

SECTION 02302 - COMPACTING EARTH MATERIALS**PART 1 GENERAL****1.01 REFERENCES**

- A. ASTM International (ASTM)
1. ASTM D 422-63(2002) Particle-Size Analysis of Soils
 2. ASTM D 653-07d Terminology Relating to Soil, Rock, and Contained Fluids
 3. ASTM D 698-07 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
 4. ASTM D 1140-00(2006) Amount of Material in Soils Finer than the No. 200 (75- μ m) Sieve
 5. ASTM D 1556-07 Density and Unit Weight of Soil in Place by the Sand-Cone Method
 6. ASTM D 2216-05 Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 7. ASTM D 2487-06 Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 8. ASTM D 2488-06 Description and Identification of Soils (Visual-Manual Procedure)
 9. ASTM D 4253-00(2006) Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 10. ASTM D 4254-00(2006) Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
 11. ASTM D 4318-05 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 12. ASTM D 4564-02a Density of Soil in Place by the Sleeve Method
 13. ASTM D 4643-00 Determination of Water (Moisture) Content of Soil by the Microwave Oven Heating
 14. ASTM D 4718-87(2001) Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
 15. ASTM D 4914-99 Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
 16. ASTM D 4959-07 Determination of Water (Moisture) Content of Soil by Direct Heating

n.	USBR 5530-89	Determining the Maximum Index Unit Weight of Cohesionless Soils
o.	USBR 5605-89	Determining Permeability and Settlement of Soils Containing Gravel
p.	USBR 7205-89	Determining Unit Weight of Soils In-Place by the Sand-Cone Method
q.	USBR 7215-89	Determining the Unit Weight of Soils In-Place by the Sleeve Method
r.	USBR 7220-89	Determining Unit Weight of Soils In-Place by the Sand Replacement Method in a Test Pit
s.	USBR 7221-89	Determining Unit Weight of Soils In-Place by the Water Replacement Method in a Test Pit
t.	USBR 7230-89	Determining Unit Weight and Moisture Content of Soil In-Place - Nuclear Moisture-Density Gauge
u.	USBR 7240-89	Performing Rapid Method of Construction Control
v.	USBR 7250-89	Determination of Percent Relative Density
w.	USBR 7255-89	Determining the Percent Compaction of Earthwork for Construction Control

1.02 DEFINITIONS

- A. Use definitions from USBR 3900 or ASTM D 653.
- B. Control Fraction: The portion of a soil sample consisting of particles smaller than a designated sieve size. The fraction is used to compare in-place unit weight with standard laboratory unit weight. The control sieve size depends on the laboratory test used (USBR 7230).
- C. C-Value: The ratio expressed as a percentage of (1) in-place unit weight at fill moisture content to (2) the wet unit weight of a laboratory-compacted specimen prepared at fill moisture content as determined by the rapid method of construction control (USBR 7240, ASTM D 5080). The C-Value is a comparison of compactive effort of field compaction equipment to standard laboratory compactive effort.
- D. D-value: The ratio expressed as a percentage of (1) in-place wet unit weight at fill moisture content to (2) laboratory maximum wet unit weight as determined from a compaction curve constructed at fill moisture content as determined by the rapid method of construction control. The D-value is the equivalent of percent compaction (USBR 7240, ASTM D 5080).

- E. Percent Relative Compaction: The percent compaction of a cohesionless soil where the laboratory maximum density is determined by Maximum Index Unit Weight test (USBR 5530, ASTM D 4253).
- F. Percent Relative Density - (D_r percent) : The ratio of, (1) the difference between void ratio of a cohesionless soil in the loosest state and any given void ratio, to (2) the difference between its void ratios in the loosest state and densest state (USBR 7250)
- G. Special compaction: Compaction close to structures or in spaces not accessible by rollers.

1.03 PROJECT ENVIRONMENTAL REQUIREMENTS

- A. Do not place and compact soil under following conditions:
 - 1. Ambient air temperature below freezing.
 - 2. Rain that creates puddles in clayey or silty materials.
 - 3. Heat or wind or both that dries material below special moisture conditions.
 - 4. Ice or snow pockets are visible in soil being placed.

PART 2 PRODUCTS

2.01 CLASSIFICATION

- A. When required, classify earth materials using the Unified Soil Classification System (USCS) according to ASTM D 2487 (or USBR 5000) or ASTM D 2488 (or USBR 5005).
 - 1. Gradation tests for classification: ASTM D 422 or D 1140 (USBR 5325, 5330, or 5335).
 - 2. Atterberg limits testing for classification: ASTM D 4318 (USBR 5350, 5355, or 5360).

2.02 SOIL TYPES

- A. Clean Fill:
 - 1. Any soil classification except for Peat (PT), Organic Silts and Organic Clays (OL and OH), and Elastic Silt (MH).
 - 2. Free of roots, stumps, limbs, vegetation, organic matter, and ice.
 - 3. Does not contain construction debris, scrap materials, refuse, man-made wastes, or chemical or hydro-carbon contamination.
- B. Do not use frozen soils.
- C. Special Gradations/Plasticity

1. In some cases, such as embedment for buried pipe, special gradations and/or plasticity characteristics may be required. These requirements are given for each special material required in the appropriate section.

2.03 DESIGNATION OF SOILS FOR COMPACTION

- A. Requirements for lift thickness, method of compaction, and method of determining degree of compaction depends on whether soil is considered to be silty or clayey, cohesionless, or cohesionless containing some silt and clay.
- B. Silty or Clayey Soils:
 1. Contain appreciable amounts of fines (generally more than 15 percent fines).
 2. Classified as GM, GC, SM, SC, CL, ML, CH, or any dual symbol or borderline soil beginning with one of these symbols.
- C. Cohesionless Soils:
 1. Contain few fines (generally less than 5 percent fines).
 2. Classified as GW, SW, GP, SP, or any borderline soil beginning with any of these symbols.
- D. Cohesionless Soils Containing Some Clay and Silt:
 1. Contain some clay and silt contain between 5 and 15 percent fines.
 2. Classified with dual symbol soils such as GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC.

2.04 MAXIMUM PARTICLE SIZE

- A. Backfill against specific structures:
 1. Maximum particle size limitations described in appropriate sections.
 2. Otherwise, no cobbles or boulders.
- B. Compacted soil for embankment: No cobbles larger than 5 inches or boulders.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- A. Clear, grub, and strip.
- B. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified compaction, if necessary.

- C. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing layer of material to be compacted.
- D. Do not place soil on frozen surface.

3.02 SOIL MOISTURE CONTENT

- A. Moisten or aerate material, as necessary, to provide moisture content that will readily facilitate obtaining specified compaction. Add water to soil only in increments that will permit moisture content to be uniform and homogenous throughout each layer after mixing.
- B. Silty and Clayey Soils:
 - 1. Moisture content during compaction: Not greater than 2 percentage points wet or not less than 2 percentage points dry of optimum moisture content.
 - 2. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.
 - a. If clayey borrow soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in the clods.
 - b. Use of disks, harrows, or rakes may be required to blend moisture in the borrow area.
 - 3. Moisture content will be determined as follows:
 - a. Moisture content is determined on the minus no. 4 sieve size control fraction material.
 - b. Variation from Optimum Moisture Content:
 - 1) Difference between optimum moisture and compaction moisture can be measured in accordance with ASTM D 5080 (or USBR 7240).
 - c. Moisture Content Comparison:
 - 1) Optimum moisture content determined by ASTM D 698 (or USBR 5500).
 - 2) Compared to field compaction moisture content with moisture contents determined in accordance with:
 - a) ASTM D 2216 (or USBR 5300), or
 - b) ASTM D 6938 (USBR 7230). The moisture from the nuclear gage will require corrections for gage error for the specific soils tested and the moisture content of the total material may require adjustment for the control fraction (see USBR 7230, Method C; ASTM D 4718), or

- c) ASTM D 4959, or ASTM D 4643 (USBR 5315), provided the results have been correlated to ASTM D 2216 (USBR 5300) for specific soil tested.

C. Cohesionless Soils:

- 1. Add water during compaction, as necessary, since these soils are free-draining.

3.03 PLACEMENT

- A. Place soils to be compacted in horizontal layers.
- B. If necessary, blend materials so that compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations, or other imperfections.

3.04 COMPACTION

- A. Compact material with following methods and techniques appropriate to type of soil.

B. Silty or clayey material in water retaining embankment:

- 1. Compact with tamping rollers specified above.
- 2. Uniformly distribute roller passes.
- 3. Compact in horizontal layers to compacted thickness of 6 inches or less.
- 4. Scarify lifts as required for lift bonding.
- 5. Density:
 - a. Percent Compaction, minimum: 95 percent, or
 - b. C-Value and D-value, minimum: 95 percent
 - c. As determined on portion of soil passing the No. 4 sieve.

C. Silty or clayey material:

- 1. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers, other suitable compaction equipment, or equipment travel.
 - a. Uniformly distribute equipment passes.
 - b. Compact in horizontal layers to compacted thickness of 6 inches or less.
- 2. Special compaction: Compact with hand held impact tampers, or small tamping equipment.
 - a. Uniformly distribute effort.
 - b. Compact in horizontal layers to compacted thickness of 4 inches.
- 3. Density:

- a. Percent Compaction, minimum: 95 percent, or
 - b. D-value, minimum: 95 percent
 - c. As determined on portion of soil passing the No. 4 sieve.
- D. Cohesionless Soils Containing Some Silt and Clay:
1. Compact in accordance with the procedure above.
 2. Density:
 - a. Percent Compaction, minimum: 95 percent, or
 - b. Relative Compaction, minimum: 95 percent.
 - c. Using whichever testing procedure result requires higher in-place dry density.
- E. Adjustment:
1. Silty and clayey soils containing more than 50 percent gravel: Required D ratio or Percent Compaction may be adjusted in accordance with appropriate curve on Figure 4 in USBR 5605.
- F. Demonstration:
1. Lift thicknesses may vary depending on equipment and methods. Before changing requirements in this section, demonstrate that required density will be obtained.

3.05 MEASURE OF COMPACTION

- A. Degree of soil compaction will be determined by one of the following.
- B. Silty or clayey soils:
1. Unit weight of soils in-place:
 - a. ASTM D 1556 (or USBR 7205), or
 - b. ASTM D 4914 (or USBR 7220), or
 - c. ASTM D 5030 (or USBR 7221), or
 - d. ASTM D 6938 (or USBR 7230).
 2. Percent Compaction will be determined by one of the following:
 - a. Rapid Method: ASTM D 5080 (or USBR 7240).
 - b. Laboratory Compaction Test: Comparison of in-place density of minus no. 4 sieve size control fraction to laboratory maximum dry density as determined by ASTM D 698, Procedure A (or USBR 5500).
 - c. Silty and clayey soils containing more than 5 percent gravel:

- 1) In-place unit weight of minus no. 4 size control fraction determined by screening gravel, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D 4718 (USBR 7205).

3.06 FIELD QUALITY ASSURANCE

A. Testing

1. The Government or its representative will perform tests as required to verify that type of soil used, placement of soil, and compaction of soil conform to contract requirements.
2. Notify the Government 24 hours before compaction work begins and 24 hours before significant change in compaction operations (major change in equipment or procedure used).
3. Notify the Government immediately of equipment change due to breakdown, or re-deployment.

B. Testing Frequency

1. Frequency of testing is at discretion of the Government.
2. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.

C. Tests:

1. Standards listed in Table 02302A - Standard Used for Testing, will be used by the Government or its representative for testing compacted soil for conformance with specification requirements. Substitution or modification of standards shall be done only with concurrence of all parties.

Table 02302A - Standard Used For Testing

PROCEDURE	STANDARD NO.
Soil Classification	ASTM D 2487 (or USBR 5000) ASTM D 2488 (or USBR 5005)
Gradation Analysis	ASTM D 422 (or USBR 5325, 5330, 5335)
Atterberg Limits	ASTM D 4318 (or USBR 5350, 5355, 5360)
Moisture Content	ASTM D 2216 (or USBR 5300) ASTM D 6938 (or USBR 7230) ASTM D 4643 (or USBR 5315)
Relative Density of Cohesionless Soils	ASTM D 4253 and ASTM D 4254 (or USBR 5525 and 5530 and 7250)

Table 02302A - Standard Used For Testing

PROCEDURE	STANDARD NO.
In-Place Density: Sand Cone Test Pits Sleeve Nuclear	ASTM D 1556 (or USBR 7205) ASTM D 4914 (or USBR 7220) ASTM D 5030 (or USBR 7221) ASTM D 4564 (or USBR 7215) ASTM D 6938
Rapid Construction Control	ASTM D 5080 (or USBR 7240)
Laboratory Maximum Density	ASTM D 698, Procedure A (USBR 5500)

D. Contractor Support

1. Provide timely access to areas for density testing and excavate and level an area in compacted material to provide a surface for testing.
 - a. Fills compacted by sheepsfoot rollers are normally tested one or two lifts below surface.
2. When density is being measured by a sand-cone device (ASTM D 1556, USBR 7205), cease construction activity in immediate vicinity of testing.
3. Dig test pits as requested to examine compacted soil against structures or pipe.
4. Backfill test pits to original requirements.
5. Provide warning lights, flags, or other safety devices as needed by testing personnel.
6. Provide adequate lighting for performing test if required because of darkness.

END OF SECTION

SECTION 02924 - SEEDING AND SOIL SUPPLEMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Pure live seed content: Weight of seed times percent purity times percent germination.

1.02 DELIVERY STORAGE AND HANDLING

A. Seed containers:

1. Sealed.

2. Labeled:

a. Identify seed origin on label.

1) Intrastate shipping: In accordance with State Seed Laws and Regulations.

2) Interstate shipping: In accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

PART 2 PRODUCTS

2.01 SEED

A. Weed seeds classified by State Seed Department:

1. Prohibited noxious weeds: None

2. Restricted noxious weeds: 0.5 percent maximum, by weight.

B. Seed mixture:

1. Purity, minimum: 85 percent.

2. Germination, minimum: 85 percent.

a. Germination test: Less than 1 year old at time of seeding.

3. Uniform mixture shown in Table 02924A - Seed Mixture.

Table 02924A - Seed Mixture

Common Name	Scientific Name	Seeding Rate (Pounds pure live seed per acre)
Pubescent wheatgrass	<i>Agropyron Trichophorum</i>	3
Western wheatgrass	<i>Pascopyrum Smithii</i>	3
Sid oats grama	<i>Bouteloua Curtipendula</i>	2

2.02 FERTILIZER

- A. Agricultural grade nitrogen fertilizer and phosphate fertilizer.
 - 1. Nitrogen fertilizer: Urea (46-0-0).

2.03 STRAW MULCH

- A. Wheat or barley straw.
- B. Free of mold or other evidence of decomposition.
- C. Free from weed seed.

2.04 HYDROMULCH

- A. Silva-Fiber, manufactured by Weyerhaeuser, Tacoma WA, 98477; Spray Mulch X-80 manufactured by Pacific Wood Fibers, PO Box 2109, Redmond WA 98052; or equal, having the following essential characteristics:
 - 1. Wood cellulose fiber.
 - 2. No germination or growth inhibiting factors.
 - 3. Dyed appropriate color to allow visual metering of application.
 - 4. Evenly dispersed and suspended when agitated in water.
 - 5. Forms blotter like ground cover that readily absorbs water and allows infiltration to underlying soil.

2.05 TACKIFIER

- A. Mixture of at least three specially blended compatible hydrocolloids.
 - 1. One hydrocolloid will act as a slippery agent during suspension.
 - 2. Will form loose, long-chain-like film on drying
 - 3. No growth or germination inhibiting factors.
 - 4. Hydrates and disperses in circulating water to form homogeneous slurry.
 - 5. Equilibrium air dry moisture content at time of manufacture of 8 percent, plus or minus 2 percent.
 - 6. Minimum water holding capacity: 6-1/2 times weight of dry material.

PART 3 EXECUTION

3.01 SEEDBED PREPARATION

- A. Complete prior to seeding, and mulching or hydromulching.

- B. Scarify or harrow and rake topsoil to minimum depth of three inches.
- C. Remove stiff clods, lumps, roots, litter, stones, and other foreign material greater than 6 inches in size from the surface. Dispose of removed materials by removal from the site.
- D. Fill or smooth topsoil surface to remove rills, gullies and depressions.
- E. Protect prepared topsoil surfaces from erosion and washouts. Repair damaged surfaces as required.

3.02 SEEDING

- A. Seed applied by: (1) broadcast seeding followed by mulching or hydromulching, (2) drilling seed followed by mulching, (3) hydroseeding followed by hydromulching, or (4) hydroseeding and hydromulching.
- B. Apply seed mixture at rate specified in Table 02924A - Seed Mixture.
- C. Seed only between September 1 and November 1 of each year.
- D. Do not seed or fertilize when ambient temperature is below 38 degrees F without approval of the COR.
- E. Do not seed or fertilize when ground is snow covered.
- F. Do not seed, fertilize, or mulch, or hydroseed when wind velocities prevent uniform application of materials or would drift materials.
- G. Apply nitrogen fertilizer uniformly at a rate of 30 pounds of nitrogen content per acre (65 pounds per acre of Urea).

3.03 BROADCAST SEEDING

- A. Broadcast seed only in areas not accessible for drilling or hydroseeding.
- B. Apply seed and fertilizer separately.
- C. Mechanical broadcasting:
 - 1. Equipment:
 - a. Centrifugal type.
 - b. Pull type similar to fertilizer spreader.
 - 2. Designed and regulated to apply seed uniformly at proper rate per acre.
- D. Hand Broadcasting:
 - 1. By hand broadcaster.
 - 2. By hand.

3. Uniformly applied.
- E. Cover seed with soil to depth of 1/4-inch to 1/2-inch immediately after broadcasting.
1. Use hand rake or float.
 2. Do not use log chain or similar device.

3.04 DRILLING SEED

- A. Regulate drill to uniformly distribute seed at rate specified and cover with soil depth of 1/4-inch to 1/2-inch.
- B. Apply seed and fertilizer separately.
- C. Drill crosswise to general slope where possible to safely operate equipment.

3.05 MULCHING

- A. Spread within 2 days of spreading seed.
- B. Rate: 2 tons per acre uniformly spread
- C. Anchor with threader.
1. Operate crosswise to slope.
 2. Depth: 3 to 4 inches.
 3. Interval: 6 to 12 inches across slope.

3.06 HYDROSEEDING

- A. Seed slurry:
1. Mix to keep homogeneous.
 2. Ingredients:
 - a. Water
 - b. Seed
 - c. Wood cellulose fiber mulch:
 - 1) Rate: 1,000 pounds per acre at 10 percent moisture content.
 - 2) Add to water slurry after seed.
 - d. Fertilizer may be applied with hydroseeding.
 3. Maximum time between batching slurry and application: 1 hour.
- B. Spray apply seed slurry mix uniformly.
- C. Use mulch coloring as metering agent.

D. Apply seed slurry before mulch slurry.

3.07 HYDROMULCHING

A. Mulch slurry:

1. Mix to keep homogeneous.
2. Ingredients:
 - a. Water.
 - b. Tackifier.
 - c. Wood cellulose fiber mulch: 3,000 pounds per acre at 10 percent moisture content.
 - d. Nitrogen fertilizer may be applied with hydromulching.
3. Maximum time between batching slurry and application: 1 hour.

B. Spray apply mulch slurry mix uniformly.

C. Use mulch coloring as metering agent.

D. Apply mulch slurry within 24 hours after applying seed.

3.08 HYDROSEEDING AND HYDROMULCHING

A. Slurry:

1. Mix to keep homogeneous.
2. Ingredients:
 - a. Water
 - b. Tackifier
 - c. Seed
 - d. Wood cellulose fiber mulch:
 - 1) Rate: 4,000 pounds per acre at 10 percent moisture content.
 - 2) Add to water slurry after seed.
 - e. Fertilizer may be applied with hydroseeding.
3. Maximum time between batching slurry and application: 1 hour.

B. Spray apply slurry mix uniformly.

C. Use mulch coloring as metering agent.

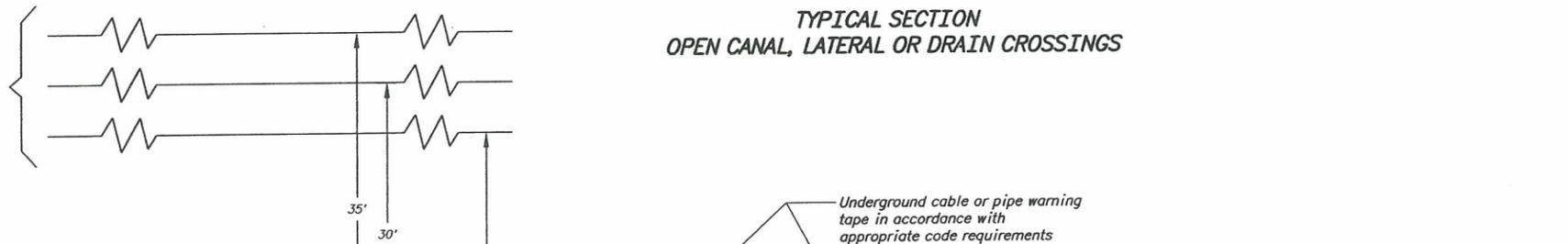
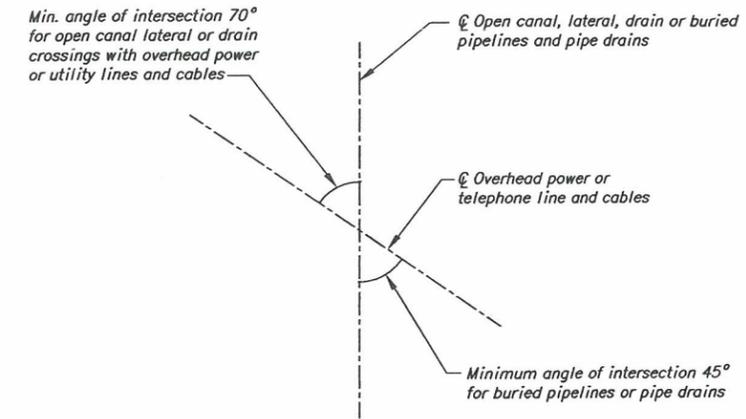
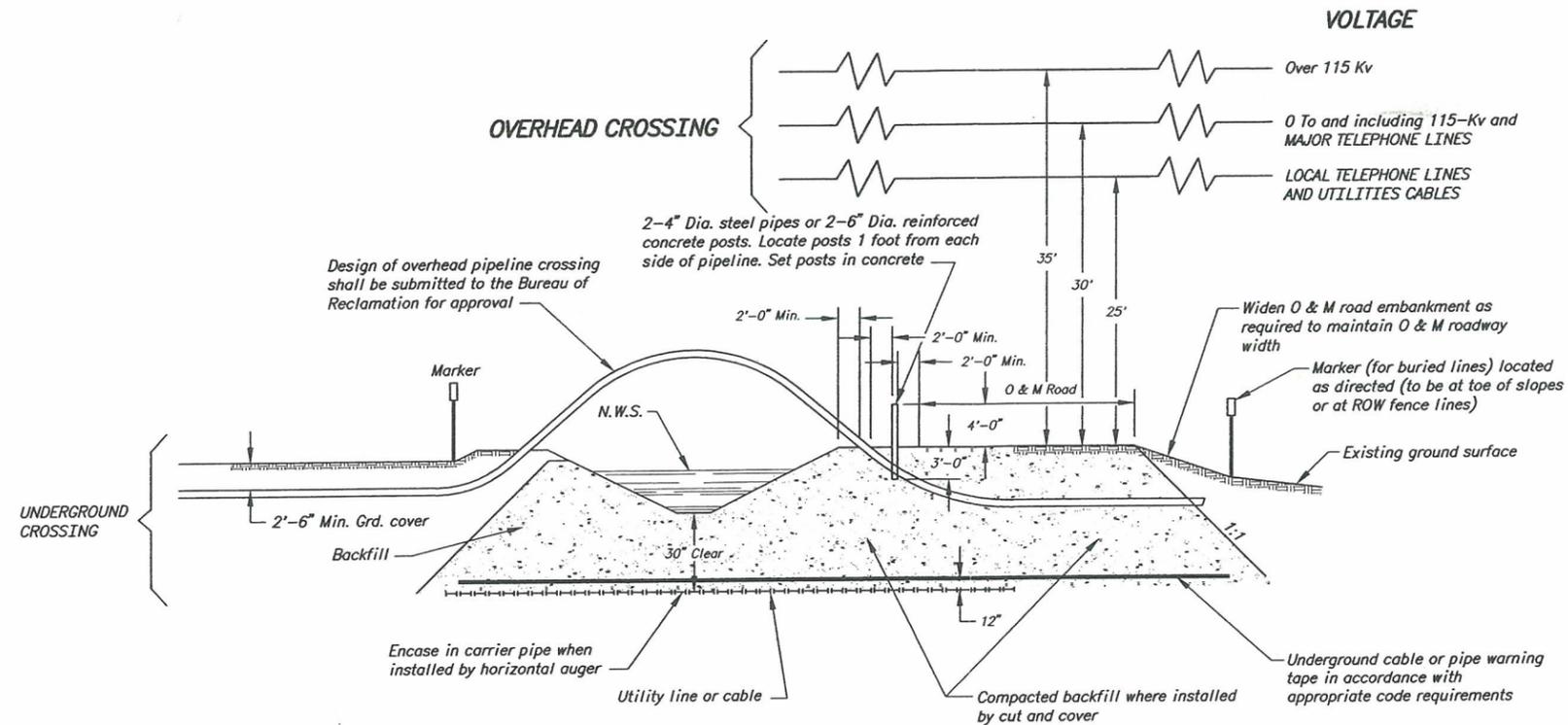
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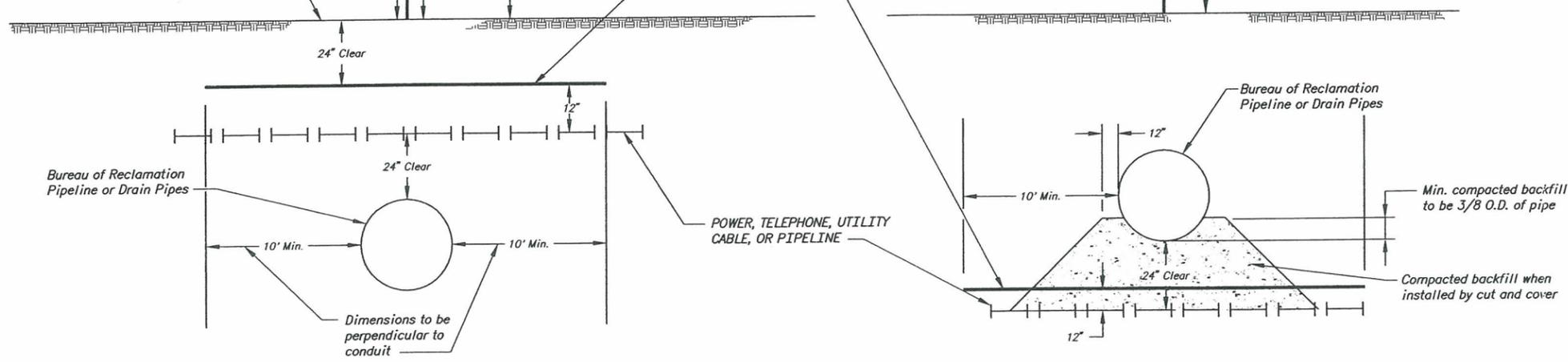
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A



UNDERGROUND CROSSING



CROSSING PLAN

NOTES

1. Drawing is not to scale.
2. Overhead crossing clearances are minimum for all conditions.
3. Any additional clearances or permits required for construction shall be provided by the Contractor.
4. Conductor clearance shown is for 60° F and final unlocked sag.

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ALWAYS THINK SAFETY		
UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION PICK-SLOAN MISSOURI BASIN PROGRAM		
STANDARD CROSSING & CLEARANCE REQ.		
UTILITY LINES AND CABLES		
DESIGNED	D. ARBUHNOT	TECH. APPROVAL
DRAWN	J. POLITRA	SUBMITTED
CHECKED	D. ARBUHNOT	APPROVED
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Vandalia South Canal

Vandalia South Canal
Glasgow Unit, Milk River Project-Montana
S1/2, Section 12, T27N, R41E, Valley County

The Vandalia South Canal delivers irrigation water from the Milk River to farmlands located along the south side of the Milk River. The canal is approximately 46 miles long and has a diversion capacity of 300 cubic feet per second. The irrigation season normally runs from mid-April through September 30th of each year. Depending on snow-pack and rainfall, the irrigation season can vary in length.

The proposed XL pipeline will cross the canal at approximate Station 2375+00±50. Exhibit A shows the proposed pipeline crossing with respect to the canal. Exhibit B shows the profile of the canal in the vicinity of the pipeline crossing and the typical cross section of the canal.

Below are the original design dimensions of the canal in the vicinity of the proposed pipeline crossing. Actual dimensions may vary from these values. Keystone XL Pipeline is responsible for verifying actual field dimensions.

- Bottom width—5.00 feet
- Side slopes—1.5:1
- Water depth—3.10 feet
- Downhill bank height—5.00 feet

All rights-of-ways for the Glasgow Unit were obtained using the 1890 Canal Act. Reclamation's easement under the 1890 Canal Act can be described as follows:

The 1890 Canal Act granted to the United States an unrestrained right-of-way for ditches and canal for any lands west of the 100th Meridian that were patented after that date. The easements are reserved in the original land patents issued for these lands and are blanket easements covering the entire tracts patented. The 1890 Act granted authority to place the ditches and canals wherever needed and as a result no legal description of the canal was necessary or required to be recorded. Wherever the canal is located is the defined area of use. This includes any supporting features including but not limited to access roads and areas alongside the canal needed for operation and maintenance of the canal.

Because the U.S. easement is first in time, any following easements granted by the underlying landowner will be subject to the easement rights of the United States and cannot unreasonably interfere with the U.S. project.

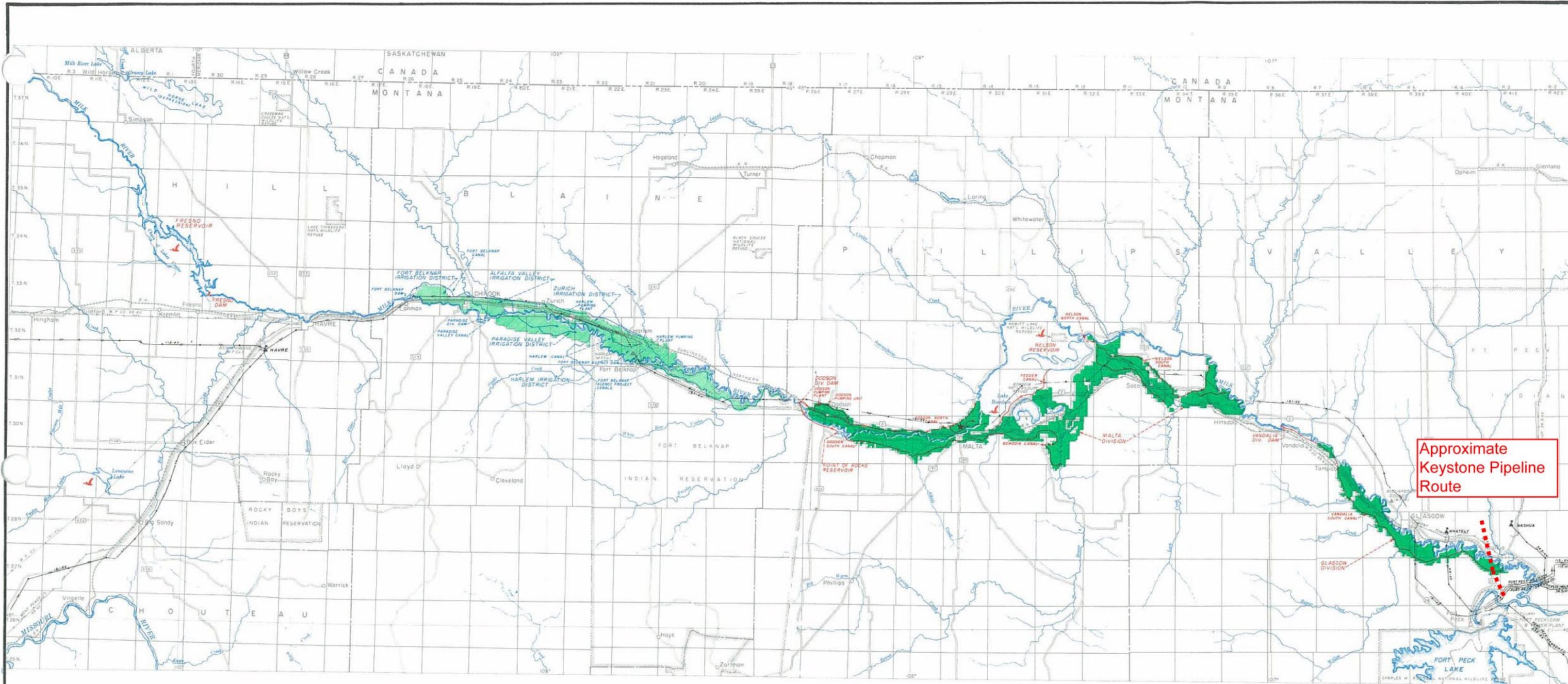
Construction requirements:

- The pipeline must be installed to ensure the minimum clearances shown on Drawing 40-600-51.
- The canal must remain in operation during the irrigation season. If the pipeline crossing is made during the irrigation season, the pipe must be bored under the canal.
- If the pipeline crossing is made during the non-irrigation season, the canal may be open cut. If the canal is open cut, all backfill within the easement boundaries shall be

compacted to 95% density in accordance with specifications Section 02302 – Compacting Earth Materials.

- All disturbed areas shall be shaped to facilitate natural drainage and reseeded in accordance with Section 02924 – Seeding and Soil Supplements.
- Pipeline markers and signs shall be installed on both sides of the canal.
- Provide 5 days prior notice work on the Government easement. No work shall be done without the presence of a Government Representative. Contact Mr. Steve Stebbleton, Field Manager, Glasgow Irrigation District at 406-228-2346 and Mr. Steve Davies, Montana Area Office at 406-247-7322.

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Approximate
Keystone Pipeline
Route



EXPLANATION

- CANAL — BUREAU OF RECLAMATION
- TRANSMISSION LINE — W.A.P.A.
- INTERCONNECTION
- POWER PLANT — U.S.C.E.
- PUMPING PLANT — W.A.P.A.
- AREA BENEFITED BY PROJECT WORKS
- ★ PROJECT HEADQUARTERS
- ★ W.A.P.A. WESTERN AREA POWER ADMINISTRATION
- ★ U.S.C.E. UNITED STATES CORPS OF ENGINEERS
- WILDLIFE MANAGEMENT AREA

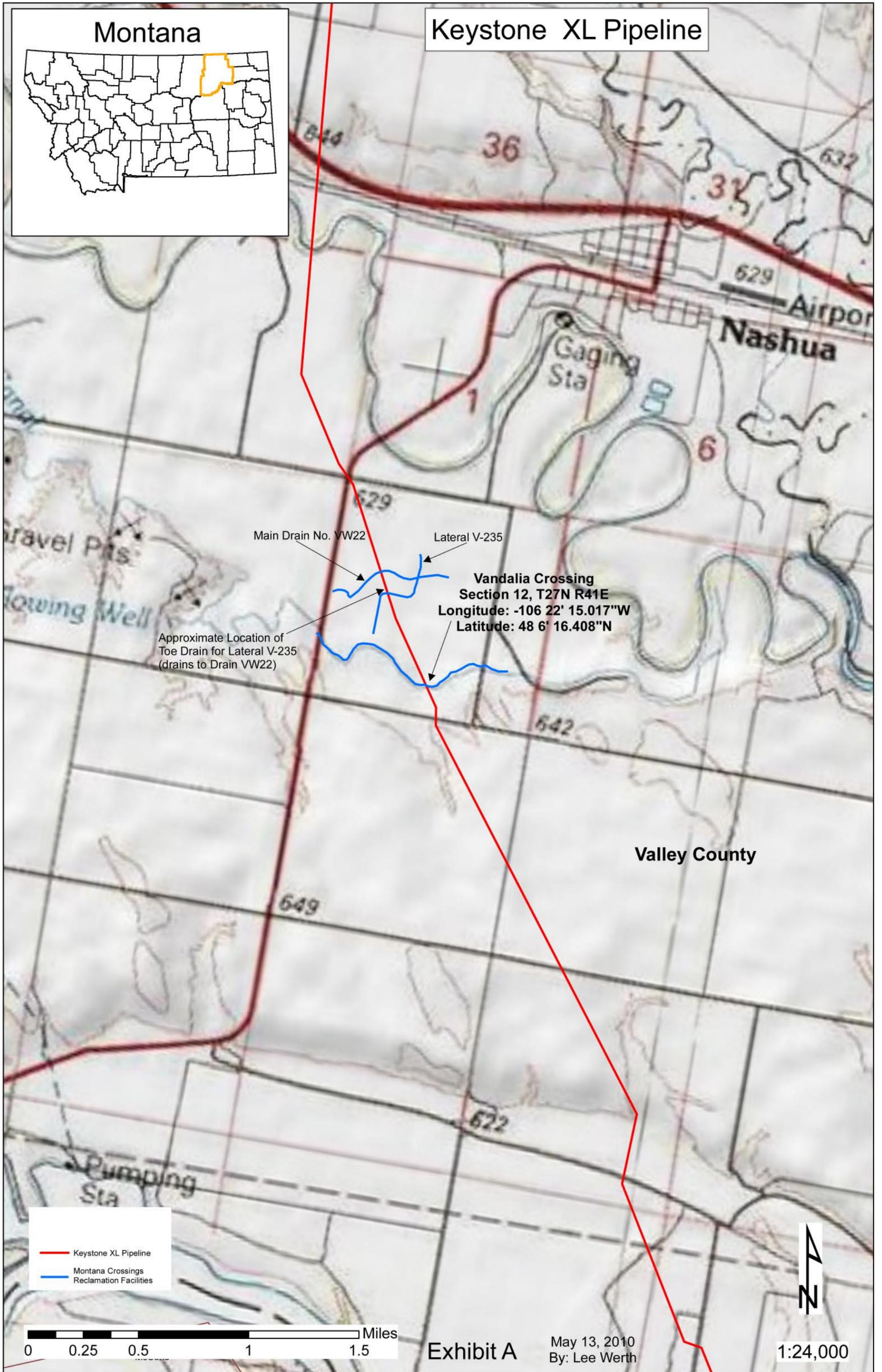
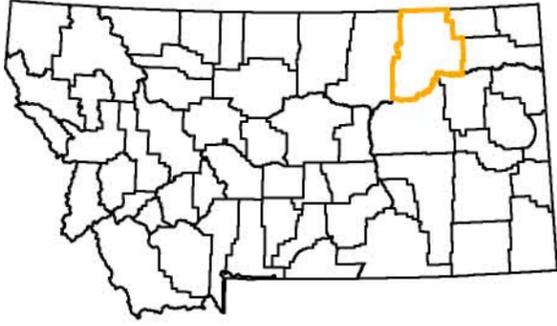
UNITED STATES
DEPARTMENT OF THE INTERIOR
JAMES G. WATT, SECRETARY
BUREAU OF RECLAMATION
ROBERT N. BROADBENT, COMMISSIONER

MILK RIVER PROJECT
MONTANA
GREAT PLAINS REGION

MAP NO. 15-600-137
NOVEMBER 1983

Montana

Keystone XL Pipeline



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Lateral V-235

Lateral V-235

Glasgow Unit, Milk River Project-Montana

W1/2, Section 12, T27N, R41E, Valley County

Lateral V-235 delivers irrigation water from the Vandalia South Canal to farmlands located along the south side of the Milk River. The irrigation season normally runs from mid-April through September 30th of each year. Depending on snow-pack and rainfall, the irrigation season can vary in length. Lateral V-235 also has a toe drain system that discharges into Main Drain VW22.

Exhibit A shows the proposed pipeline crossing with respect to the lateral. A plan and profile drawing is not available for the lateral or the toe drain. Keystone XL Pipeline is responsible for verifying actual field conditions.

All rights-of-ways for the Glasgow Unit were obtained using the 1890 Canal Act. Reclamation's easement under the 1890 Canal Act can be described as follows:

The 1890 Canal Act granted to the United States an unrestrained right-of-way for ditches and canal for any lands west of the 100th Meridian that were patented after that date. The easements are reserved in the original land patents issued for these lands and are blanket easements covering the entire tracts patented. The 1890 Act granted authority to place the ditches and canals wherever needed and as a result no legal description of the canal was necessary or required to be recorded. Wherever the canal is located is the defined area of use. This includes any supporting features including but not limited to access roads and areas alongside the canal needed for operation and maintenance of the canal.

Because the U.S. easement is first in time, any following easements granted by the underlying landowner will be subject to the easement rights of the United States and cannot unreasonably interfere with the U.S. project.

Construction requirements:

- The pipeline must be installed to ensure the minimum clearances shown on Drawing 40 600-51.
- The canal and canal toe drain system must remain in operation during the irrigation season. If the pipeline crossing is made during the irrigation season, the pipe must be bored under the canal.
- If the pipeline crossing is made during the non-irrigation season, the canal may be open cut. If the canal is open cut, all backfill within the easement boundaries shall be compacted to 95% density in accordance with specifications Section 02302 – Compacting Earth Materials.
- All disturbed areas shall be shaped to facilitate natural drainage and reseeded in accordance with Section 02924 – Seeding and Soil Supplements.
- Pipeline markers and signs shall be installed on both sides of the canal.
- Provide 5 days prior notice work on the Government easement. No work shall be done without the presence of a Government Representative. Contact Mr. Steve Stebbleton,

Field Manager, Glasgow Irrigation District at 406-228-2346 and Mr. Steve Davies,
Bureau of Reclamation, Montana Area Office at 406-247-7322.

Main Drain VW22

Main Drain VW22
Glasgow Unit, Milk River Project-Montana
W1/2, Section 12, T27N, R41E, Valley County

Main Drain VW22 carries surface and subsurface water off of farmlands to the Milk River. Flows occur year round, however they increase during the irrigation season which normally runs from mid-April through September 30th of each year. Depending snow-pack and rainfall, the irrigation season can vary in length.

Exhibit A shows the proposed pipeline crossing with respect to the drain. A plan and profile drawing is not available for the drain. Keystone XL Pipeline is responsible for verifying actual field conditions.

All rights-of-ways for the Glasgow Unit were obtained using the 1890 Canal Act. Reclamation's easement under the 1890 Canal Act can be described as follows:

The 1890 Canal Act granted to the United States an unrestrained right-of-way for ditches and canal for any lands west of the 100th Meridian that were patented after that date. The easements are reserved in the original land patents issued for these lands and are blanket easements covering the entire tracts patented. The 1890 Act granted authority to place the ditches and canals wherever needed and as a result no legal description of the canal was necessary or required to be recorded. Wherever the canal is located is the defined area of use. This includes any supporting features including but not limited to access roads and areas alongside the canal needed for operation and maintenance of the canal.

Because the U.S. easement is first in time, any following easements granted by the underlying landowner will be subject to the easement rights of the United States and cannot unreasonably interfere with the U.S. project.

Construction requirements:

- The pipeline must be installed to ensure the minimum clearances shown on Drawing 40-600-51.
- The drain must remain in operation and the pipe must be bored under the drain.
- All disturbed areas shall be shaped to facilitate natural drainage and reseeded in accordance with Section 02924 – Seeding and Soil Supplements.
- Pipeline markers and signs shall be installed on both sides of the drain.
- Provide 5 days prior notice work on the Government easement. No work shall be done without the presence of a Government Representative. Contact Mr. Steve Stebbleton, Field Manager, Glasgow Irrigation District at 406-228-2346 and Mr. Steve Davies, Montana Area Office at 406-247-7322.

Glendive Mail Canal

Glendive Main Canal Buffalo Rapids Project-Montana

NE1/4, Section 10, T13N, R53E, Dawson County

The Glendive Main Canal delivers irrigation water from the Yellowstone River to farmlands located along the north side of the Yellowstone River. The canal is approximately 34 miles long and has a diversion capacity of 330 cubic feet per second. The irrigation season normally runs from May 1st through September 30th of each year.

The proposed XL pipeline will cross the canal at approximate Station 309+00±10. Exhibit A shows the proposed pipeline crossing with respect to the canal. Exhibit B shows the plan view and the right of way widths. Exhibit C shows the profile and the typical cross section of the canal in the vicinity of the pipeline crossing.

Below are the original design dimensions of the canal in the vicinity of the proposed pipeline crossing. Actual dimensions may vary from these values. Keystone XL Pipeline is responsible for verifying actual field dimensions.

- Bottom width—12.00 feet
- Side slopes—1.5:1
- Water depth—6.4 feet
- Downhill bank height—9.00 feet
- Easement width—125 feet total (50 feet left of centerline and 75 feet right of centerline)

Construction requirements:

- The pipeline must be installed to ensure the minimum clearances shown on Drawing 40-600-51.
- The canal must remain in operation during the irrigation season. If the pipeline crossing is made during the irrigation season, the pipe must be bored under the canal.
- If the pipeline crossing is made during the non-irrigation season, the canal may be open cut. If the canal is open cut, all backfill within the easement boundaries shall be compacted to 95% density in accordance with specifications Section 02302 – Compacting Earth Materials.
- All disturbed areas shall be shaped to facilitate natural drainage and reseeded in accordance with Section 02924 – Seeding and Soil Supplements.
- Pipeline markers and signs shall be installed on both sides of the canal.
- Provide 5 days prior notice work on the Government easement. No work shall be done without the presence of a Government Representative. Contact Mr. Larry Heimbuch, Manager, Buffalo Rapids District No. 1 at 406-939-1750 and Mr. Steve Davies, Bureau of Reclamation, Montana Area Office at 406-247-7622.

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Approximate
Keystone Pipeline
Route

- EXPLANATION**
- CANAL
 - SIPHON
 - PUMPING PLANT
 - SUBSTATION - U.S.B.R.
 - AREA BENEFITED BY PROJECT WORKS
 - PROJECT HEADQUARTERS
 - TRANSMISSION LINE - U.S.B.R.
 - TRANSMISSION LINE - PRIVATE
 - STEAM PLANT - PRIVATE
 - SUBSTATION - PRIVATE

UNITED STATES
DEPARTMENT OF THE INTERIOR
CECIL D. ANDRUS, SECRETARY
BUREAU OF RECLAMATION
R. KEITH HIGGINSON, COMMISSIONER

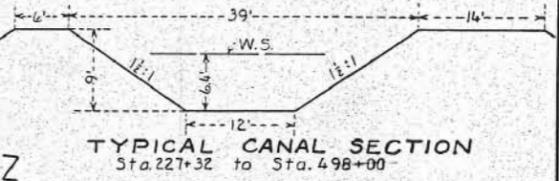
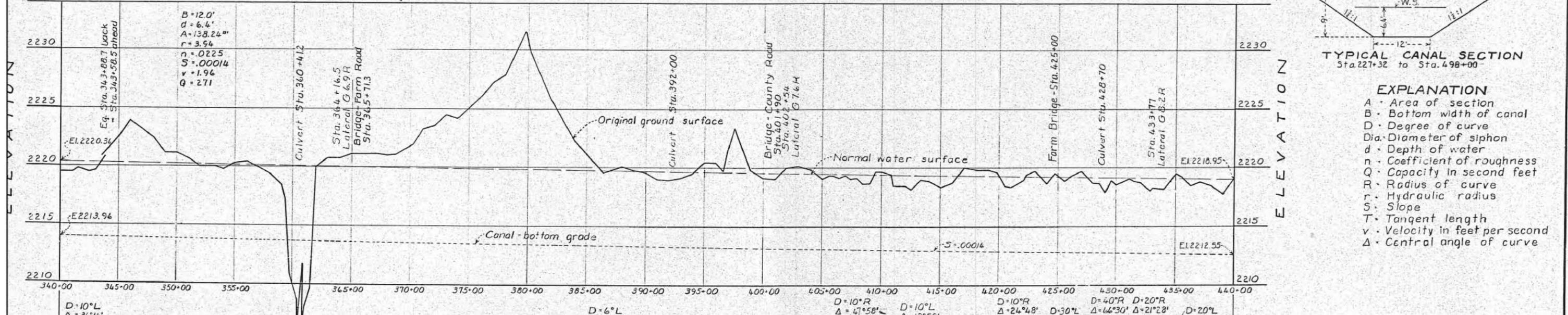
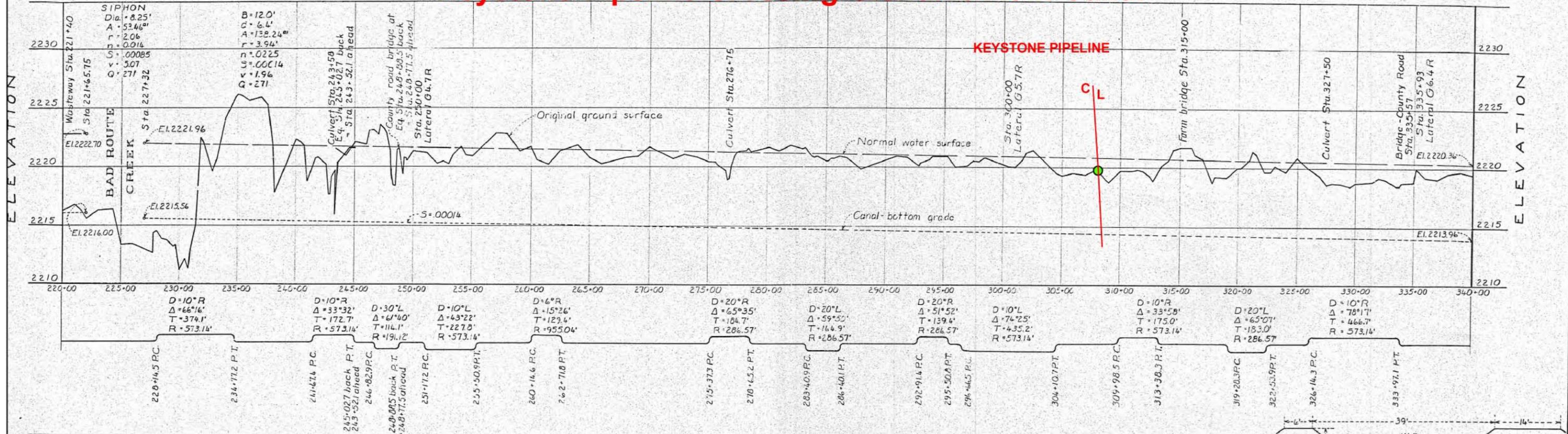
BUFFALO RAPIDS PROJECT

MONTANA
GREAT PLAINS REGION
MAP NO. 243-600-53



SEPTEMBER 1977

Keystone Pipeline Crossing Glendive Main Canal



- EXPLANATION**
- A - Area of section
 - B - Bottom width of canal
 - D - Degree of curve
 - Dia. - Diameter of siphon
 - d - Depth of water
 - n - Coefficient of roughness
 - Q - Capacity in second feet
 - R - Radius of curve
 - r - Hydraulic radius
 - S - Slope
 - T - Tangent length
 - v - Velocity in feet per second
 - Δ - Central angle of curve

DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION
 BUFFALO RAPIDS PROJECT - MONT.

MAIN CANAL - GLENDIVE UNIT
 STA. 220+00 TO STA. 440+00

REV. 5-25-38	DRAWN: R.R.R.	SUBMITTED: Paul A. Jones
	TRACED: D.R.B.	RECOMMENDED:
	CHECKED: S.R.B.	APPROVED:
	4-A-3	
	GLENDIVE, MONTANA MARCH 15, 1938	
	SHEET 2 OF 8	
	243-605-140	

Plan View - Keystone Pipeline Crossing Glendive Main Canal

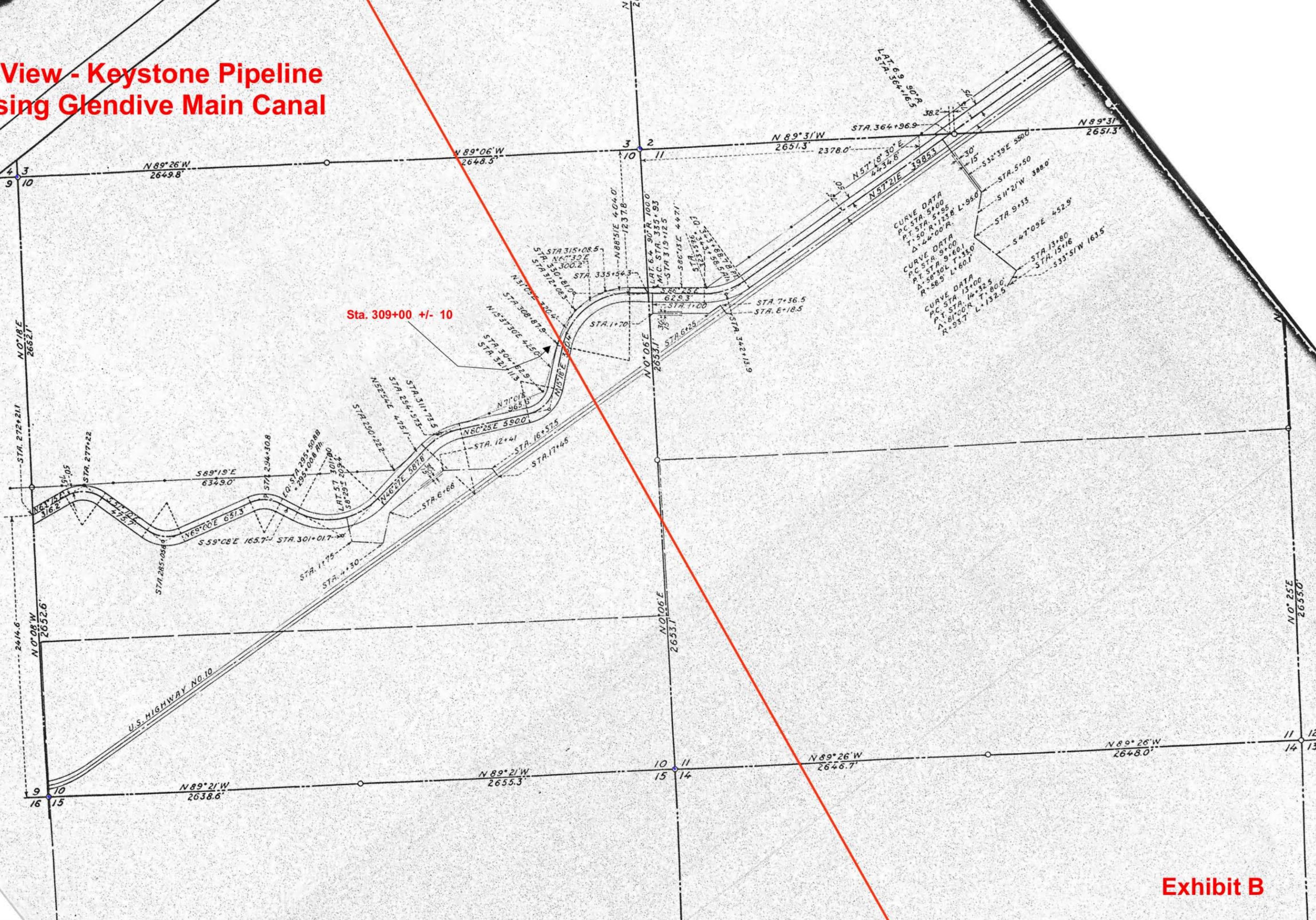
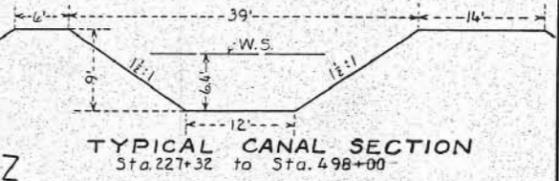
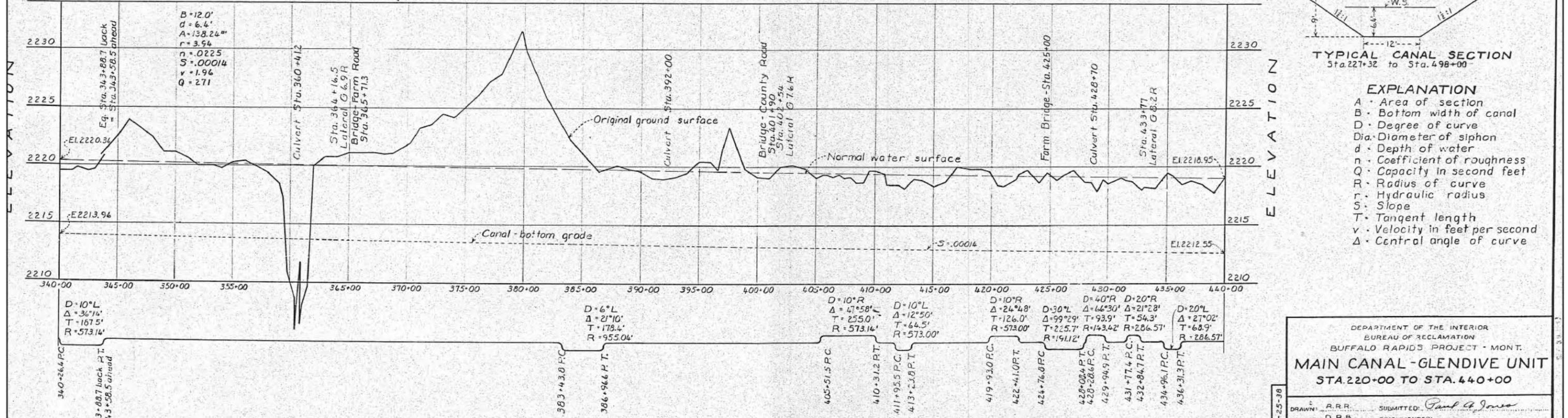
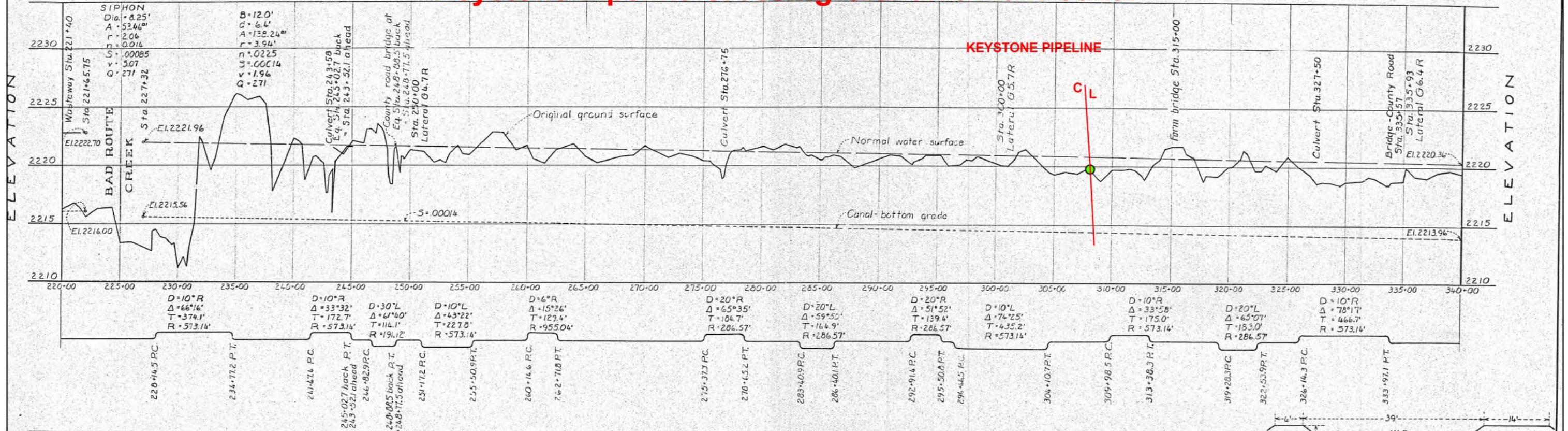


Exhibit B

Keystone Pipeline Crossing Glendive Main Canal



- EXPLANATION**
- A - Area of section
 - B - Bottom width of canal
 - D - Degree of curve
 - Dia. - Diameter of siphon
 - d - Depth of water
 - n - Coefficient of roughness
 - Q - Capacity in second feet
 - R - Radius of curve
 - r - Hydraulic radius
 - S - Slope
 - T - Tangent length
 - v - Velocity in feet per second
 - Δ - Central angle of curve

DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION
 BUFFALO RAPIDS PROJECT - MONT.
MAIN CANAL - GLENDIVE UNIT
 STA. 220+00 TO STA. 440+00

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243-605-140