermally bonded to both sides. The HPDE drainage net (geonet) will be an integrally formed polyethylene structure. It will have uniform channels, open area, and thickness to ensure uniform flow throughout the surface. The drainage net will be resistant to ultraviolet degradation.

The drainage net will comply with the following properties:

| Property | Units | Test Method | Value |
|------------------------------------|-------------------------------------------------------------------------------------------------------|-------------|-----------------|
| Transmissivity | $10^{-3} \text{m}^2/\text{sec.}$ (@gradient=1.0 and normal stress=4,000 lb/ft ²) | ASTM D4716 | 1 (minimum) |
| Specific Gravity | g/cm ³ | ASTM D1505 | 0.93 9(minimum) |
| Carbon Black Content | Percent | ASTM D4218 | 2 to 3 |
| Thickness @ Strand Intersection | Inches | ASTM D374 | 0.20 |
| Weight | oz./sy | ASTM D3776 | 20 (minimum) |

lb/= pounds per square foot
 m^2/sec =square meters per second
 g/cm^3 -grams per cubic centimeter
 oz/sy=ounces per square yard

The geotextile filter will be a non-woven, needle-punched geotextile fabric from polypropylene or polyester resin. The fabric will comply with Standard Specification Subsection 650.00 for "Drainage Fabric."

Physical properties will be as follows:

| Property | Units | Test Methods | Value |
|------------------------------|-----------------|--------------|---------------|
| Unit Weight | Oz./sy | ASTM D5261 | 4 (minimum) |
| Grab Strength | Lbs | ASTM D4632 | 100 (minimum) |
| Trapezoidal Tear Strength | Lbs | ASTM D4533 | 40 (minimum) |
| Puncture Strength | Lbs | ASTM D4833 | 40 (minimum) |
| Thickness | Mils | ASTM D5199 | 50 (minimum) |
| Apparent Opening Size | US Sieve Number | ASTM D4751 | 70 (maximum) |

oz/sy=ounces per square yard
 lbs=pounds

NOTE: If the geotextile fabric is bonded to a drainage net (geonet), it will be done so in a manner that does not impede the function of either component of the lining system. The method of bonding must be identified by the Manufacturer and approved by Engineer.

The geocomposite materials will be thermally bonded so that the minimum laminate bond strength between the geotextile filter fabric and the geonet is 400 grams per inch, as determined by ASTM F904. The method of bonding must be identified by the

Manufacturer and approved by Engineer. Contractor is encouraged to utilize a geocomposite material, rather than lying separate materials.

563.03 CONSTRUCTION REQUIREMENTS

A. GENERAL

1. Workmen. Geosynthetic installation shall be performed by qualified, adequately supervised workmen.
2. The following requirements apply if more than 10,000 square feet of geosynthetic liner are to be installed at any one location or if required by the Special Provisions.
 - a. Manufacturer's Instructions. No later than the time of geosynthetic liner delivery to the site, manufacturer's complete instructions for handling, storage, assembly, and installation of the geosynthetic liner shall be available to Contractor, Engineer, and Owner.

B. SUBGRADE PREPARATION – The area to be covered with geosynthetic liner shall be allowed to dry until firm enough for equipment to operate without rutting.

The surface to be covered shall be smooth and free of projections greater than $\frac{3}{4}$ -inches that can damage the liner. Organic material, and roots shall be removed. Rock, hard clods, and other such material shall be removed, rolled so as to provide a smooth surface, or covered with a cushion of fine soil. The smoothed graded surface will limit liner bridging to less than 1 inch.

The surface to be covered shall be graded to the lines and dimensions showed on the Drawings. Fill material as required shall be placed to the thickness shown in the Drawings.

C. TERMINAL EDGE ANCHOR TRENCH – An anchor trench shall be excavated and the geosynthetic liner shall be backfilled along the terminal edges of the liner. Anchor trenching and backfilling shall be constructed around the area to be covered according to the manufacturer's recommendations and as shown on the Drawings.

D. GEOSYNTHETIC LINER INSTALLATION

1. General. The geosynthetic liner shall be placed over the surface to be covered in such a manner as to assure minimum handling. Liner installation shall be performed in complete accordance with the installation with the instructions for the manufacturer's instructions and the requirements of the Contract shall be promptly brought to the attention of Engineer in writing prior to commencing the portion of the installation affected. Installation shall be performed in such a manner as to avoid damaging any portion of the liner and shall provide for relief of all unintended residual stresses or folds in the liner at the completion of installation.
2. Field Seams, Patching, and Joints to Structures. All field-constructed seams shall be made in accordance with the manufacturer's recommendations. Sufficient and appropriate adhesive shall be applied to the seams to be jointed, and the two surfaces shall be pressed

together as recommended by the manufacturer. All seam wrinkles shall be smoother and/or repaired by patching. All seam joints shall be tightly bonded.

All patching to the geosynthetic liner shall be of like materials. Any surface showing injury due to scuffing, penetration by foreign objects or distress from rough subgrade shall be replaced or covered and sealed with an additional liner patch of the proper size.

Geosynthetic liner joints to structures shall be cleaned and fastened according to manufacturer's recommendations or as shown on the Drawings.

3. Key Trenches. Key trenches, where specified on the Drawings, shall be installed as shown on the Standard Drawing for Subsection 561.00 of the Standard Specifications.
4. Cover Material. The cover material shall be placed on the geosynthetic liner to the depth specified on the Drawings, without damage to the liner. Engineer shall be present during liner covering. Driving on the liner shall be **NOT** permitted until the liner has been covered with a minimum of 12 inches of cover soil material. Equipment travel on the liner will be kept to a minimum and only tracked vehicles without grousers will be allowed.

Any damage to the liner shall be repaired and the manufacturer's warranty shall take effect after the cover soil has been fully completed.

5. Cleanup. After completion of cover installation, the site shall be thoroughly cleaned of all construction debris, tools and foreign materials.

SECTION 600: PIPED UTILITIES AND DRAINAGE SYSTEM

SUBSECTION 610.00: STORM DRAIN AND CULVERTS

610.01 GENERAL

- A. **DESCRIPTION** - This section covers drainage culverts and storm drains, constructed of corrugated metal, reinforced concrete, and plastic pipe, along with manholes, inlets, and other appurtenances. Pipe material classifications, inlet and manhole types, and coatings or linings shall be as shown on the Drawings and/or listed in the Bid Form.
- B. **SUBMITTALS** - The following submittals are required in accordance with the Supplementary Conditions:
- * Manufacturers' catalog cuts and product specifications for pipe and fittings.
 - * Certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe complies with the applicable specifications.
 - * Layout drawings for manholes, inlets, and structures indicating dimensions and inlet/outlet connections.
 - * Concrete mix design and strength for precast and cast-in-place concrete.
 - * Manufacturers' catalog cuts, dimensional data, materials, and product specifications for manhole steps, rings and covers, grates, joint sealant, and appurtenances.
 - * Manufacturers' installation manuals for pipe and fittings.
- C. **REFERENCE STANDARDS** - All pipe, fittings, manholes, precast concrete structures, and appurtenance shall be manufactured and installed in accordance with all applicable requirements of the most current editions of ASTM, ANSI, and AASHTO.
- D. **PIPE MARKINGS** - All pipe shall be clearly and permanently marked by the manufacturer with type, class, and/or thickness as applicable. Lettering shall be legible at the time of installation.

610.02 MATERIALS

A. **CORRUGATED STEEL PIPE AND PIPE ARCHES**

1. **Pipe and Joints.** Corrugated steel pipe and pipe arches and coupling bands shall meet the requirements of AASHTO M 36 except as modified as follows:

Bands with projections (dimple bands) will be allowed only to join dissimilar ends of pipe and shall be approved by the Engineer.

Pipe with helical corrugations shall be rerolled at the ends to form a minimum of 2 annular corrugations to accommodate the use of annular corrugated locking bands.

Minimum band width shall be 10 1/2 inches for "hugger" type bands and 12 inches for annular type bands.

Lock seam helically corrugated pipe to be used for drain pipe installations shall have the lock seams at the pipe ends welded prior to rerolling to prevent unraveling of the seams.

Pipe with helical corrugations shall have a continuous seam extending from end-to-end of each length of pipe section. Helical seams shall be fabricated in a manner that they will develop the full strength of the pipe and not affect shape or nominal diameter of the pipe. Folded lock seams or ultra-high-frequency resistance butt-welded seams shall be

used. Any damage to the spelter coating shall be cleaned and painted as specified in AASHTO M 35.

When specified "WATERTIGHT", the following additional requirements shall apply:

- a. The pipe supplied may be annular corrugated pipe, lock seam helically corrugated pipe, or welded seam helically corrugated pipe. Annular corrugated pipe shall be close-riveted and soldered or close-riveted and welded. Lock seam helically corrugated pipe shall have the lock seams welded continuous from end-to-end of each pipe section. The welding shall be accomplished prior to rerolling of the ends. All fabrication shall be in accordance with AASHTO M 36.
- b. Field joints shall be constructed to provide watertight connections. The basic connection shall be a minimum 12 inches wide "rod and lug" type band or a 10 1/2 inches wide "hugger" type band. Joints constructed with "rod and lug" type bands shall be gasketed with a minimum 3/8 inch thick by 12 inches wide neoprene gasket. "Hugger" type bands shall be provided with O-ring gaskets. If required, gaskets and/or coupling bands or devices shall require prior approval of the Engineer.
- c. When required, the fabricator shall conduct watertightness tests, in the presence of the Engineer if specified, on the type or types of pipe and coupling devices to be supplied. The test method or procedure shall be submitted to the Engineer for approval prior to any testing. The Engineer may require the fabricator to conduct the tests using a test method or procedure specified by the Engineer.

2. Corrugated Pipe - Coatings. When specified, the following conduits shall meet all the requirements for Corrugated Steel Pipe, as well as the following:

- a. Bituminous Coated Corrugated Steel Pipe and Pipe Arches. These conduits and the coupling bands shall meet the requirements of AASHTO M-190 for the specified sectional dimensions, thickness, and type of bituminous coating.

Type A - Fully Bituminous Coated

Type B - Half Bituminous Coated with Paved Invert

Type C - Fully Bituminous Coated with Paved Invert

Type D - Fully Bituminous Coated and 100% Paved or
Lined Interior

Special sections such as elbows and prefabricated flared end sections shall be fully coated with bituminous material.

- b. Type II Aluminized Corrugated Steel Pipe and Pipe Arches. These conduits and coupling bands shall meet the requirements of AASHTO M-274.
- c. Precoated, Galvanized Corrugated Steel Pipe and Pipe Arches. These conduits and coupling bands shall meet the requirements of AASHTO M-245 and M-246. Coating shall be 0.010 inch (0.25 mm) minimum on both inside and outside surfaces and shall meet the requirements of AASHTO M-246, Section 7.
- d. Asbestos-Bonded, Bituminous Coated Corrugated Steel Pipe and Pipe Arches. These conduits and coupling bands shall meet the requirements of Federal Specification WW-P-405B. Bituminous coating shall comply with "a" above.

3. Corrugated Aluminum Pipe and Pipe Arch. These conduits and coupling bands shall meet the requirements of AASHTO M-196.
- B. POLYVINYL CHLORIDE (PVC) PIPE - PVC pipe used for storm drains or culverts shall meet the material requirements of Subsection 620.00, Sanitary Sewer Mains and Service Connections.
- C. CORRUGATED POLYETHYLENE PIPE - Corrugated polyethylene pipe and fitting shall meet the requirements of AASHTO M252 and M294 and ASTM F667. The pipe and fittings shall be Advanced Drainage System 1201 or equal. Where called for on the Drawings, corrugated polyethylene pipe shall be perforated (slotted) with the manufacturer's standard perforation; field perforating will not be allowed. Pipe shall be furnished in continuous coils of the manufacturer's standard length with joints and/or couplings as recommended by the manufacturer. Fittings shall likewise be of the manufacturer's recommended type for the pipe and shall be constructed of like material to the pipe.
- D. REINFORCED CONCRETE PIPE - Reinforced concrete pipe shall meet the requirements of ASTM C76, and shall be Class 3 unless otherwise noted on the Drawings. Pipe joints shall be either gasketed or ungasketed as noted on the Drawings and/or listed on the Bid Form. Pipe joints for ungasketed applications shall be of the tongue-and-groove design and for gasketed pipe shall be either modified tongue-and-groove or bell- and-spigot. Gasketed pipe shall use a round rubber gasket meeting ASTM C361, and the joint system shall meet ASTM C443. Ungasketed pipe shall likewise be equal to that manufactured by Elk River Concrete. Pipe laying lengths shall be the manufacturer's standard, modified as necessary to meet specific project installation requirements.

Cement for use in manufacturing of concrete pipe shall be Type IIA Modified, Type V, or any other approved cement which contains less than 5% Tricalcium Aluminate. Strength classifications for C14 and/or C76 specification pipe shall be as listed in the Bid Form, Special Provisions, and/or Drawings.

The maximum absorption allowed shall be 7% rather than 8% as stated in the ASTM specification. For pipe sizes smaller than 12 inches in diameter, the proportion of Portland cement in the concrete mixture shall not be less than 6.5 U.S. standard (94 pounds) bags per cubic yard of concrete, and the water cement ratio shall not exceed 6 gallons per sack of cement.

Each pipe shall be marked with gage marks to indicate that the joint has closed properly to a uniform and minimum allowable gap.

- E. MANHOLES AND INLETS
 1. General. The type of manhole, channel, and inlet shall be as specified and indicated on the Drawings and Drawings. Manholes shall be constructed according to the material requirements in Subsection 620.00, Sanitary Sewer Mains and Service Connections.
 2. Inlet Frames and Grates. Cast iron, model as noted on the Drawings.

610.03 CONSTRUCTION REQUIREMENTS

- A. EXCAVATION AND BACKFILL - Excavation and backfill for pipelines shall conform to the applicable portions of Subsection 210.00, Trench Excavation and Backfill.
- B. RESPONSIBILITY FOR MATERIAL - The Contractor shall be responsible for all material

furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling or storage after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.

- C. HANDLING OF PIPE - Pipe, fittings and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the pipe shall be replaced or a repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

- D. LAYING PIPE - All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations. Pipe installation shall be in accordance with the manufacturer's recommendations.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. The Contractor shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.

- E. TOLERANCES - The storm drains and culverts shall be installed within 1/4 inch for grade and shall not be off more than 1/2 inch for alignment.

- F. MANHOLES - Manholes shall be constructed according to the Construction Requirements of Subsection 620, Sanitary Sewer Mains and Service Connections, and Drawings of that section. Inlet structures shall be as shown on the Drawings.

G. TESTS

1. Light Test. After the trench has been backfilled a light test shall be made between the ends of the culverts to check alignment and grade for displacement of pipe. Except for curved alignments shown on the Drawings, the completed pipeline shall be such that a true circle of light can be seen from one end of the culvert to the other end or between adjacent manholes. If alignment or grade is other than specified and displacement of pipe is found, the Contractor shall remedy such defects at his own expense.
2. Leakage Test. Unless specified in the Special Provisions, a leakage test will not be required. However, this does not preclude the fact that obvious and concentrated leaks (such as open joints, pinched gaskets, cracked barrels or bells, etc.) will not be allowed.

SUBSECTION 650.00: CONSTRUCTION FABRIC

650.01 GENERAL

- A. **DESCRIPTION** - This section covers installation of construction fabrics for drainage, silt control or embankment stabilization. Material classifications, location and installation shall be shown on the Drawings and/or listed in the Bid Form.
- B. **SUBMITTALS** - The following submittals are required in accordance with the Supplementary Conditions:
- * Manufacturers' catalog cuts, material, and product specifications for construction fabric.
 - * Certification by the manufacturer of the fabric to be furnished on this project, certifying that the fabric complies with the applicable specifications.
 - * Certified test results for permeability, tensile and burst strength for fabric material.
 - * Certified test results for UV resistance of fabric material.
 - * Manufacturer's installation instructions for seaming and installing fabric.
- C. **REFERENCE STANDARDS** - All fabric shall be manufactured and installed in accordance with all applicable requirements of the most current editions of ASTM, ANSI, and AASHTO.

650.02 MATERIALS

- A. **GENERAL** - Construction fabrics shall be of the type noted on the Bid Form or described on the Drawings or in the Special Provisions. Fabric type will be identified based on appropriateness for the application.
- B. **DRAINAGE FABRIC** - Drainage fabric shall be non-directional (non-woven) designed to allow water passage while retaining soil particles, allowing a water flow rate of at least 250 gpm/sf (clean fabric condition). Thickness shall be at least 50 mils with a minimum weight of 4 oz/sy. Fabric shall be constructed of spun or matted fibers or random orientation. Equivalent U.S. Standard Sieve opening size shall be no greater than 200 per test method COE CW 02215-77. Grab strength per ASTM D-1682-64 shall be at least 100 lb. Drainage fabric shall be equal to Mirafi 140N.
- C. **BANK STABILIZATION FABRIC** - Bank stabilization fabric shall be woven (directional), and designed to provide a filter medium beneath riprap or on slopes to prevent erosion. Thickness shall be at least 16 mils, with a grab strength per ASTM D-1682-64 of at least 300 lb. in each direction. Water flow rate shall be at least 100 gpm/sf. Mullen burst strength (ASTM D-3786-80) shall be a minimum of 500 psi, and puncture strength per ASTM D-3787-80 shall be at least 135 lb. UV radiation stability shall be at least 85% as determined by ASTM G-26/D-1682-64. Bank stabilization fabric shall be equal to Mirafi 700X.
- D. **GRADE STABILIZATION FABRIC** - Grade stabilization fabric shall be woven (directional), and designed to stabilize subgrades for roadways or prevent migration of fines into aggregate courses. Thickness shall be at least 20 mils, with a grab strength per ASTM D-1682-64 of at least 200 lb. Water flow rate shall be at least 30 gpm/sf. Mullen burst strength (ASTM D-3786-80) shall be a minimum of 350 psi, and puncture strength per ASTM D-3787-80 shall be at least 80 lb. UV radiation stability shall be at least 30% as determined by ASTM G-26/D-1682-64. Grade stabilization fabric shall be equal to Mirafi 500X.
- E. **SILT FENCE** - Silt fence shall be a woven (directional) fabric designed for retention of silt in runoff, backed by an industrial netting stitched to the fabric. Fabric shall be furnished in 100

feet continuous rolls of at least 3-foot width. Net backing may be 6 inches less than fabric width. Silt fence shall be suitable for attachment to driven wood or steel posts. Silt fence shall be equal to Mirafi Enviro-Fence 100X.

650.03 CONSTRUCTION REQUIREMENTS

- A. CONSTRUCTION FABRICS - Construction fabrics shall be installed on prepared subgrade surfaces or otherwise installed as shown on the Drawings. The surface receiving the fabric shall be free of excessive irregularities and sharp or pointed rocks or debris that may puncture or tear the fabric. If necessary a sand or soil cushioning course of 2 inches thickness shall be used beneath the fabric at no additional cost to the Owner.

Fabric shall be continuous for the entire width of area shown on the Drawings. End joints shall be lapped at least 3 feet. Fabric shall be folded to form the radius around bends. All tears, holes and other imperfections shall be covered with a patch extending no less than 3' feet in each direction from the imperfection.

- B. SILT FENCE - Silt fence shall be erected by attachment to driven wood or metal posts or other suitable anchors at a maximum spacing of 10 feet. Fence shall be erected to prevent sags that runoff water may overtop. If necessary to prevent sagging, silt fence shall be backed with metal mesh. Joints in silt fence shall be lapped a minimum of 5 feet, and secured against breaching.

SUBSECTION 651: COMPOST FILTER SOX

651.01 GENERAL

- A. DESCRIPTION - This work shall consist of furnishing, installing, and maintaining water permeable compost filter sox for silt control in lieu of silt fence. The filter sox shall be placed on the down slope side of all topsoil storage piles, in the drainage outlets from the site and any other location as shown on the Drawings.
- B. Submittals - The following shall be submitted in accordance with the Supplementary Conditions:
- Manufacturer's catalog cuts, product and materials specifications and material samples.
 - Certified test results for permeability, tensile and burst strength for fabric material.
 - Certified test results for UV resistance of fabric material.
 - Manufacturer's certification of the fabric to be furnished on this project, certifying that the fabric complies with the applicable specifications.
 - Manufacturer's installation instructions for seaming and installing fabric.
- C. Reference STANDARDS - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. All fabric shall be manufactured and installed in accordance with all applicable requirements of the most current editions of ASTM, ANSI, and AASHTO.

651.02 MATERIALS

- A. General - Construction fabrics shall be of the type noted or described on the Drawings or in the Special Provisions. Fabric type will be identified based on appropriateness for application.
- B. Compost Sox Fabric - Compost Filter Sox shall be a 5 mil continuous, tubular, HDPE 3/8" knitted biodegradable mesh netting material, fabric shall be designed for filtration of silt during runoff events. Fabric shall be furnished in 100 feet continuous tubes of a minimum of 8-inches in diameter. Compost Sox fabric shall be suitable for staking with driven wood stakes as shown on the Drawings. Compost Sox fabric shall be equal to Filtrexx Silt Soxx or as approved by the Contracting Officer.
- C. Compost (Organic Matter)

Compost shall meet all requirements specified in Section 308 MANURE and as specified in the Special Provisions ORGANIC AMENDMENT.

650.03 CONSTRUCTION REQUIREMENTS

- A. Construction Fabrics - Construction fabrics shall be installed on prepared subgrade surfaces or otherwise installed as shown on the Drawings. The surface receiving the fabric shall be free of excessive irregularities and sharp or pointed rocks or debris that may puncture or tear the fabric. If necessary a sand or soil cushioning course of two inches thickness shall be used beneath the fabric at no additional cost to OWNER.

Fabric shall be continuous for the entire width of area shown on the Drawings. End joints shall be completed according to manufactures instructions. All tears, holes and other imperfections shall be repaired according to manufactures instructions.

-- END OF SECTION --

SECTION 700: STRUCTURES

SUBSECTION 720.00 STRUCTURAL STEEL AND MISCELLANEOUS METAL

720.01 GENERAL

- A. DESCRIPTION - This section covers the requirements for structural steel, miscellaneous metal fabrications, bolts, and metal accessories.
- B. STANDARDS - Except as otherwise specifically noted on the drawings or specified herein, all materials furnished and work performed in connection with structural steel shall be in conformity with the AISC "Manual of Steel Construction, Eighth Edition". Welded connections shall be in accordance with applicable requirements of the American Welding Society.
- C. SUBMITTALS - The following submittals are required in accordance with the Supplementary Conditions:
- * Material specifications for metals, structural members and metal accessories.
 - * Certification by the manufacturer of structural members and connections to be furnished on this project, certifying that they comply with the applicable specifications.
 - * Layout (erection) drawings for metal fabrications and structural steel indicating dimensions and connections. Field and shop connections shall be distinguished.
 - * Manufacturers' catalog cuts, dimensional data, materials, and product specifications for metal accessories and coatings.
 - * Manufacturers' application instructions for metal coatings.
 - * Structural calculations bearing the seal of a registered professional engineer for structural elements noted as requiring same on the Drawings or Special Provisions.

720.02 MATERIALS

Contractor-furnished structural steel items shall be new and undamaged and shall conform to pertinent AISC and ASTM Standard Specifications and the following requirements:

A. STEEL -

| | |
|-------------------|------------------------------------------------------------------------------------------------------|
| Plates & Shapes | ASTM A36, min. yield of 36 ksi |
| Sheets | ASTM A366 or A569, zinc-coated |
| Pipe | ASTM A120 |
| Bolts & Nuts | ASTM A307, zinc-plated as per ASTM A164, Type GS |
| Self-Locking Nuts | Prevailing torque type; IFI-100, Grade A |
| Flat Washers | ANSI B18.22.1 |
| Lock Washers | Spring type, ANSI B18.21.1 |
| Checkered Plate | Inland "4-Way Floor Plate" or US Steel "Multigrip Floor Plate" |
| Steel Grating | McNichols Co. 1 1/2-inch by 3/16-inch Type SGW-150 or equal; hot-dipped galvanized with edge banding |
| Structural Tubing | ASTM A500 or A501 |

| | |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Welding Electrodes | Low hydrogen type, E70xx electrodes, AWS Specifications |
| B. <u>STAINLESS STEEL</u> - | |
| Plates & Shapes | ASTM A167 |
| Bolts & Nuts | IFI-104, Grade 303 or 305 |
| C. <u>ALUMINUM</u> - | |
| Sheet & Plate | ASTM B209, alloy 6061-T6 |
| Rod & Bar | ASTM B211, alloy 6061-T6 or 2017-T4 |
| Pipe | ASTM B429, alloy 6061-T6 or 6063-T6 |
| Checkered Plate | Alcoa B26 or B85 |
| D. <u>CHAIN</u> - | Galvanized, welded steel, twist-link style, short link pattern |
| | Stainless steel, 3/16 inch or 2/0 min., for railing applications |
| E. <u>EXPANSION ANCHORS</u> - | |
| For Concrete | Fed Spec FF-S-325; wedge type, Group II, Type 4, Class 1 or 2, self-drilling type, Group III, Type 1; or non-drilling type, Group VIII, Type 1 or 2; Phillips, Rawlplug, USM, or Wej-It |
| For Masonry | Fed Spec FF-S-325; lag shield (zinc) type, Group II, Type 1; or split shield type, Group II, Type 3, Class 3, Phillips or Rawlplug |
| F. <u>BIRD SCREEN</u> - | 2 mesh, galvanized steel, min. wire dia. 0.125 inch. |
| G. <u>SPECIALTY ITEMS</u> - | |
| Stainless cable | 2,000 lb. min. stainless steel cable with stainless steel cable clamps of equal strength |
| Galvanized cable | 2,000 lb. min. galvanized steel cable with galvanized steel cable clamps of equal strength |
| Low friction bearing plates | Lubrite Type F or acceptable equal. |
| Metal primer paint | Zinc-Rich rust-inhibitive, Tnemec "77 Chem-Prime", Kopper "No. 10 Inhibitive Primer", or equal |

720.03 CONSTRUCTION REQUIREMENTS

A. STRUCTURAL STEEL FABRICATION -

1. General. Structural steel shall be fabricated in conformity with the dimensions, arrangements, sizes, and weights or thicknesses indicated on the Drawings or stipulated in the Specifications. Framing and connections of all members shall be detailed and fabricated in accordance with AISC Standards, Specifications and Details unless otherwise indicated on the Drawings or specified herein.

All fabricated materials shall conform to the tolerances specified in the AISC Manual and ASTM A46.

All members and other parts of fabricated material, as delivered, shall be free of winds, warps, local deformations, unauthorized splices, or unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked so that proper fit will be provided when the units are assembled in the field. Erection drawings shall be prepared and all separate pieces shall be piece marked as indicated on such drawings. Where required, either by notations on the drawings or by the necessity of proper identification and fitting of field connections, the connections shall be matchmarked.

Structural steel shall be fabricated and assembled in the shop to the greatest extent practicable. Shearing, flame cutting, and chipping shall be done carefully and accurately. Soleplates, fillers, stiffeners, and splice plates shall be neatly fitted and shall not have ragged edges. Holes shall be cut, drilled, or punched at right angles to the surface and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges, and burrs resulting from drilling or reaming operations shall be removed with the proper tool. Deburring will not be required for holes punched in stair stringers to receive stair tread bolts.

Structural steel shall be fabricated to tolerances that will permit field erection within AISC tolerances, except that the displacement of any column center line from the established column line shall be no more than 1 inch at any point in the total height of the column.

The shop portion of beam-to-column connections shall be attached to the beams unless otherwise specified or indicated on the Drawings.

The end connections of all beams connecting to existing steel framing shall be slotted for adjustment and shall be bolted with high strength bolts. Slotted end connections shall be friction type and shall permit adjustment in the horizontal plane of 1 inch from the theoretical dimensions, either toward or away from the existing structure.

Contact surfaces at all column splices and at all other compression joints depending upon contact bearing shall have the bearing surfaces prepared to a common plane by milling, sawing or other acceptable means.

Typical shop beam connections shall be all welded. If shop bolted connections are used, gauges of connections shall be modified to provide adequate clearance for power wrench type bolting tools when the steel is erected. Where slotted beam connections are required, gauges of connections shall be modified to provide for bolting tool clearances. Typical field beam connections shall be with high strength bolts. When a particular connection method (bolting or welding) is specified or detailed for a particular

connection or class of connections, such particular method shall take precedence over the typical connections.

Unless other specified or indicated on the Drawings, both shop and field beam connections shall correspond to the details indicated on Standard Drawing 720.01, Standard Beam Connections.

Where no beam connection detail is indicated on the drawings, the appropriate 2B through 20B connection shall be used.

The gauge of the holes in the outstanding legs shall be 5-1/2 inches unless otherwise required.

All bolts shall be 3/4 inch diameter unless otherwise indicated on the Plan.

High strength bolts shall conform to all requirements for A325 bolts of the "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" including the commentary given therewith, as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, and endorsed by AISC, except as otherwise modified and supplemented herein. The Research Council Specification is dated May 8, 1974, with an errata sheet dated October 22, 1974.

High strength bolted connections shall be bearing type connections with threads permitted in the shear planes except where other type connections are required by the Drawings or Specifications.

Connections of wind bracing and other members subject to stress reversal shall be friction type connections. Contact surfaces of bearing type connections may be painted. Contact surfaces of friction type connections shall not be painted and shall be free of loose scale, dirt, burrs, oil, paint, lacquer, galvanizing and other foreign materials that would prevent solid seating of the parts.

2. Welding. Except as otherwise specified, all welds, welding, and related operations for structural steel shall be in conformity with the applicable provisions of the AWS Structural Welding Code, AWS D1.1-75 and its 1976 revisions, as issued by the American Welding Society.

All welding shall be performed in accordance with written procedures and only the following welding processes will be permitted subject to proper code qualifications.

- * Shielded metal arc
- * Flux cored arc
- * Submerged arc
- * Gas metal arc
- * Electroslag/electro gas

The short circuiting transfer mode of the gas metal arc process shall not be used.

All welds shall be made with the addition of filler metal.

Except as otherwise specified, welding shall be performed using only those joint details which have a prequalified status when performed in accordance with the referenced AWS Code.

All welding procedures and operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of the referenced AWS Code. All procedure qualifications shall be in written form and shall be submitted to the Engineer for review prior to beginning the work. Accurate records of welder and welding operator qualifications shall also be maintained by the Contractor and shall be made available to the Owner upon request.

The use of self-shielded electrodes in the flux cored arc welding process will be permitted only in certain cases with the specific permission of the Engineer. Supplemental shielding of self-shielded electrodes, in the flux cored arc welding process, will be acceptable.

Low hydrogen electrodes shall be stored and handled during use in a manner that will maintain their low hydrogen characteristics.

All welded joints exposed in exterior locations or subject to submergence in any location shall be provided with continuous welds along all contact edges.

Welds that are not dimensioned on the Drawings shall be sized to develop the full strength of the least strength component involved in the connection.

Components to be welded shall be accurately positioned and shall be rigidly secured during welding.

Groove welds shall be terminated at the ends of the joint by use of extension bars or runoff plates. Extension bars and runoff plates shall be removed upon completion and cooling of the weld, and the ends of the weld shall be made smooth and flush with the edges of the abutting parts.

If proposed by the Contractor for use on this project, electroslag and electrogas welding procedures and operators shall be fully qualified under the provisions of the referenced AWS Code. The Engineer will accept properly documented evidence of previous qualification tests. Qualification tests shall be made for this project. Impact tests are required. Documentation for electroslag and electrogas welding procedures, testing, and operator qualifications shall be submitted to the Engineer.

When welding is called for on galvanized surfaces the surface shall first be ground to remove all galvanizing. After welding these surfaces all ground or weld surfaces shall be coated with cold zinc.

3. Shop Painting. All structural steel materials furnished under these specifications, unless specifically exempted, shall be painted with one coat of metal primer paint after shop fabrication and before moving from the fabricating shop or manufacturing plant. Surfaces shall be dry and proper temperature when painted, and free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld spatter, or other objectionable substance.

Cleaned surfaces shall be kept dry and clean and shall be prime coated within 8 hours after cleaning.

All shop paint shall be applied in a skillful manner by acceptable methods which will provide a closely adhering coating of uniform thickness not less in any location than 1-1/2 mils (dry film) or such greater thickness as may be recommended by the paint manufacturer. If spray painting is permitted or allowed, a sufficient number of passes shall be made to build up a uniform coat of acceptable thickness which is free of sags, blisters, and runs. Should materials which have been shop coated, arrive on the job with an inadequate or damaged coating, or a coating which is not free of sags, blisters, and runs or shows evidence of being handled or loaded before the paint has properly set, the Contractor shall be responsible for removing any rust that has formed, cleaning of the surface, and application of an adequate and defect-free coat of the primer paint.

Prepared edges which will be field welded shall not be painted or prepared for painting.

During painting, the ambient temperature shall not be below 50°F. During damp or wet weather all painting shall be done in a dry shelter.

Materials shall not be handled in any manner until the shop paint is dry, hard and able to resist abrasion.

Contact surfaces at friction type high strength bolted field connections shall not be painted.

4. Erection. All materials erected under this section shall be erected in accordance with AISC, the Drawings, approved submittals, and these Specifications.

All parts shall be assembled accurately as indicated on the Drawings and matchmarks shall be carefully followed. Light drifting to draw the parts together will be acceptable, but drifting to match unfair holes will not be acceptable. Any enlargements of holes necessary to make corrections in the field shall be done by reaming with twist drills, care being taken not to weaken the adjoining metal. Enlarging of holes by burning is prohibited. Connections requiring extensive hole enlargements or adjustments, other than provided for by shop fabricated slotted holes, shall be brought immediately to the Engineer's attention. The necessary adjustments shall be made as approved by the Engineer.

All joints shall be assembled and abutted surfaces drawn tightly together and the framework shall be checked for alignment, plumb, and level in accordance with the specified tolerances.

5. Baseplates. Baseplates shall be neatly cut to the proper size. The baseplate top shall be pressed or milled at the bearing surface to provide full bearing to the column.

Plates bent at an angle greater than 90 degrees shall be forged to prevent cracking and reduction in metal thickness.

Baseplates shall be leveled and aligned carefully before they are grouted. Grouting shall be "Embeco 636 Grout" as manufactured by Master Builders Co. of Cleveland, Ohio, or equal. Installation and mixing shall be in accordance with the manufacturer's recommendations.

6. Tolerances. Unless specified otherwise, erection tolerances shall be as specified in the AISC Code of Standard Practice given in the AISC "Manual of Steel Construction, 8th Edition" and as specified under Section 720.03-A, "Structural Steel Fabrication".

The displacement of any column center line from the established column line shall be no more than 1/500 of the column height with a maximum displacement of no more than 1 inch at any point in the total height of any column. The limit of tolerance in column plumbness shall be based on the height from the baseplate to the point being plumbed and shall be measured from the true center line of the column.

7. Field Bolting. The length of high strength bolts installed in field connections shall be determined in accordance with the Research Council Specification and Commentary specified hereinafter. Two types of field bolted connections are required as follows:
- a. Bearing type connections with bolt threads permitted in the shear planes of the connected materials shall be used unless otherwise indicated.
 - b. Friction type connections with uncoated contact surfaces shall be used for connections of vertical and horizontal wind bracing and other members subject to stress reversal. Slotted connections shall also be friction type.

Tightening shall be done using either the calibrated wrench method or the "turn-of-nut" method. All methods, tools, and equipment shall be acceptable to the Engineer. The work shall be done by competent and experienced bolting crews.

If the bolts are tightened by the calibrated wrench method, each impact wrench shall be calibrated at the start of each day's work and at least once during the day. Calibration records showing the serial number of each wrench used shall be submitted weekly to the Engineer. Wrench calibration shall be performed using the same diameter and length of hose and air pressure used during the tightening method, a washer shall be used under the element turned in tightening.

For either method, bolted connections shall be drifted to proper position and the holes inspected to ensure that bolt threads will not be damaged by forcing the bolts in place. Connections shall be tightly drawn together using not less than 25% of the total number of bolts in the completed joint but never less than 2 bolts. Bolts for initial tightening shall be distributed uniformly about the joint. Either fitting-up bolts or high strength bolts may be used for this purpose.

Any ASTM bolt which has been tightened more than one-half turn beyond snugtight shall not be loosened and retightened. All such bolts shall be discarded and new bolts used in their place.

Smooth beveled washers shall be used when the bearing faces of the bolted parts have a slope of 1:20 or greater with respect to a plane normal to the bolt axis.

The tightened bolts shall be checked at random in the presence of the Engineer. Calibrated hand torque wrenches and the necessary platforms, equipment, and personnel shall be provided for the random check.

The torque wrench shall be constructed so that it will visually or audibly indicate when the proper torque is reached. The wrench shall be calibrated to indicate a torque

equivalent to bolt tension of 28,000 pounds for 3/4 inch bolts. The number of bolts checked shall be acceptable to the Engineer based upon the Engineer's observance of the quality and completeness of the tightening operation. A minimum of 10% of the bolts in each connection, but not less than 2 bolts in each connection, shall be checked.

8. Field Welding. Field welding shall conform to the welding requirements specified under "Welding" and to these additional requirements.

Each welding operator shall be qualified for all welding procedures and positions required in a joint that he welds. The entire weld of any structural joint shall be made by one operator.

Each welding operator shall be assigned an identification mark or symbol, and upon completion of a structural weld, the operator shall apply his assigned mark in the parent metal adjacent to the weld.

The Contractor shall provide visual inspection of all welds and shall correct all defective welds in accordance with the requirements of AWS D1.1-75 and its 1976 revisions.

9. Touch-Up Painting. After erection of steel, touch-up paint all abrasions and fasteners. Touch-up with paint using the same material as used for the shop paint.

B. MISCELLANEOUS METAL FABRICATIONS -

1. Connections. All bolts shall be equipped with self-locking nuts or lock washers. Where welding is required or permitted, all butt and miter welds shall be continuous and where exposed to view shall be ground smooth. In addition, intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.
2. Fabrication and Erection. Miscellaneous metal shall be fabricated in conformity with dimensions, arrangement, sizes and weights or thicknesses shown on the Drawings or stipulated in the Specifications.

All members and parts, as delivered and erected, shall be free of winds, warps, local deformations, and unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked so that proper fit will result when the units are assembled in the field. Erection drawings shall be prepared if required, and each separate piece shall be marked as indicated thereon. All field connection materials shall be furnished.

Before assembly, surfaces to be in contact with each other shall be thoroughly cleaned. All parts shall be assembled accurately as shown on the Drawings. Light drifting will be permitted to draw parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills. Enlarging holes by burning is absolutely prohibited.

3. Storage. Miscellaneous metal shall be stored on blocking so that no metal touches the ground and water cannot collect thereon. The material shall be protected against bending under its own weight or superimposed loads.

4. Edge Grinding. Sharp corners shall cut or sheared edges that will be submerged in operation shall be dulled by at least one pass of a power grinder to improve paint or galvanizing adherence.
 5. Galvanizing. All galvanizing shall be done by the hot-dip process after fabrication in conformity with requirements of ASTM A123, A153, and A385.
 6. Dissimilar Metals. Direct contact of dissimilar metals shall be avoided. When necessary, such contact shall be protected with a liberal coating of thixotropic coal tar paint.
- C. CHECKERED FLOOR PLATES - Checkered floor plates shall be painted steel unless specifically designated on the Drawings to be aluminum.

Lifting holes shall be provided in all checkered plates which are not required to be bolted or welded in place. Warped or bent checkered plate shall be shop-straightened so they will lie perfectly flat.

Steel members which support checkered plates shall be hot-dip galvanized after fabrication.

D. GRATING -

1. General. All grating shall be steel. Support angles for grating shall be full-length steel shapes as shown on the Drawings. Where supports are secured to concrete, stainless steel anchor bolts shall be used.

Except as modified herein, grating manufacture, fabrication and installation shall comply with recommendations in the "Metal Bar Grating Manual" of the National Association of Architectural Metal Manufacturers.

2. Fabrication. Grating shall be laid out so that openings are centered on a joint between sections. Cuts in grating shall be sawed or sheared. Cuts shall be clean and smooth without fins, beads, or other projections. Ends of bearing bars in grating floor sections shall be provided with full-depth steel bands 3/16 inch thick.

Grating shall be fabricated in panels that can be easily handled in the future by plant personnel. Unless otherwise shown on the Drawings, panels should not exceed 100 pounds, nor be less than 40 pounds in weight. Panels shall be within 3/16 inch plus or minus of authorized width, and shall have a maximum difference in length of opposite diagonals of 1/4 inch. The spacing of bearing bars shall be within 1/32 inch of authorized spacing. Cross bars of adjacent panels shall align. After installation, there shall be not more than 1/4 inch clearance between panels. All bearing bars shall be parallel.

Grating sections, frames, and support angles including anchor straps shall be hot-dipped galvanized after fabrication.

3. Installation. Grating shall not be damaged during handling and installation.

Grating shall rest unanchored on support angles. All grating shall lie flat with no tendency to rock when installed. Poorly fitting or damaged grating will be rejected.

- E. METAL LADDERS AND GRAB BARS - Metal ladders and grab bars shall be provided where indicated on the Drawings. Ladders shall be fabricated of aluminum shapes as shown. Support

brackets and angles shall likewise be aluminum secured with stainless steel fasteners. All aluminum in contact with concrete shall be liberally coated with thixotropic coal tar on the contacting surface prior to installation.

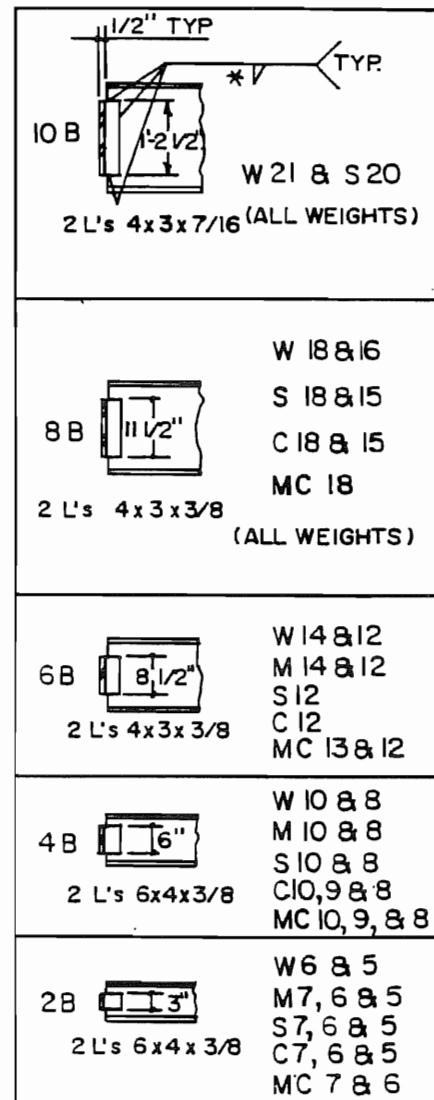
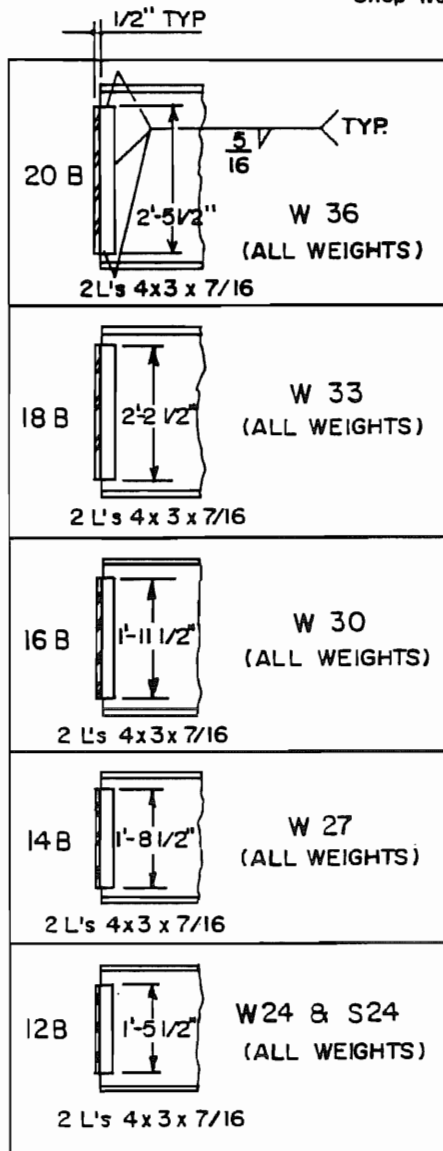
- F. ANCHOR BOLTS - Anchor bolts shall conform to the material requirements for bolts and nuts in this section and to the placement requirements of Section 720.03-A.6. All bolts shall be delivered in time to permit setting when structural concrete is placed. Anchor bolts which are cast-in-place in concrete shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template. Anchor bolts shall be set per Standard Drawing 720.02.

- G. EXPANSION ANCHORS - Expansion anchors shall be installed in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than 4-bolt hole diameters. Minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall be at least 4 1/2 times the diameter of the hole in which the anchor is installed, unless otherwise indicated on the Drawings. The minimum distance between the centers of expansion anchors shall be at least 8 times the diameter of the hole in which the anchors are installed.

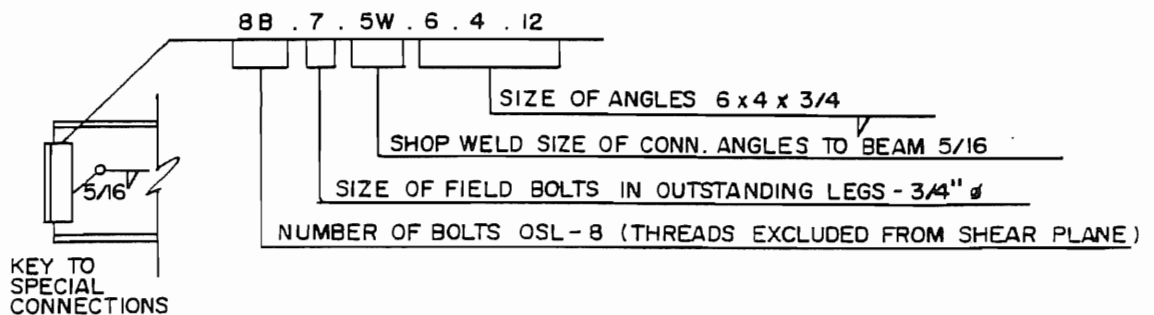
Nuts and washers for expansion anchors shall be as specified for anchor bolts. Expansion anchors shall be zinc-plated steel unless otherwise specified or indicated on the Drawings.

- H. GUARDPOSTS - Guardposts shall be installed in accordance with Standard Drawing 720.03.

NOTE: Standard Beam Connections (Unless
Otherwise Shown on the Plans) Using
Shop Welded Angles & A325 3/4" ϕ Bolts



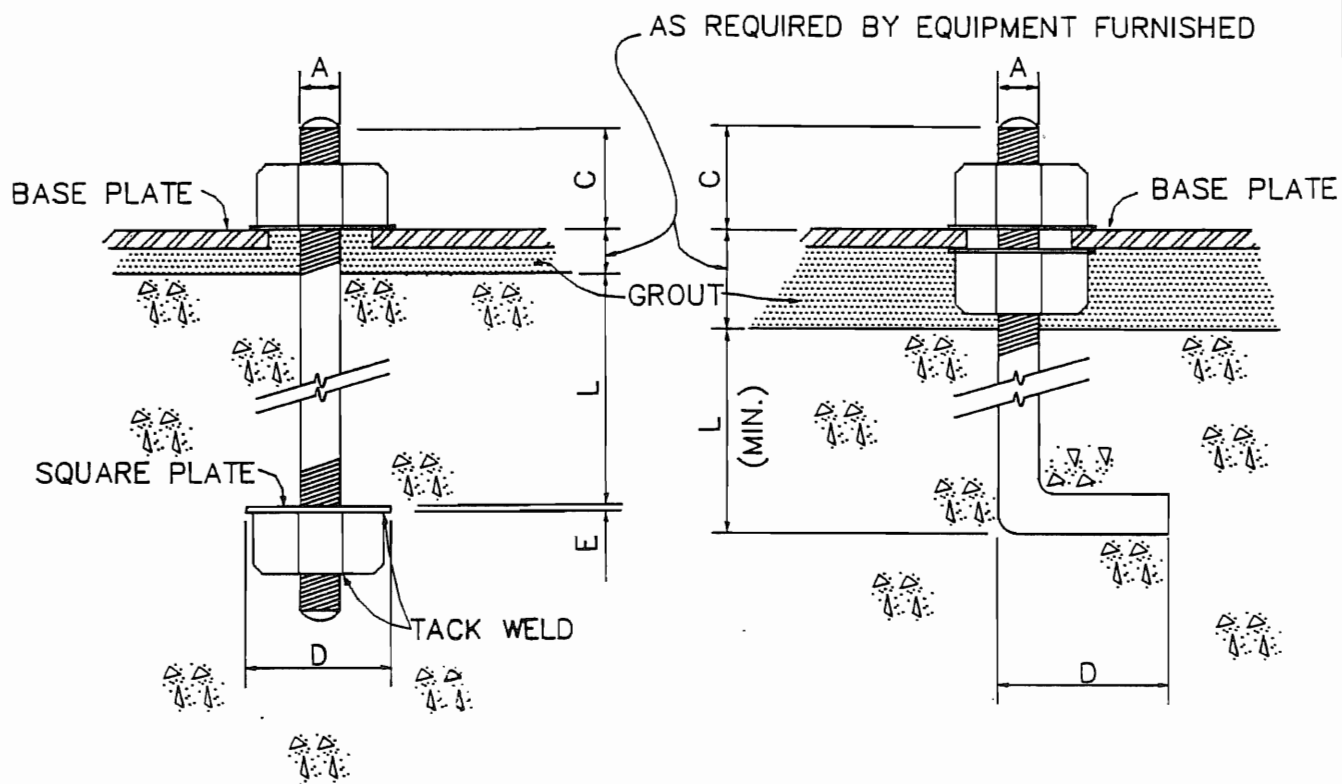
* USE 1/16" FILLET LESS THAN
BEAM WEB THICKNESS 5/16"
MAX., 3/16" MIN.



STATE OF MONTANA
DEPARTMENT OF STATE LAN

Standard Beam
Connections

Dwg. No. 720.01



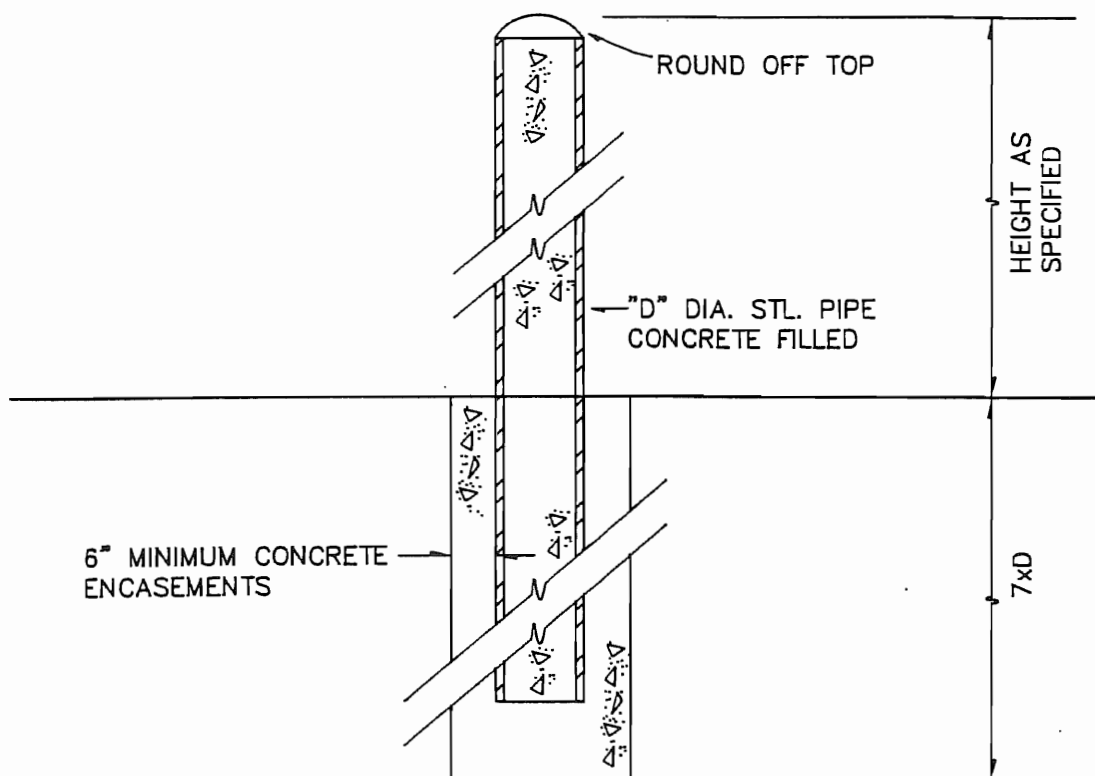
| A | C | D | E | L |
|--------|--------|----|------|-----|
| 3/4" | 1 3/4" | 3" | 3/8" | 6" |
| 7/8" | 2" | 3" | 1/2" | 8" |
| 1" | 2 1/4" | 4" | 1/2" | 8" |
| 1 1/4" | 2 3/4" | 4" | 1/2" | 10" |
| 1 1/2" | 3" | 5" | 3/4" | 12" |

NOTE: PRIOR TO TIGHTENING TOP NUT, COAT
BOLT THREADS WITH SEALANT
(LOC TITE or EQUAL)

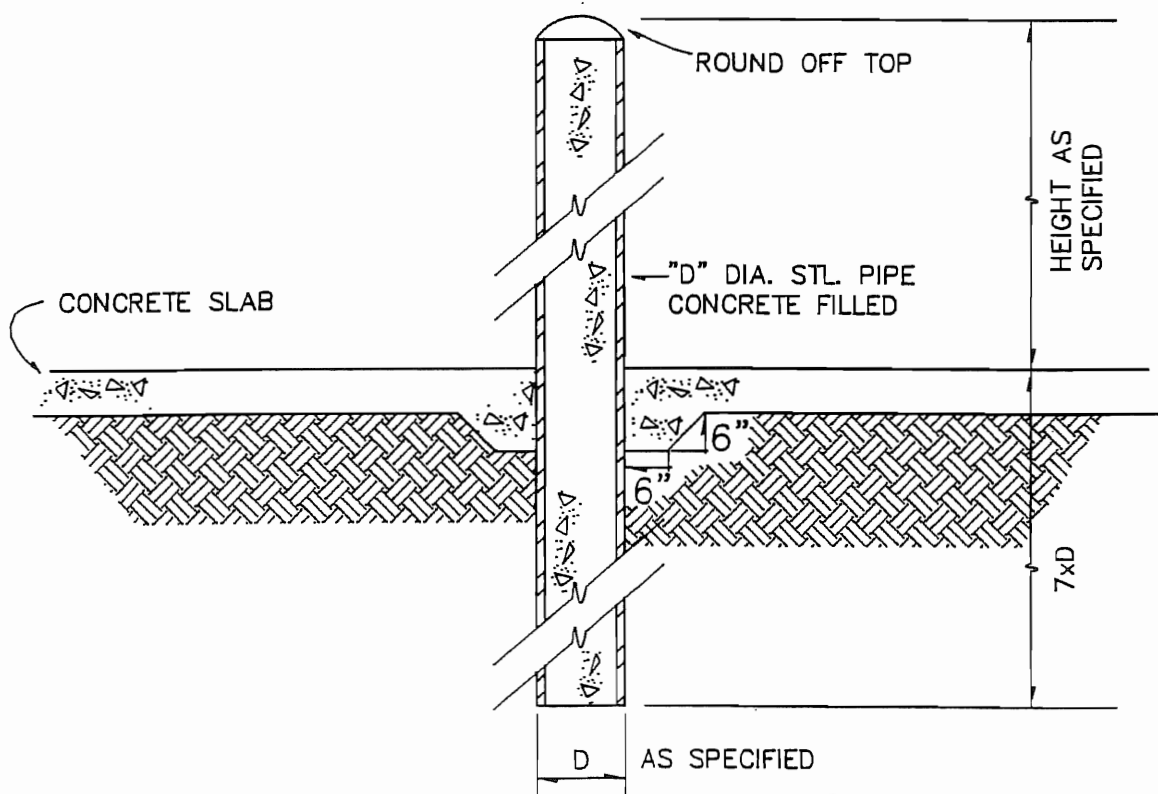
STATE OF MONTANA
DEPARTMENT OF STATE LANDS

TYPICAL ANCHOR BOLT DETAILS

DRAWING No. 720.02



NOTE: MOUNT AS APPLICABLE FOR LOCATION



STATE OF MONTANA
DEPARTMENT OF STATE LANDS

GUARDPOSTS

DRAWING No. 720.03

**SECTION 800: SURFACING – AGGREGATE, BASE COURSE,
AND PAVEMENT**

SUBSECTION 820.00 CRUSHED TOP SURFACING COURSE

820.01 GENERAL

- A. DESCRIPTION - This work shall consist of furnishing and placing one or more aggregate surfacing courses composed of crushed gravel, or stone, or other similar materials meeting the grade or maximum size specified in the Proposal or shown on the Drawings and constructed on the roadway in conformance with these Specifications and the Drawings.
- B. SUBMITTALS - The following submittals are required in accordance with the Supplementary Conditions:
- * Gradation(s) of aggregate materials.
 - * Standard Proctor, including moisture density curve for aggregate materials.
 - * Atterberg Limits and Los Angeles Rattler Test for aggregate materials.
 - * Percentage of aggregate (by weight) having at least one fractured face.
 - * Soundness test results.
- C. REFERENCE STANDARDS - Standard Proctor Density, where referenced herein, shall refer to AASHTO T-99. Other standards shall be as noted herein.

820.02 MATERIALS

- A. GENERAL - The aggregate surfacing material shall meet the applicable requirements of Subsection 830.00, General Requirements for Production, Crushing, and Stockpiling of Aggregates for Surfacing and Asphalt Plant Mixes, of the Standard Specifications.
- B. CRUSHED SURFACING MATERIAL - shall consist of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved by the Engineer, blended with sand, finely crushed stone, crusher screenings, or other similar materials. The completed mixture of aggregates shall be capable of being compacted into a dense and well-bonded base.

The crushed stone or gravel shall consist of hard durable particles or fragments of stone, free from an excess of flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter, and shall have a percent of wear of not more than 45 at 500 revolutions as determined by AASHTO T-96 (Los Angeles Rattler Test).

The method used in production shall be such that the percentage of fractured particles occurring in the finished product shall be as nearly constant and uniform as practicable. The crushing shall result in a product that at least 50% of the material retained on a No. 4 mesh sieve will have at least one fractured face. If necessary to meet this requirement or to eliminate an excess of fine, uncrushed particles, gravel shall be screened before crushing.

Coarse and fine aggregates shall be tested for soundness in accordance with AASHTO T-104. The number of cycles shall be 5, the solution shall be sodium sulphate, and the maximum loss shall not exceed 12%.

All material passing the No. 4 sieve produced in the crushing operation shall be incorporated in the base material unless there is an excessive amount which, if included, would not meet the gradation requirements.

- C. GRADATION - As determined by "Montana Test Method MT-202", the material shall, for the grading specified in the Proposal, including any binder or filler which may have been added at the plant or on the roadway, meet the requirements of that grading in the Table of Gradations:

TABLE OF GRADATIONS

| PERCENTAGE BY WEIGHT PASSING SQUARE MESH SIEVES | | | | | |
|-------------------------------------------------|---------|---------|---------|---------|---------|
| Sieve Size | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 |
| 1" | 100 | | | | |
| 3/4" | --- | 100 | | | |
| 5/8" | --- | --- | 100 | | |
| 1/2" | --- | --- | --- | 100 | |
| 3/8" | --- | --- | --- | --- | 100 |
| No. 4 | 40 - 70 | 40 - 70 | 40 - 70 | 40 - 70 | 50 - 80 |
| No. 10 | 25 - 55 | 25 - 55 | 25 - 55 | 25 - 60 | 35 - 70 |
| No. 200 | 2 - 10 | 2 - 10 | 2 - 10 | 2 - 10 | 2 - 10 |

1. Dust Ratio. The portion passing the No 200 sieve shall not be greater than 2/3 of the portion passing the No. 40 sieve.
2. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve shall not exceed 25 nor shall the plasticity index exceed 6, as determined by AASHTO T-89, T-90, and T-91.
3. The composite aggregate shall be free from adherent films of clay or other matter that will prevent thorough coating with bituminous material. It shall be of such nature that the coating of bituminous material will not slough off upon contact with water.
4. Unless otherwise specified, when the aggregate is to be bituminized, both the material source and the composite aggregate shall not have a swell of more than 10% in 8 days and shall show no cracking or disintegration when tested for volume swell and water absorption by Montana Test Method MT-305.
5. No intermediate sizes for cover aggregate or for other purposes shall be removed from the material in the course of production, unless authorized in writing.

820.03 CONSTRUCTION REQUIREMENTS

- A. GENERAL - Immediately prior to the placing of the top surfacing course, the surface of underlying subgrade, sub-base or base course shall be bladed smooth and shaped to the cross section as shown on the Drawings before the top surfacing course is placed on the roadway. No top surfacing course shall be placed upon wet or muddy subgrade or sub-base course.

The material shall be mixed and placed in horizontal layers of not more than 6 inches loose thickness except as allowed by the Engineer. The depositing and spreading of the material on the prepared subgrade, or on a completed sub-base or base course layer, shall commence at

the point farthest from the point of loading, unless otherwise instructed, and shall progress continuously without breaks. Hauling over the subgrade or over any sub-base or base course completed or in the process of construction, will not be permitted at such times and in such manner as to be detrimental to the subgrade, sub-base, or base course. The material shall be deposited and spread in a uniform layer without segregation of size to such loose depth that when compacted, making due allowance for any filler that is to be blended on the road, the layer will have the required thickness. Spreading shall be from dump boards, spreader boxes, or moving vehicles equipped to distribute the material in a uniform layer, or the material may be deposited in windrows mixed and spread as described below. When more than one layer is required, the construction procedure described shall apply to each layer. Each layer shall be bladed smooth and thoroughly compacted as hereinafter specified before the succeeding layer is placed.

Binder, when required, may be added at the plant or on the roadway. If added on the roadway, the binder shall be spread uniformly across the roadway over the loosely spread surfacing course layer in the amounts determined by the Engineer. It shall then be thoroughly blended and mixed into the surfacing material by approved methods and equipment. Where the depth of the course is 4 inches or less, the binder shall be processed into the entire depth. Where the depth of the course exceeds 4 inches, the binder shall be processed into not less than the upper 4 inches.

If when the above methods are used and improper segregation, moisture, or compaction exists or if the material was deposited on the road in windrows, it shall be thoroughly blade mixed to the full depth of the layer by alternately blading the entire layer to the center and back to the edges of the roadway.

Prior to and during the mixing operations water shall be added to the material in such amounts that the entire mass during mixing is wetted to such an extent as to prevent segregation of fine and coarse materials. The sprinkler or other water spreading device shall be of such type as to provide a uniform distribution of the water without producing any noticeable washing effect upon the surfacing material.

Material placed shall be compacted to the full width by rolling with approved tamping or power rollers. Any irregularities or depressions that develop under rolling shall be corrected by loosening the material in these places and adding or removing material, as the case may require, until the surface is smooth and uniform. Where the next course will be an asphalt base course, or asphalt surface course, the final rolling on the sub-base course shall be made with an approved self-propelled steel wheeled roller.

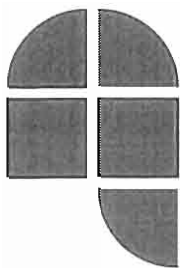
Blading and compacting shall be performed alternately as required to maintain a smooth, even, uniformly compacted surface until the final inspection. Along drop inlets, manholes, and similar structures and at all places not accessible to the roller, the surfacing course material shall be tamped thoroughly with approved mechanical tampers or hand tampers to obtain a density conforming to the compaction requirements.

- B. COMPACTION REQUIREMENTS FOR TOP SURFACING COURSES - The Contractor shall provide watering and rolling as required to obtain a field density of 95% of Standard Proctor Density. Compaction approval is good for 48 hours only. If asphalt surfacing is required and not put down within 48 hours after approval, reapproval of compaction must be obtained before any surfacing operations begin.

- C. SURFACE SMOOTHNESS - The surface of any top surfacing course, when finished, shall be such that when tested with a 10-foot template placed on the surface with its center line parallel to the center line of the roadway, the maximum deviation of the surface from the edge of the straight edge shall no where exceed 3/8 inch. In addition, the finished grade shall not deviate more than 0.05 foot at any point from the staked elevation, and provided further, the sum of the deviations from two points not more than 30 feet apart shall not exceed 0.05 foot.

If asphalt concrete surfacing is to be placed on the aggregate surfacing course, no portion of the completed surface of a top surfacing course shall be more than 1/4 inch below the edge of template 10 feet in length laid parallel to the center line of the roadway. In addition, the finished grade shall not deviate more than 0.02 foot at any point from the staked elevations and provided further, the sum of the deviations from two points not more than 30 feet apart shall not exceed 0.02 foot.

Should patching of the surfacing course be necessary in order to meet such tolerances, it shall be performed using methods and aggregates described herein. Payment for such aggregate used for patching shall be at the unit price bid for the top surfacing course material.



**NORTHWEST LININGS &
GEOTEXTILE PRODUCTS, Inc.**

21000 77th AVE. SOUTH

KENT, WA 98032

253-872-0244

FAX 253-872-0245

www.northwestlinings.com

Standard Geotextile Installation Specifications

ISO 9002 standard

DELIVERY, STORAGE, AND HANDLING

Wrap geotextile in black protective wrap.

Attach durable label to rolls readable on inside of core and outside of roll wrapping, indicating manufacturer, product name or style number, roll and lot number, and roll dimensions.

Deliver, store, and handle rolls in manner to prevent damage.

After unloading, inspect rolls for defects and damage.

Do not leave covered rolls exposed to elements for more than 30 days unless additional heavy-duty waterproof cover is provided.

Store rolls off ground, protected from precipitation, ultraviolet radiation, strong chemicals, sparks and flames, temperatures in excess of 71 degrees C and other environmental condition that could cause damage to geotextile.

Prevent damage to wrappings and geotextile.

PRODUCTS

MANUFACTURERS

Northwest Linings & Geotextile Products, Inc.

Substitutions: Under provisions of Section [01630] [_____].

EXECUTION

PREPARATION

Clear, grub, and excavate installation site to design grade. Remove topsoil, soft soils, and other unsuitable materials.

If moderate site conditions exist, including CBR greater than 2, proofroll with lightweight equipment to locate unsuitable materials.

Backfill pockets where additional excavation is required to promote positive drainage.

Exercise care during stripping operations to prevent excessive disturbance to subgrade. Use lightweight dozers or grade-alls for low-strength, saturated, noncohesive and low cohesive soils.

For extremely soft ground such as peat bog areas, do not over excavate surface materials to take advantage of root mat strength.

If vegetation is present, cut at ground surface and place sawdust or sand over stumps and roots extending above ground surface.

INSTALLATION

After subgrade has been prepared, place geotextile in line with placement of new roadway aggregate.

Do not drag geotextile across subgrade. Place entire roll and roll out smoothly. Remove wrinkles and folds by stretching and staking as required.

Include the first option if the CBR is not known. If the CBR is known, select the correct overlap from the following table, then utilize the second option to specify.

Join parallel rolls of geotextile as follows:

| CBR | Method of Joining |
|---------------|------------------------|
| Over 2 | 300 - 450 mm overlap |
| 1 - 2 | 600 - 900 mm overlap |
| 0.5 - 1 | 900 mm overlap or sewn |
| Less than 0.5 | Sewn |
| All roll ends | 900 overlap mm or sewn |

For very soft subgrades with CBR less than or equal to 1 where the geotextile is to provide reinforcement, include the following to pretension geotextile.

Pretensioning Geotextile:

Proofroll with heavily loaded, rubber-tired vehicle. Wheel load of truck shall be equivalent to maximum expected for site. Vehicle to make at least four passes over first lift in each area of site.

Once design aggregate has been placed, use roadway prior to paving to prestress geotextile-aggregate system in key areas.

If required, staple or pin geotextile at overlaps to maintain position during construction activities. Use 250 to 300 mm long nails placed at minimum 15 m on center for parallel rolls and 1.5 m on center for roll ends.

Do not place overlaps along anticipated primary wheel path locations. Place overlaps at end of rolls in direction of aggregate placement with previous roll on top.

When sewn seams are required, strength of seams shall be greater than or equal to 80 percent of tensile strength of unseamed geotextile as determined by same testing methods.

When placing woven geotextile on curves, fold or cut geotextile and overlap in direction of turn with previous fabric on top. Staple or pin folds in geotextile approximately 0.6 m on center.

When geotextile intersects an existing pavement area, extend geotextile to edge of old system. For widening or intersecting existing roads where geotextiles have been used, anchor geotextile at roadway edge.

Prior to covering, inspect geotextile for excessive damage including holes, rips, and tears.

If excessive defects are observed, repair affected area by placing new layer of geotextile over damaged area.

Extend new layer beyond damaged area the same distance as required for overlap of adjacent rolls.

End-dump base aggregate on previously placed aggregate.

For very soft subgrades, limit pile heights to prevent possible subgrade failure.

Maximum placement thickness for very soft subgrades not to exceed design thickness of road.

Spread and grade first lift of aggregate to 300 mm or to design thickness if less than 300 mm, prior to compaction. Do not allow traffic on soft roadway with less than 200 mm of aggregate over geotextile, except 150 mm for CBR greater than or equal to 3.

Compact first lift of base aggregate by tracking dozer, then compact with smooth-drum vibratory roller to obtain minimum compacted density.

Compaction of permeable bases shall meet specified requirements.

Perform construction parallel to road alignment.

Fill ruts formed during construction to maintain adequate cover over geotextile. Do not blade ruts down.

Place remaining base aggregate in lifts not exceeding 250 mm in loose thickness and compact to specified density.

PROTECTION

Equipment may operate on roadway without aggregate for geotextile installation under permeable bases if subgrade is of sufficient strength.

For extremely soft soils, use lightweight construction vehicles for access on first lift.

Limit construction vehicles in size and weight to limit rutting in initial lift to 75 mm.

If rut depths exceed 75 mm, decrease construction vehicle size or weight or increase lift thickness.

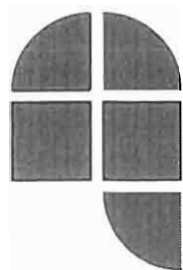
Turning not permitted on first lift of base aggregate. Construct turn-outs at roadway edge to facilitate construction.

FILL PLACEMENT

Fill should be placed directly over the geosynthetic in 20 cm (8 in) to 30 cm (12 in) loose lifts. For very weak subgrades, 45 cm (18 in) lifts or thicker lifts, may be required to stabilize the subgrade, as directed by the Engineer.

Most rubber-tired vehicles can be driven at slow speeds, less than 16 km/h (10 mph) and in straight paths over the exposed geosynthetic without causing damage to the geosynthetic. Sudden braking and sharp turning should be avoided. Tracked construction equipment should not be operated directly upon the geosynthetic. A minimum fill soil thickness of 15cm (6 in) is required prior to operation of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geosynthetic.

Once a stable working platform has been obtained, as determined by the Engineer, fill shall be compacted to 95% of standard Proctor density at a moisture content within + or – 3% of optimum moisture content.



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NORTHWEST LININGS & GEOTEXTILES PRODUCTS, INC.

SPECIFICATIONS

FOR HDPE AND LLDPE CONTAINMENT MEMBRANE

FIELD INSTALLATIONS

NORTHWEST LININGS AND GEOTEXTILES

HDPE/LLDPE-FIELD SPECIFICATIONS AND INSTALLATION

I. INTRODUCTION

- A. This manual describes the Quality Control Procedures utilized by Northwest Linings (NWL) Installation Personnel to assure quality workmanship and installation integrity of HDPE/LLDPE Geomembranes.
- B. Geosynthetic components of lining systems which are addressed in this manual are HDPE/LLDPE Geomembranes. NWL recognizes that specific documentation of the specific installation is required to substantiate this Quality Control Program.

II. REFERENCES

Note: Test equipment and procedures are used which enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

- A. American Society for Testing and Materials (ASTM)
 - 1. D 638 Standard Test Method for Tensile Properties of Plastics
 - 2. D 792 Standard Test Method for Specific Gravity and Density of Plastics by Displacement
 - 3. D 1004 Test Method for Initial Tear Resistance of plastic Film and Sheeting
 - 4. D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
 - 5. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
 - 6. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
 - 7. D 1593 Specification for Nonrigid Vinyl Chloride plastic Sheeting
 - 8. D 1603 Test Method for Carbon Black in Olefin Plastics
 - 9. D 1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
 - 10. D 3015 Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds
 - 11. D 4437 Practice for Determining Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
- B. Federal Test Method Standards – 101 Puncture Resistance
- C. NSF International – Standard 54 Flexible Membrane Liners

III. DEFINITIONS

- A. Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.
- B. Construction Quality Assurance Consultant: Party, independent from Manufacturer and Installer, that is responsible for observing and documenting activities related to quality assurance during the lining system construction.
- C. Engineer: The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.
- D. Geomembrane Manufacturer: The party responsible for manufacturing the geomembrane rolls.
- E. Geosynthetic Quality Assurance Laboratory (Testing Laboratory): Party, independent from the Owner, Manufacturer, and Installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing usually under the direction of the Owner.

- F. Installer: The party responsible for field handling, transporting, storing, deploying, seaming, seam testing.
- G. Panel: The unit area of geomembrane that will be seamed in the field. A panel is identified as a roll or portion of a roll that is larger than 100 square feet.
- H. Subgrade Surface: The soil layer surface which immediately underlies the geosynthetic material(s).

IV. SUBMITTALS POST-AWARD

- A. Conform to pertinent provisions of Specification Section _____, Submittals.
- B. Furnish the following product data, in writing, to the Engineer prior to installation of the geomembrane material.
 - 1. Certify that geomembrane manufacturer is listed by Northwest Linings & Geotextile Products, Inc.
 - 2. Resin Data shall include the following:
 - a) Certification stating that the resin meets the specification requirements.
 - b) Certification stating all resin is from the same Manufacturer.
 - c) Copy of Quality Assurance/Quality Control certificates issued by Geomembrane Manufacturer and resin supplier shall be submitted.
 - 3. Geomembrane Roll
 - a) Certification stating that the resin meets the specification requirements.
 - b) Statement certifying no reclaimed polymer is added to resin (product run may be recycled)
 - c) Copy of quality assurance certificates issued by Geomembrane Manufacturer shall be furnished.
 - 4. Extrudate resins and/or rod shall be certified that all extrudate is from one Manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.
- C. Furnish the following information to the Engineer and Owner prior to installation
 - 1. Installation layout drawings-Submit drawings showing proposed panel layout including field seams and details. These drawings shall be approved prior to installing the geomembrane. This approval will be for concept only and actual panel placement will be determined by site conditions.
 - 2. Installer's geosynthetic Field Installation Quality Assurance Plan
- D. Submittals on a daily basis during installation
 - 1. Subgrade Acceptance Forms
 - 2. All QC Documentation and Field Testing Results (Destructive & Non-Destructive Test Results)
- E. Submit the following to the Engineer upon completion of installation
 - 1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents.
 - 2. Material and installation warranties.

3. As-built drawings showing actual Geomembrane panel placement and seams including typical anchor trench.

V. QUALITY ASSURANCE

- A. The owner will engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

VI. QUALIFICATIONS

A. Geomembrane Manufacturer

1. Geomembrane shall be manufactured by one of the following manufacturer's (or approved equal).
 - a) Serrot
2. The manufacturer shall have manufactured a minimum of 50,000,000 square feet of HDPE geomembrane during the last three years.

B. Installer

1. Installation shall be performed by one of the following installation companies (or equal)
 - a) Northwest Linings & Geotextile Products, Inc.
2. The Installer shall have installed a minimum of 10,000,000 square feet of HDPE geomembrane during the last 5 years. The installer shall have been in business under the same name for at least the last 5 continuous years.
3. The Installer shall have worked in a similar capacity on at least 10 projects similar in size and complexity to the project described in the Contract Documents.
4. The Master Welder shall have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

VII. MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

- A. Labeling – Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall clearly state the manufacturer's name, product identification, thickness, length, width and roll number. The label shall be found on either of the endcaps, an inside edge of the core, and outside the core.
- B. Delivery – The rolls of liner shall be packaged and shipped by appropriate means to prevent damage to the material and to facilitate off-loading
- C. Storage – The on-site storage location for geomembrane material should be level, smooth, elevated and dry (not wooden pallets). The storage place should be protected from theft and vandalism, and should be adjacent to the area to be lined. The Contractor shall provide a suitable storage site, which will protect the geomembrane from punctures, abrasions, excessive moisture and dirt.
- D. Handling – The materials are to be handled so as to prevent damage. Instructions for moving geomembrane rolls shall be provided by the Manufacturer upon request.

VIII. WARRANTY

1. The material shall be warranted, on a pro-rata basis against manufacturer's defects for a period of 5 years from the date of geomembrane installation.
2. The installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

IX. GEOMEMBRANE

1. The material shall be smooth/textured polyethylene geomembrane as shown on the drawings.
2. Resin
 - A. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
 - B. Do not intermix resin types.
 - C. Natural resin (without carbon black) shall meet the following additional requirements.

| Property | Test Method ¹ | HDPE Resin |
|------------------------------|--------------------------|-------------------------------|
| Density (g/cm ³) | ASTM D 792 (B) or D 1505 | 0.932-0.940 g/cm ³ |
| Melt Flow Index | ASTM D 1238 | .20 - .23 g/10mm |

¹All procedures and values are subject to change without prior notification.

3. Geomembrane Rolls
 - A. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
 - B. Geomembrane shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
 - C. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating number, thickness, length, width and Manufacturer.
 - D. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical appearance requirements listed in previous section and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified, and indicated during manufacturing, these pinholes may be corrected during installation.
4. Extrudate Rod or Bead
 - A. Extrudate material shall be made from same type resin as the geomembrane.
 - B. Additives shall be thoroughly dispersed.
 - C. Shall be free of contamination by moisture or foreign matter.

X. HDPE/LLDPE GEOMEMBRANE INSTALLATION

A. Earth Work

1. The general and/or earthwork contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for liner installation unless agreed otherwise.

2. Surfaces to be lined shall be smooth and free of debris, roots, and angular or sharp rocks to a depth of four (4) inches. All fill shall consist of well-graded material free of organics, trash, clayballs or other harmful matter. No sharp edged stones, stones larger than one (1) inch diameter or hard objects shall be allowed within the top four (4) inches of the subgrade. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.
3. The earthwork contractor shall protect the subgrade from becoming too dry, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer) installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than 1/2 inch in width or depth or which exhibit swelling, heaving or other similar conditions shall be reworked by the general contractor to remove these defects.
4. Surface acceptance: Upon request, NWL will provide the Owner's Representative with a written acceptance of the surface to be lined. This acceptance will be limited to an amount of area that NWL is capable of lining in a particular work shift. Subsequent repairs to the subgrade and the surface shall remain the responsibility of the earthwork contractor.

B. Crest Anchorage System

1. The anchor trench shall be excavated by the earthwork contractor to lines and widths shown on the design drawings prior to geomembrane placement.
2. Anchor trenches excavated in clay soils susceptible to desiccation cracks should be excavated only the distance required for that days liner placement to minimize the potential for cracking of the clay soils.
3. Corners in the anchor trench shall be slightly rounded where the geomembrane enters the trench to minimize sharp bends in the liner.

C. Preparation for Geomembrane Deployment

1. Panel Layout: Prior to liner deployment, layout drawings shall be produced to indicate the panel configuration and location of seams.
2. Identification: Each panel used shall be given a numeric or alpha-numeric identifier consistent with the layout drawing. This identification number shall be related to a manufacturing roll number.

D. Field Panel Placement

1. Location: NWL will attempt to install field panels at the location indicated on the layout drawing. If panels are positioned in a location other than that indicated on the layout drawings, the revised location shall be noted in the field on a layout drawing, which will be modified at the completion of the project to reflect actual panel locations.
2. Weather Conditions: Geomembrane deployment shall not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing or ponded water, or during high winds.
3. Method of Deployment:
 1. The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface.
 2. No personnel working on the liner will smoke, wear shoes that can damage the geomembrane, or engage in actions which could result in damage to the geomembrane.

3. Adequate temporary ballast and/or anchoring, (i.e. sandbags,) which will not damage the geomembrane, will be placed to prevent uplift of the liner by wind.
4. The geomembrane will be deployed in a manner to minimize wrinkles.
5. Any damage to a panel of geomembrane will be repaired in accordance with Section IV. Any area of a panel seriously damaged (torn, twisted, or crimped) will be marked, cut out, and removed from the work area with resulting seaming and/or repairs performed in accordance with Section IV of this document.

E. Field Seaming

1. General Requirements:
 1. Layout: In general, seams shall be oriented parallel to the slope, (down hill) not across the slope. Whenever possible, horizontal seams should be located not less than five (5) feet from the toe of the slope. Each seam shall be numbered in a manner compatible with the panel layout drawing for documentation of seam testing results.
 2. Personnel: All personnel performing seaming operations shall be trained in the operation of the equipment being used and will qualify by successfully welding a test seam as described herein. The project foreman will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

F. Equipment:

1. Fusion Welding: Fusion Welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600 degrees F. to 950 degrees F. After being heated by the wedge, the overlapped edges pass through a set of preset pressure rollers which compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device which continuously monitors the temperature of the wedge.
2. Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

G. Seam Preparation:

1. Fusion Welding:
 1. Overlap the panels approximately four (4) inches.
 2. Clean the seam area prior to seaming to assure the area is lean and free of moisture, 1dust, dirt and debris.
 3. No grinding is required for fusion welding.
 4. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths".
2. Extrusion Welding:
 1. Overlap the panels a minimum of three (3) inches.

2. Temporarily bond the panels to be welded taking care not to damage the geomembrane.
3. Grind seam overlap prior to welding within 15 minutes of welding operation in manner that does not damage the geomembrane.
4. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust dirt and debris of any kind.
5. Purge the extruder prior to beginning the seam to remove all heat-degraded Extrudate from the barrel.
6. Keep welding rod clean and off the ground.

H. Test Seams:

Test seams shall be performed at the beginning of each seaming period and at least once each five hours for each seaming apparatus used that day. Test seams shall be made on fragment pieces of the liner and under the same conditions as actual seams.

1. Test Seam Length:

The test seam shall be at least three feet long, made by joining 2 pieces at least 9" in width.

2. Sample Procedures:

1. Visually inspect the seam for squeeze out, footprint, pressure and general appearance.
2. Two samples one inch wide shall be cut from the test seam. The samples shall then be tested in peel and shall not fail in the seam. Failure shall be a film tear bond (FTB). If a sample fails, the entire procedure shall be repeated.
3. If any of the second set of samples fail, the machine shall not be accepted and used for seaming until the problem is corrected and 2 passing tests are achieved.
4. After completion of the test the remaining portion of the test seam shall be discarded. Documentation of the test seams will be maintained by listing machine I.D. number, operators name, temperature control setting and test results.
5. Passing test results records shall be maintained on NWL's test weld report form.
6. If test samples are to act as destructive samples then the sample shall be marked, logged and saved. If samples are to be cut from the actual finished seam for Lab Testing, the test seams shall be discarded per above.

I. General Seaming Procedures:

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.
2. While welding a seam, monitor and maintain the proper overlap.
3. Inspect seam area to assure area is clean and free of moisture, dust, dirt and debris of any kind.
4. While welding a seam, monitor temperature gauges to assure proper settings are maintained and that the machine is operating properly.
5. Align wrinkles at the seam overlap to allow welding through a wrinkle.

6. Fishmouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut area shall be seamed. Any portion where the overlap is inadequate shall be patched with an oval or round patch extending six inches beyond the cut in all directions.
7. All cross/butt seams between two rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.
8. All "T" joints shall have the overlap from the wedge welder seam trimmed back to allow an extrusion fillet weld. Then grind two inches on either side of the seam and extrusion weld all of the area prepared by grinding.

J. Weather Conditions:

NWL relies on the experience of the Project Superintendent and the results of test seams to determine seaming restriction by weather. Many factors, such as ambient temperature, humidity, wind, sunshine, etc., can effect the integrity of field seams and must be taken into account when deciding whether or not seaming should proceed. Test seams are required prior to daily production seaming to determine if the weather conditions will effect NWL's ability to produce quality seams. Additional non-destructive and destructive testing of production seams substantiate the decision made by the Project Superintendent to seam on any given day.

SECTION III

Seam Testing-Quality Control-Geomembranes

A. Concept:

NWL installation crews will non-destructively test all field seams over their full length using air pressure testing, vacuum testing or other approved method, to verify the continuity and integrity of the seams.

B. Air Pressure Testing:

The weld seam created by the fusion welding process is composed of two welded seams separated by an unwelded channel approximately 3/8 of an inch wide. This channel permits seams to be tested by inflating the sealed channel with air to a predetermined pressure and observing the stability of the pressurized channel over time.

C. Equipment for air testing:

1. An air pump (manual or motor driven) capable of generating and sustaining a pressure of 30 PSI.
2. A rubber hose with fittings and connections.
3. A sharp hollow needle with a pressure gauge capable of reading and sustaining a pressure of 30 PSI.
4. Procedure for air testing:
5. Seal both ends of the seam to be tested.
6. Insert needle in the sealed channel.
7. Inflate the test channel to a pressure between 25 to 30 PSI, in accordance with the following schedule, close valve, and observe initial pressure after approximately 2 minutes.

INITIAL PRESSURE SCHEDULE***MAX. PRESSURE DIFF.**

| MATERIAL | (MIL) | MIN. PSI | MAX. PSI | AFTER 5 MINUTES |
|----------|-------|----------|----------|-----------------|
| | 40 | 25 | 30 | 4 |
| | 50 | 26 | 30 | 4 |
| | 60 | 27 | 30 | 4 |
| | 80 | 30 | 30 | 4 |
| | 100 | 30 | 30 | 4 |

* Initial pressure settings are read after a two minute relaxing period. The purpose of this period is to permit the air temperature and pressure to stabilize.

8. Observe and record the air pressure five minutes after the relaxing period ends. If loss of pressure exceeds the value above or if the pressure does not stabilize, locate the faulty area and repair.
9. Upon completion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered blocked and the test will be repeated after the blockage is corrected.
10. Remove needle and seal resulting hole by extrusion welding.
11. Record test results on non-destructive test form
12. In the event of a Non-Complying Air pressure test, the following procedure shall be followed.
13. Check seam-end seals and retest seams.
14. If non-compliance reoccurs, cut one inch samples from each end of the seam and additional samples at the distance specified.
15. Perform destructive field peel test on the samples.
16. If all samples pass destructive testing remove the overlap left by the wedge welder and perform an Air Pressure/Soap Test or vacuum test.
17. If a leak is detected by the air pressure/soap or the vacuum test, repair by extrusion welding. Test repair by vacuum testing.
18. If no leak is discovered air pressure/soap testing, the seam will pass non-destructive testing.
19. If no leak is discovered by vacuum testing, the seam will pass non-destructive testing.
20. If one or more samples fail the peel test, additional samples will be taken.
21. When two passing samples are located, the seam between these two locations will be considered complying. The area outside of this length will be considered non-complying and the entire length extrusion welded.
22. Test the entire length of the repaired seam by vacuum testing.

D. Air Pressure Testing/Soap Testing:

This test is used when the seam fails the air pressure test due to slow pressure loss. The procedure is to constantly supply pressure to the seam air channel while spraying the length with a soap and water solution and visually examining the seam for bubbles. Note: This option is not recommended during high wind conditions.

1. Equipment for Air Pressure/Soap Testing:

1. The same equipment as the air pressure test.
 2. A soap solution and means to apply the solution.
2. Procedure for Air Pressure/Soap Testing:
1. Trim excess overlap material off at edge of seam
 2. Insert needle gauge assembly in opposite ends of the seam to be tested to show that pressure is continuous throughout the channel.
 3. Maintain 30 psi
 4. Apply soap solution to the weld edge and visually examine for bubbles.
 5. If no bubbles appear the problem is with the inside track "secondary weld". This seam is acceptable providing it has passed peel tests.
 6. If any bubbles appear on the outside track "Primary weld", repair defect by extrusion welding and vacuum test the repair.

E. Vacuum Testing:

This test is used when the geometry of the weld makes air pressure testing impossible or impractical or when attempting to locate the precise location of a defect believed to exist after air pressure testing.

1. Equipment for vacuum testing:
 1. Vacuum box consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly and a vacuum gauge.
 2. Vacuum pump assembly or compressor with a venturi equipped with a pressure controller and pipe connections.
 3. A rubber pressure/vacuum hose with fittings and connections.
 4. A soap solution with a means to apply the solution.
2. Procedure for Vacuum Testing:
 1. Trim excess overlap from seam.
 2. Apply soap solution to the area to be tested.
 3. Place the vacuum box over the area and apply sufficient downward pressure to seal the box against the liner.
 4. Open the vacuum valve and apply a minimum of 5 in. Hg vacuum to the area as indicated by the gauge on the box.
 5. Ensure that a leak-tight seal is created.
 6. For a period of not less than thirty seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
 7. If no bubbles appear after thirty seconds, close the valve and move overlap and repeat the process.

3. Procedure for non-complying test:

1. Mark all areas where soap bubbles appear and repair the marked areas.
2. Retest repaired areas.

F. Destructive Testing:

The purpose of destructive testing is to determine and evaluate seam strength. These tests require direct sampling and thus subsequent patching. therefore destructive testing should be held to a minimum to reduce the amount of repairs required.

1. Procedure for Destructive Testing:

- 1.1. Destructive test samples shall be marked and cut out randomly at a minimum average frequency of one test location every 700 feet of seam length.
- 1.2. Additional test may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds.

1) Sample Size:

- a) The sample should be twelve inches wide with a seam fourteen inches long centered Lengthwise in the sample. The sample may be increased in size to accommodate independent lab testing by the owner or by specific project specifications.
 - b) A one inch sample shall be cut from each end of the test seam for field testing on a calibrated field tensiometer.
- 2) The one inch wide samples shall be tested in the field for peel. If any field sample fails to pass FTB, it will be assumed the sample fails destructive testing. The procedures outlined in Section 2 shall be followed to locate passing samples to send to the laboratory.
- i) If the sample passes the field test, the remaining portion of the sample test strip shall be sent to Northwest Linings for laboratory testing to evaluate seam strength and confirm field testing.

1. Procedure in the event of Destructive Test Failure:

1. Cut additional field samples for testing. In the case of a field production seam, the samples must lie a minimum of ten feet in each direction from the location of the failed sample. Perform a field test with the tensiometer for peel strength. and confirm field testing.

2. If the laboratory samples pass, then reconstruct the seam up to the two passing sample locations.

1. Heat tack the overlap along the length of the seam to be reconstructed and extrusion weld.

2. Vacuum test the extrusion weld.

3. If either of the samples fail then additional samples are taken in accordance with the above procedure until two passing samples are found to establish the zone in which the seam should be reconstructed.
4. All passing seams must be bounded by two locations from which samples passing destructive test have been taken.
5. In the case of reconstructed seams exceeding 150 feet, a sample must be taken and pass destructive testing.
6. All destructive seam samples sent to Northwest Linings shall be numbered and recorded on a destructive seam test form.

3. Northwest Linings Quality Assurance Laboratory Testing:

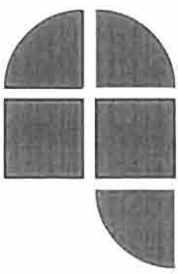
The remaining destructive sample will be sent to a qualified laboratory and will be tested in "Seam Strength" and "Peel Adhesion" (ASTM D 3083 and ASTM D413) as modified in NSF Standard No. 54. Five specimens shall be tested for each test method with data recorded. Four out of the five specimens must pass for each test in order for the seam to pass the destructive test.

G. Defects and Repairs:

1. Northwest Linings Project Superintendent shall conduct a detailed walk through and visually check all seams and non-seam areas of the geomembrane for defects, holes, blisters and signs of damage during installation.
2. All other NWL installation personnel shall at all times, be on the lookout for any damaged areas. Damaged areas shall be marked and repaired.
3. Repair procedures: Any portion of the geomembrane showing a flaw, or failing destructive or non-destructive test shall be repaired. Several procedures exist for repair, and the decision as to the appropriate procedure shall be made by NWL's Project Superintendent. Procedures available for repair:
 1. Patching - used to repair large holes, tears and destructive sample locations. All patches shall extend at least six inches beyond the defect and all corners of patches shall be rounded.
 2. Grinding and welding - used to repair sections of extruded seams.
 3. Spot welding or seaming - used to repair small tears, pinholes or other minor localized flaws.
 4. Capping - used to repair lengths of failed extruded areas.
 5. Removal of a bad seam and replacement with a strip of new material seamed into place.

H. Verification of Repairs:

Every repair shall be non-destructively tested using the methods set out in this manual Repairs which pass the non-destructive test shall be deemed adequate. Large repairs may require a destructive test. Repair test results shall be logged on a repair report form. The repair location shall be recorded on a record drawing.



NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc.

21000 77th AVE. SOUTH
KENT, WA 98032
253-872-0244
FAX 253-872-0245
www.northwestlinings.com

GEOCOMPOSITE INSTALLATION GUIDELINES

1.0 Handling and placement

All geocomposites shall be handled in such a manner as to ensure they are not damaged. The following special handling requirements shall be adhered to.

- 1.1 On slopes the geocomposite shall be secured in the anchor trench and then rolled down the slope when practical. In any event, it should be deployed in such a manner as to continually keep the geocomposite sheet in sufficient tension to reduce folds and wrinkles.
- 1.2 In the presence of high wind, all geocomposites shall be weighted with sandbags or the equivalent.
- 1.3 Geocomposite shall be cut using an approved cutter (i.e., hook blade). If the material is being cut in place, special care must be taken to protect other geosynthetic materials from damage.
- 1.4 Care shall be taken not to entrap stones or excessive dust that could damage the geocomposite or geomembrane, or generate clogging of drains or filters.

2.0 Seams and Overlaps

Geocomposites may be seamed by overlapping and tying the geonet and then overlapping or thermal bonding the geotextile, per the project specifications. Sewing of the geotextile may be required on individual projects.

- 2.1 When connecting the rolls side to side, the geonet shall be overlapped four inches and securely tied. Tying shall be every five to ten feet across the bottom and every five feet along the slope. The top of the berm and anchor trench shall be tied at one foot intervals.
When connecting rolls end to end, the net shall be overlapped one foot and tied every 12 inches across the roll. The geotextile should be overlapped, thermally bonded or sewn, per the project specifications. No horizontal seams should be allowed on side slopes greater than 4:1 without engineer approval.
- 2.2 Tying of the geonet will be with plastic fasteners. Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

3.0 Repairs

The repair will be observed and if smaller than three feet by three feet, the geocomposite will be repaired. If the tear or hole is larger, than the roll will be cut and a butt joint placed.

- 3.1 If the geonet is undamaged, and the geotextile is damaged, a patch of geotextile shall be placed. The geotextile patch shall be thermally bonded in place with a minimum of twelve inches overlap in all directions.

APPENDIX G
CONSTRUCTION DRAWINGS

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
MINE WASTE CLEANUP BUREAU

MCLAREN TAILINGS ABANDONED MINE SITE
RECLAMATION PROJECT
COOKE CITY, MONTANA

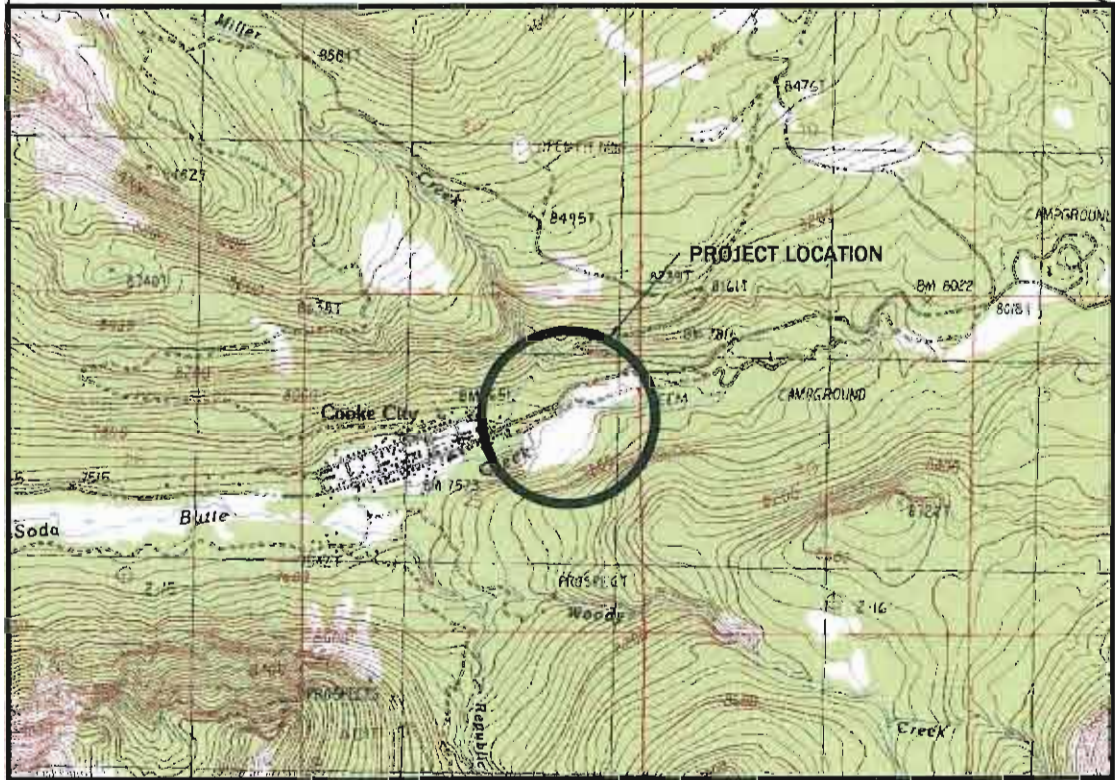
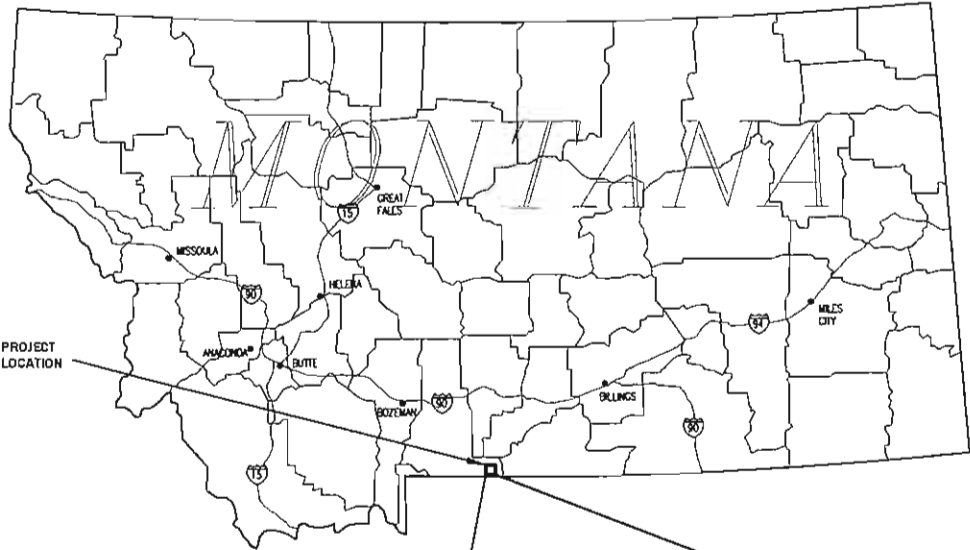
PREPARED BY

PIONEER TECHNICAL SERVICES, INC.

APRIL, 2009

SHEET INDEX

| SHEET NO. | DESCRIPTION |
|-----------|--------------------------------------------------------------------|
| 1 | TITLE SHEET AND SITE VICINITY |
| 2 | LEGEND |
| 3 | SITE VICINITY MAP |
| 4 | MCLAREN TAILINGS PROJECT OVERVIEW |
| 5 | EXCAVATION PLAN VIEW |
| 6 | WASTE ROCK EXCAVATION PLAN VIEW |
| 7 | WASTE ROCK EXCAVATION CROSS SECTIONS 0+00 TO 5+50 |
| 8 | TAILINGS IMPOUNDMENT EXCAVATION PLAN VIEW |
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| 27 | SODA BUTTE CREEK RECONSTRUCTION PLAN AND PROFILE STA 0+00 TO 7+50 |
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| D12 | BMP'S DETAILS |
| D13 | 8' SECURITY FENCE DETAILS |
| D14 | 8' SECURITY FENCE DETAILS |



SITE VICINITY MAP

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LEGEND

EXISTING - PLAN VIEW

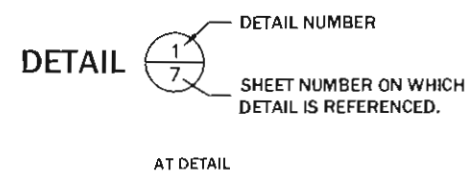
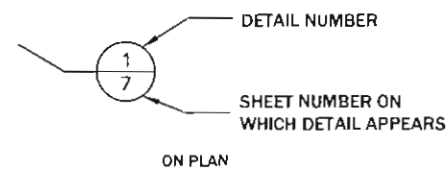
- INDEX CONTOURS
- INTERMEDIATE CONTOURS
- CULVERT
- EXISTING ROAD
- STREAM CHANNEL/SURFACE WATER
- ELECTRICAL LINE
- PROPERTY LINE

PROPOSED - PLAN VIEW

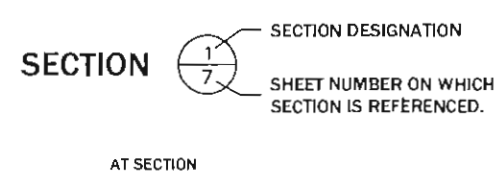
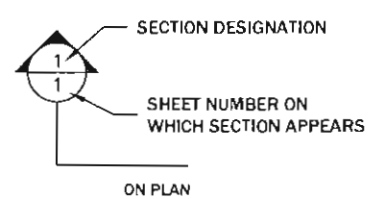
- INDEX CONTOURS
- INTERMEDIATE CONTOURS
- 100 FT. STATIONING
- GRADE OR SURFACE SLOPE (PERCENT)
- EXISTING ROAD

- CENTERLINE
- CENTERLINE
- SLOPE DESIGNATION (ARROWS POINT DOWN SLOPE)
- SLOPE DESIGNATION

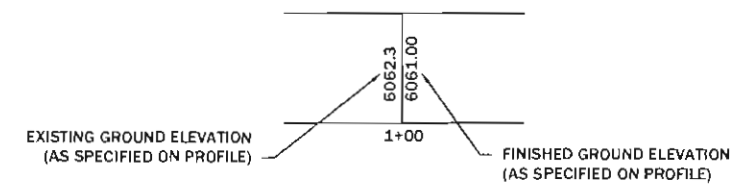
DETAIL INDICATOR



SECTION INDICATOR



PROFILE ELEVATIONS

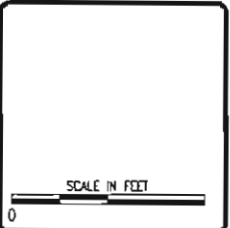


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AT DETAIL/SECTIONS: "1" SYMBOL (NO DRAWING NUMBER) IN LOWER HALF OF BUBBLE INDICATES DETAIL/SECTION IS REFERENCED ON MORE THAN ONE DRAWING.

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| DESIGNED BY: | JSM |
| CHECKED BY: | MSB |
| APPROVED BY: | JSM |
| PROJECT NO: | 10133 |
| DATE: | 4/15/09 |

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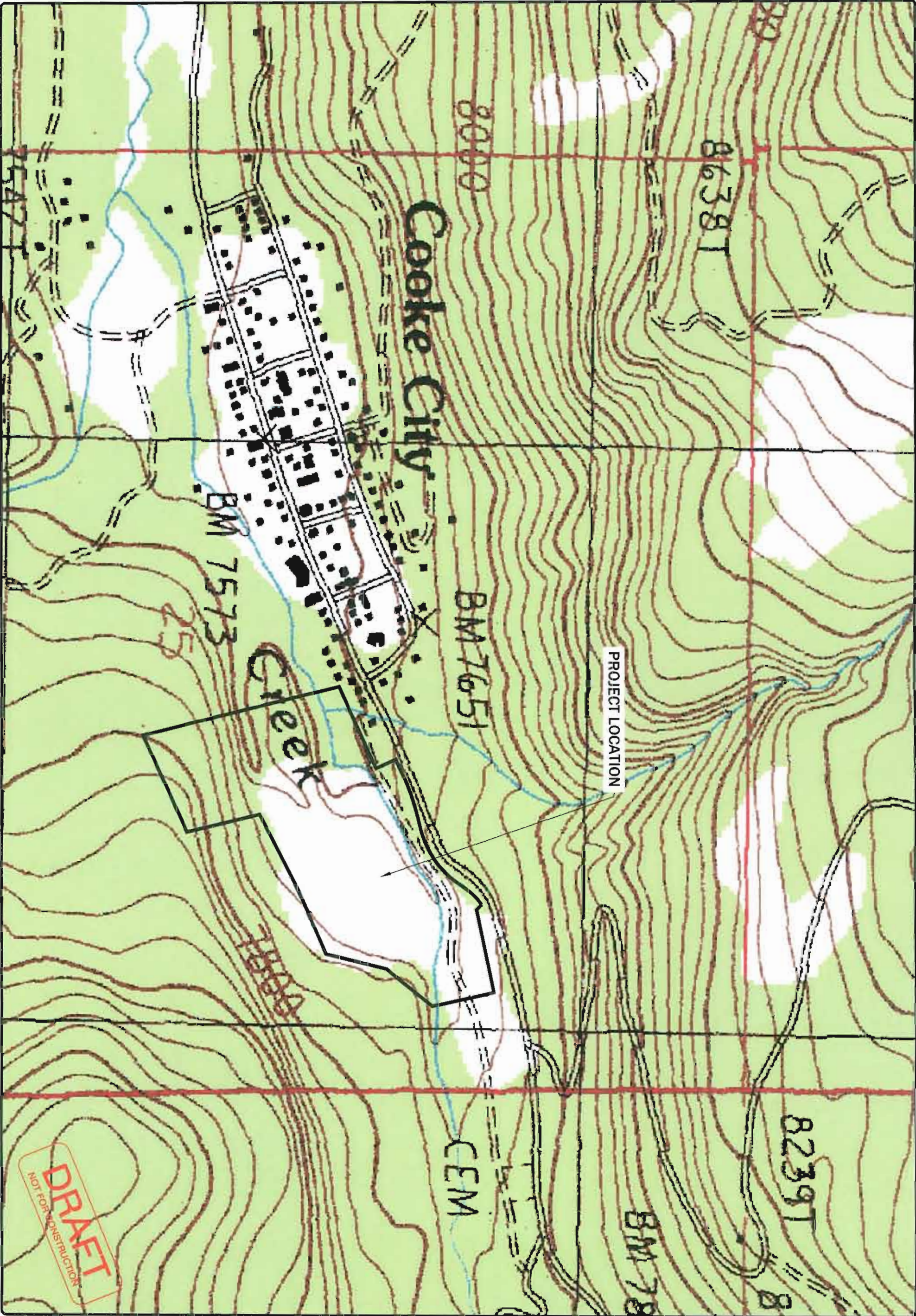
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MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

LEGEND

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

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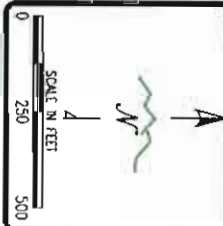
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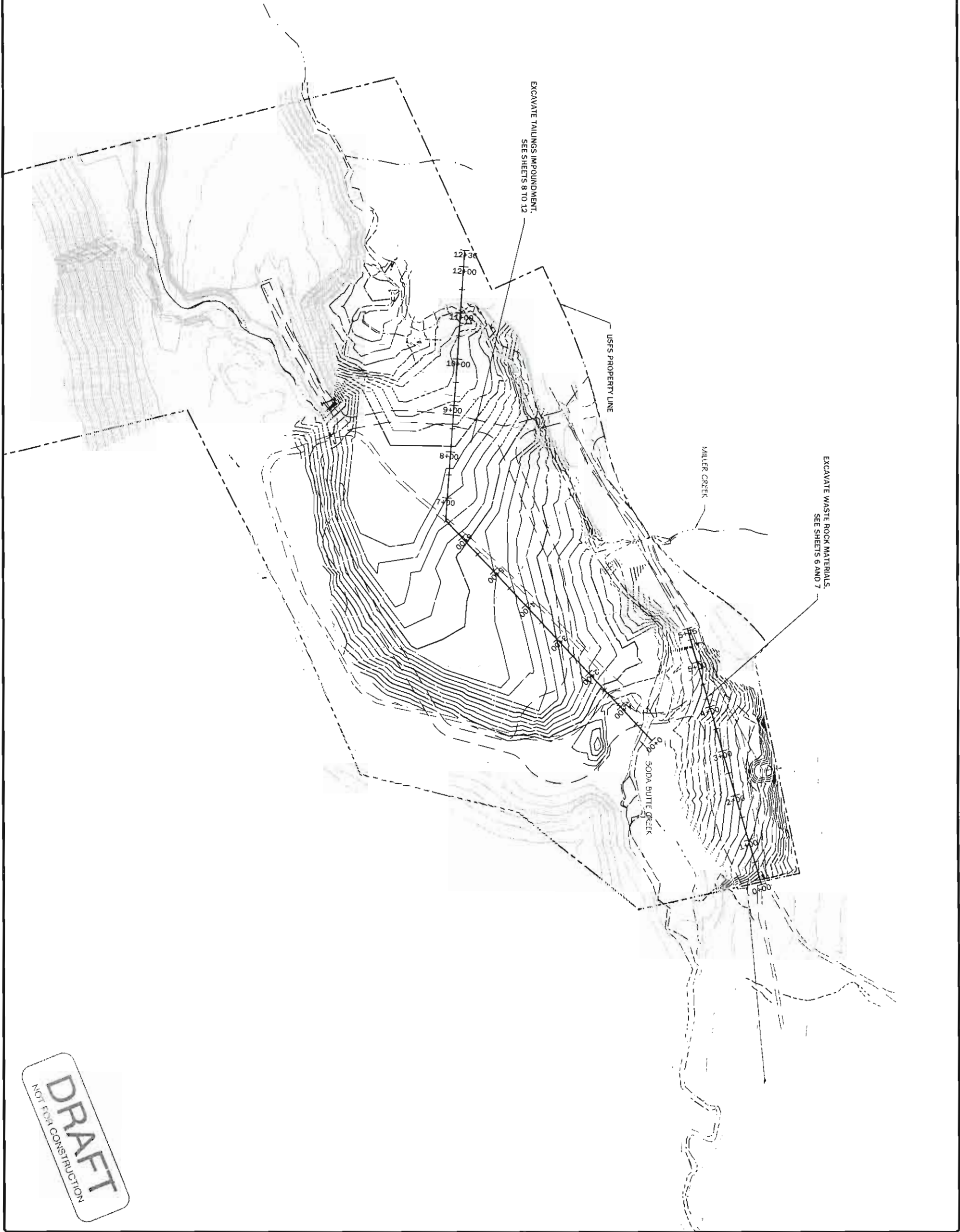
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| SOURCE | USGS 7.5 MINUTE QUAD |



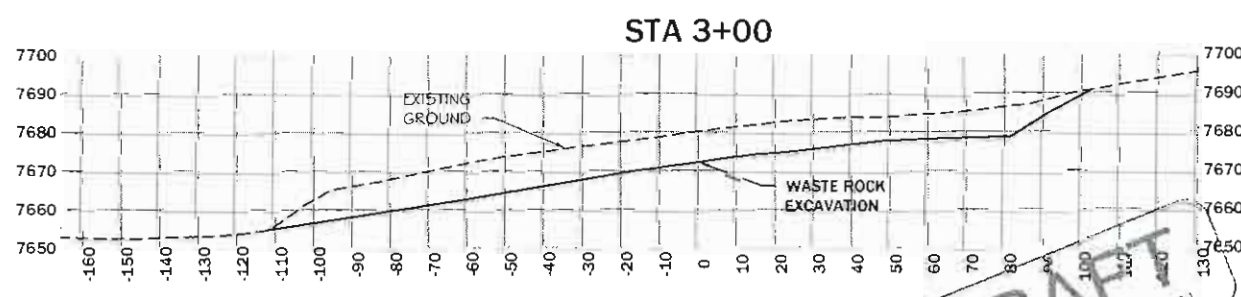
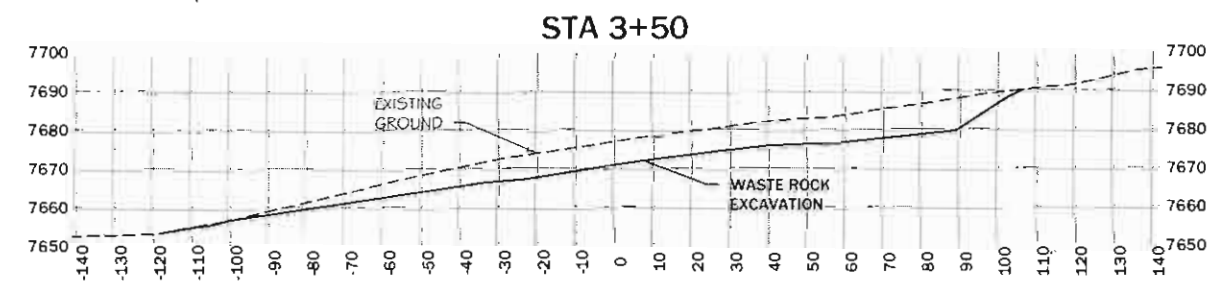
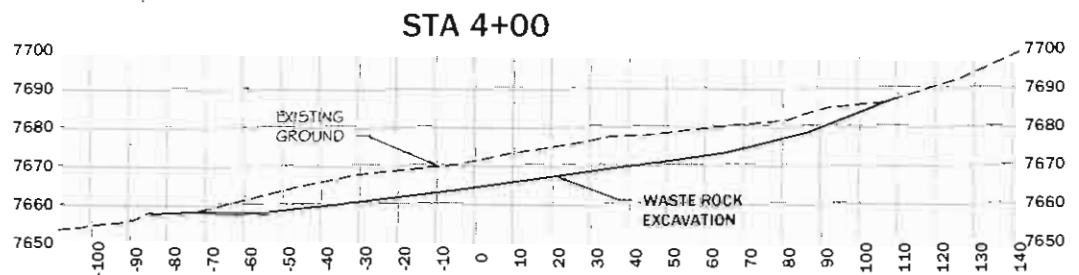
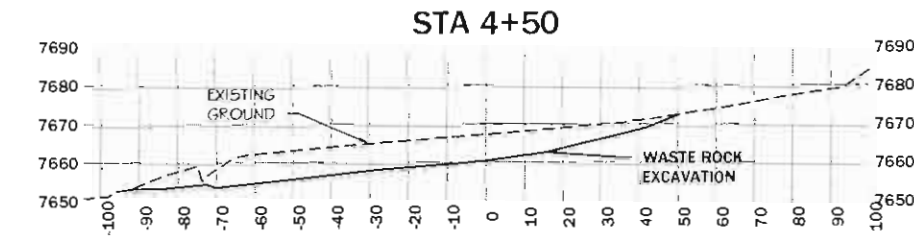
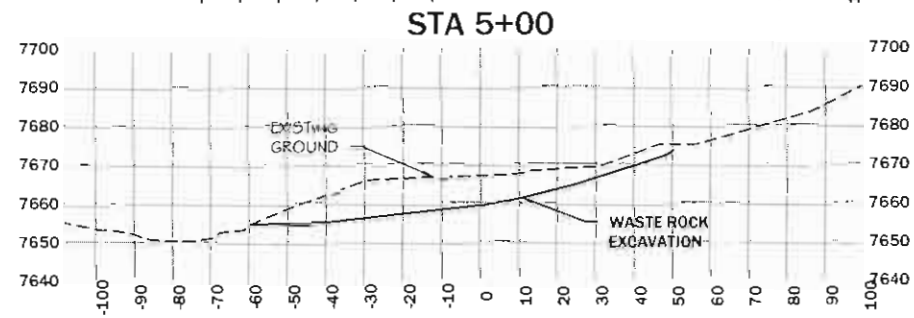
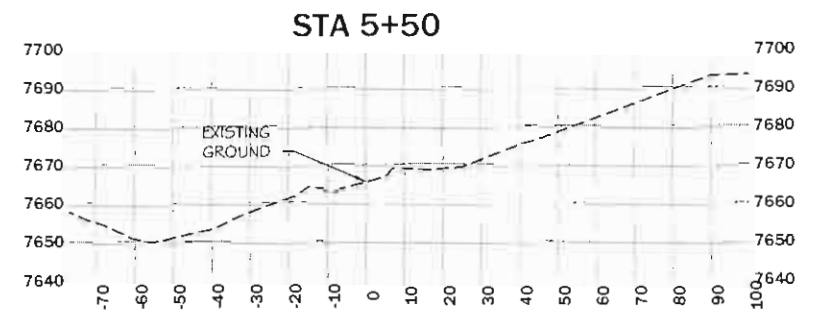
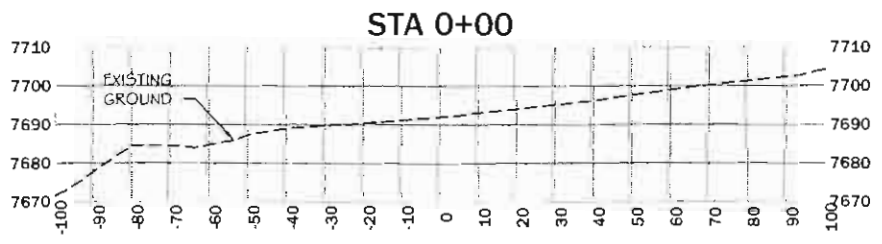
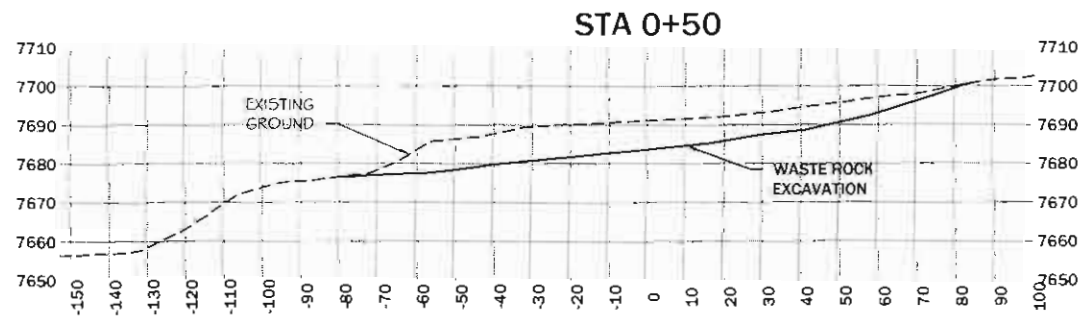
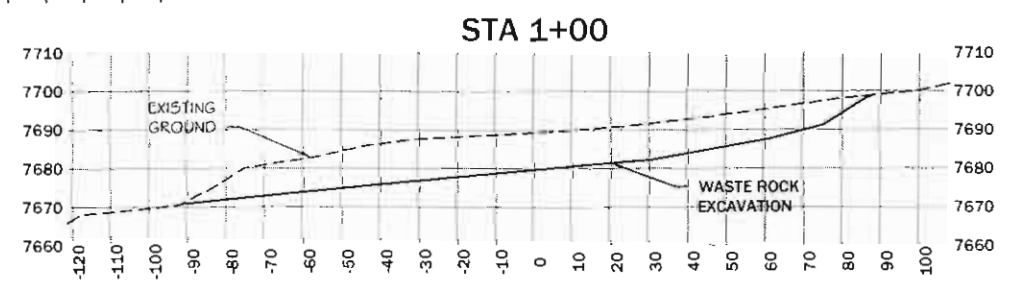
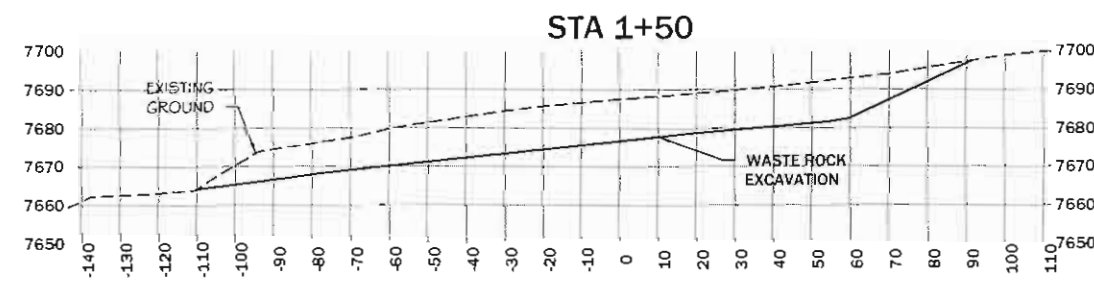
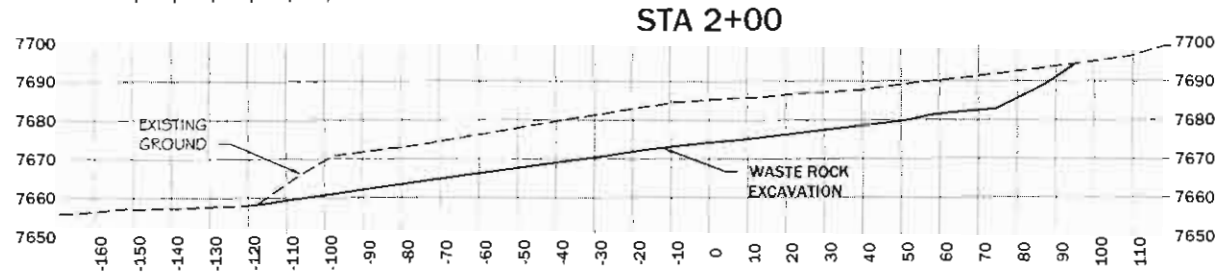
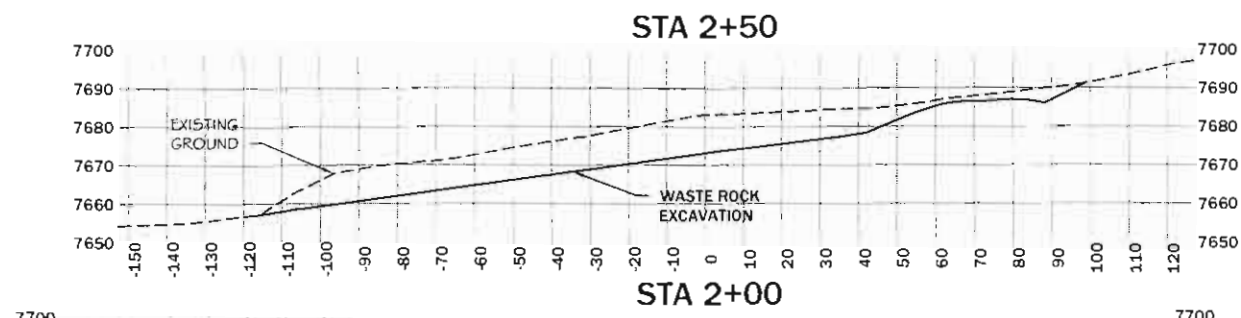
MDEQ\MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

SITE
VICINITY
MAP





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| SHEET 5 | PIONEER TECHNICAL SERVICES, INC. Butte, Helena, Anaconda | EXCAVATION PLAN VIEW | MDEQ/MWCB MCLAREN TAILINGS ABANDONED MINE SITE RECLAMATION PROJECT | | DESIGNED BY: <u>SEA</u> | PROJECT NO.: <u>4113.07</u> | PROJECTION: <u>TRANSVERSE MERCATOR</u> ZONE: <u>12N</u> DATUM: <u>NAD 83</u> UNITS: <u>FEET</u> SOURCE: <u>NOVIER</u> | DATE: <u>11/13/07</u> | APPROVED BY: <u>SEA</u> | CHECKED BY: <u>SEA</u> | DESIGNED BY: <u>SEA</u> |
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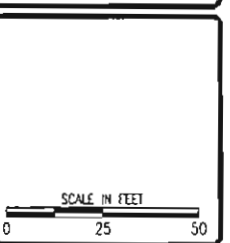


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DESIGNED BY: JSC
CHECKED BY: JSM
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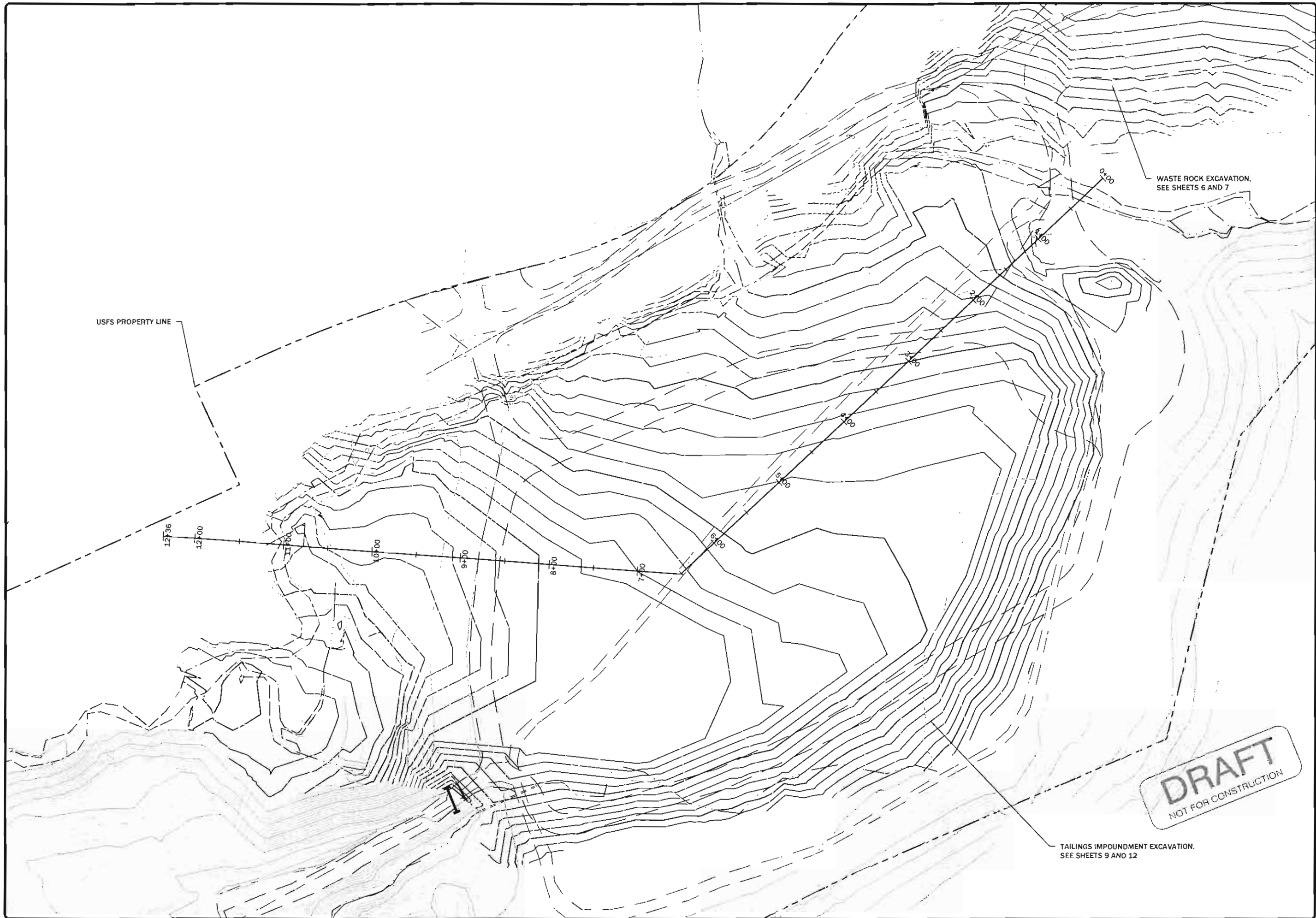


MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

WASTE ROCK
EXCAVATION
CROSS SECTIONS
STA 0+00 TO 5+50

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

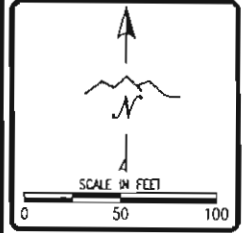
SHEET
7



| REVISION | DATE | BY | DESC. |
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DRAWN BY: CL
DESIGNED BY: MCB
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO.: 10133
DATE: 4/15/09

PROJECTION: TRANSVERSE MERCATOR
ZONE: MONTANA
DATUM: NAD83
UNITS: FEET
SOURCE: FIELD

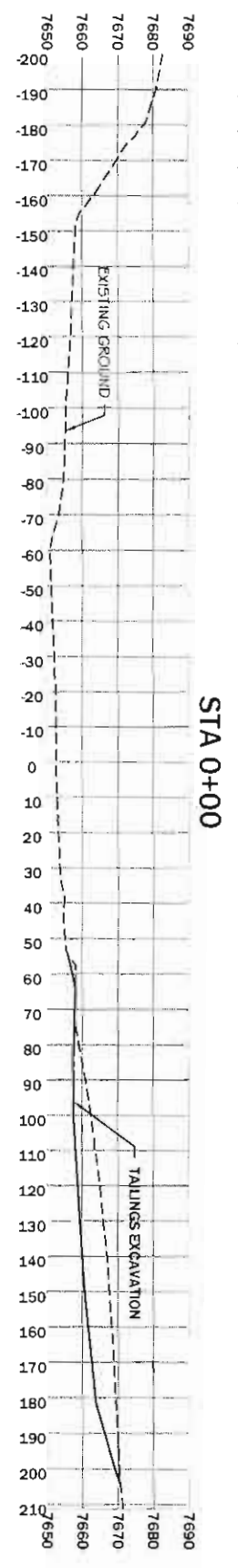
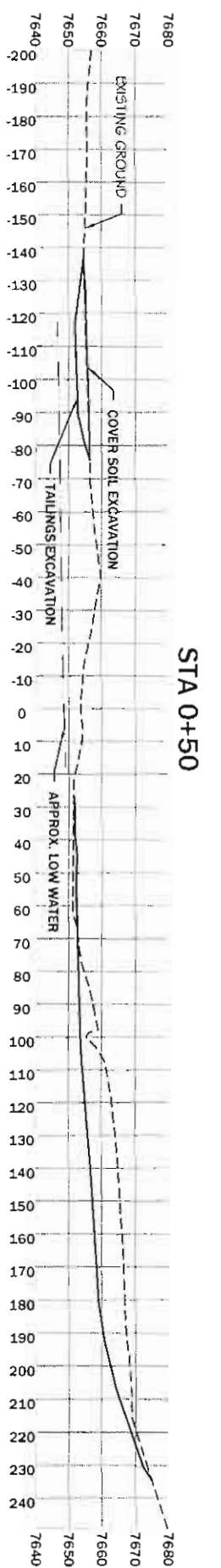
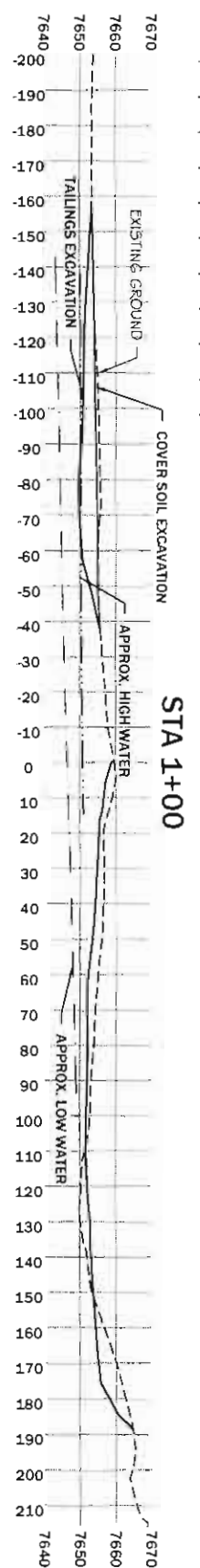
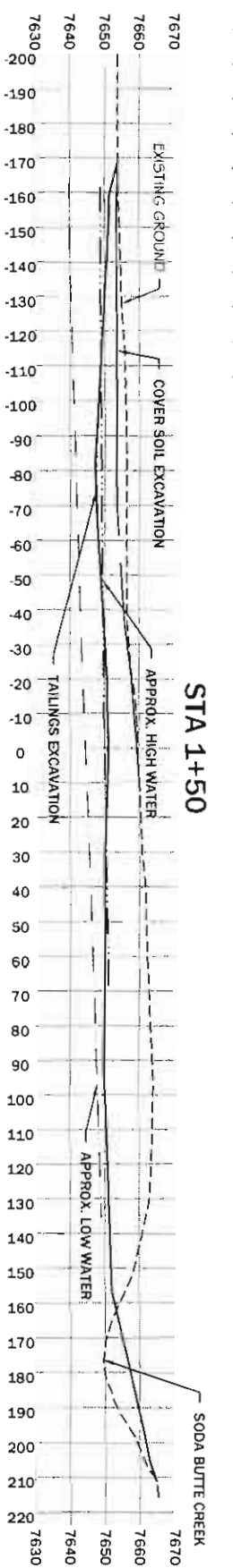
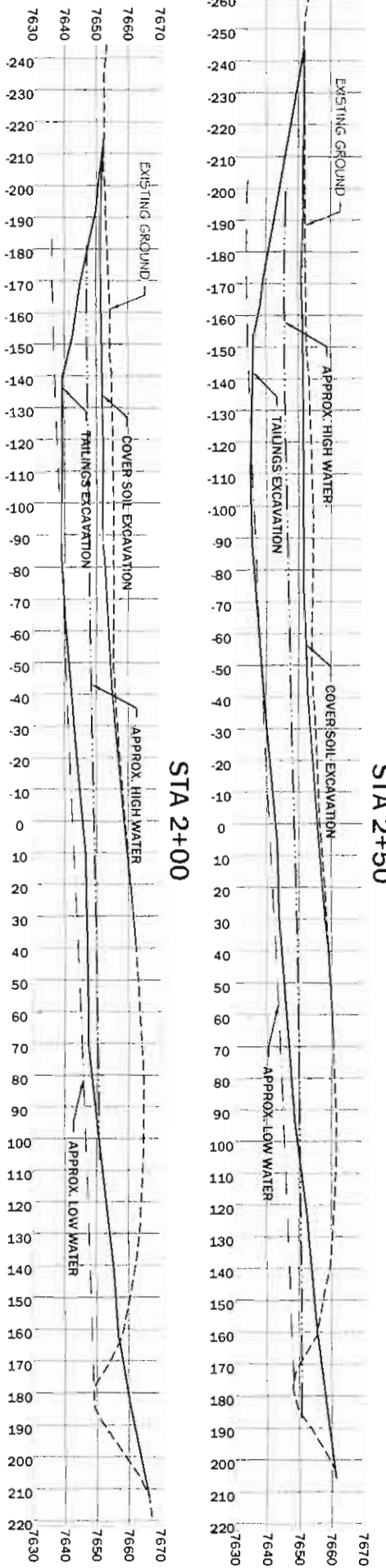
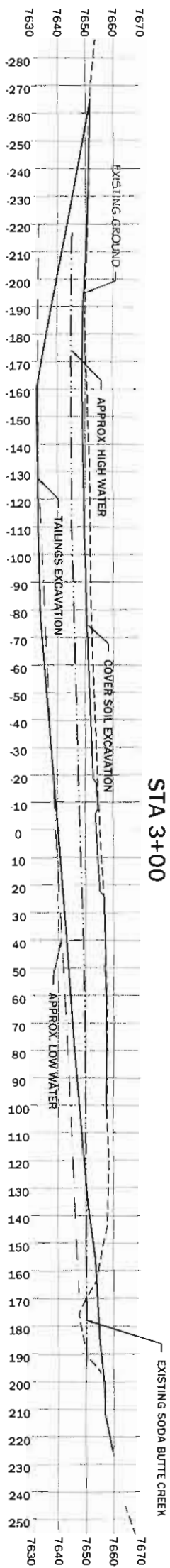
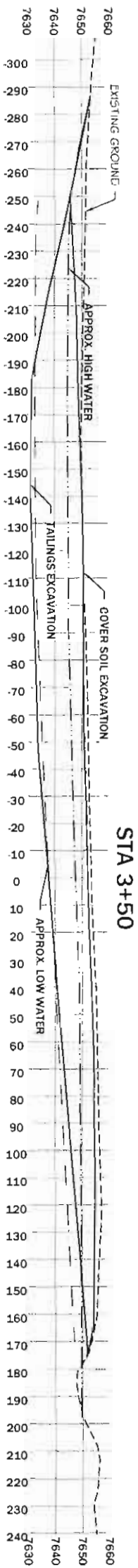


MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

TAILINGS
IMPOUNDMENT
EXCAVATION
PLAN VIEW

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

SHEET
8



DRAFT
NOT FOR CONSTRUCTION

| REVISION | DATE | BY | CHK. |
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| CHECKED BY | MDA |
| APPROVED BY | MDA |
| PROJECT NO. | 101312 |
| DATE | 4/15/09 |

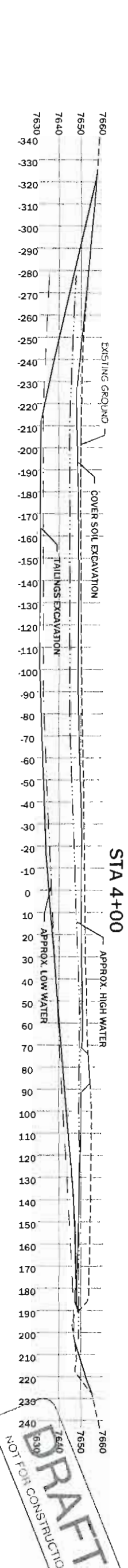
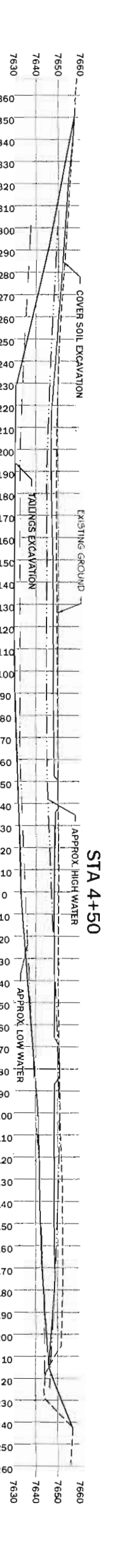
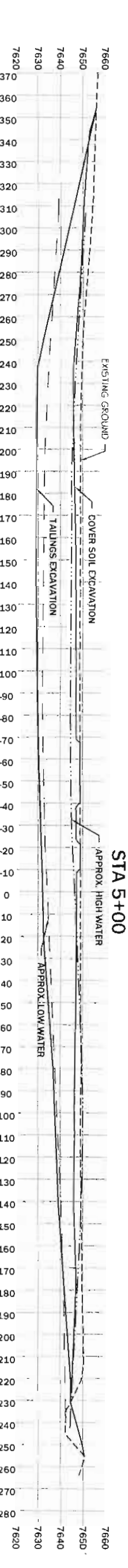
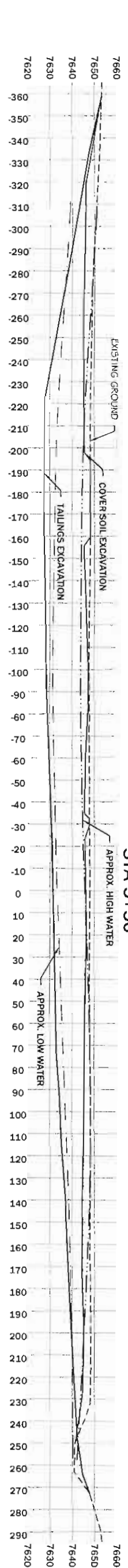
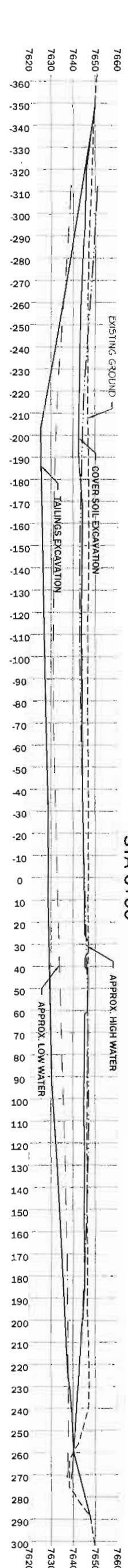
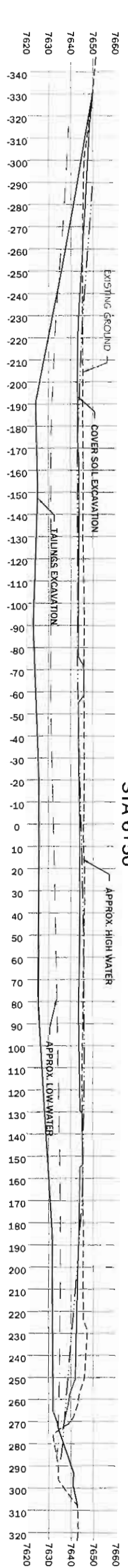
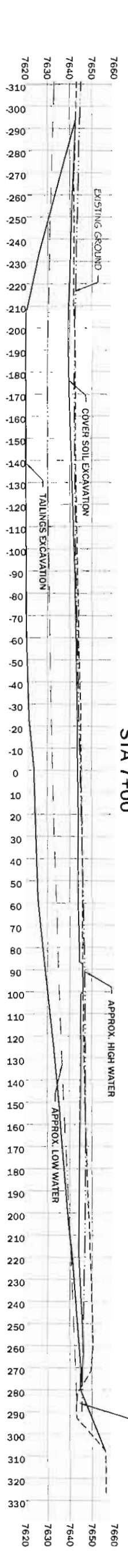
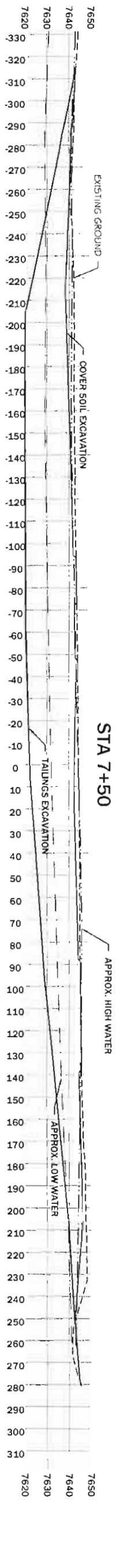
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| PROJECT | |
| ZONE | |
| DATUM | |
| UNIT | FEET |
| SOURCE | POINTER |

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| SCALE IN FEET | |
| 0 | 25 50 |

MDEQ\MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

TAILINGS IMPOUNDMENT
EXCAVATION
CROSS SECTIONS
STA 0+00 TO 3+50



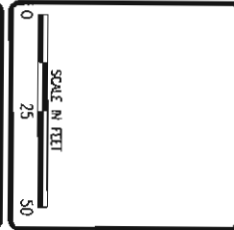


NOT FOR CONSTRUCTION

| APPROVED | DATE | BY | CHK |
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| DRAWN BY | SEALED BY |
| CHECKED BY | APPROVED BY |
| PROJECT NO. | DATE |

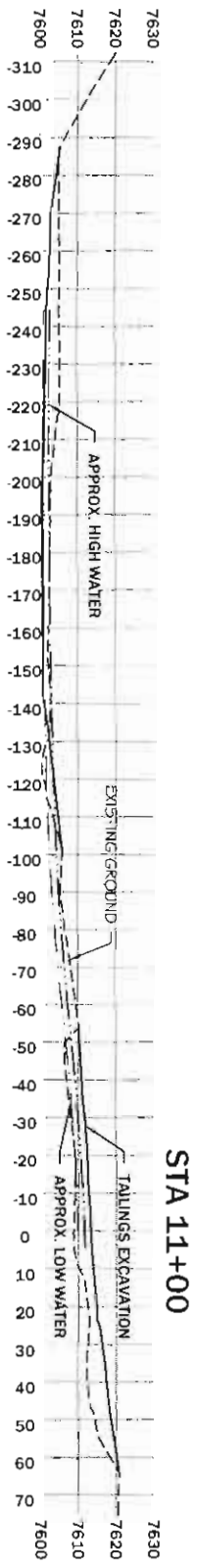
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| ZONE | UNIT | FED | STATE |
| | | | |



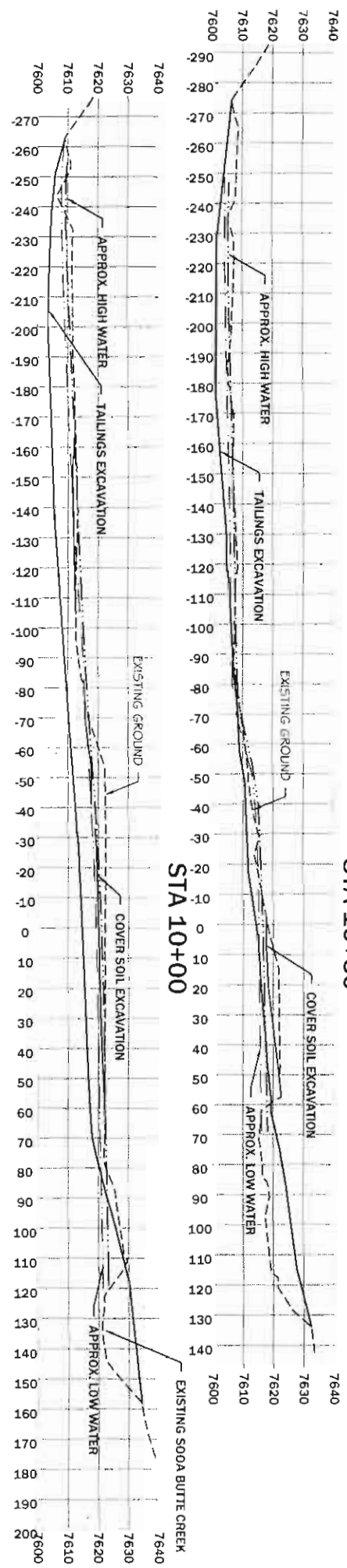
MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

TAILINGS IMPOUNDMENT
EXCAVATION
CROSS SECTIONS
STA 4+00 TO 7+50

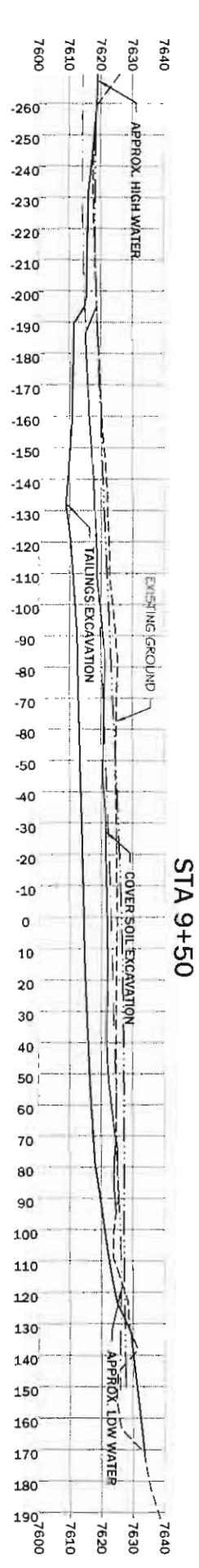




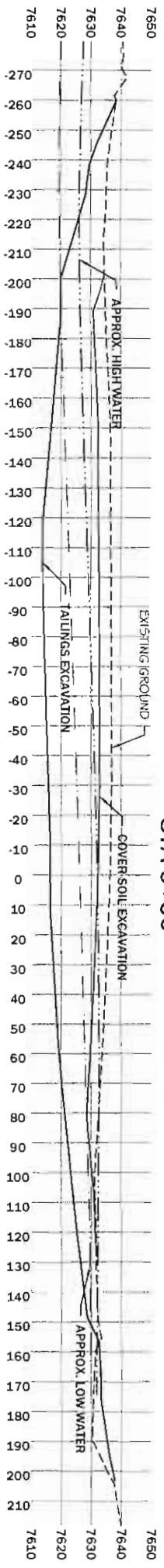
STA 11+00



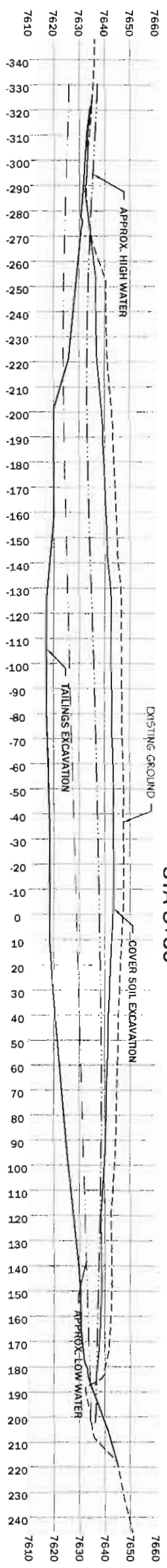
STA 10+50



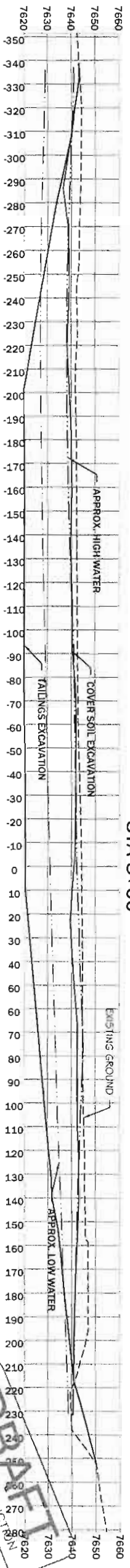
STA 10+00



STA 9+50



STA 8+50



STA 8+00

NOT FOR CONSTRUCTION
DRAFT

| REVISION | DATE | BY | DESC. |
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| DRAWN BY: JCA |
| DESIGNED BY: JSC |
| CHECKED BY: JSM |
| APPROVED BY: JSM |
| PROJECT NO: 10133 |
| DATE: 4/15/09 |

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| PROJECTION: |
| ZONE: |
| DATUM: |
| UNIT: FEET |
| SOURCE: FINDER |



MDEQ\MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

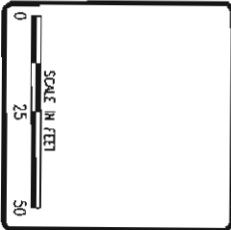
TAILINGS IMPOUNDMENT
EXCAVATION
CROSS SECTIONS
STA 8+00 TO 11+00



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| REVISION | DATE | BY | DESCRIPTION |
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| DRAWN BY | QA |
| DESIGNED BY | JCB |
| CHECKED BY | JCB |
| APPROVED BY | JCB |
| PROJECT NO. | 1013 |
| DATE | 5/11/08 |

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| PROJECTION | |
| ZONE | |
| DATUM | |
| UNITS | FEET |
| LOADS | PIONEER |

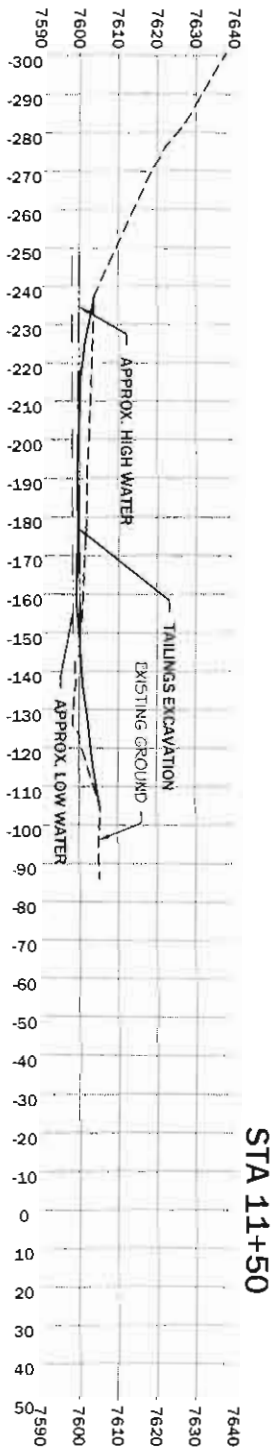
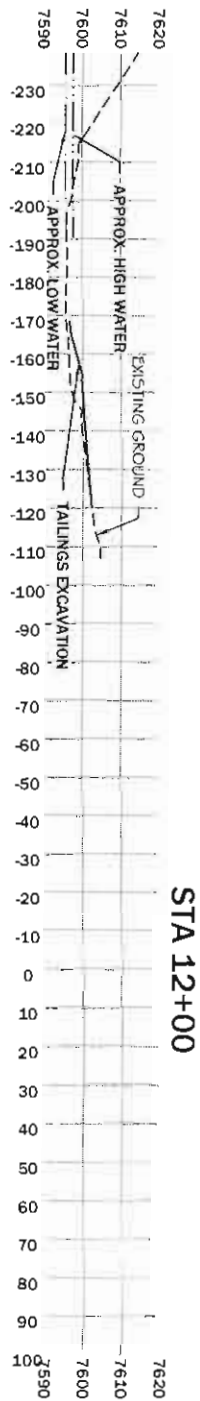


MDEQ\MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

TAILINGS IMPOUNDMENT
EXCAVATION
CROSS SECTIONS
STA 11+50 TO 12+00



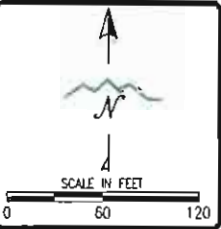
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| DRAWN BY: | GLA |
| DESIGNED BY: | JSM |
| CHECKED BY: | JSCB |
| APPROVED BY: | JSM |
| PROJECT NO: | 10133 |
| DATE: | 4/15/09 |

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| PROJECTION | TRANSVERSE MERCATOR |
| ZONE | MONTANA |
| DATUM | NAD83 |
| UNITS | FEET |
| SOURCE | PIONEER |



MDEQ\MMWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

EXCAVATION
SEQUENCE
PLAN

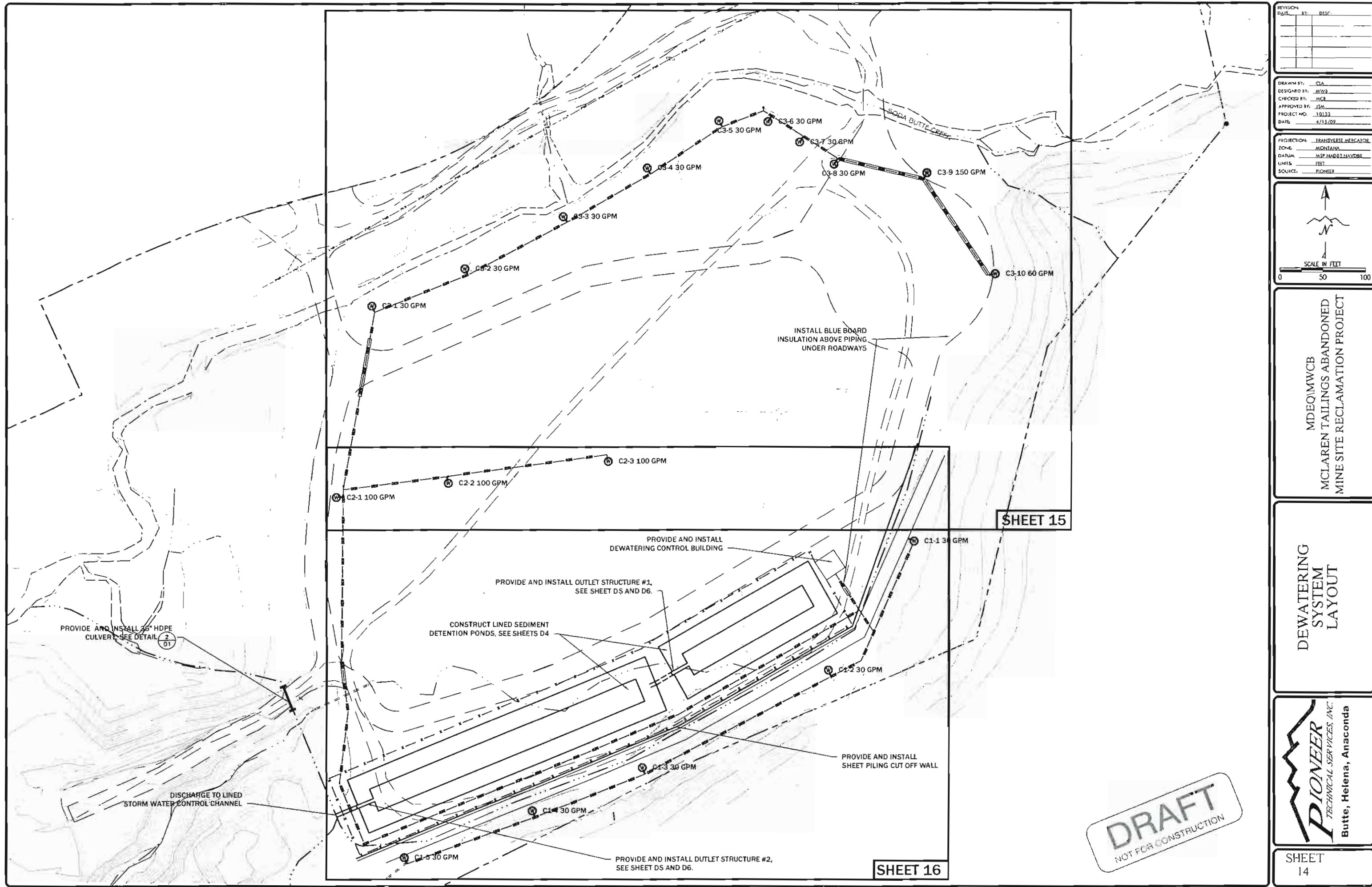


SHEET
13

| LEGEND | |
|-----------|--|
| 2009 | |
| 2010 | |
| 2011 | |
| 2012 | |
| 2013 | |
| 2009\2013 | |



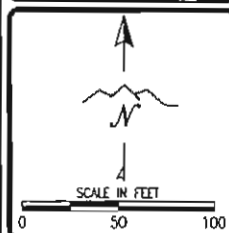
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NOT FOR CONSTRUCTION



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DRAWN BY: CIA
DESIGNED BY: MWW
CHECKED BY: MCE
APPROVED BY: JSM
PROJECT NO. 19133
DATE 4/14/09

PROJECTION: TRANSVERSE MERCATOR
ZONE: MONTANA
DATUM: NAD83 NAVD83
UNITS: FEET
SOURCE: PIONEER



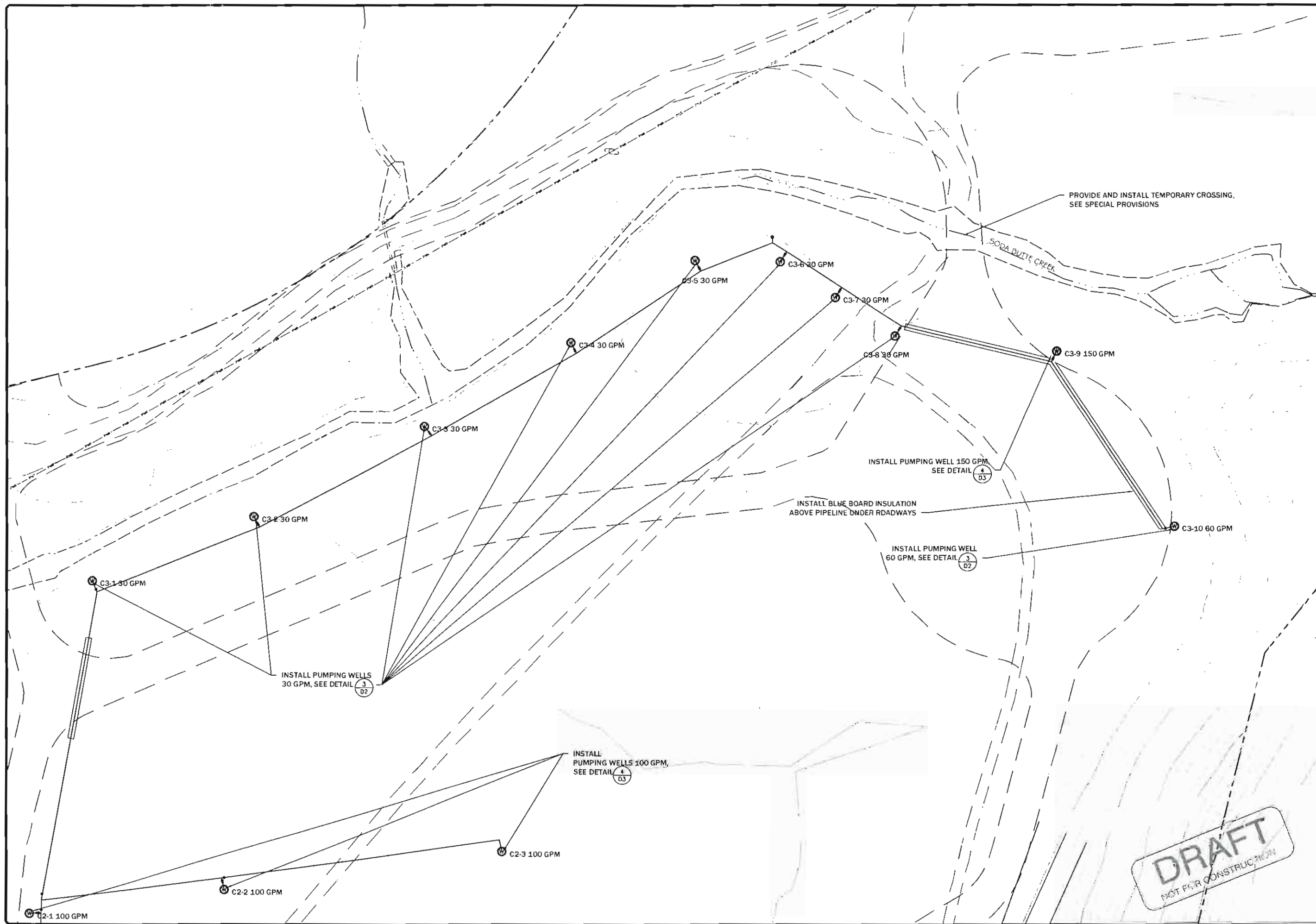
MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

DEWATERING
SYSTEM
LAYOUT



DRAFT
NOT FOR CONSTRUCTION

SHEET 16



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| REVISION | DATE | BY | DESC. |
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| DRAWN BY: | CLA |
| DESIGNED BY: | AWB |
| CHECKED BY: | MCE |
| APPROVED BY: | JSM |
| PROJECT NO. | 10133 |
| DATE: | 4/15/09 |

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| PROJECTION | TRANSVERSE MERCATOR |
| ZONE | MONTANA |
| DATUM | NAD 83 |
| UNITS | FEET |
| SOURCE | PIONEER |

SCALE IN FEET

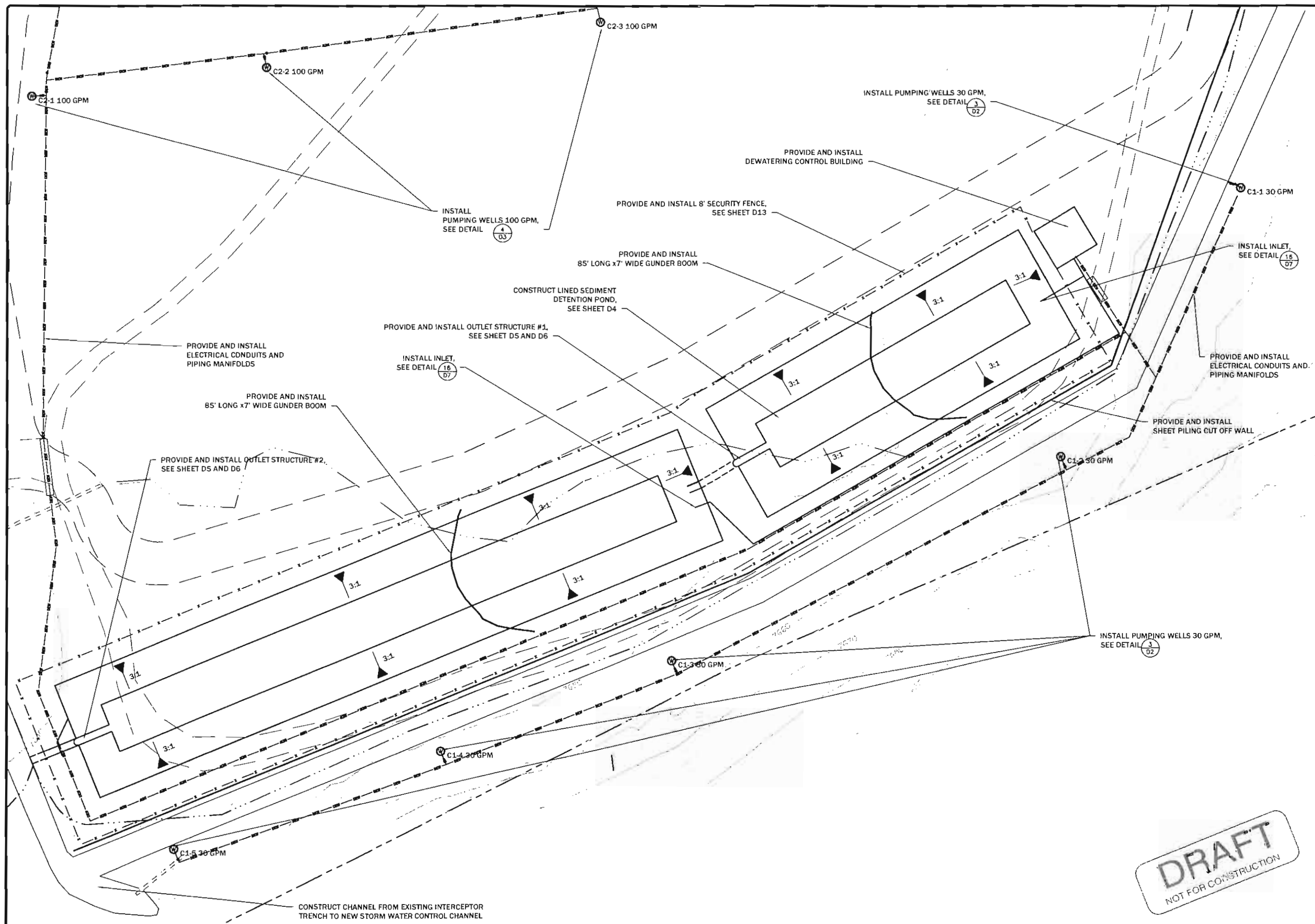
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MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

DEWATERING SYSTEM
AND PUMPING
WELL
LOCATIONS

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

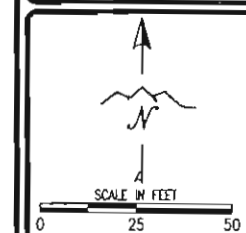
SHEET
15



| REVISION | DATE | BY | DESC. |
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DRAWN BY: CLC
DESIGNED BY: MWS
CHECKED BY: MWS
APPROVED BY: JSM
PROJECT NO: 10131
DATE: 4/18/09

PROJECTION: TRANSVERSE MERCATOR
ZONE: MONTANA
DATUM: NAD 83
UNITS: FEET
SOURCE: PIONEER

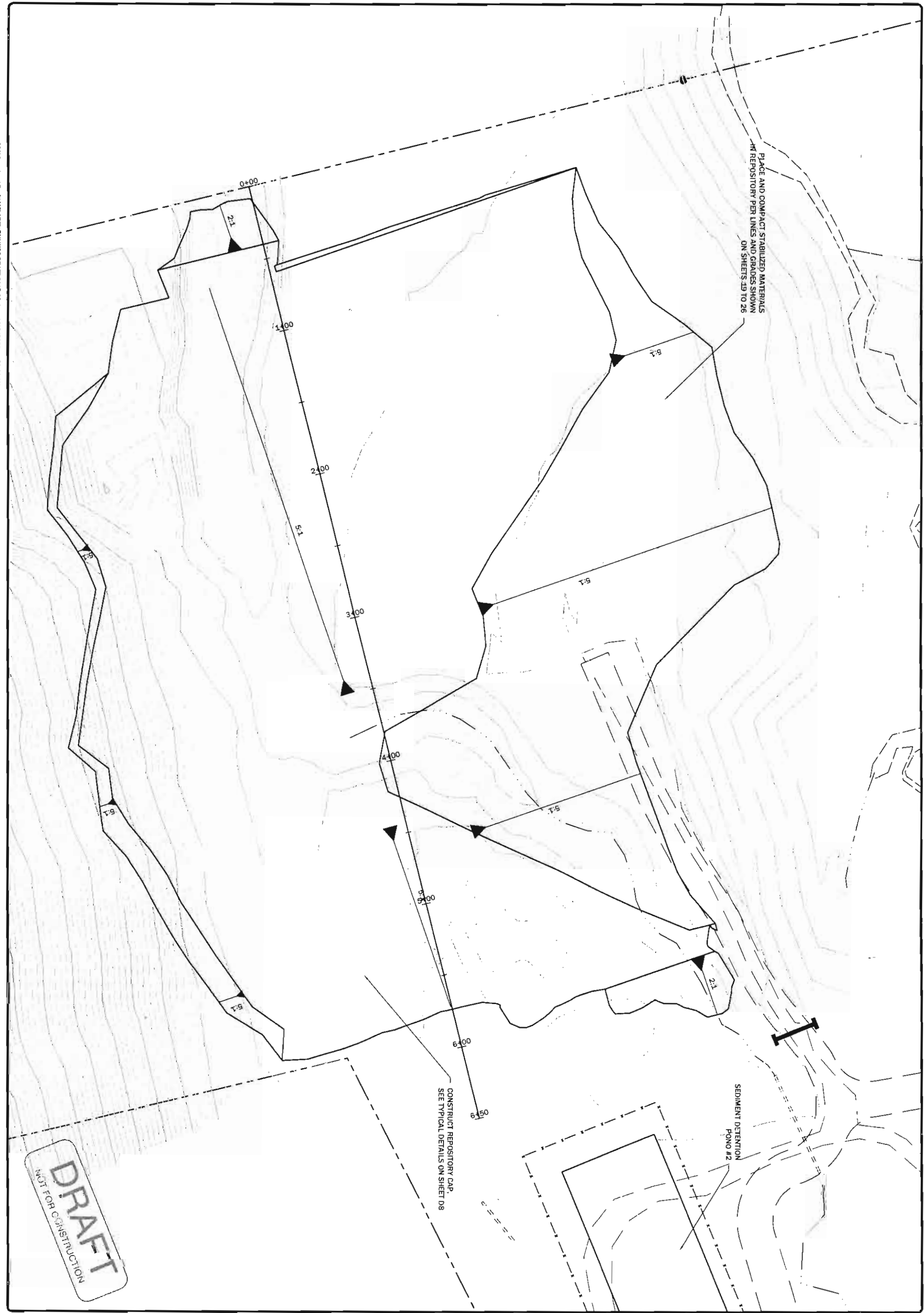


MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

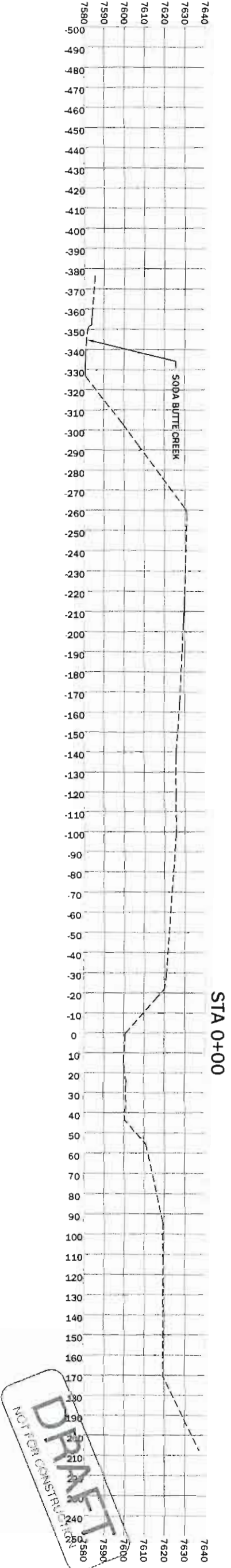
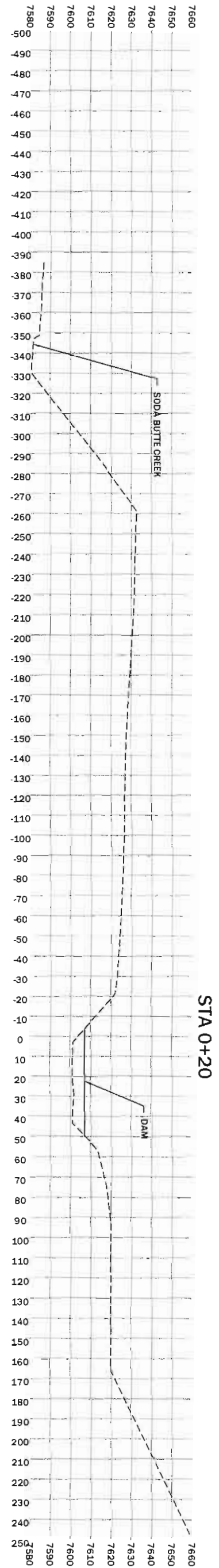
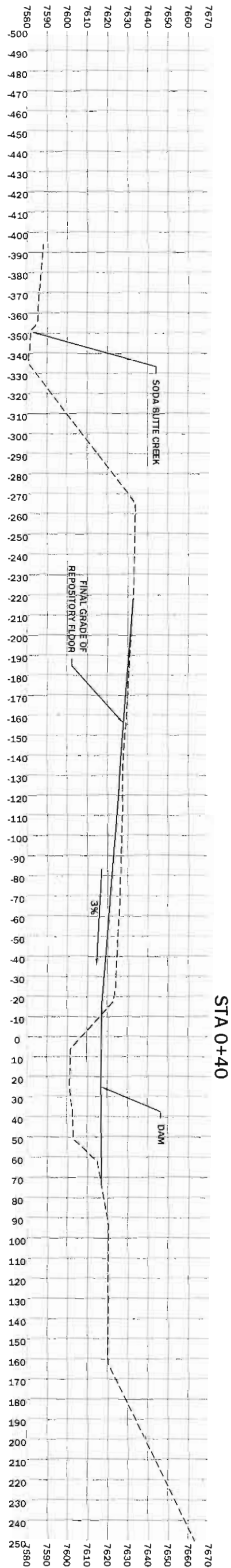
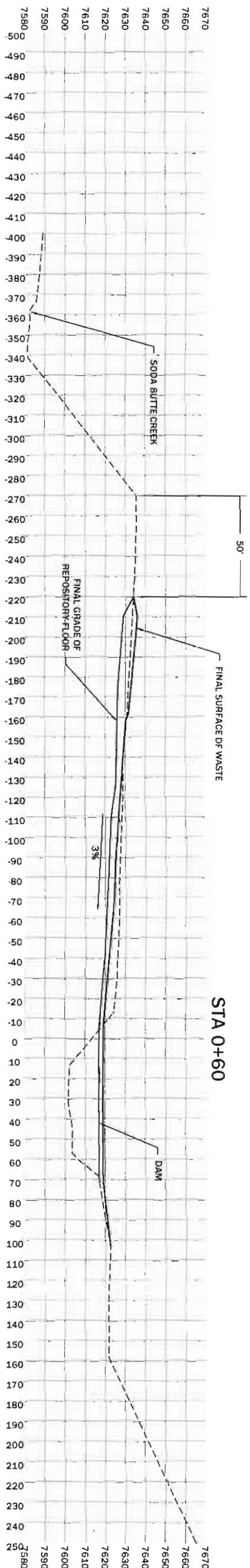
DEWATERING SYSTEM
AND PUMPING
WELL
LOCATIONS



DRAFT
NOT FOR CONSTRUCTION



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| SHEET 18 | PIONEER TECHNICAL SERVICES, INC. Butte, Helena, Anaconda | REPOSITORY FINAL SURFACE CAPPING PLAN | MDEQ/MWCB MCLAREN TAILINGS ABANDONED MINE SITE RECLAMATION PROJECT | | DESIGNED BY: JCA | DATE: 4/13/09 |
| | | | | | CHECKED BY: JSM | DATE: 4/13/09 |
| | | | | PROJECT NO.: 10133 | | DATE: 4/13/09 |
| | | | | PROJECT ON: JAMES R. MCLAREN | | DATE: 4/13/09 |
| | | | | PROJECT AT: MCLAREN TAILINGS ABANDONED MINE | | DATE: 4/13/09 |
| | | | | PROJECT FOR: MCLAREN TAILINGS ABANDONED MINE | | DATE: 4/13/09 |



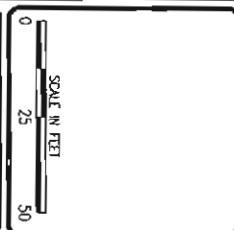
NOT FOR CONSTRUCTION

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| REVISION | BY | DATE |
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| DESIGNED BY | SEA |
| CHECKED BY | JWM |
| APPROVED BY | JWM |
| PROJECT NO. | 10133 |
| DATE | 4/15/02 |

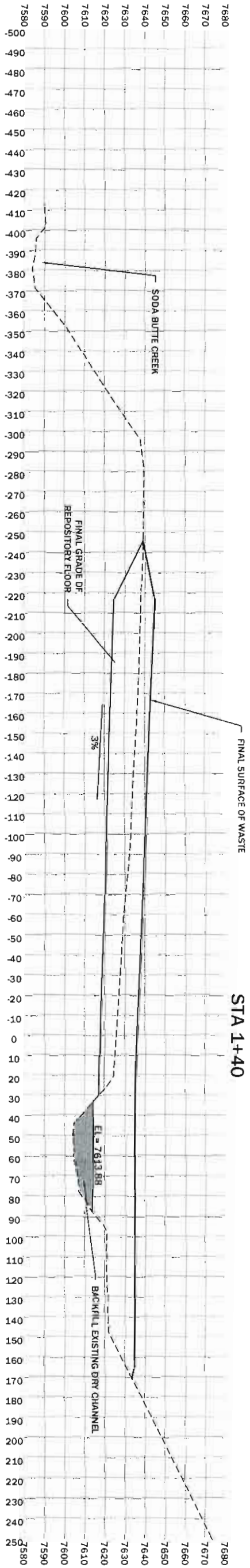
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| PROJECT | |
| ZONE | |
| DRAWN | |
| UNIT | FEET |
| SHEET | 19 |



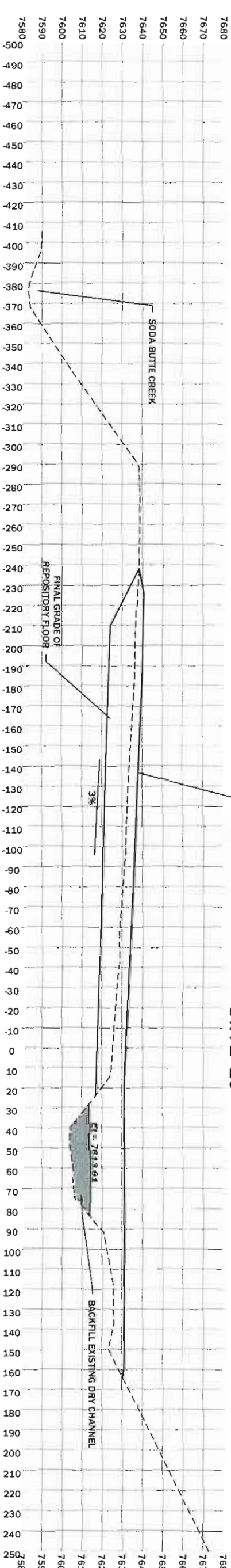
MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 0+00 TO 0+60

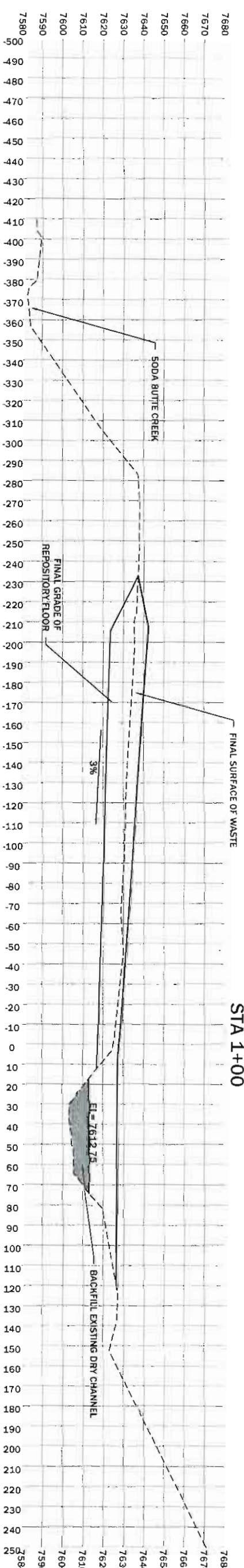




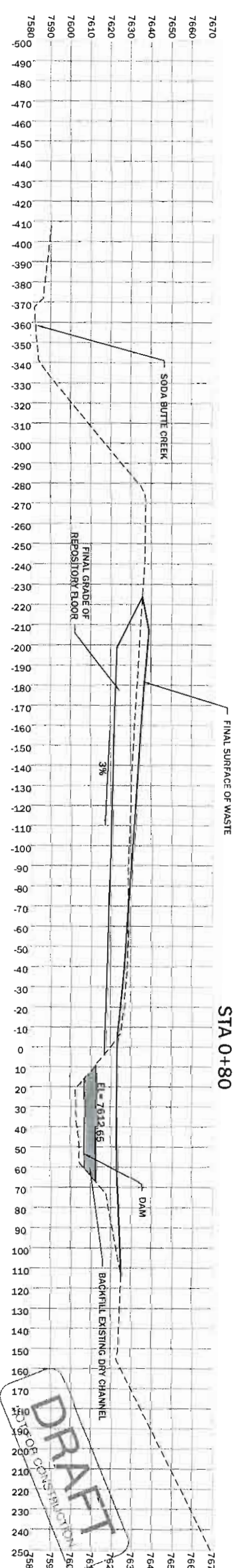
STA 1+40



STA 1+20



STA 1+00

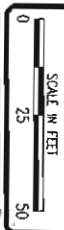


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| REVISION | BY | DATE |
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| DRAWN BY | CIA |
| CHECKED BY | JSM |
| APPROVED BY | JSM |
| PROJECT NO. | 10123 |
| DATE | 4/15/02 |

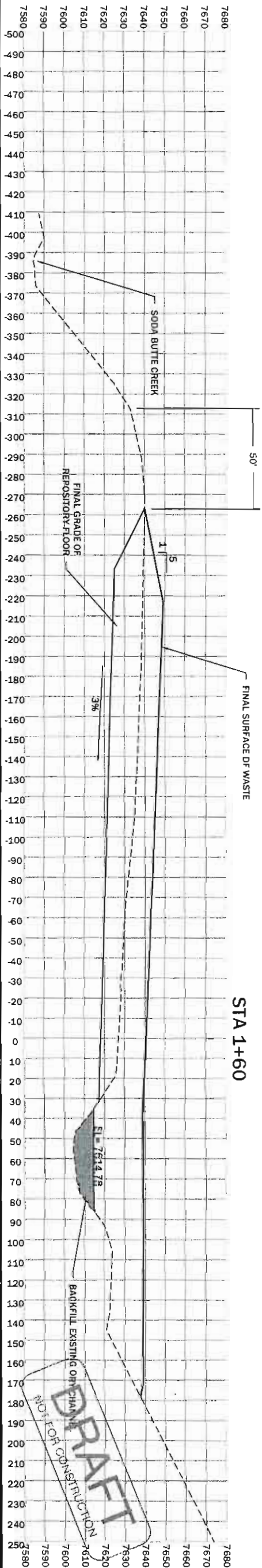
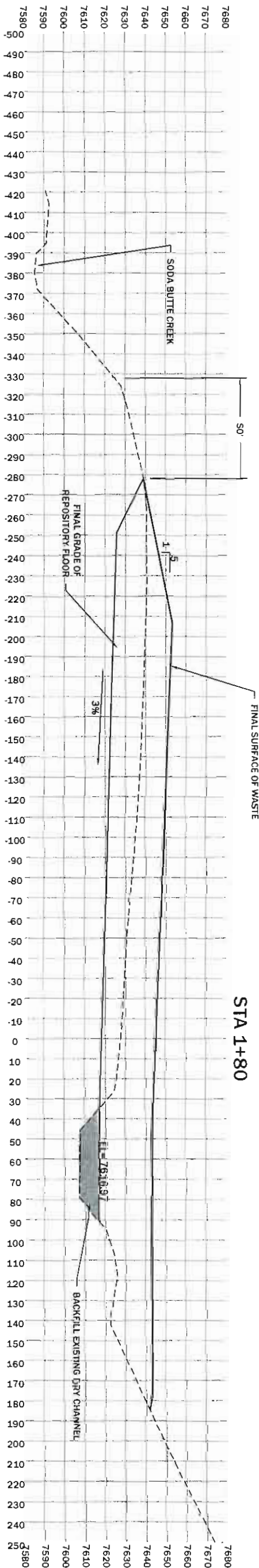
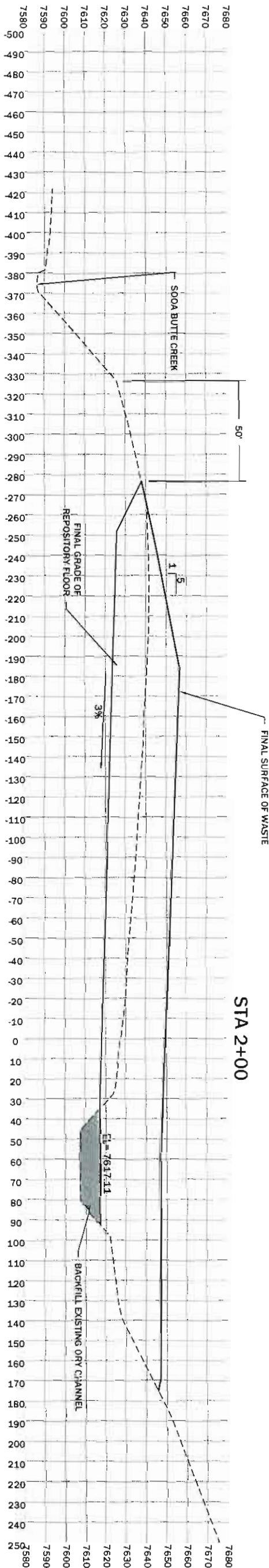
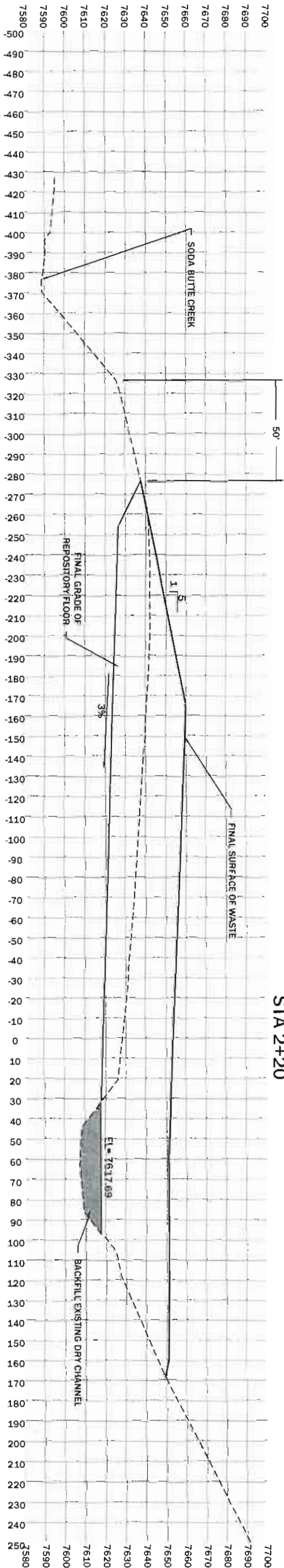
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| PROJECT NO. | 10123 |
| DATE | 4/15/02 |
| SCALE | AS SHOWN |



MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 0+80 TO 1+40

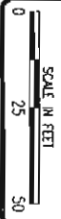




| REVISION | DATE | BY | CHK |
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DRAWN BY: CJA
DESIGNED BY: JSM
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO. 10131
DATE 4/15/08

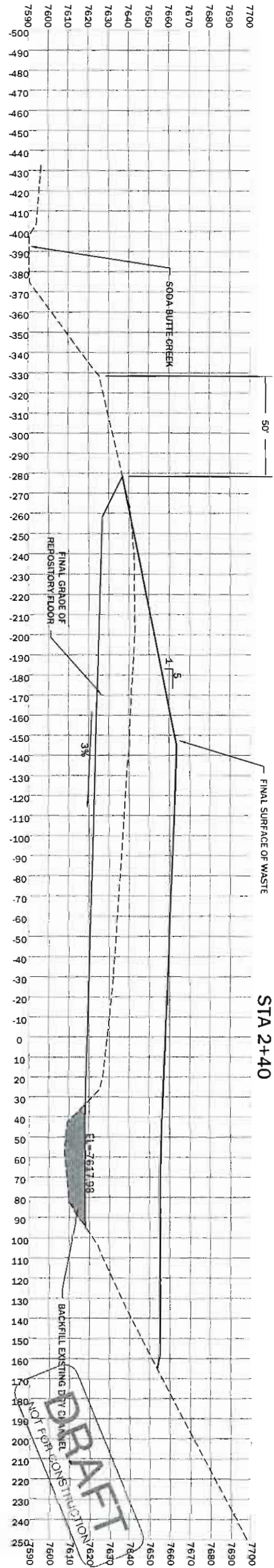
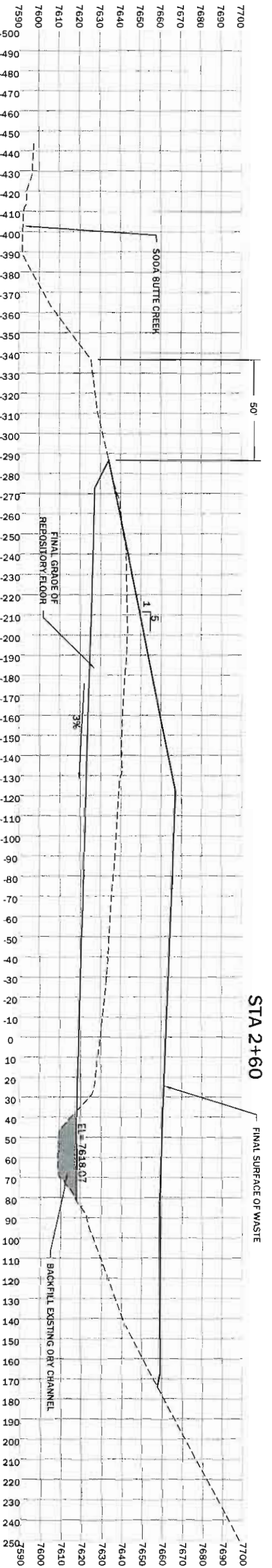
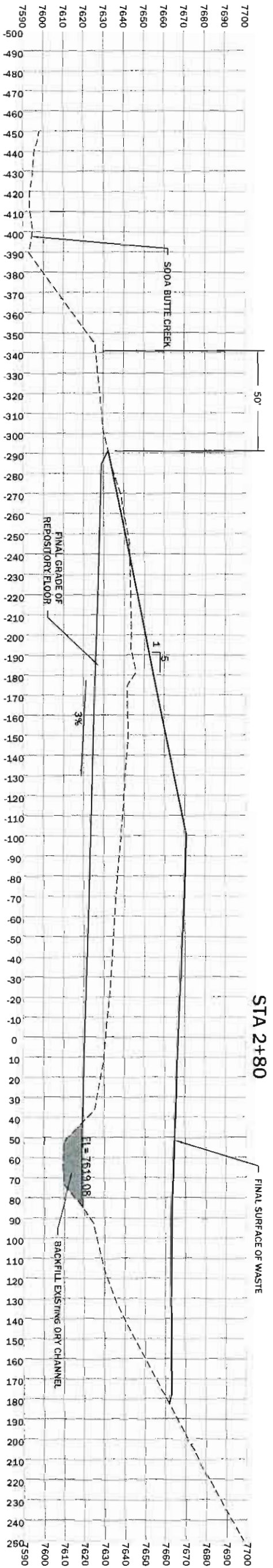
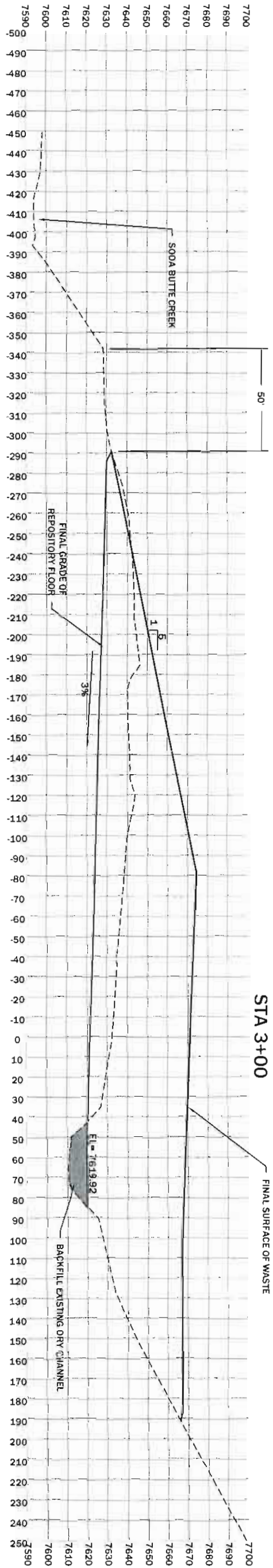
PROJECT:
ZONE:
DRAIN:
UNITS: FEET
SOURCE: PIONEER



MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 1+60 TO 2+20





| REVISION | BY | DATE |
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| DESIGNED BY | CA |
| CHECKED BY | JM |
| APPROVED BY | JM |
| PROJECT NO. | 10133 |
| DATE | 4/13/09 |

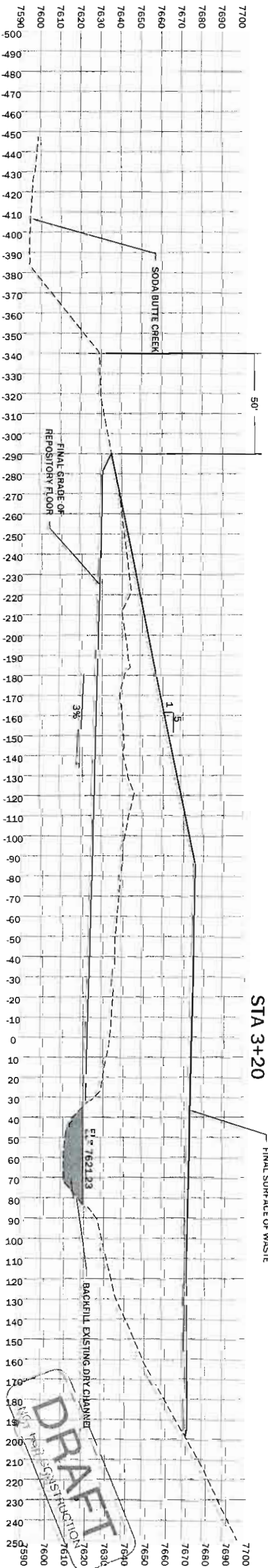
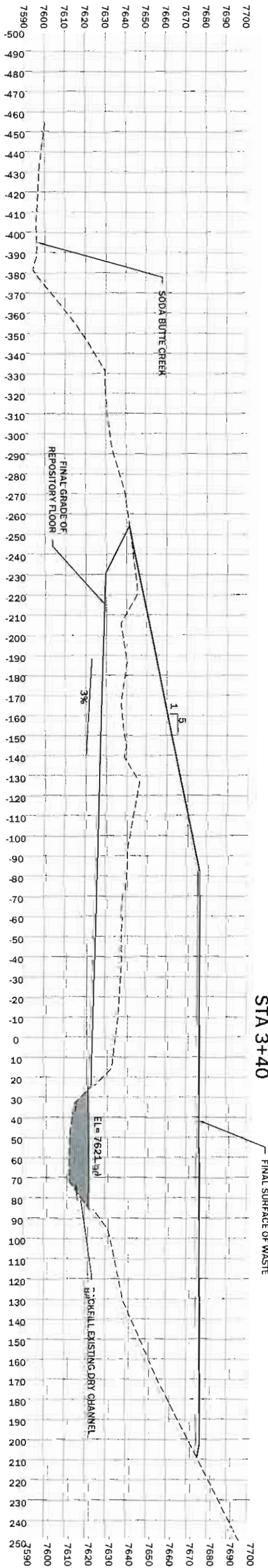
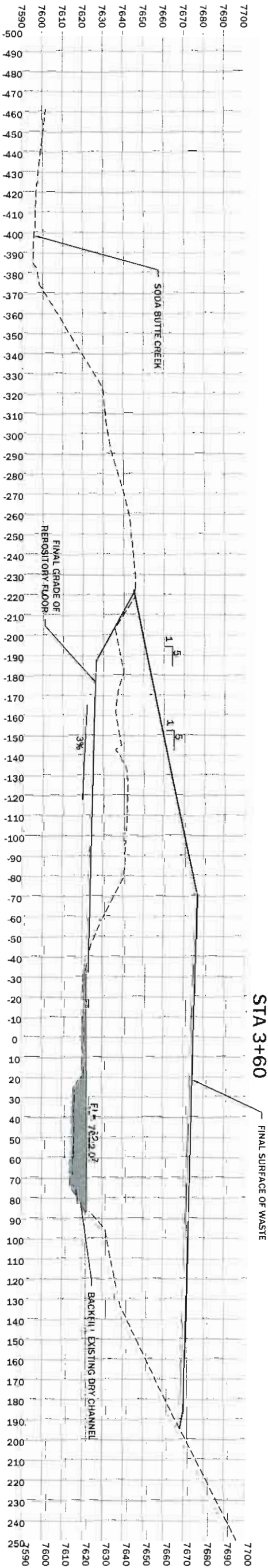
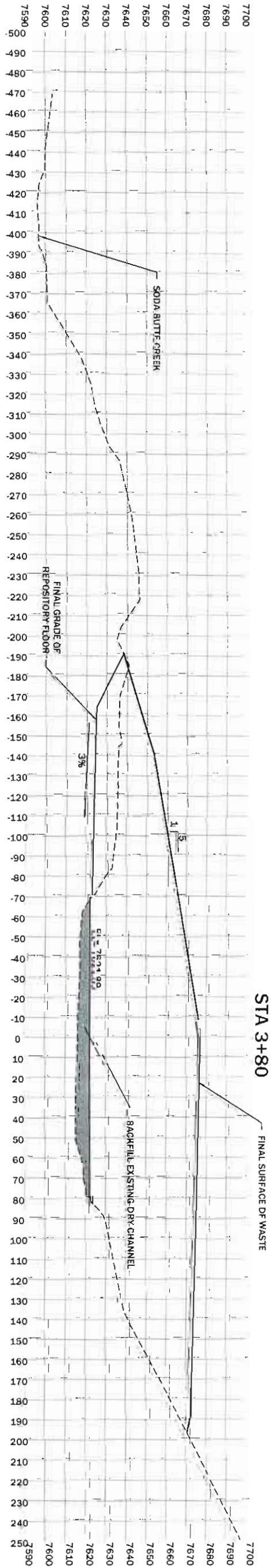
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| PROJECTION | |
| ZONE | |
| BATHY | |
| UNIT | FEET |
| SOURCE | POWER |

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| SCALE IN FEET |
| 0 |
| 25 |
| 50 |

MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 2+40 TO 3+00

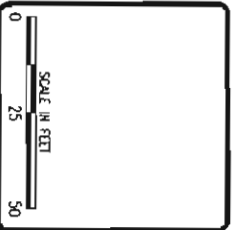




| REVISION | BY | DATE |
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| DRAWN BY: | CA |
| CHECKED BY: | JSM |
| APPROVED BY: | JSM |
| PROJECT NO. | 10133 |
| DATE | 4/12/02 |

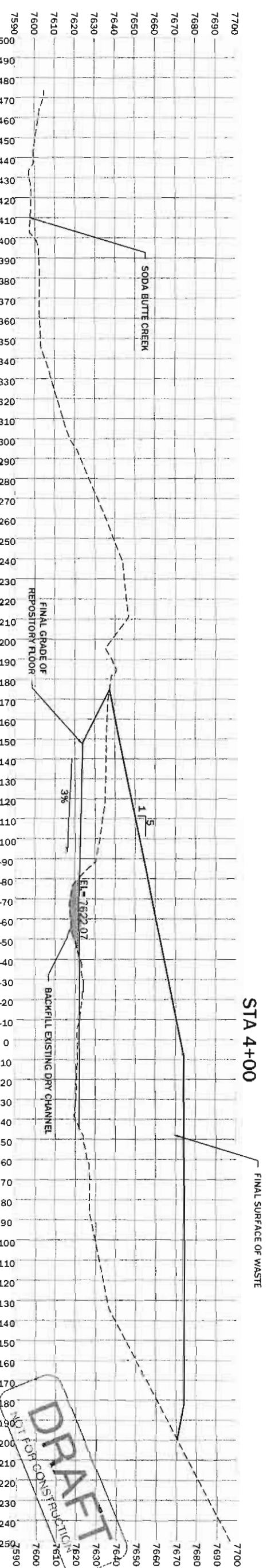
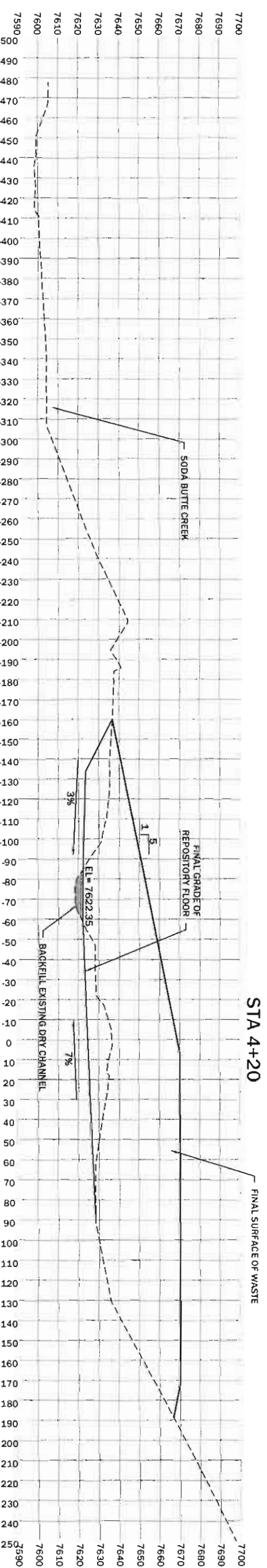
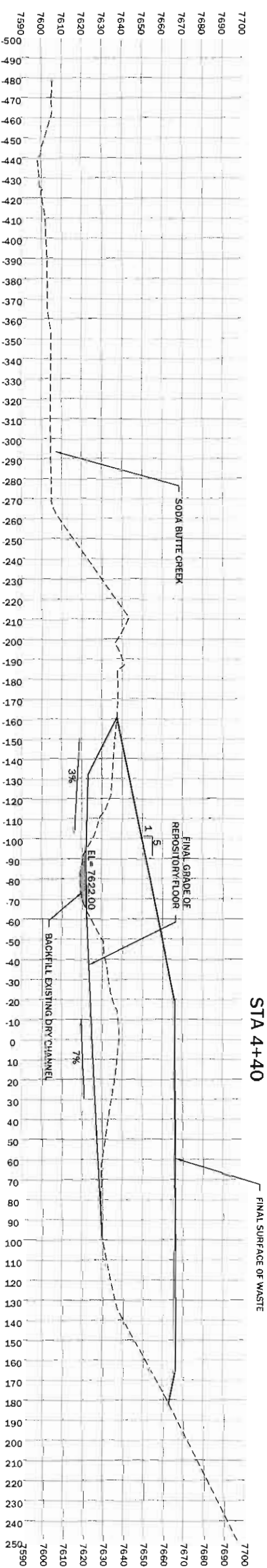
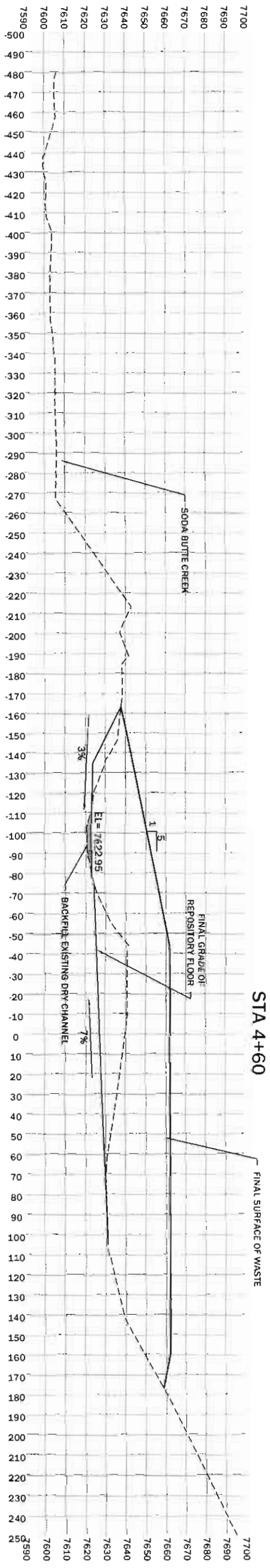
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| PROJECT | |
| ZONE | |
| DATE | |
| UNITS | FEET |
| SOURCE | ADDITIONAL |



MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 3+20 TO 3+80





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| DATE | BY | DISC |
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| DRAWN BY | CA |
| CHECKED BY | JSM |
| APPROVED BY | JSM |
| PROJECT NO. | 1013 |
| DATE | 6/15/09 |

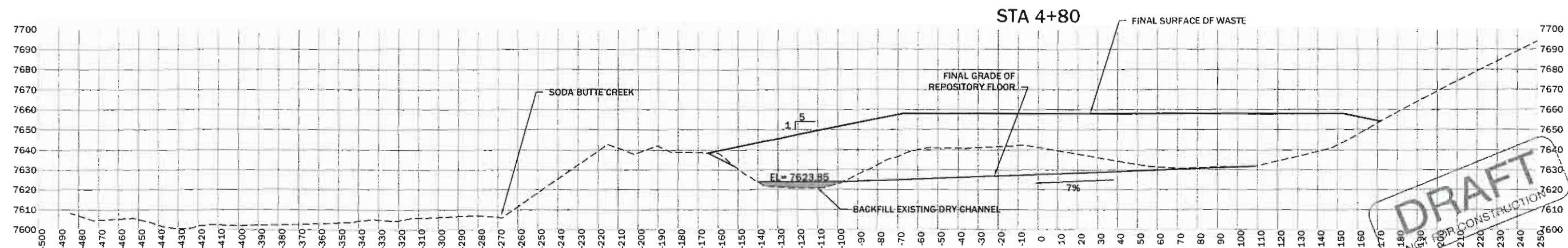
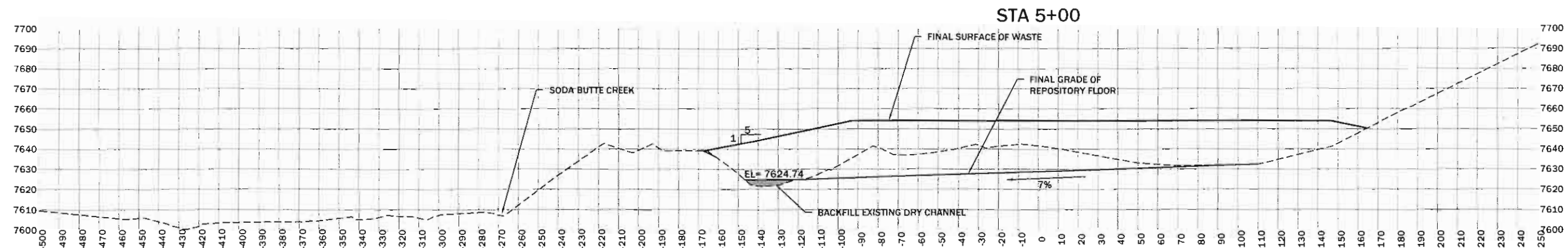
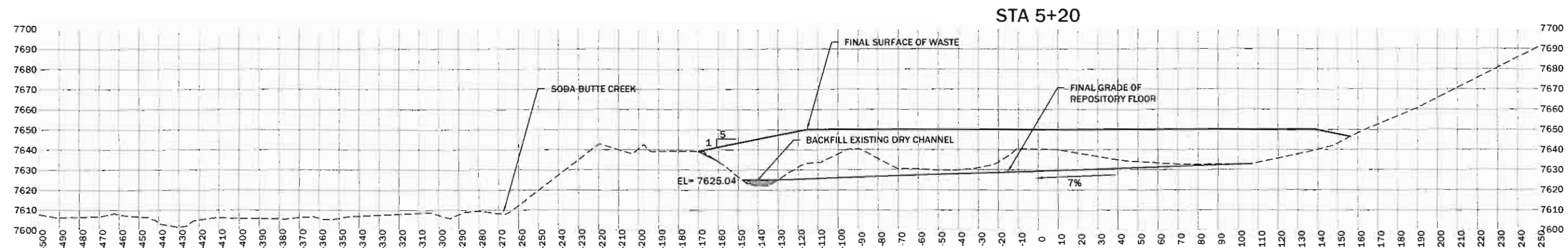
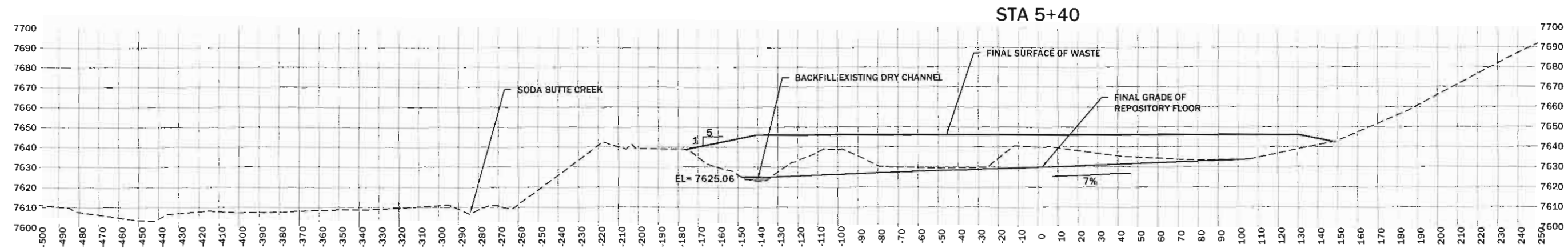
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| PROJECTION | |
| ZONE | |
| DATUM | |
| UNITS | FEET |
| SOURCE | DOUGHER |

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| SCALE IN FEET |
| 0 |
| 25 |
| 50 |

MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 4+00 TO 4+60

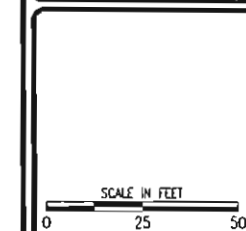




| REVISION | DATE | BY | DESC |
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DRAWN BY: CLM
 DESIGNED BY: JSM
 CHECKED BY: JSM
 APPROVED BY: JSM
 PROJECT NO.: 10133
 DATE: 4/13/09

PROJECTION:
 ZONE:
 DATUM:
 UNITS: FEET
 SOURCE: PIONEER

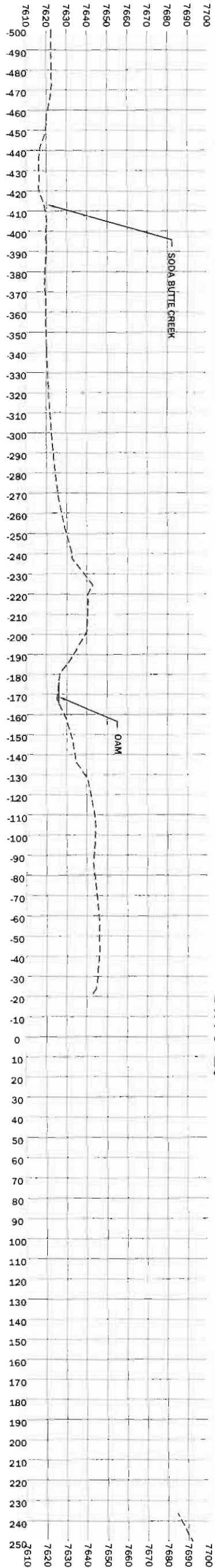


MDEQ/MWCB
 MCLAREN TAILINGS ABANDONED
 MINE SITE RECLAMATION PROJECT

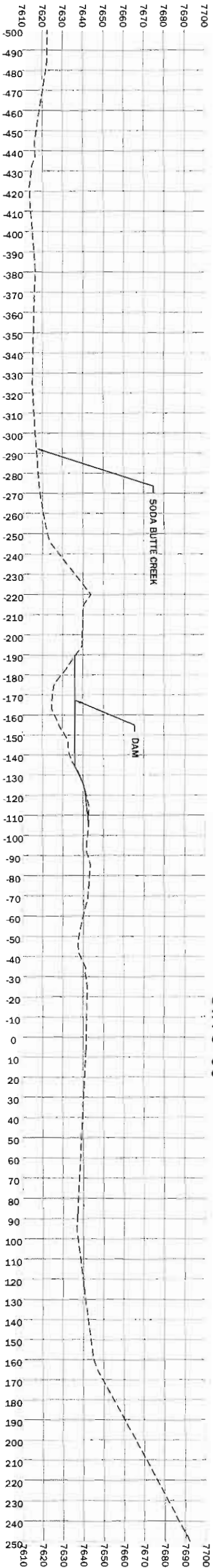
REPOSITORY
 CROSS SECTIONS
 STA 4+80 TO 5+40

PIONEER
 TECHNICAL SERVICES, INC.
 Butte, Helena, Anaconda

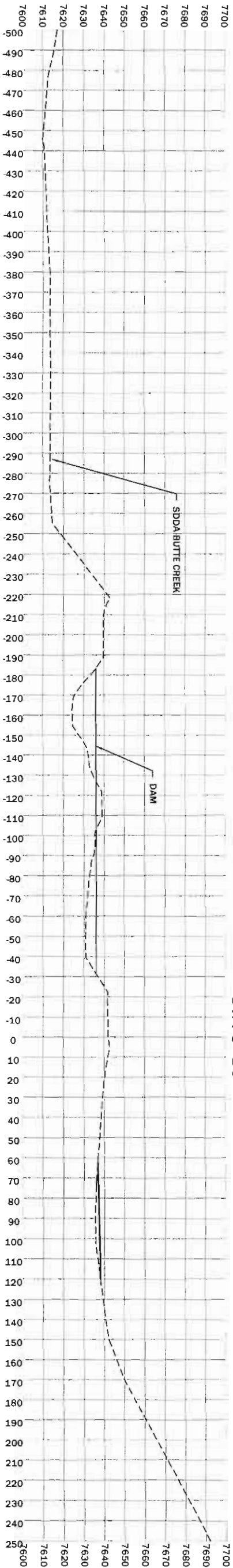
SHEET
 25



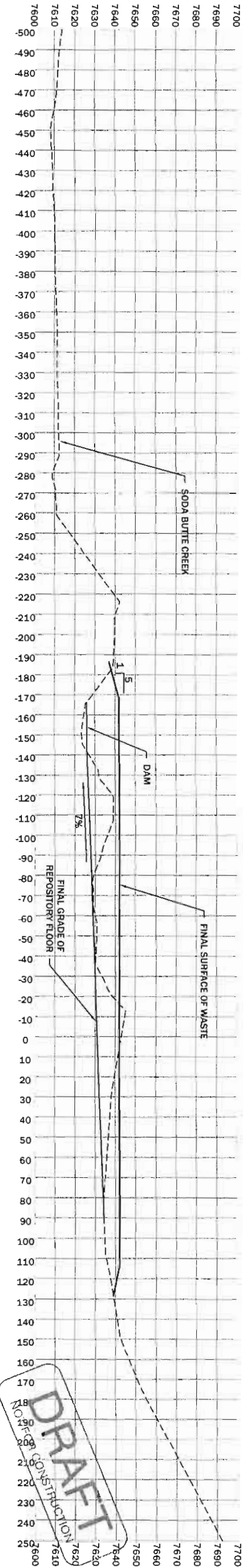
STA 6+20



STA 6+00



STA 5+80

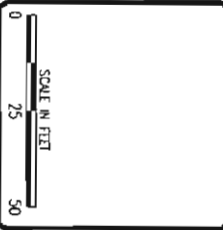


STA 5+60

| REVISION | |
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| DATE | BY |
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| DESIGNED BY | CHK |
| CHECKED BY | JSM |
| APPROVED BY | JSM |
| PROJECT NO. | 10111 |
| DATE | 4/17/2008 |

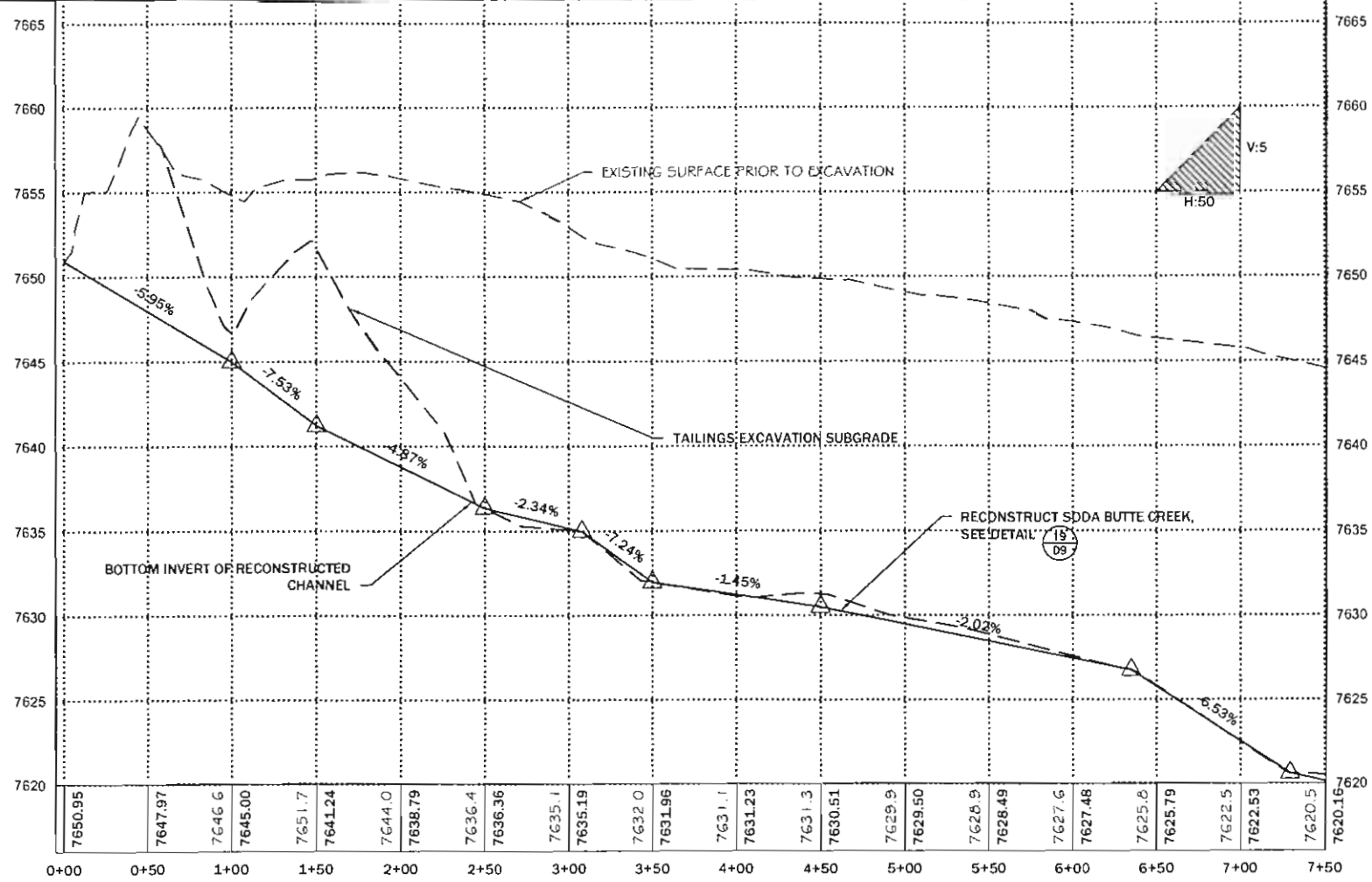
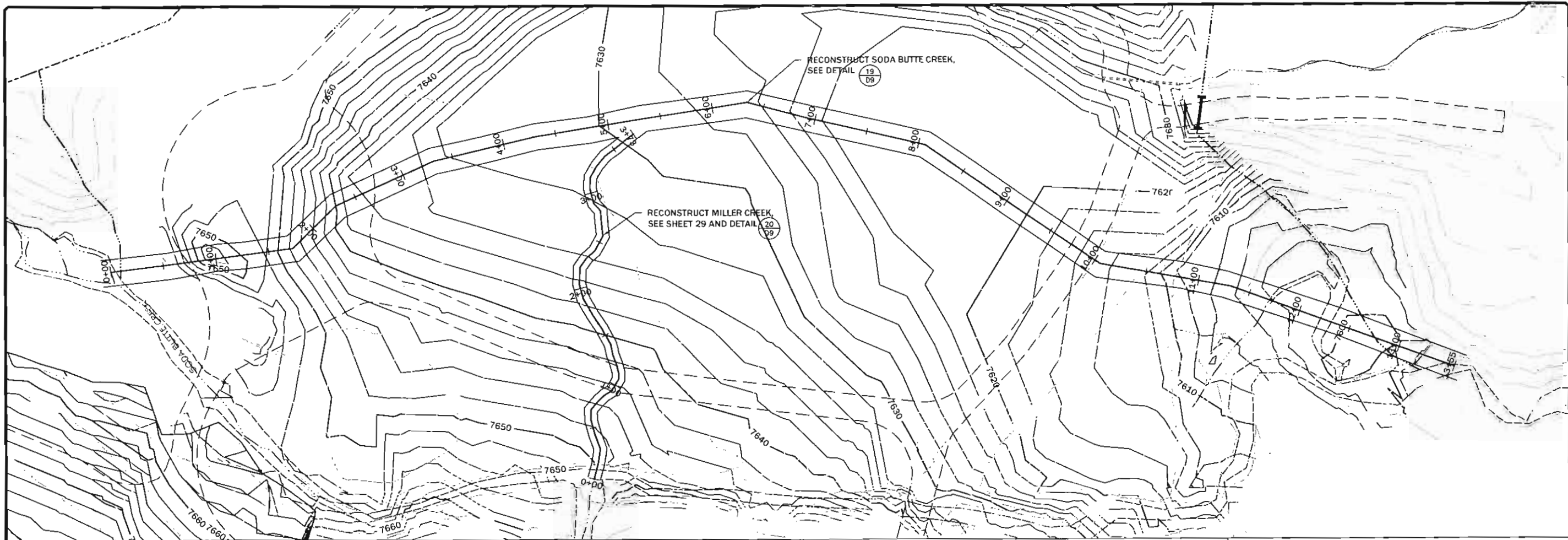
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| PROJECTION | |
| ZONE | |
| DATUM | |
| UNITS | FEET |
| SOURCE | POINTER |



MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY
CROSS SECTIONS
STA 5+60 TO 6+20



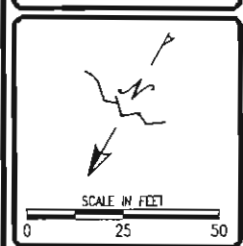


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NOT FOR CONSTRUCTION

| REVISION | DATE | BY | DESC |
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DRAWN BY: CIA
DESIGNED BY: MCB
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO: 10133
DATE: 4/15/02

PROJECTION: TRANSVERSE MERCATOR
ZONE: MONTANA
DATUM: MSP NAD83 NAVD88
UNITS: FEET
SOURCE: PIONEER

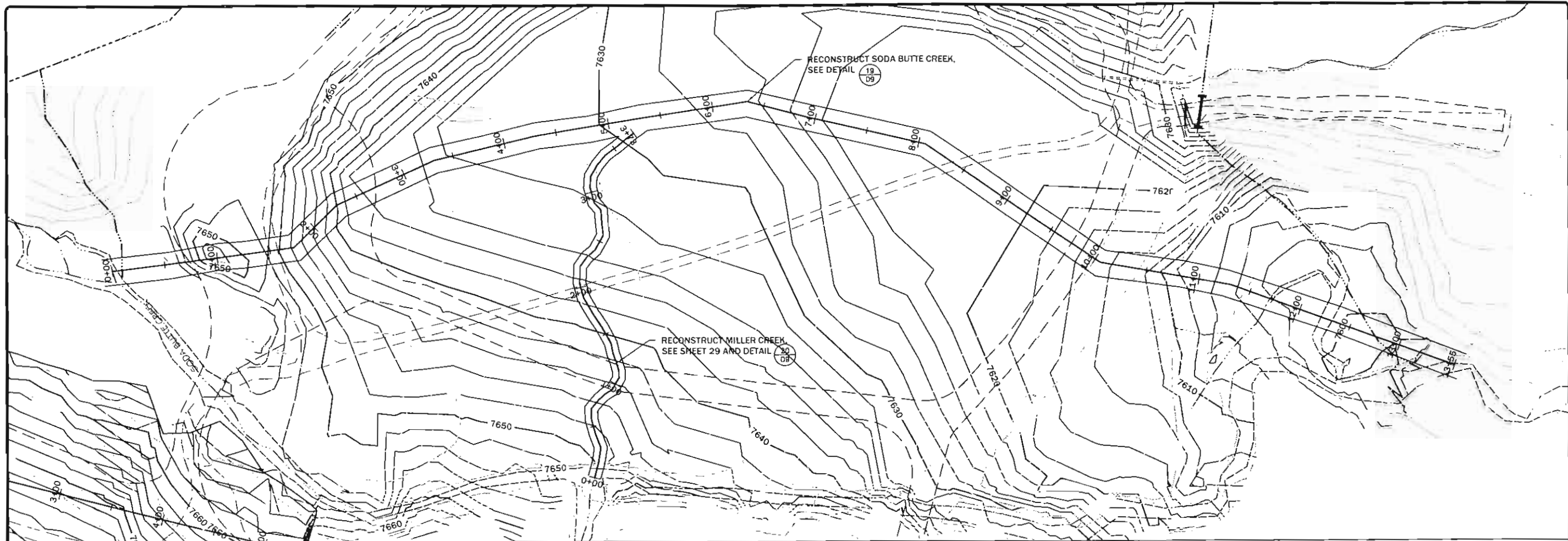


MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

SODA BUTTE CREEK
RECONSTRUCTION
PLAN AND PROFILE
STA 0+00 TO 7+50

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

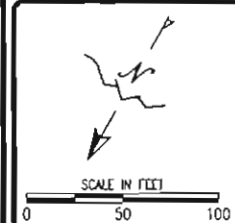
SHEET
27



| REVISION | DATE | BY | DESC. |
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DRAWN BY: CJA
 DESIGNED BY: JSM
 CHECKED BY: JSM
 APPROVED BY: JSM
 PROJECT NO: 10133
 DATE: 4/13/09

PROJECTION: TRANSVERSE MERCATOR
 ZONE: MONTANA
 DATUM: MSP NAD83 NAVD83
 UNITS: FEET
 SOURCE: PIONEER

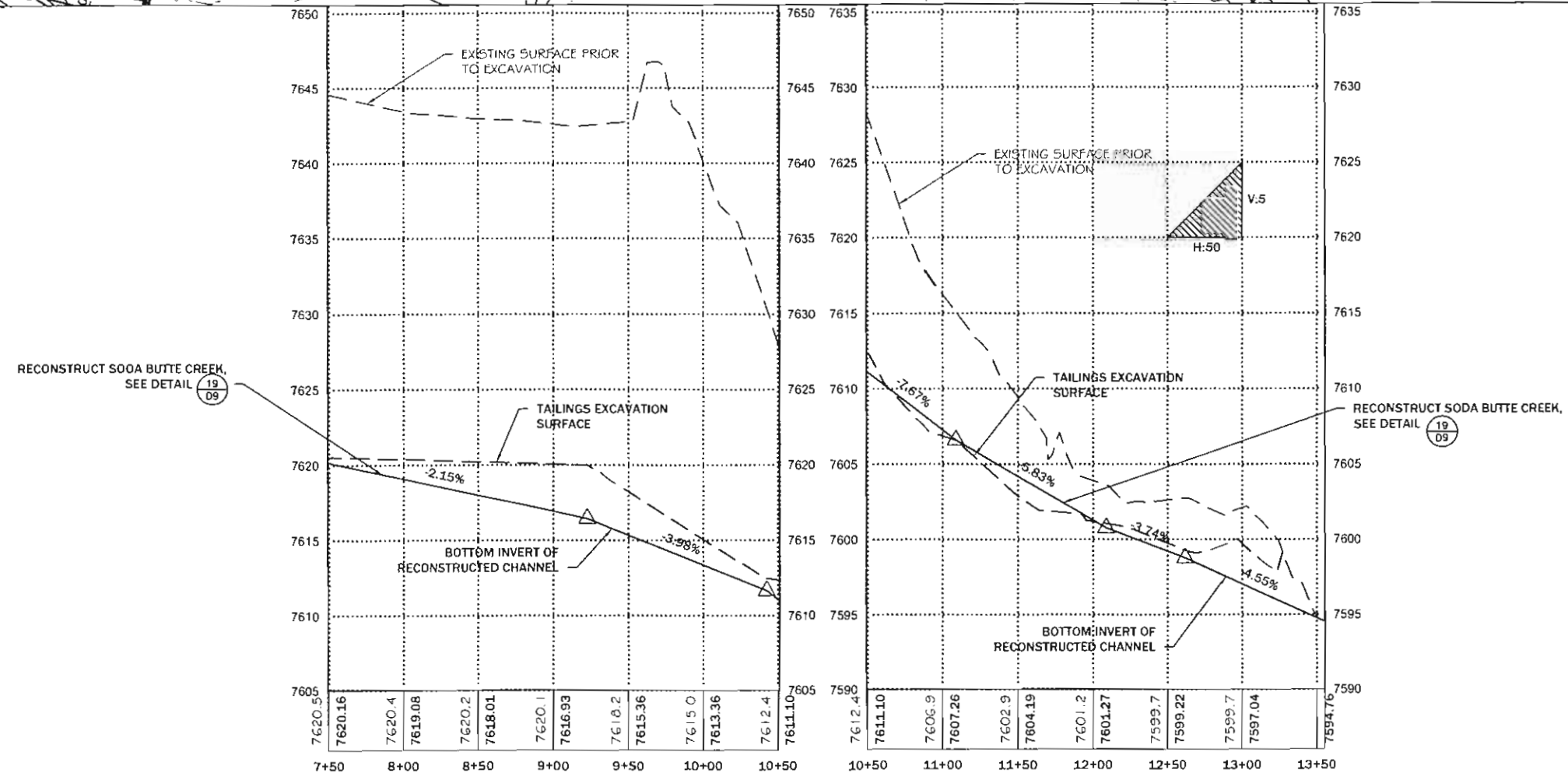


MDEQ/MWCB
 MCLAREN TAILINGS ABANDONED
 MINE SITE RECLAMATION

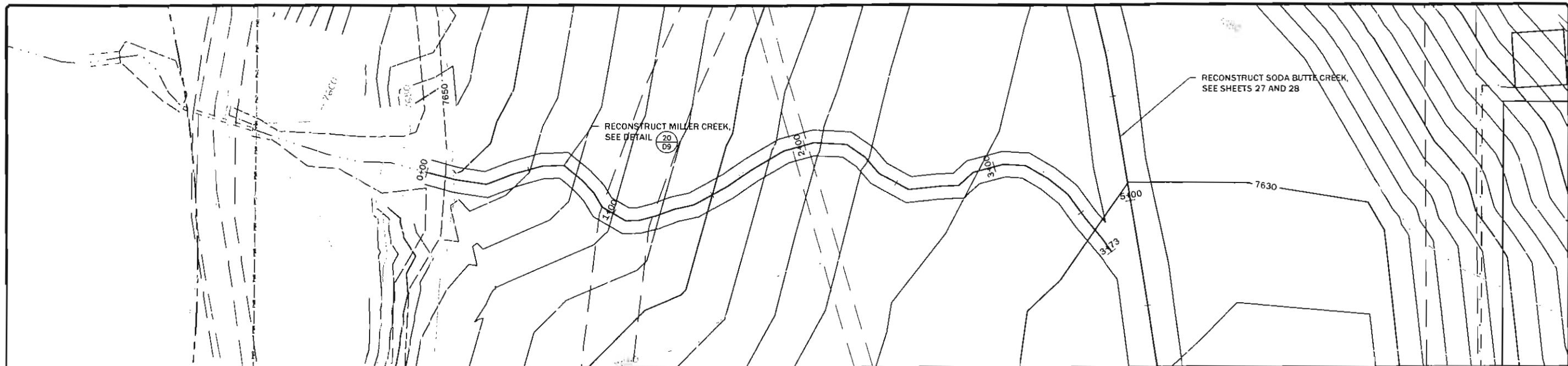
SODA BUTTE CREEK
 RECONSTRUCTION
 PLAN AND PROFILE
 STA 7+50 TO 13+55



SHEET
 28



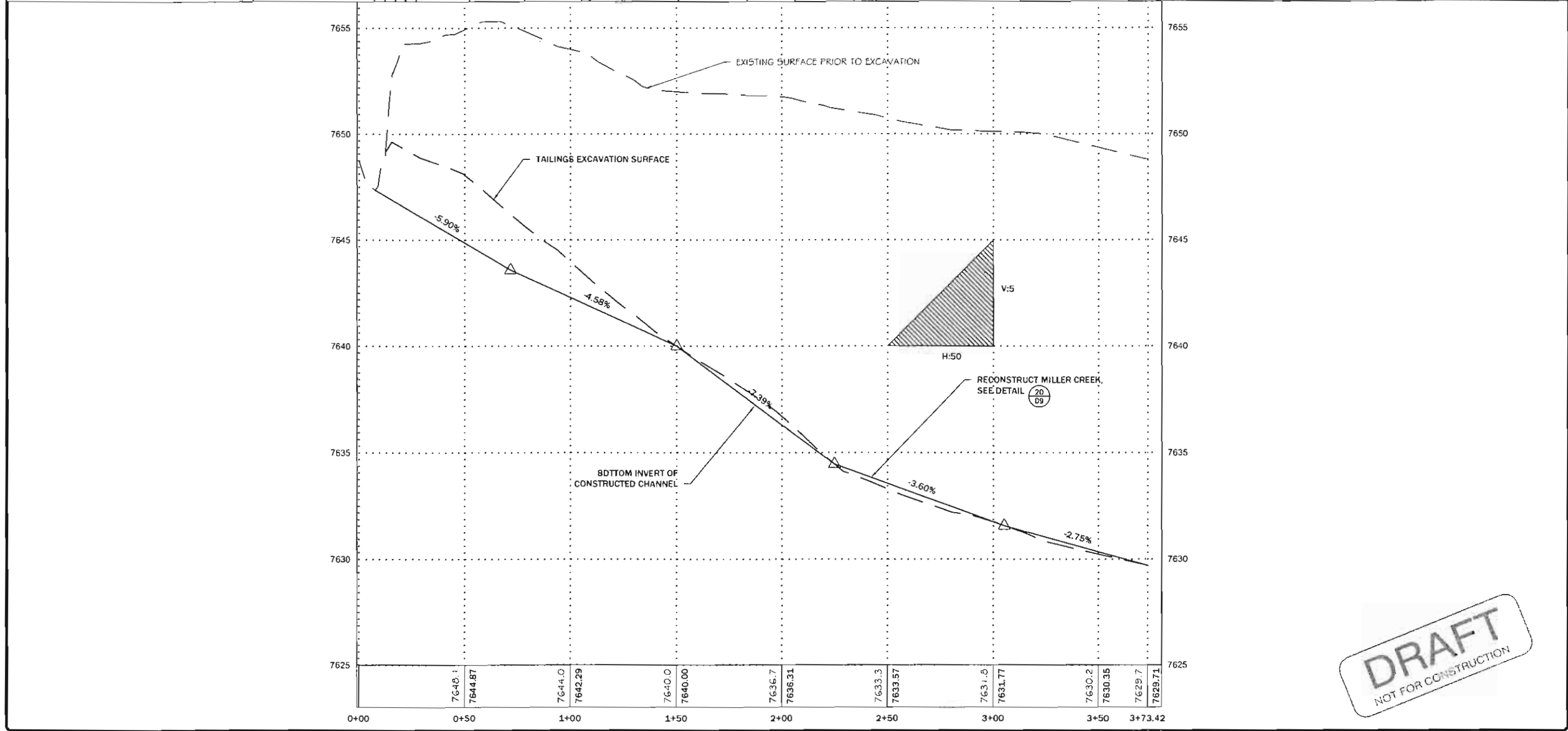
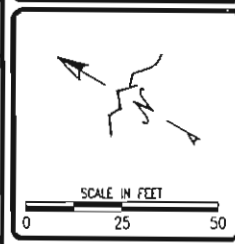
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 NOT FOR CONSTRUCTION



| REVISION | DATE | BY | DESC. |
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DRAWN BY: CJA
 DESIGNED BY: MCB
 CHECKED BY: JSM
 APPROVED BY: JSM
 PROJECT NO.: 10133
 DATE: 4/15/09

PROJECTION: TRANSVERSE MERCATOR
 ZONE: MONTANA
 DATUM: MSP NAD83 NAVD83
 UNITS: FEET
 SOURCE: PIONEER

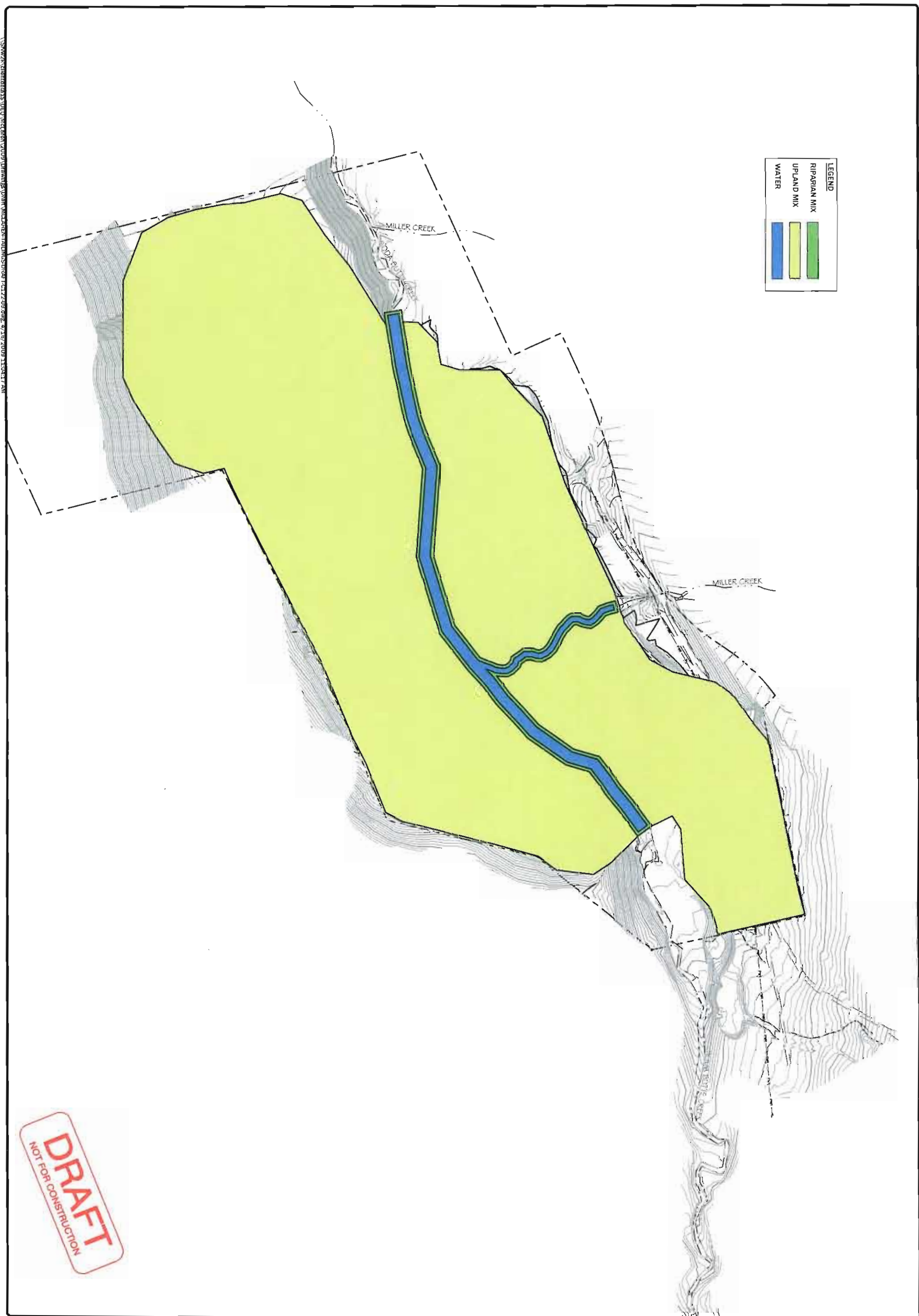


MDEQ/MWCB
 MCLAREN TAILINGS ABANDONED
 MINE SITE RECLAMATION PROJECT

MILLER CREEK
 PLAN AND PROFILE
 STA 0+00 TO 3+73

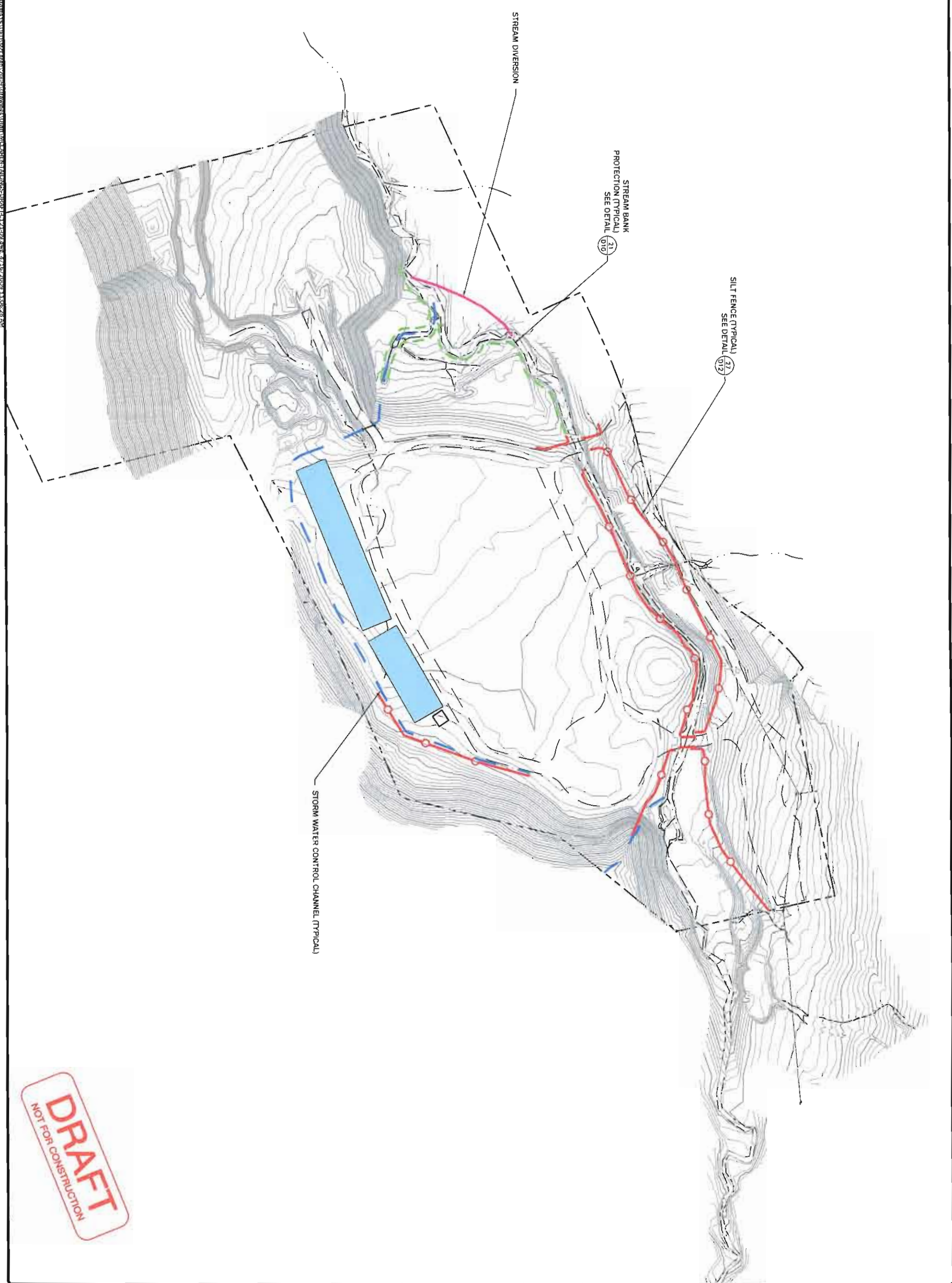


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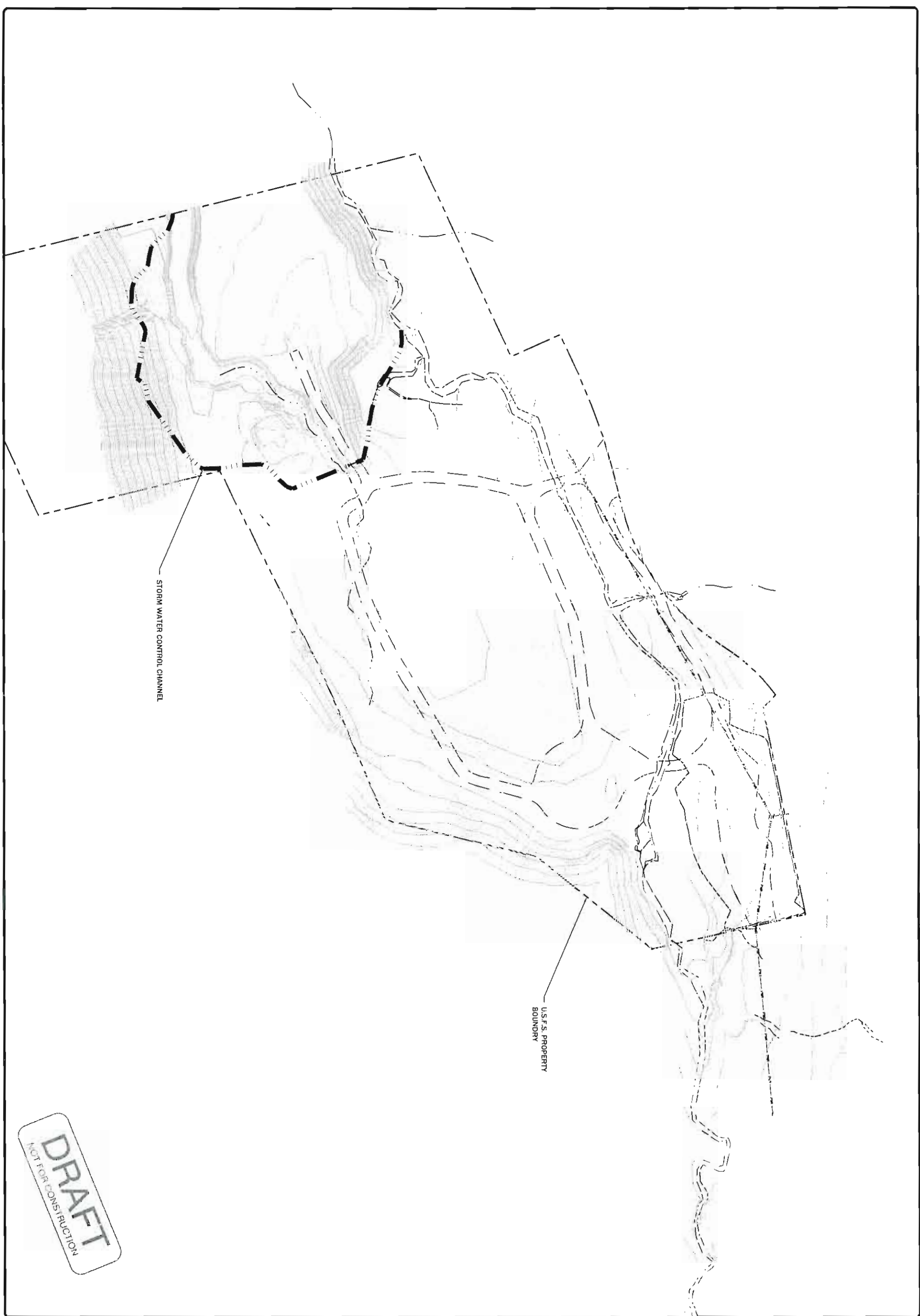
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| SHEET 31 |  PIONEER TECHNICAL SERVICES, INC. Butte, Helena, Anaconda | CONSTRUCTION BMP'S | MDEQ\MWCB MCLAREN TAILINGS ABANDONED MINE SITE RECLAMATION PROJECT |  SCALE IN FEET 0 100 200 | DESIGNED BY: JLB | PROJECT NO.: 10131 | DATE: 6/15/09 | |
| | | | | | CHECKED BY: JLB | PROJECT NO.: 10131 | DATE: 6/15/09 | |
| | | | | | PROJECTION: TRANSVERSE MERCATOR | ZONE: 18N | UNIT: FEET | SOURCE: POSNER |

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|-------------|---------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------|--|------------------|--------------------|---------------|
| SHEET 32 | PIONEER TECHNICAL SERVICES, INC. Butte, Helena, Anaconda | LONG TERM BMP'S | MDEQ\MWCB MCLAREN TAILINGS ABANDONED MINE SITE RECLAMATION PROJECT | | DESIGNED BY: JLM | PROJECT NO.: 10113 | DATE: 4/13/09 |
| | | | | | CHECKED BY: JLM | APPROVED BY: JLM | |
| | | | | | PROJECTION: UTM | ZONE: 18N | UNIT: METERS |
| | | | | | SOURCE: PIONEER | | |

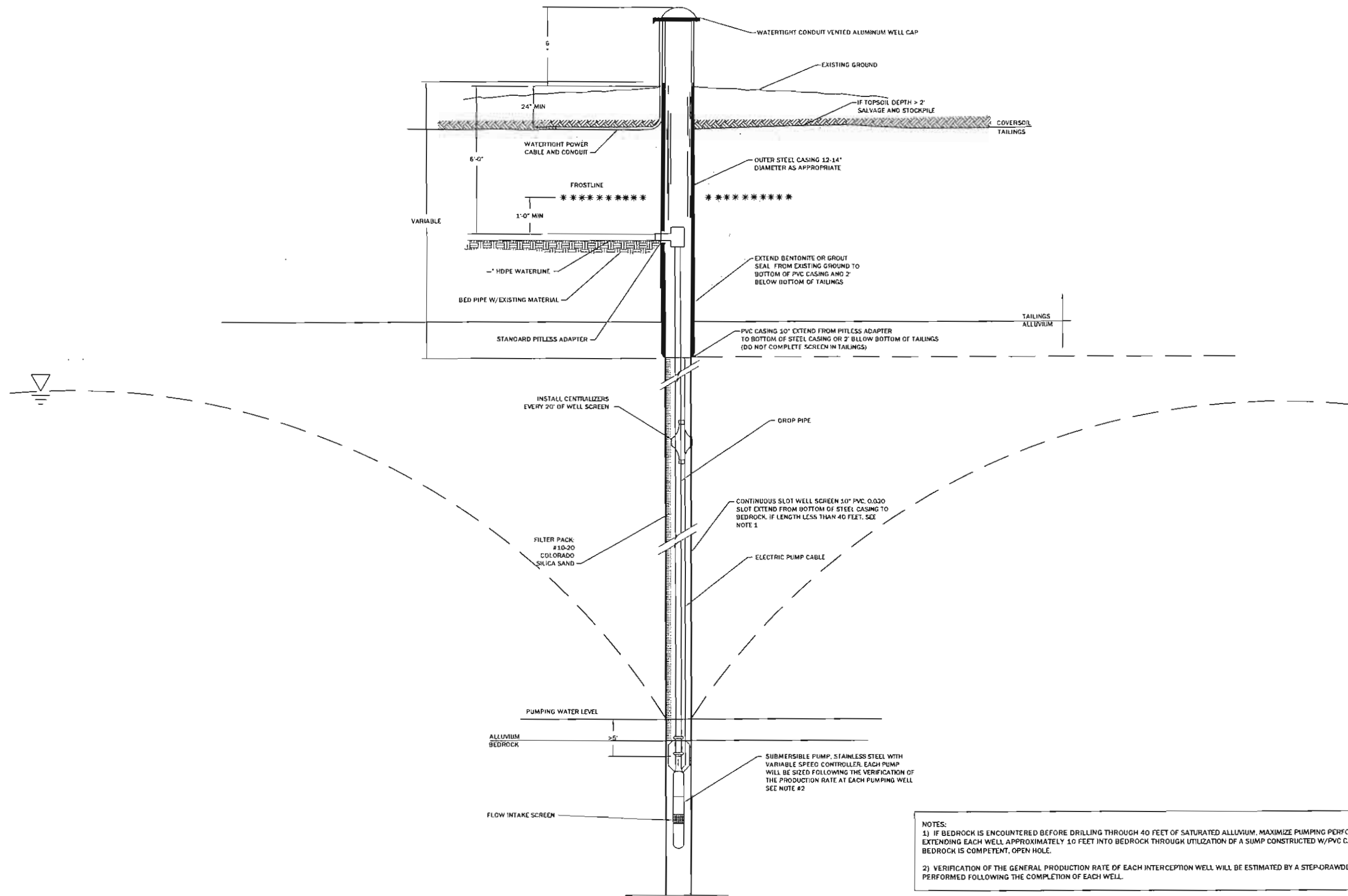
3. CONTRACTOR SHALL SALVAGE EXCAVATED COVER SOIL AND STOCKPILE AS DIRECTED BY ENGINEERS.



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1. INSTALL CULVERT PER MANUFACTURER'S RECOMMENDATIONS.

SHEET
D1



100-200 GPM WELL INSTALLATION DETAIL

4

NOT TO SCALE

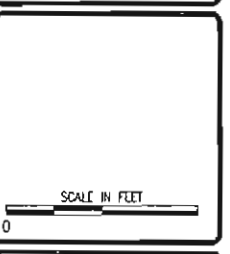
NOTES:
 1) IF BEDROCK IS ENCOUNTERED BEFORE DRILLING THROUGH 40 FEET OF SATURATED ALLUVIUM, MAXIMIZE PUMPING PERFORMANCE BY EXTENDING EACH WELL APPROXIMATELY 10 FEET INTO BEDROCK THROUGH UTILIZATION OF A SUMP CONSTRUCTED W/PVC CASING. OR IF BEDROCK IS COMPETENT, OPEN HOLE.
 2) VERIFICATION OF THE GENERAL PRODUCTION RATE OF EACH INTERCEPTION WELL WILL BE ESTIMATED BY A STEP-DRAWDOWN TEST TO BE PERFORMED FOLLOWING THE COMPLETION OF EACH WELL.

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| REVISION | DATE | BY | DESC. |
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DRAWN BY: SKJ
 DESIGNED BY: MMB
 CHECKED BY: JSM
 APPROVED BY: MMB
 PROJECT NO: 10133
 DATE: 4/15/09

PROJECTION:
 ZONE:
 DATUM:
 UNITS:
 SOURCE:

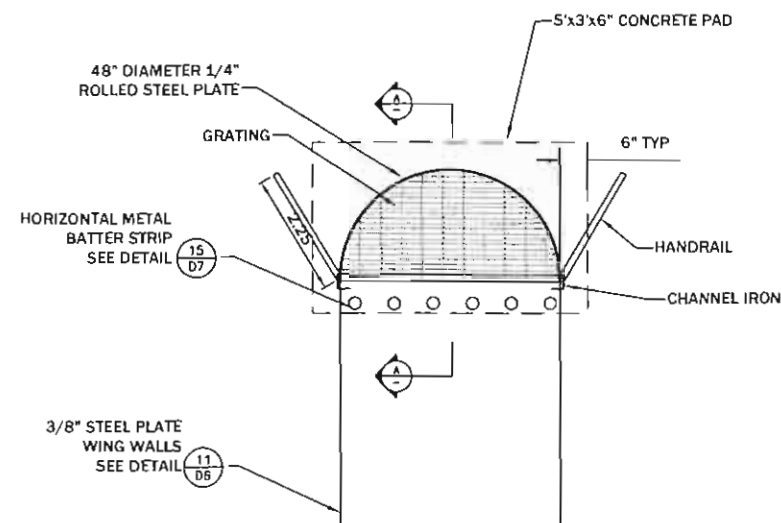


MDEQ/MWCB
 McLAREN TAILINGS ABANDONED
 MINE SITE RECLAMATION PROJECT

TYPICAL 100 TO 200 GPM
 PUMPING WELL
 DETAILS

PIONEER
 TECHNICAL SERVICES, INC.
 Butte, Helena, Anaconda

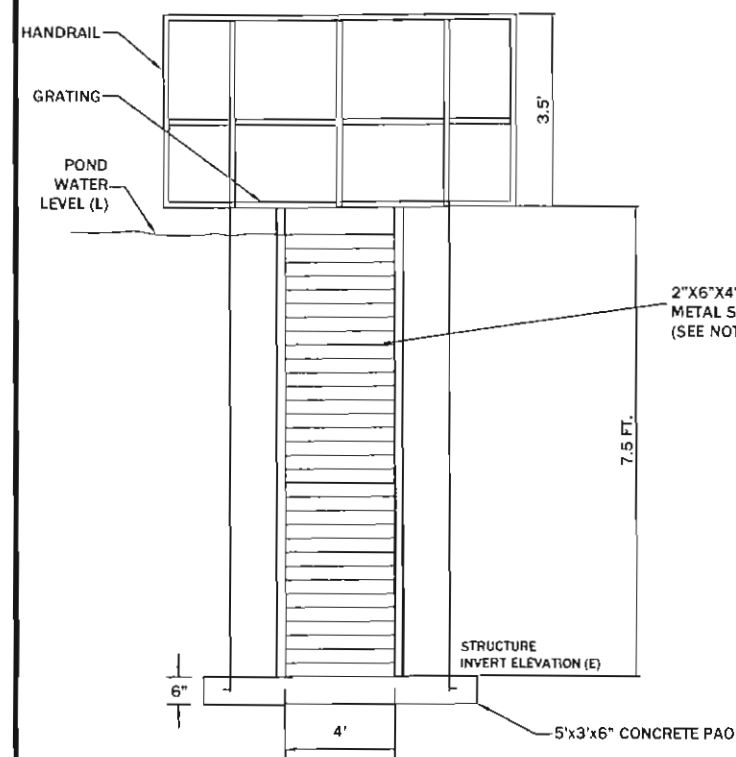
SHEET
 D3



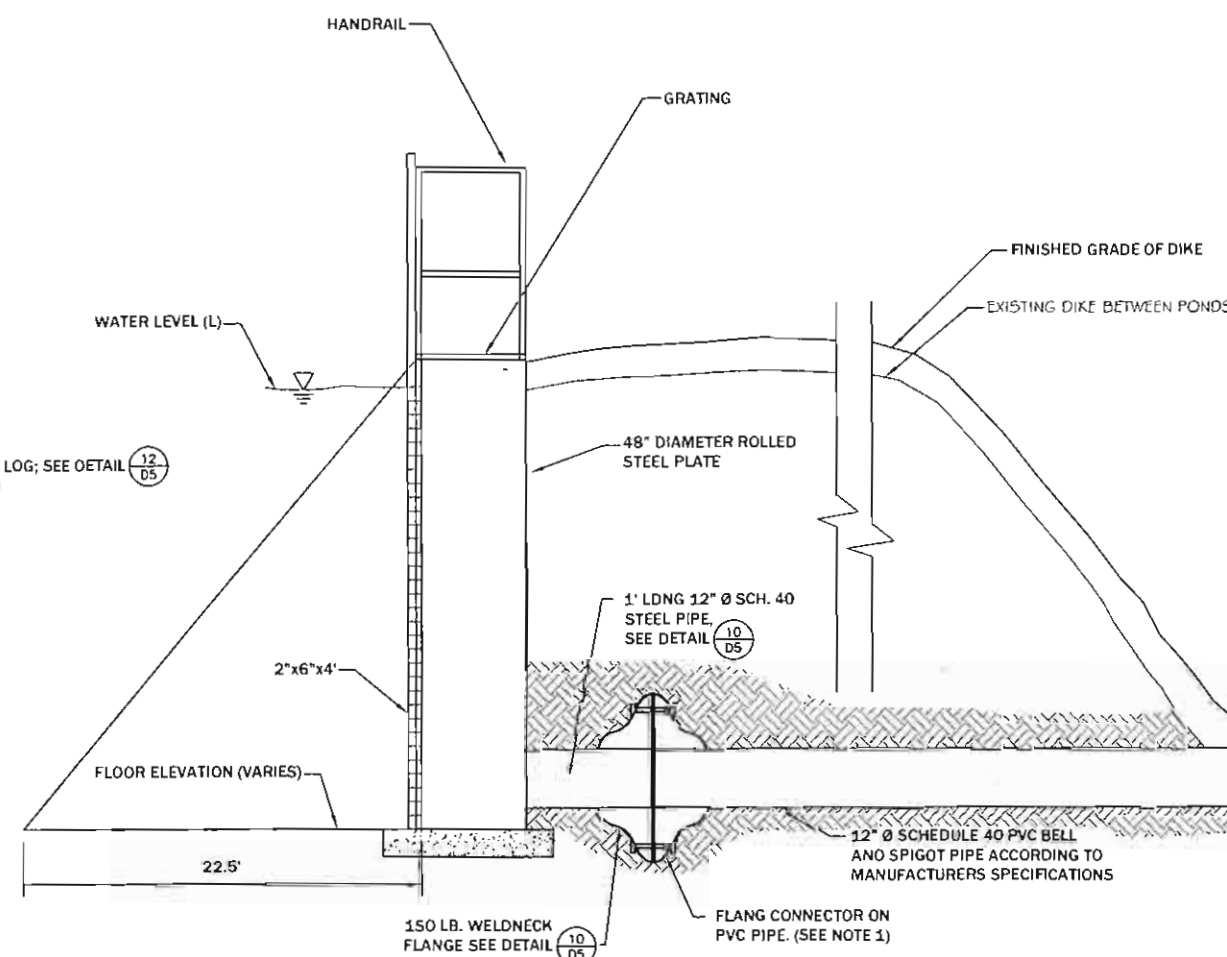
PLAN VIEW
8
14

| STRUCTURE NAME | STRUCTURE HEIGHT (H) | STRUCTURE INVERT ELEV. (E) | POND OPERATING RANGE (L) | STATUS | OUTLET LAYOUT | STOP LOG HEIGHT (S) | OUTLET PIPE INVERTS AND SIZES |
|----------------|----------------------|----------------------------|----------------------------|--------|---------------|---------------------|-------------------------------|
| OS1 | 8' | 7645' | MIN. 7645.5' MAX. 7652' | NEW | | 7' | 12" Ø 7644.5' |
| OS2 | 8' | 7637.5' | MIN. 7640 MAX. 7644.5' | NEW | | 7' | 12" Ø 7635.5' |

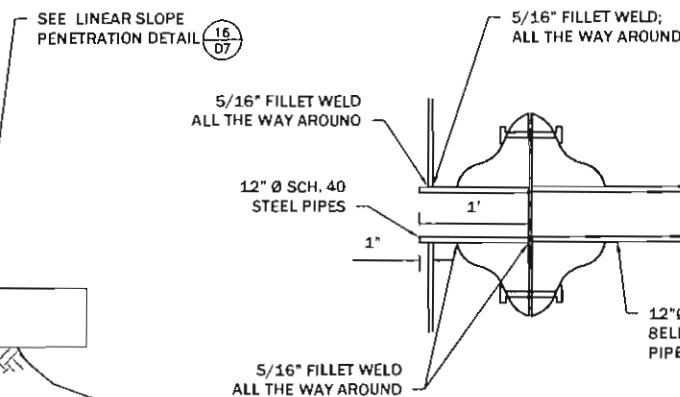
- NOTES
- 1) FLANGE CONNECTOR ON PVC PIPE WILL BE COMPATIBLE WITH WELD NECK FLANGE ON STEEL PIPE. INSTALL FLANGE CONNECTOR, AND BOLT TO WELD NECK PER MANUFACTURERS SPECIFICATIONS.
 - 2) DRILL 2 ONE-INCH DIAMETER HOLES IN ONE OF THE 2-INCH WIDE FACES OF EACH STOP LOG. POSITION ONE HOLE ON EITHER SIDE OF THE CENTER POINT OF THE SELECTED 2-INCH WIDE FACE.



ELEVATION VIEW
9
14
N.T.S.



SECTION A-A
A
D5
N.T.S.

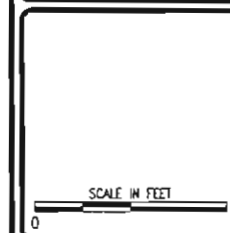


STEEL PIPE DETAIL
10
D5
N.T.S.

| REVISION | DATE | BY | DESC. |
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| DRAWN BY: | SSA |
| DESIGNED BY: | MWB |
| CHECKED BY: | JSM |
| APPROVED BY: | JSM |
| PROJECT NO. | 10133 |
| DATE: | 4/13/09 |

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| UNITS | |
| SOURCE | |



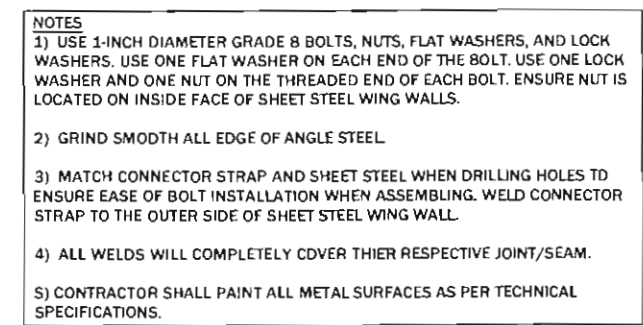
MDEQ/MWCB
McLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

OUTLET STRUCTURE
DETAILS

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

SHEET
D5

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[illegible]

DRAWN BY: SKL
DESIGNED BY: MWD
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO: 10133
DATE: 4/15/09

PROJECTION: _____
 ZONE: _____
 DATUM: _____
 UNITS: _____
 SOURCE: _____



MDEQ/MWCB
McLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

OUTLET STRUCTURE DETAILS



SHEET
D6

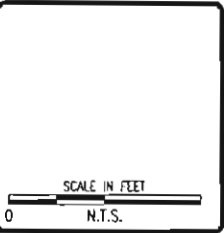


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| REVISION | DATE | BY | DESC. |
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DRAWN BY: NORTHWEST LININGS
 DESIGNED BY: NORTHWEST LININGS
 CHECKED BY: JSM
 APPROVED BY: JSM
 PROJECT NO: 19133
 DATE: 4/13/09

PROJECTION:
 ZONE:
 DATUM:
 UNITS:
 SOURCE: NORTHWEST LININGS

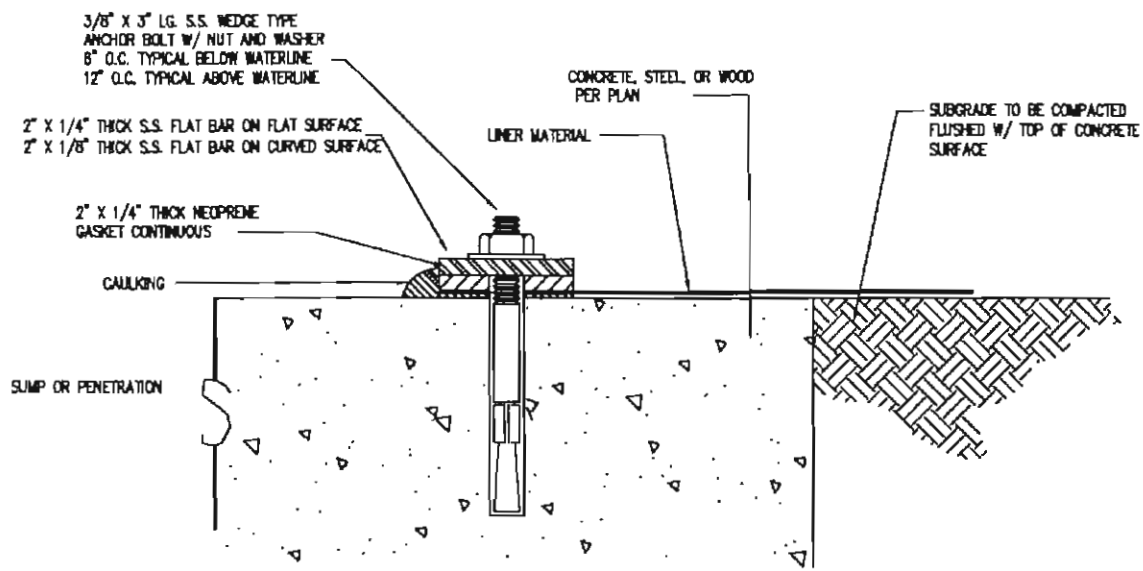


MDEQ/MWCB
 MCLAREN TAILINGS ABANDONED
 MINE SITE RECLAMATION PROJECT

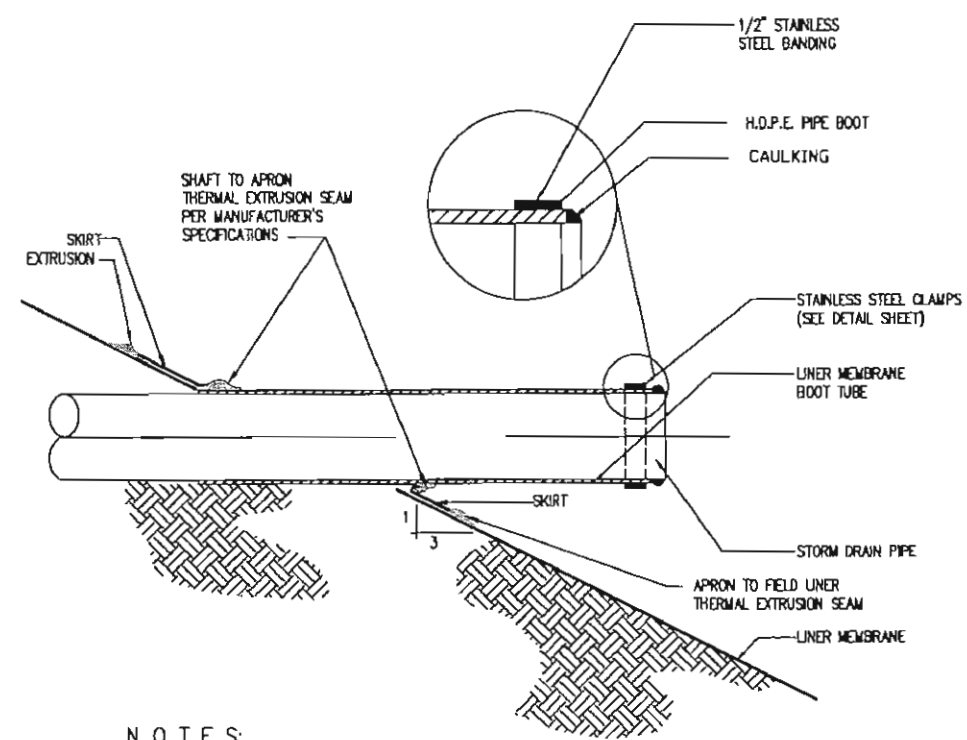
HDPE LINER
 DETAILS



SHEET
 D7



HORIZONTAL METAL BATTEN STRIP DETAIL (15)
 12\"/>



NOTES:
 HOLE FOR PENETRATION OF MEMBRANE
 SHALL BE CUT UNDERSIZED SO THAT
 STRETCHED LINER FORMS A 1\"/>

LINER SLOPE PENETRATION DETAIL (PIPE) (16)
 HDPE, LLDPE N.T.S.

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NORTHWEST LININGS &
 GEOTEXTILE PRODUCTS, Inc.
 www.northwestlinings.com
 21000 77TH AVE. SOUTH
 KENT, WA. 98032
 (253) 872-0244 (253) 872-0245 FAX

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| REVISION | BY | DESC. |
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DRAWN BY: CLJ
DESIGNED BY: SDR
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO: 10131
DATE: 4/15/09

PROJECTION:
ZONE:
DATUM:
UNITS: FEET
SOURCE: PIONEER


SCALE IN FEET

0 10 20 30 40 50 60 70 80 90 100

N.T.S.

MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

REPOSITORY DETAILS

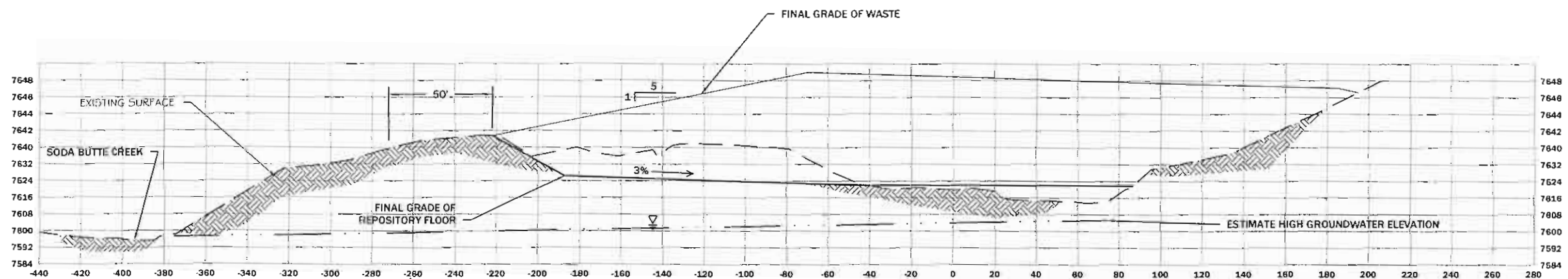


PIONEER

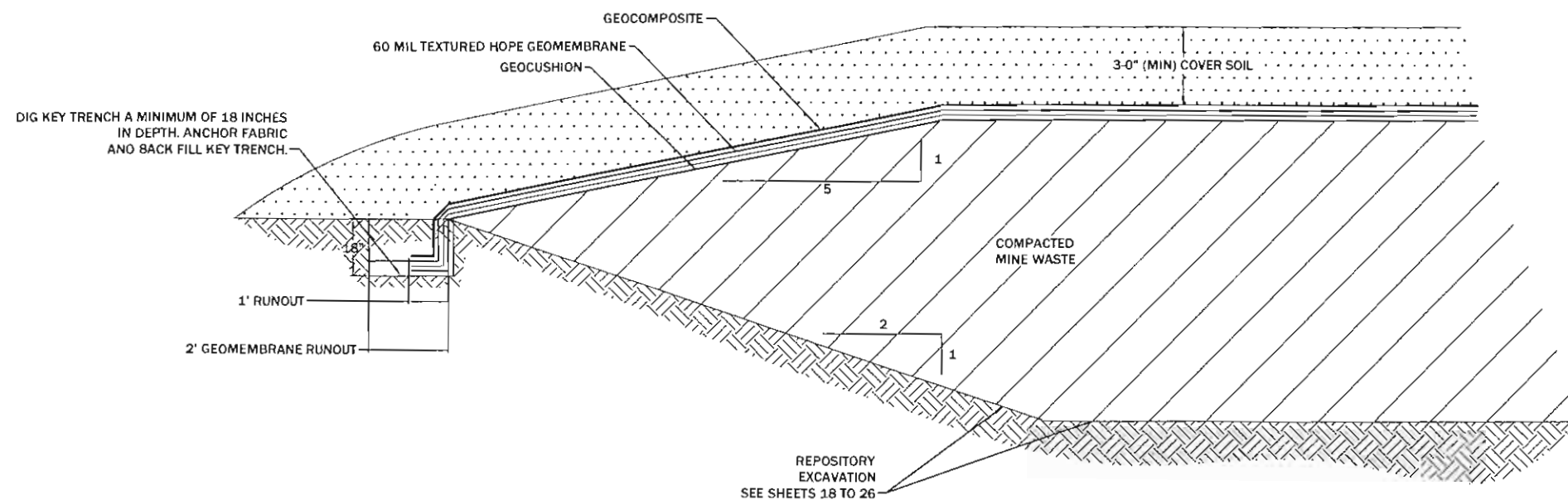
TECHNICAL SERVICES, INC.

Butte, Helena, Anaconda

SHEET
D8

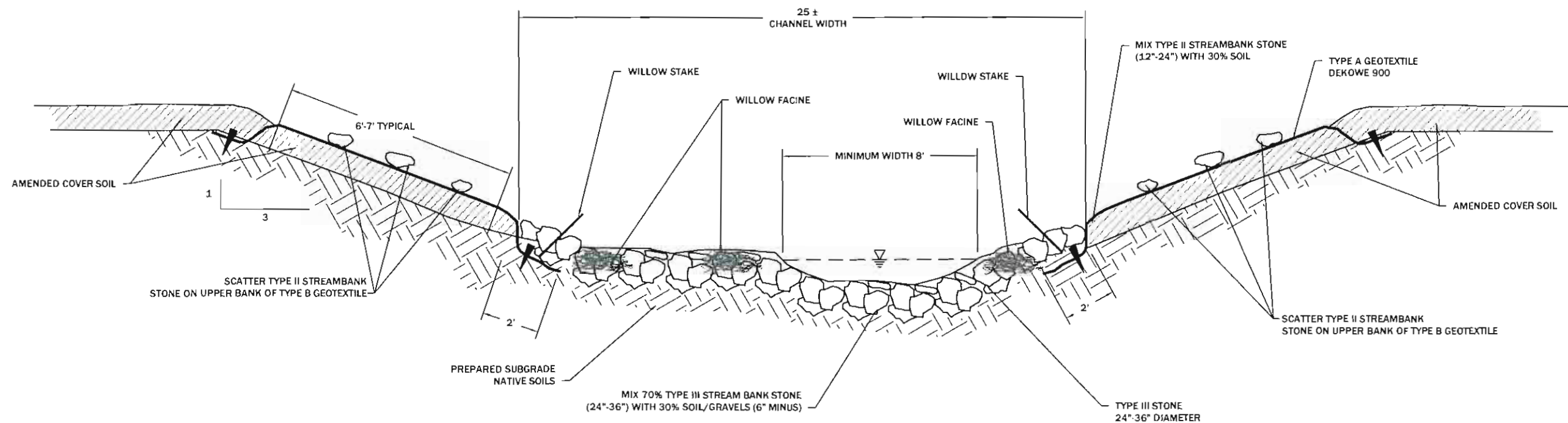


TYPICAL REPOSITORY CROSS SECTION (17)

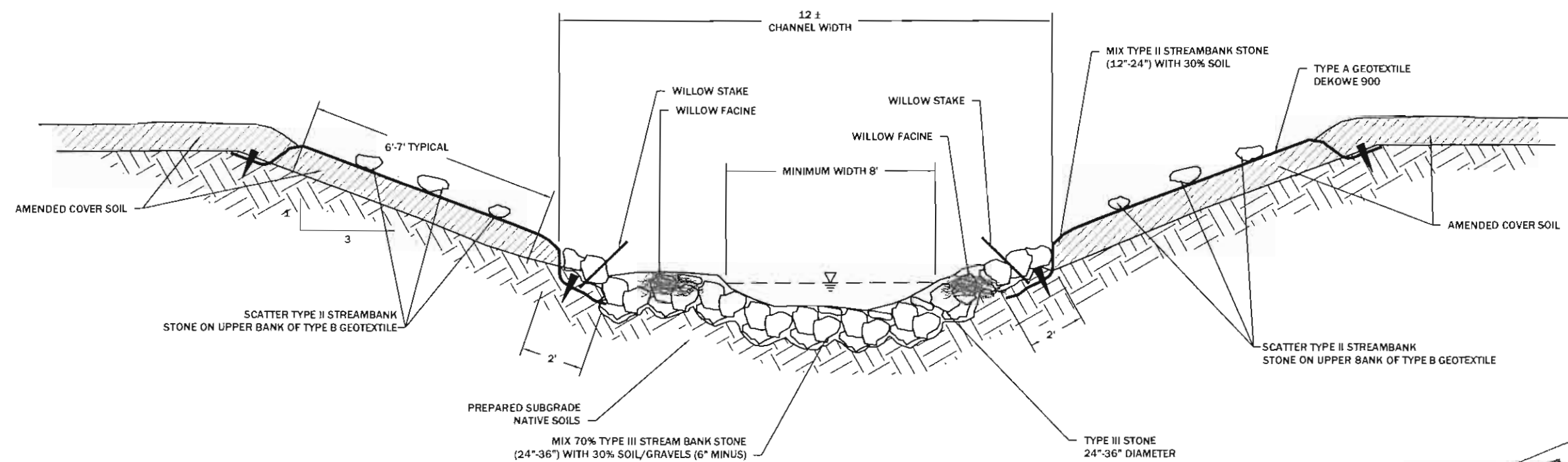


TYPICAL REPOSITORY LAYERING DETAIL (18)

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TYPICAL CROSS SECTION SODA BUTTE CREEK (19)



TYPICAL CROSS SECTION MILLER CREEK (20/29)

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| REVISION | DATE | BY | DESC. |
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DRAWN BY: QA
DESIGNED BY: JMB
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO.: 10133
DATE: 4/15/09

PROJECTION:
ZONE:
DATUM:
UNITS:
SOURCE:

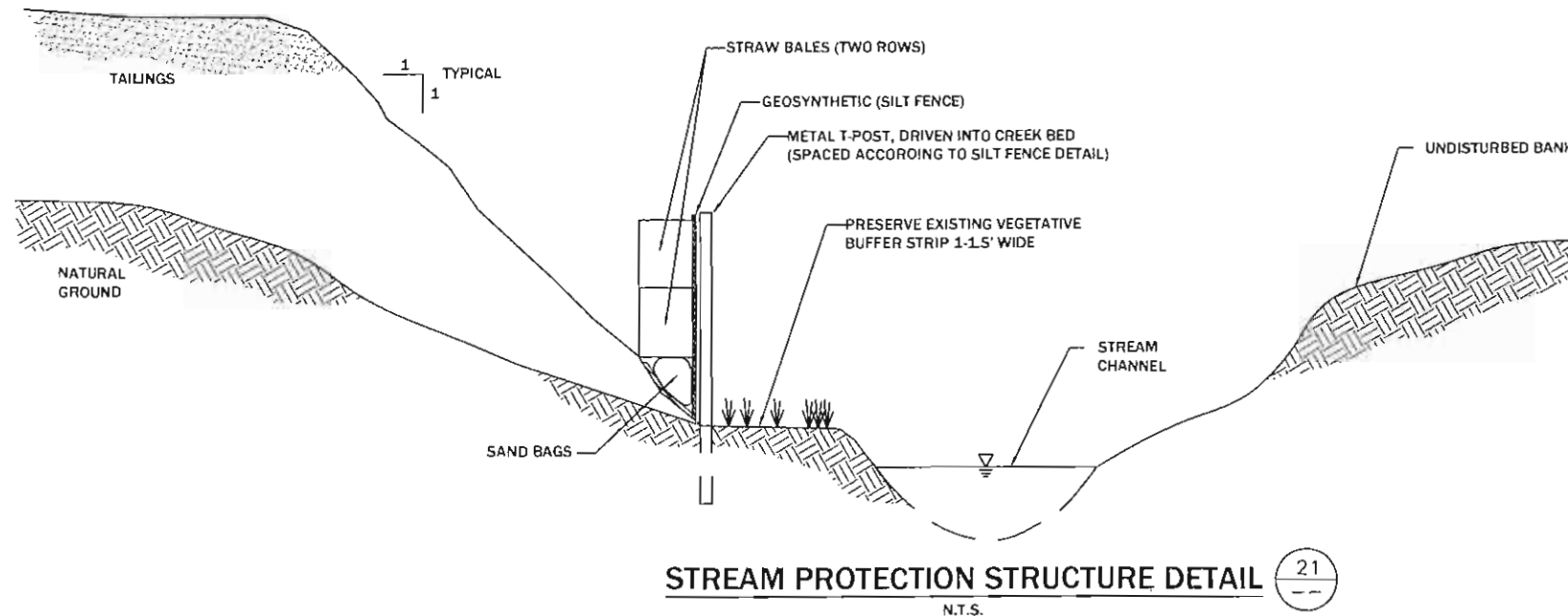
SCALE IN FEET
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MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

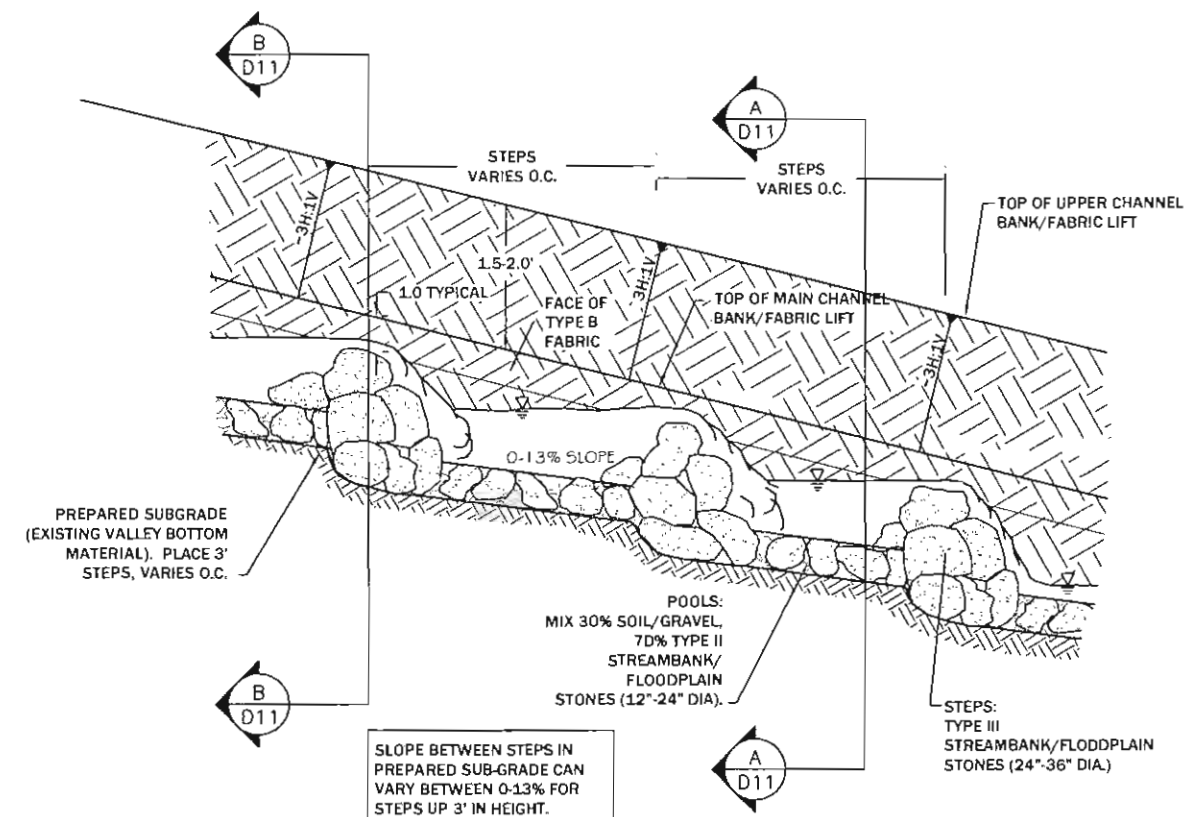
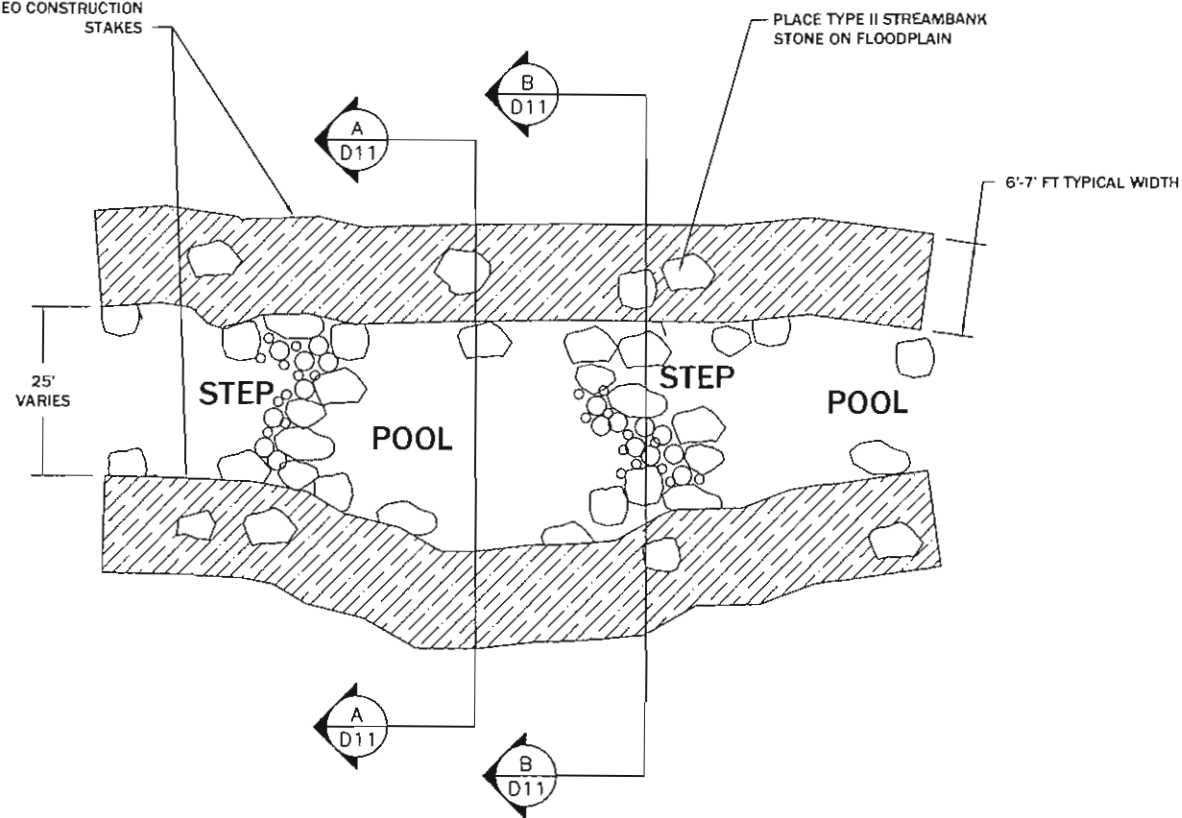
STREAM
RECONSTRUCTION
DETAILS

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda

SHEET
D9



CONSTRUCTED FLOODPLAIN OF VARIABLE WIDTH PROTECTED BY TYPE B GEOTEXTILE SECURELY STAKED ON 3 FOOT CENTERS WITH WEDGE CONSTRUCTION STAKES



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| REVISION | DATE | BY | DESC. |
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| | | | |

DRAWN BY: CLS
DESIGNED BY: MCB
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO: 10123
DATE: 4/15/09

PROJECTION:
ZONE:
DATUM:
UNITS:
SOURCE:

SCALE IN FEET
0 N.T.S.

MDEQ/MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

STREAM
RECONSTRUCTION AND
STREAM PROTECTION
DETAILS

PIONEER
TECHNICAL SERVICES, INC.
Butte, Helena, Anaconda


SHEET
D10



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MDEQ\MWCB
MCLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

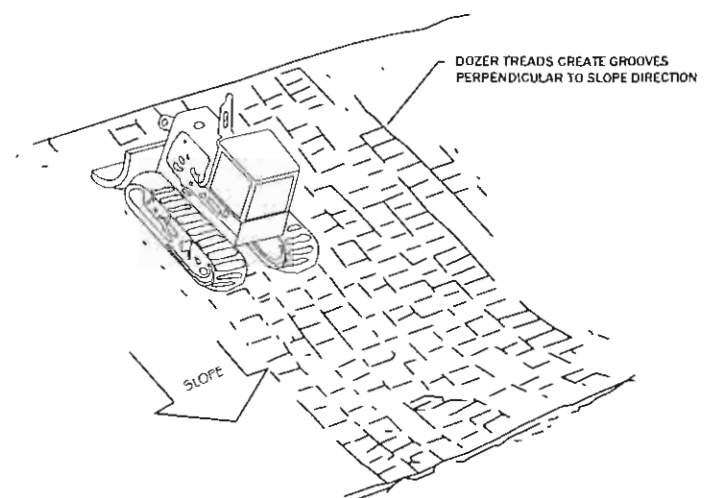
STREAM RECONSTRUCTION DETAILS



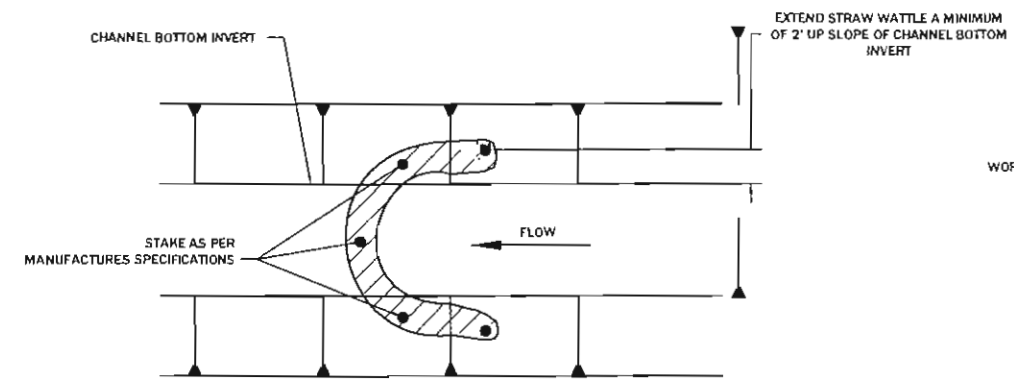
PIONEER
TECHNICAL SERVICES, INC.

Butte Helena Anaconda

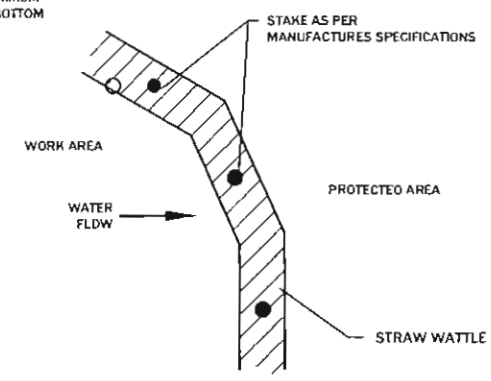
SHEET
D11



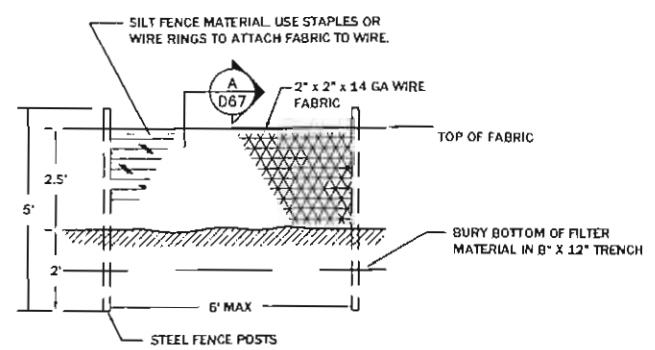
SLOPE ROUGHING DETAIL (24)
NOT TO SCALE



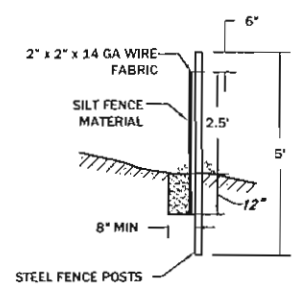
BIO-9 STRAW WATTLE CHECK DAM (25)



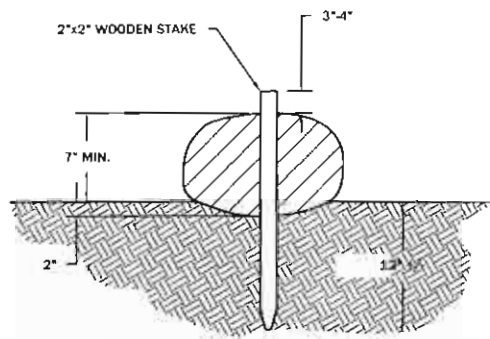
BIO-9 STRAW WATTLE PLAN VIEW (26)



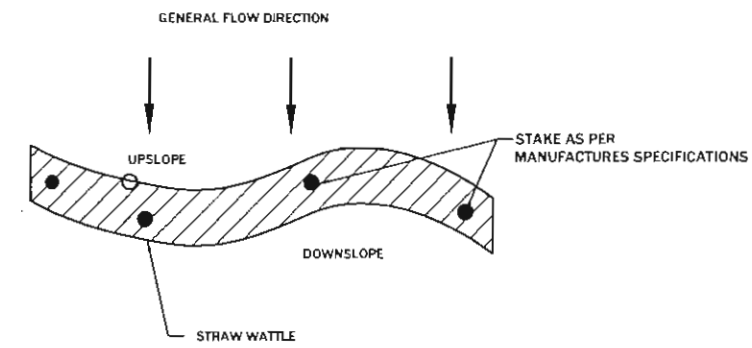
SILT FENCE DETAIL (27)
NOT TO SCALE



SILT FENCE SECTION (CROSS SECTION) (A D12)



BIO-9 STRAW WATTLE CROSS SECTION (TYPICAL) (28)

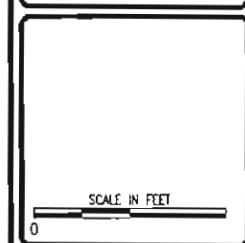


BIO-9 STRAW WATTLE ON SIDE SLOPE PLAN VIEW (29)

| REVISION | DATE | BY | DESC. |
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| DRAWN BY: | SEL |
| DESIGNED BY: | |
| CHECKED BY: | JSM |
| APPROVED BY: | JSM |
| PROJECT NO: | 10133 |
| DATE: | 4/15/09 |

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| PROJECTION: | |
| ZONE: | |
| DATUM: | |
| UNITS: | |
| SOURCE: | |



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McLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

BMP'S
DETAILS

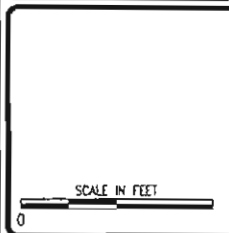


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NOT FOR CONSTRUCTION

| REVISION | DATE | BY | DESC. |
|----------|------|----|-------|
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DRAWN BY: SKS
DESIGNED BY: JSM
CHECKED BY: JSM
APPROVED BY: JSM
PROJECT NO: 19133
DATE: 4/15/09

PROJECTION:
ZONE:
DATUM:
UNITS:
SOURCE:

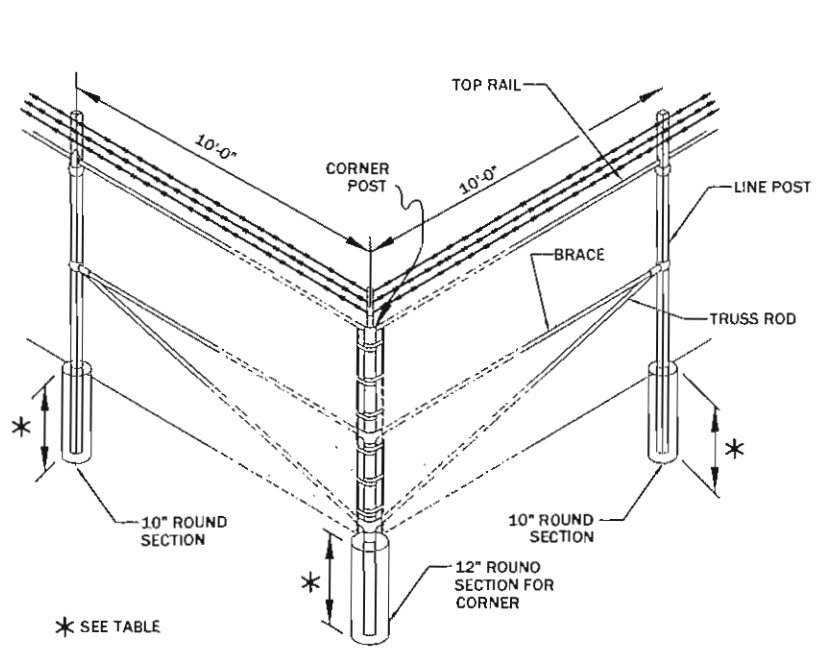
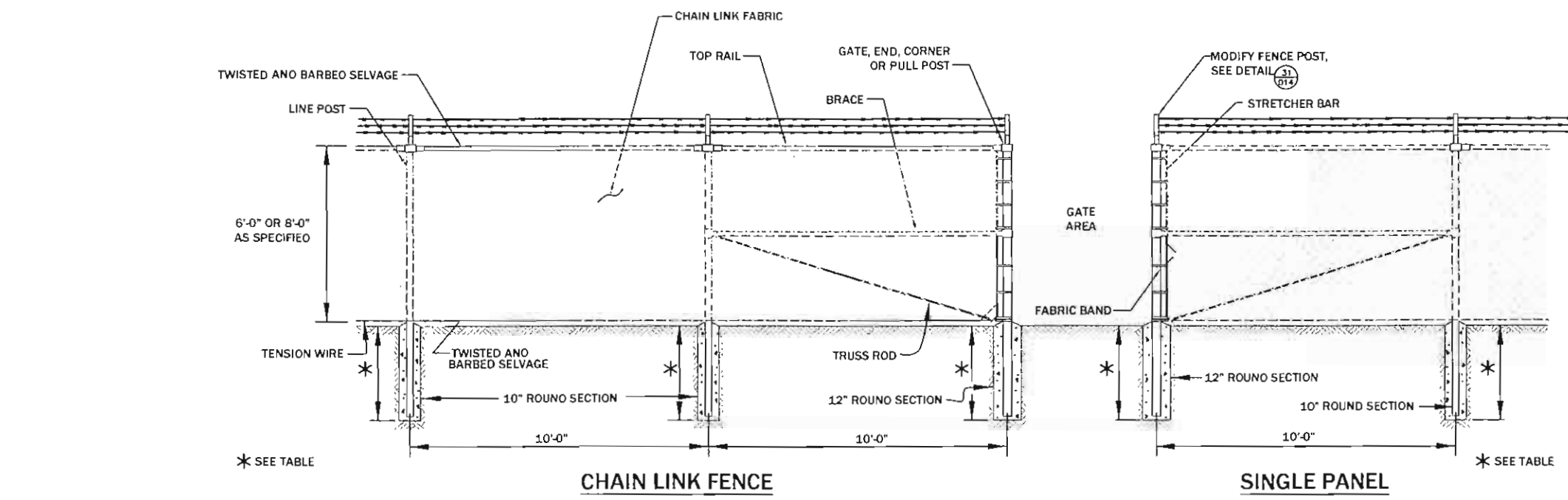


MDEQ/MWCB
McLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

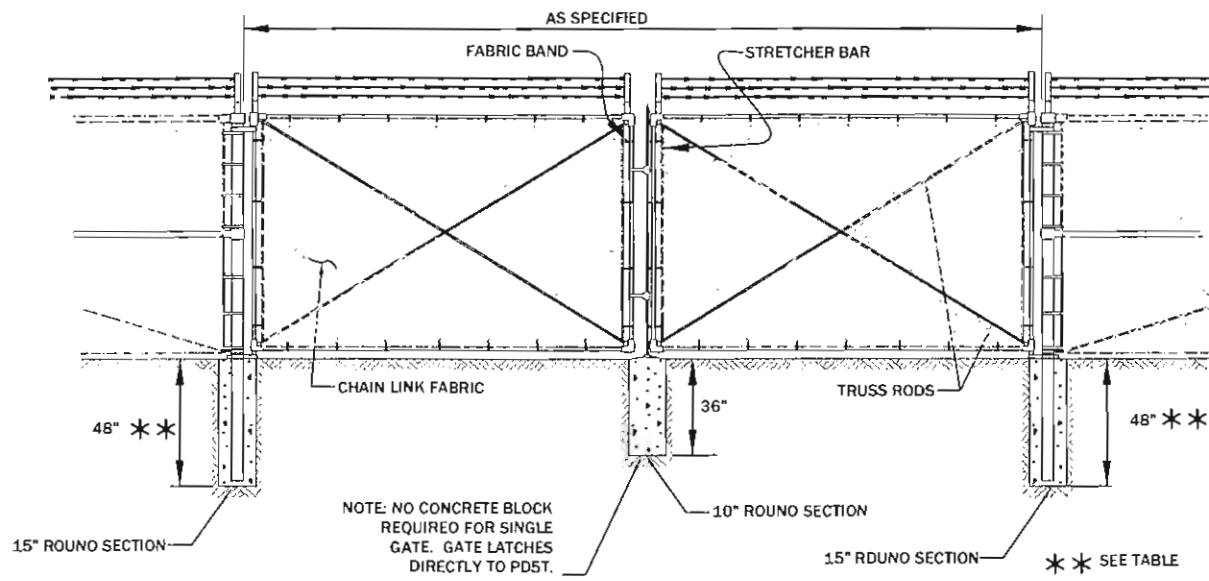
8' SECURITY FENCE
DETAILS

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SHEET
D13



DOUBLE PANEL
PULL POST AND CORNER POST BRACING



GATES

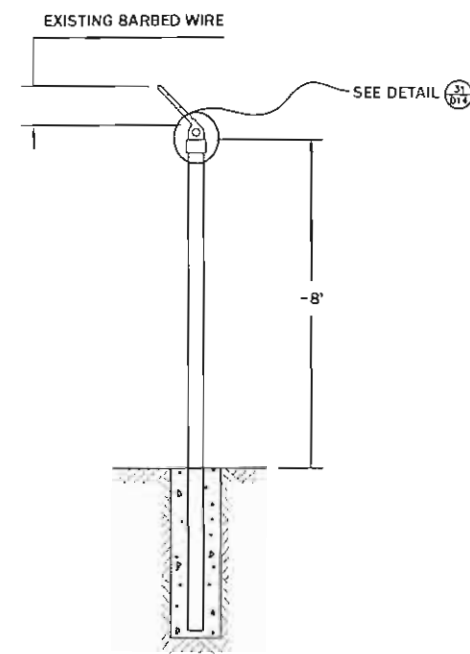
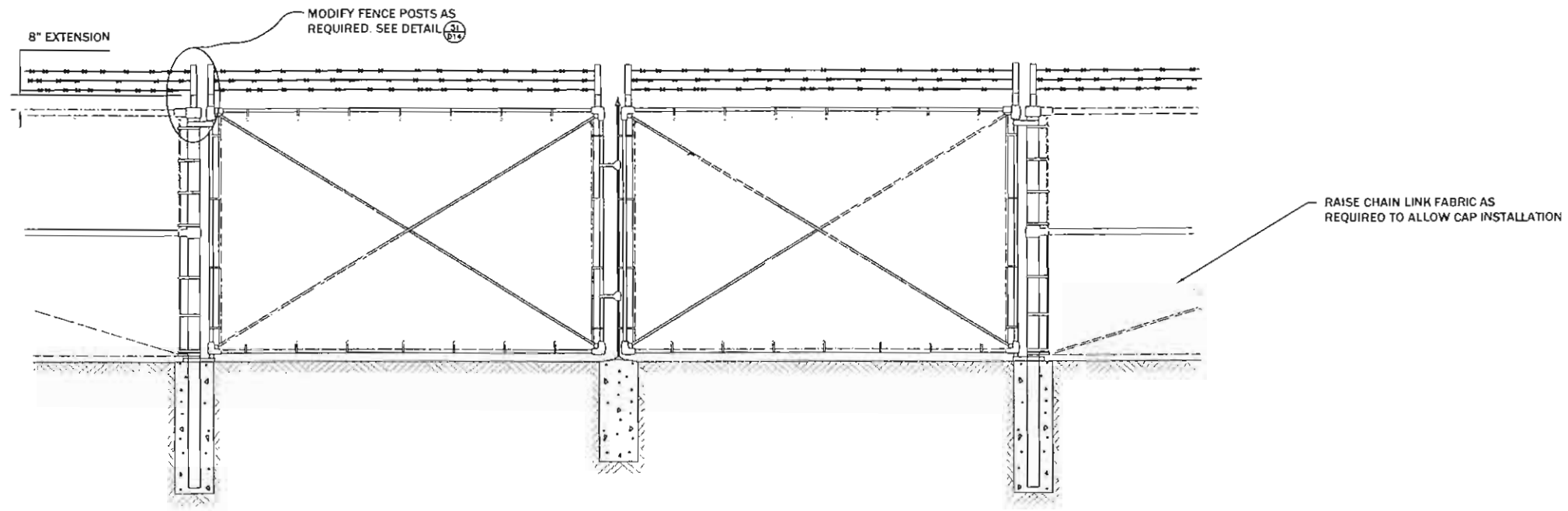
| HEIGHT OF FABRIC | WIRE FABRIC ABOVE GROUND | DEPTH OF CONCRETE * | DEPTH OF POST IN CONCRETE (MIN.) |
|------------------|--------------------------|---------------------|----------------------------------|
| 6' | 1'-2" | 36" | 32" |
| 8' | 1'-2" | 36" | 32" |

** PROVIDE 48" DEPTH OF CONCRETE FOR GATE POSTS AT ALL DOUBLE SWING GATES.

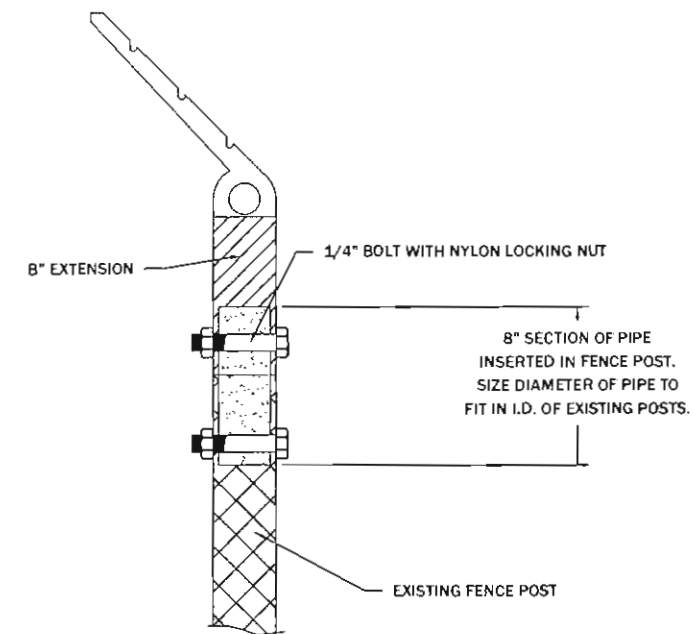
- NOTES:
- SEE THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
 - INSTALL DOUBLE PANELS AT 300' MAXIMUM SPACING AND AT ALL FENCE CORNERS WITH DEFLECTION ANGLES GREATER THAN 10°.
 - PULL POST BRACING IS THE SAME AS CORNER BRACING.
 - A DROP BAR LOCKING DEVICE IS REQUIRED FOR ALL DOUBLE GATE INSTALLATIONS. THE DROP BAR MUST BE ABLE TO BE INSERTED INTO THE CONCRETE BLOCK AT LEAST SIX INCHES.
 - ALL CONCRETE IS M-3000 CLASS "C" OR BETTER.

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RAISE CHAIN LINK FABRIC AS
REQUIRED TO ALLOW GRAVEL
INSTALLATION



DETAIL 30
D13
NOT TO SCALE



DETAIL (31)
NDT TO SCALE (D13)

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NOT FOR CONSTRUCTION

| REVISION | | |
|----------|----|------|
| DATE | BY | DESC |
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DRAWN BY: CLA
DESIGNED BY: MWB
CHECKED BY: ISM
APPROVED BY: ISM
PROJECT NO: 10133
DATE: 4/15/09

PROJECTION: _____
 ZONE: _____
 DATUM: _____
 UNITS: _____
 SOURCE: _____

SCALE IN FEET



McLAREN TAILINGS ABANDONED
MINE SITE RECLAMATION PROJECT

8' SECURITY FENCE DETAILS



PIONEER
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SHEET
D14