



USDA NRCS Bismarck State Office

Dam Assessment Report

English Coulee Dam

Grand Forks County, North Dakota



DECEMBER 2021

**Prepared for: Grand Forks County Water Resources District
151 South 4th Street
Grand Forks, North Dakota 58201**



Prepared by:



**Natural Resources Conservation Service
North Dakota Engineering Staff
220 E Rosser Ave, Box 1458
Bismarck, ND 58502-1458**



**United States
Department of
Agriculture**



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Sections 10-13, 24, 25 T150N-R52W

Grand Forks County, North Dakota

National Inventory of Dams ID: ND00425

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REPORT

1 INTRODUCTION AND PURPOSE

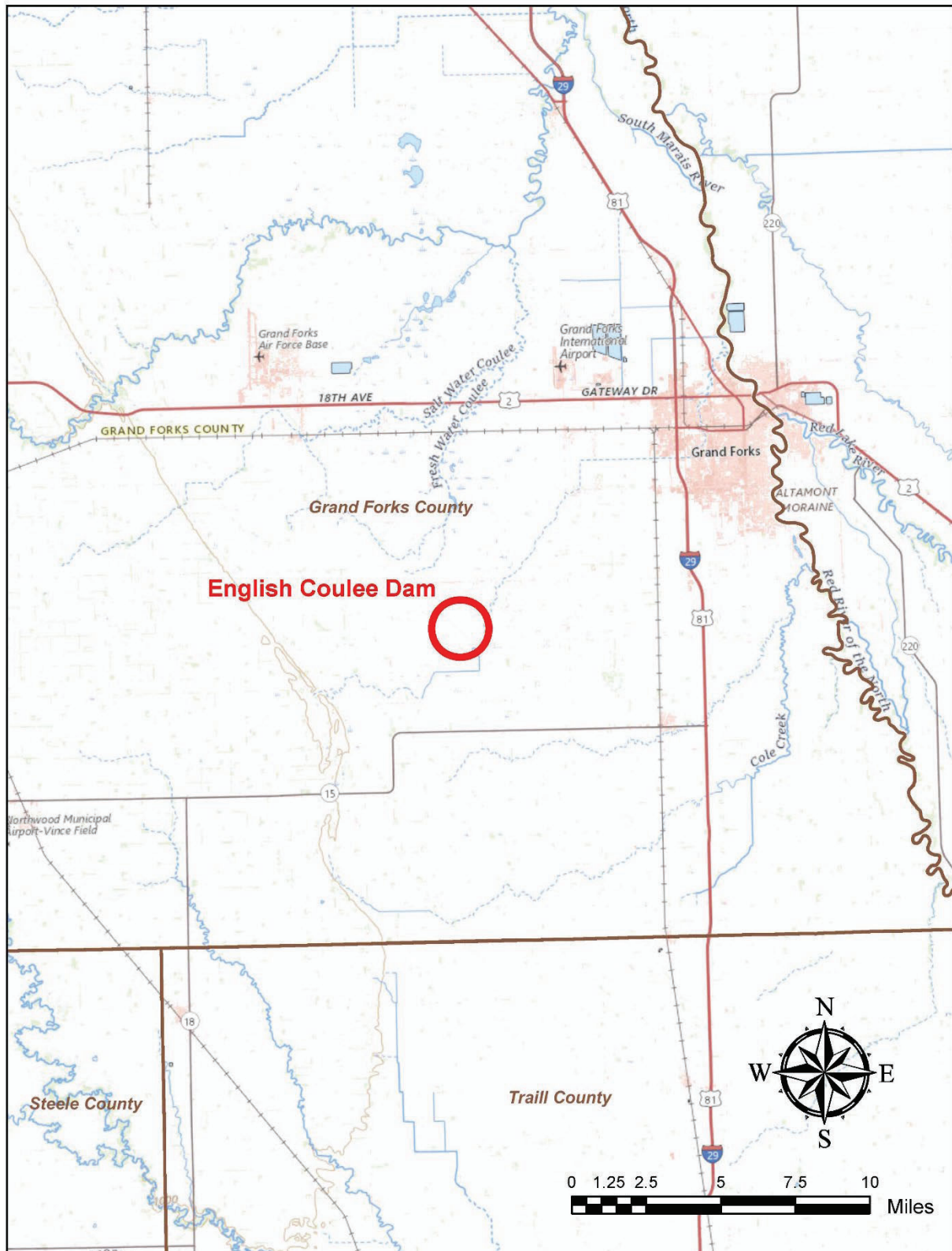
The purpose of this report is to provide an assessment of English Coulee Dam in light of current standards for dam safety as well as hydrologic, hydraulic, and topographic data that were not available at the time of original design. The report provides a description of the dam, an assessment of the current conditions and status of operation and maintenance, and the scope of potential rehabilitation alternatives. In addition to assessing the overall integrity of the structure, available design information was reviewed to determine whether the structure meets current Natural Resources Conservation Service (NRCS) and North Dakota State Water Commission (ND SWC) design criteria. This information is provided to assist the Grand Forks County Water Resources District (WRD) in determining future actions concerning potential rehabilitation of the dam that would extend the service life of the dam and meet current dam safety criteria.

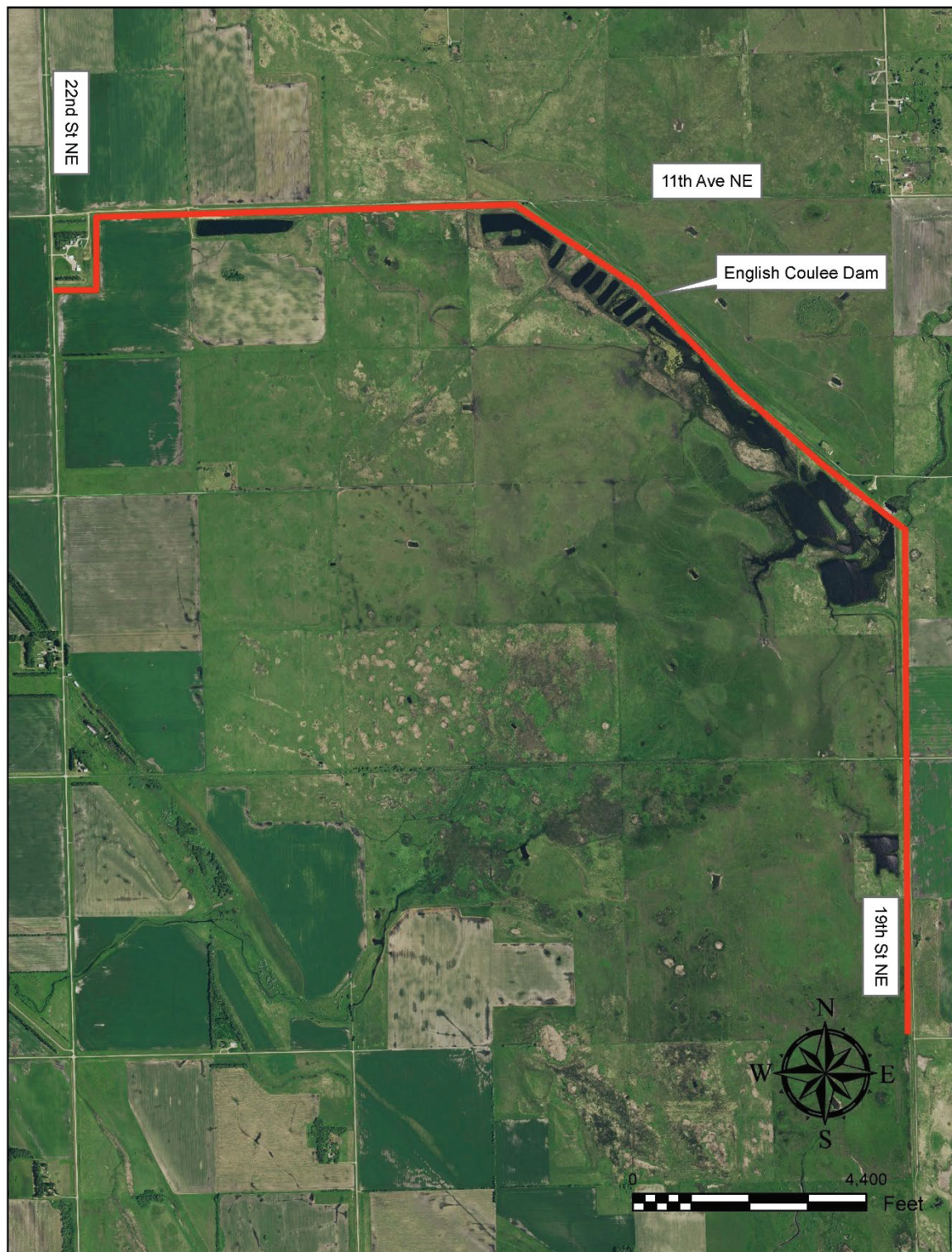
NRCS provided technical and financial assistance for the planning, design, and construction of English Coulee Dam to the Grand Forks County Water Resource District through the PL-566 Watershed and Flood Prevention Operations Program. The dam is owned, operated, and maintained by the Grand Forks WRD under an Operation and Maintenance Agreement with NRCS, which is active through 2040. The Grand Forks WRD and NRCS jointly conduct annual inspections of the dam, and the ND State Water Commission conducts periodic inspections as well.

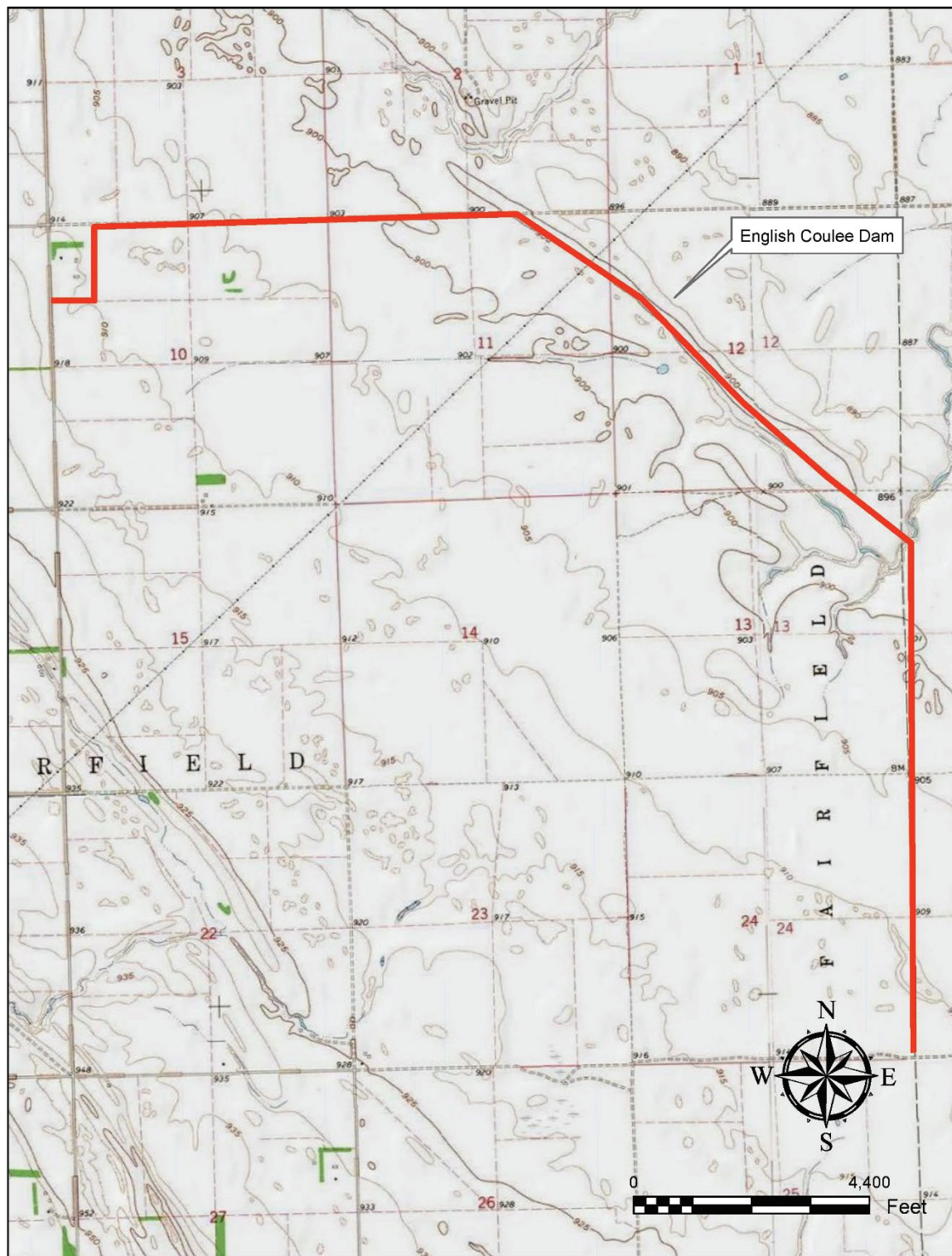
The Watershed Protection and Flood Protection Act (Section 14 of PL-83-566, as amended) authorizes the funding and technical assistance to rehabilitate aging flood control dams originally built under the program, to extend the project service life and ensure that the facility meets applicable safety and performance standards. Sponsors of these dams may apply for assistance to extend the project service life and ensure the facility meets applicable safety and performance standards, however repairs considered as maintenance are not eligible. If a dam is eligible for rehabilitation assistance, the NRCS may provide funding for 65 percent of the total rehabilitation costs; the project sponsors are responsible for the remaining 35 percent.

2 PROJECT SETTING AND DATA REVIEW

English Coulee Dam is an unattended flood control dam located 15 miles southwest of Grand Forks, ND, in Sections 10-13, 24, 25, T150N, R52W. The dam is currently classified as a high-hazard structure, as defined by both the NRCS and the ND SWC. A location map, an aerial photo, and a topographic map are shown on Figures 1, 2, and 3, respectively.







English Coulee Dam and its appurtenances consists of a 6-mile long, homogeneous earthfill embankment with a structural height of 27 feet. As-built drawings for the structure are included in Appendix G.

The dam has a principal spillway (PSW) and an auxiliary spillway (ASW). The PSW consists of a non-standard reinforced concrete weir box with hood inlet, a 66-inch diameter concrete pipe (128 feet long), and a Saint Anthony Falls (SAF) basin. A 24-inch diameter reinforced concrete pipe extends from a gate well on the weir box to a drawdown inlet structure. Drawdown is controlled by a 24" x 24" slide gate in the gate well. The ASW is a baffled chute constructed over the embankment with a crest elevation 9-feet below the top of the dam. All locations where water may flow into the PSW (top inlet of the weir box, drawdown inlet) are protected with trash racks.

The PSW inlet structure is an 11' x 16' weir box with an antivortex splitter wall. This antivortex wall is also used to support the slide gate. The weir box has an inlet crest elevation of 899.6 feet (NAVD88), approximately 7 ½ feet below the ASW crest. The 24-inch low-level drawdown is provided to drain or lower the reservoir to water surface elevations below the weir crest. The 24-inch low-level drawdown consists of a headwall structure at the upstream intake and a 24-inch inside diameter reinforced concrete pipe connecting the intake to the weir box structure. The gate well for the low-level drawdown is constructed upon the upstream face of the weir box and contains a slide gate, manually operated by a handwheel located on top of the weir box. The PSW outlet conduit is a 66" reinforced concrete pipe which discharges into a concrete St. Anthony Falls (SAF) basin. The SAF basin is approximately 52-feet in length, with an entrance elevation of 889.2 feet (NAVD88) and an exit elevation of 882.9 feet (NAVD88).

The ASW is a concrete baffled chute spillway that is constructed over the embankment. The spillway has a width of 200-feet and a Fugimoto entrance (serrated horizontal broad crested weir) with a crest elevation of 907.2 feet (NAVD88). The spillway discharges into a riprap stilling basin.

The ASW is uncontrolled. All flow is discharged through the PSW until the pool level exceeds the ASW crest elevation. A summary of specific design data is presented in Table 1.

Topographic data was obtained as LiDAR (Light Detection and Ranging) grid from the Red River Basin Mapping Initiative (2008-2010). This data is publicly stored by the ND SWC online at the following address: <https://lidar.swc.nd.gov>. Data was collected with leaf off conditions over a two-year period between spring of 2008 and spring of 2010. The elevation quality is considered QL3, which is documented as having horizontal accuracy less than or equal to 1 meter, and vertical accuracy less than or equal to 15 cm. The LiDAR vertical datum is NAVD88.

Available data utilized in the compilation of this report include:

- Design Report
- Structure As-built Plans (1990)
- Emergency Action Plan (2009)
- Watershed Plan (1984)
- Operation and Maintenance Reports
- Soil Mechanics Laboratory Report (1980)
- LiDAR Survey Data
- Red River of the North Basin-Wide HEC-HMS Model

Table 1. As-Built Design Data for English Coulee Dam

Description	Value	
General Data		
Year Designed	1987	
Year Constructed	1990	
Purpose	Flood control	
Original Hazard Classification	High	
Current Hazard Classification	High	
Design Life based on Watershed Work Plan	100 Years	
Original Design Drainage Area	53.5 Mi²	
Revised Drainage Area	54.7 Mi³	
Dam Height (Along Centerline)	27 Feet	
Embankment Length	6.02 Miles	
Embankment Top Width	14 Feet	
Embankment Upstream Slope	3.5H:1V	
Embankment Downstream Slope	2.5H:1V (3H:1V STA 276+50 - 281+80)	
Critical Elevations	NGVD29	NAVD88
Top of Dam	915.0 Feet	916.2 Feet
ASW Crest	906.0 Feet	907.2 Feet
PSW Weir Crest	889.4 Feet	899.6 Feet
PSW SAF Entrance Invert	888.0 Feet	889.2 Feet
PSW SAF Exit Invert	881.7 Feet	882.9 Feet
PSW Outlet Channel Invert	886.5 Feet	887.7 Feet
Storage Capacities		
PSW Weir Crest	286 Acre-Feet	
ASW Crest	6,648 Acre-Feet	
Top of Dam	30,289 Acre-Feet	
Pool Surface Areas		
PSW Weir Crest	118 Acres	
ASW Crest	2,719 Acres	
Other Features		
PSW Weir Crest Length	32 Feet (Total)	
PSW Conduit Diameter	66 Inches	
PSW Conduit Length	127.85 Feet	
ASW Width	200 Feet	

3 SITE INSPECTION SUMMARY & OPERATION AND MAINTENANCE

English Coulee Dam was inspected on September 10, 2020 by ND NRCS State Office staff. Inspection observations and inspection photographs are provided in the Dam Inspection Report in Appendix A. A summary of maintenance deficiencies that were found are noted below:

- Trees were observed to be growing at different locations along the embankment.
- The drainage of the stilling basins of the principal and auxiliary spillways appeared to be restricted due to heavy vegetative growth.
- Access roads across the embankment are at a lower elevation than the dam crest.
- Vehicle ruts are located on the embankment faces in various locations. Near the left wall of the auxiliary spillway, the rutted area has begun to erode.
- Vehicle ruts are located in locations along the dam crest.
- Prior concrete repair in the approach floor of the auxiliary spillway is not adhered to surrounding structure.
- Excessive vegetation is growing in the floor joints of the auxiliary spillway.
- The wall joints of the principal spillway outlet chute were found to be separating. Over the 30 years the dam has been in place, joint gaps have increased by up to 0.5 inches at the top of the walls. No tracking of the gap sizes has been recorded but subsequent inspections will begin to monitor any changes.

Review of prior inspection reports indicate that the only recurring issues with the structure was been vegetation management. The only substantial maintenance on the structure has been concrete patching of the left wall of the auxiliary spillway approach section. The most recent inspection of the structure shows that this patch is in good condition.

The original Operation and Maintenance Plan is provided in Appendix B. The plan was reviewed and is determined to be adequate and sufficient for continued use. In addition to the plan, it is recommended that the dam owner maintain records of maintenance activities completed on the structure, high water event stages and durations, and gate testing/operation.

An Emergency Action Plan (EAP) has been developed for this structure and was last updated in 2009. In discussing with current members of the Grand Forks County Water Resource District, it is unknown when the last table-top exercise was completed. The existing EAP should be updated to reflect the hydraulic and hydrologic modeling results that were developed as part of this dam assessment.

4 HYDROLOGIC AND HYDRAULIC ANALYSES

Hydrologic and hydraulic analyses were conducted to determine whether the existing dam meets current NRCS and ND SWC criteria. Review of hydrologic criteria for a Class IV structure according to the ND SWC guidance document, *North Dakota Dam Design Handbook (June 1985)*, indicates that the requirements are substantially less than the NRCS requirements for a High hazard structure with a structural auxiliary spillway. The spillway design criteria for a SWC Class IV structure includes 2% exceedance precipitation for the principal spillway, 0.3PMP for the auxiliary spillway hydrograph, and 0.5PMP for the freeboard hydrograph. NRCS criteria include 1% exceedance precipitation for the

principal spillway, 0.48PMP for the auxiliary spillway hydrograph, and the full PMP for the freeboard hydrograph. Therefore, only the NRCS criteria are considered in the evaluation of the structure.

The analysis involved evaluation of the 100-year frequency and the Probable Maximum Precipitation (PMP) design storms in accordance with procedures outlined in the latest version of *Technical Release No. 60 Earth Dams and Reservoirs* (TR-60). Catchment area is a critical component of hydrologic analysis. The dam design documented 53.5 mi². The International Water Institute (IWI) delineation Map Portal (<https://gisapps.iwinst.org/map-portal/>) determined the approximate catchment area to be 55.6 mi² based on hydro-conditioned LiDAR topography. Hydro-conditioning occurred on a basin wide scale that burned flow paths through digital dams, such as culverts through roadways, based on National Hydrography Dataset or user defined streams and watercourses. The dam catchment was analyzed in further detail using raw LiDAR, available at <https://lidar.swc.nd.gov/>, with field check of eighteen critical culverts to determine catchment size to be 54.7 mi². This catchment area is considered the most accurate representation of the watershed due to more precise ground elevations than past analyses, and most accurate representation of artificial drainage patterns, including culverts in place at time of assessment.

The stage-discharge rating provided with the original design documents of the structure were found to have some errors in the calculations. Minor changes to the spillways between initial planning and final design were not accounted for. Therefore, the stage-discharge rating for English Coulee Dam was re-calculated with the results shown below in Table 2. Additionally, the stage-storage relationship of the structure was re-analyzed utilizing current LiDAR data for the area. Note that the original stage-storage values up to elevation 898.7 (NAVD88) were confirmed using the average-end-area method with the acreages determined in the original design of the structure. LiDAR could not be utilized for elevations below this threshold due to the reservoir pool level at the time of data collection. Calculations for the principal spillway stage-discharge analysis are provided in Appendix D and were completed assuming the drawdown gate was in a closed position. Actual rates of sedimentation were not considered in this assessment; however, a conservative assumption is that sediment has filled the reservoir up to the low-level drawdown invert. Routing of the PSH was started at an elevation of 899.6 feet, per TR-60 guidance.

Table 2. Stage - Storage - Discharge Structure Rating

ELEVATION NGVD 29 (FT)	ELEVATION NAVD 88 (FT)	AREA (AC)	VOLUME (AC-FT)	DISCHARGE (CFS)	FEATURE
888.0	889.2	0.0	0	0	
890.0	891.2	2.6	3	0	
892.0	893.2	7.8	13	0	
894.0	895.2	23.2	41	0	
896.0	897.2	54.9	109	0	
898.4	899.6	118.1	286	0	PS INVERT
900.0	901.2	475.2	682	201	
902.0	903.2	1023.6	1973	432	
904.0	905.2	1452.9	3975	469	
906.0	907.2	2718.8	6648	503	AS INVERT
908.0	909.2	3341.1	10232	2289	
910.0	911.2	5363.6	14765	5526	
912.0	913.2	6060.2	20128	9706	
914.0	915.2	9120.0	26604	14651	
915.0	916.2	21096.6	30289	17375	TOP OF DAM

NRCS design criteria for precipitation and other hydrologic parameters have become more stringent since the original design of the dam. Updated hydrologic and hydraulic analyses were performed using a HEC-HMS model with current parameters. The Red River of the North Basin-Wide HEC-HMS model was originally prepared by the U.S. Army Corps of Engineers (USACE) with hydrologic parameters developed assuming antecedent moisture condition II and calibrated based upon known precipitation events. NRCS updated the USACE model to meet TR-60 Hydrology criteria, including basin and reach parameters, and applied precipitation for the Auxiliary Spillway Hydrograph (ASH) and Freeboard Hydrograph (FBH). The Principal Spillway Hydrograph (PSH) was run in SITES for return period calculations, for which the 10-day drawdown water surface elevation was determined to be 902.0, which was then used for the starting reservoir level for ASH and FHB. It should be noted that the effects of the existing structural auxiliary spillway were included in the analysis of the PSH, as allowed by TR-60. The key parameters and results of hydrologic analysis of the structure are presented in Tables 3-5.

The primary HEC-HMS model updates included limiting sub basin size to 20 square miles, modifying reach parameters, and updating reservoir relationships as listed in the table above. The basin-wide HMS model reaches were modeled with Modified Puls routing method, which provided storage with relationship to flow. Both reaches needed to be extended to include higher flows; the upper reach was extended linearly from lower values. The lower reach is approximately 2.5 miles before the confluence with the reservoir pool and had very considerable storage that could only be attained including the reservoir. However, the reservoir was already accounting for this storage. A two-dimensional (2-D) RAS model was developed to determine lower reach function; excess precipitation or runoff was input over a 2-D mesh of the watershed. The 2-D RAS model evaluated the basin's roughness as Manning's n was

calibrated to HMS upper basins outflow. Then, the HMS lower reach routing was calibrated to 2-D RAS reservoir inflow. The reach Modified Puls relationships are documented in Appendix C.

Table 3. Principal Spillway Hydrograph Results

Principal Spillway Hydrograph Summary Table Results	
Watershed Runoff Curve Number	72.5
Total Watershed Drainage Area (Square Miles)	54.7
Watershed Time of Concentration (Hours)	36
PSH 1-Day Rainfall (Inches)	6.06
PSH 10-Day Rainfall (Inches)	8.46
Initial Reservoir Elevation (Feet)	899.6
Existing ASW Crest Elevation (Feet)	907.2
Maximum WS (Feet)	907.31
100-Year ASW Crest Elevation (Feet) ⁵	N/A
PSH Drawdown WSE at 10-Days (Ft)	902.0
Complete Drawdown Time (Days)	10.5
Capacity Evacuated in 10 Days (Percent)	88.60

Table 4. Auxiliary Spillway Hydrograph Results

Auxiliary Spillway Hydrograph Summary Table Results			
	6-Hour	ASH 24-Hour	48-Hour ³
Watershed Runoff Curve Number ²	72.5	72.5	72.5
Total Watershed Drainage Area (Sq.Miles) ¹	54.7	54.7	54.7
Watershed Time of Concentration (Hours)	36	36	36
ASH 100-Year, Rainfall (Inches)	4.44	6.06	6.82
General PMP (Inches)	13.68	21.7	22.5
Local PMP (Inches)	16.92	20.65	N/A
ASH Precipitation Input (Inches)	6.84	10.13	10.90
Initial Reservoir Elevation (Feet) ⁶	902.0	902.0	902.0
Max WS: TR-60 Distribution Criteria (Feet) ^{4,7}	908.7	910.0	910.2
Max WS: Balanced Hyetograph (Feet) ⁴	908.7	909.9	910.2
Wave Height (Feet)	4.0	4.0	4.0
Required Top of Dam (Feet) ⁷	912.7	914.0	914.2

Table 5. Freeboard Hydrograph Results

Freeboard Hydrograph Summary Table Results			
	6-Hour	FBH 24-Hour	48-Hour ³
Watershed Runoff Curve Number ²	72.5	72.5	72.5
Total Watershed Drainage Area (Sq.Miles) ¹	54.7	54.7	54.7
Watershed Time of Concentration (Hours)	36	36	36
General PMP (Inches)	13.68	21.7	22.5
Local PMP (Inches)	16.92	20.65	N/A
Initial Reservoir Elevation (Feet) ⁶	902.0	902.0	902.0
Max WS: TR-60 Distribution Criteria (Feet) ^{4,7}	912.7	914.1	914.3
Max WS: Balanced Hyetograph (Feet) ⁴	912.7	914.1	914.2
Required Top of Dam (Feet)	912.7	914.1	914.3

- (1) Watershed area used for the hydrologic analysis was revised from the original design watershed based upon evaluation as previously described in this report. The catchment is considered a large drainage area, as the basin upstream of the dam is over 50 square miles.
- (2) The weighted curve number and the time of concentration are calibrated values taken from the HEC HMS model originally prepared by the USACE. Uncalibrated curve numbers were developed following 210-NEH-Part 630 guidance using land use and soil hydrologic soil group classifications.
- (3) The time of concentration is approximately 36 hours; therefore 48-hour duration precipitation events were used for the ASH and FBH. The 48-hr duration, 100-year frequency precipitation is 6.82 inches, which was obtained from NOAA Atlas 14. The 48-hr duration, Probable Maximum Precipitation (PMP) is 22.5 inches, which was obtained from North Dakota Statewide PMP Study.
- (4) The critical 48-hr storm type is general (in comparison to local or cool-season) and the critical distribution is 5-pt using critical local storm 6-hr amount (in comparison to hourly balanced hyetograph). The rainfall distribution is included as Figure 2 in Hydrology Appendix.
- (5) In accordance with TR-60 criteria, the required elevation of a structural spillway crest is independent of the reservoir pool elevation associated with the PSH.
- (6) Starting reservoir pool elevation for the initial PSH is set equal to 899.6 feet, which is the lowest ungated outlet. SITES analysis indicates that the corresponding 10-day drawdown elevation is 902.0 feet. This is the starting reservoir pool elevation when routing the ASH and FBH.
- (7) For the 6-Hour events, a specified, centrally loaded 6-Hour distribution was applied. This distribution is hard coded into the SITES software and was derived from training materials to be used in the HMS model. The 24 and 48-Hour storm events utilized the 5-point rainfall distribution.

In accordance with TR-60 criteria, the crest elevation of the earthen embankment shall contain the maximum water surface elevation associated with the FBH. The results of the hydrologic and hydraulic analysis indicate that the exiting crest elevation of 916.2 feet provides nearly 2-feet of freeboard over the FBH reservoir level.

Additionally, the structure was evaluated to ensure that the dam height is sufficient to provide protection against wave action and potential frost conditions when combined with the maximum water surface elevation attributed to the ASH (910.2 feet). A wave height of 4.0-feet was calculated in accordance with TR-56 "A Guide for Design and Layout of Vegetated Wave Protection for Earthen

Embankments and Shorelines” (calculations provided in Appendix D). Thus, the existing dam crest provides 2-feet of freeboard over the ASH reservoir level and associated wave height.

Frost conditions at the site were also considered. As water seeps through the embankment at different reservoir levels during cool seasons, there is a potential for frost cracking in the embankment soils. A potential failure mode exists if the cracking extends far enough through the embankment such that water is able to seep through the structure and outlet in the face or at the toe of the downstream embankment. While frost cracking can be a concern in cold climates, recent and prior inspections of the site have not indicated the presence of cracks on the embankment faces or crest.

5 AUXILIARY SPILLWAY EVALUATION

The structural auxiliary spillway was examined for its ability to adequately pass the Freeboard Hydrograph (FBH). The spillway dimensions and features were obtained from the structure as-built plans and confirmed during the field investigation. Additionally, the hydraulic features and capacity of the spillway were examined in order to determine the performance of the spillway under modeled conditions.

The hydraulic proportioning of the baffled chute spillway was originally done in accordance with TR-60 requirements and Bureau of Reclamation design procedures. Prior versions of TR-60 allowed structural spillways to be hydraulically proportioned based on two-thirds of the discharge flow associated with the Freeboard Hydrograph (FBH). This applied to the energy dissipation devices associated with the baffles of the spillway. The chute dimensions were designed to ensure the capability of containing the full FBH. Changes in the most recent version of TR-60 (dated March 2019) no longer allow proportioning based upon a reduced discharge flow. Structural spillways are now required to be hydraulically proportioned based upon the full FBH. The chute spillway was re-proportioned based upon the updated hydraulic analysis. The calculations are presented in Appendix D.

The analysis indicates that some of the baffle dimensions and spacings do not meet the recommended proportions. However, the differences are negligible (fractions of an inch) and are not considered to affect the performance of the spillway.

6 DAM FAILURE INUNDATION MAPPING

The limits of the downstream area inundated by dam failure have been updated as part of this assessment, beyond the past Emergency Action Plan (EAP) extents with Demers Avenue as the northern boundary and Red River of the North as the eastern boundary. The English Coulee Dam breach model was completed with HEC-RAS version 5.0.7. The area downstream of the dam is an extremely wide, flat lacustrine lakebed, with a considerable number of excavated channels, raised roads, and floodplain development. Therefore, a 2-D mesh was used for the breach modeling.

The dam failure was setup in relation to the peak reservoir elevation resulting from the aforementioned FBH, which is resulting from the PMP and is considered the Probable Maximum Flood (PMF). The peak breach discharge is approximately 18,500 CFS, which was calculated from TR-60 criteria. This breach discharge was assumed at the maximum reservoir height, adjacent to spillways, and combined with

auxiliary spillway flows; the maximum combined spillway and breach flow is approximately 30,000 CFS. The English Coulee embankment is much longer than most dams at approximately 6 miles. Therefore, breach flow could be separated from spillway flows causing two unique flow paths. With the breach based on TR-60 criteria (relatively low height of 27 feet), it seems the worst-case scenario could include both breach (18,500 CFS) and spillway flows (11,500 CFS).

The HEC-RAS model storage area connection representing English Coulee Dam was breached using parameters to match the aforementioned TR-60 peak discharge of 30,000 CFS. An unsteady flow regime was used to analyze breach flows downstream of the dam. The breach location is at the toe of the dam adjacent to the principal spillway. The HEC-RAS breach model schematic, inflow hydrograph, and breach parameters are summarized in Appendix C, page C-13.

The breach inundation zone is very large ($>50 \text{ mi}^2$) and has very diverse floodplain roughness. Therefore, the mesh was set with 500 foot spacing and a Manning's n value of 0.06. A sensitivity run on the roughness assumption found no sensitivity to hazard class, even though there are small differences to maximum depth and depth times velocity. Four break lines were included to incorporate critical raised roads, diversions, and levees. These include 12th Ave NE, English Coulee Diversion near 13.5th Ave NE, 32nd Ave NE with adjoining levee, and 69th St S with adjoining USACE diversion levee.

Downstream boundary conditions were also critical, which included the Red River of the North on the eastern boundary, and four along Demers Ave. on the northern boundary. The Demers Ave flow exits from west to east including the English Coulee Diversion near 16th St NE, Demers Ave overtopping between the diversions, USACE Diversion at 69th St S, and English Coulee near the University of North Dakota. These boundary conditions were based on normal depth ranging from 0.01 to 2%, which was adopted based on reasonable outflows and model stability. These model outflows are identified in the breach maps in Appendix E. There are still considerable outflows to residential areas north of Demers Ave that should be considered in future EAP modeling and mapping. However, results from this breach model indicate that residences and overtopped roads considerably upstream of the downstream boundary conditions are threatened, confirming the current hazard classification.

The breach mapping identified 236 residences with risk to human life and property that have greater than 3 feet of maximum depth inundation or greater than 4 feet²/s of maximum depth times velocity, parameters derived from 210-NEM-520.14. Twenty-four of these residences are greater than one mile upstream of the downstream boundary condition; therefore, these locations have relatively low sensitivity to changes. The residences near the downstream boundary condition will have higher sensitivity to extending the model north. There are also several roads overtopped throughout the breach inundation zone. Even if model extension beyond Demers changed results near the boundary condition, the 24 upstream residences and overtopped roads would place the dam in "High Hazard Potential" class, according to TR-60 and 210-NEM-520.

7 REVIEW OF AVAILABLE GEOTECHNICAL INFORMATION

During the original planning of the structure, a detailed geologic investigation was conducted (dated 1980), with soil testing being performed by the NRCS Soils Mechanics Laboratory. Construction files of the structure were also reviewed to confirm embankment densities and moisture content. Additionally, the 1990 structure as-built plans provide boring locations along with boring log stick figures with general

soil and rock descriptions. These documents show that non-dispersive CL material was used in the construction of the embankment. Embankment material was provided from borrow areas located within the reservoir and was composed of glacial drift. The borrow material was noted to have some soluble salt content but was deemed usable in the embankment fill. Foundation soils are predominantly glacial drift soils that classify as CL material. Surface lacustrine soil classifying as ML was removed to varying depths until suitable glacial drift was encountered. This excavation was done for installation of the structure's core trench.

Current dam design criteria require that filtration and drainage features be included in all high hazard potential embankments. The governing guidance at the time of dam design and construction did not include such requirements. The existing structure lacks internal drainage features throughout the length of the embankment. Drainage systems are in place for the principal and auxiliary spillway structures but do not extend through the 6-miles of embankment.

The structure is not currently equipped with instrumentation (observation wells, piezometers, etc.) that would allow for obtaining water levels throughout the structure and developing phreatic surface models in relation to different pool levels. Thus, effects of seepage and saturation of the structure are limited to the models developed and considered in the original design of the structure. Prior to any potential modifications to the structure, appropriate instrumentation should be installed in order to monitor the effects of the reservoir pool on the phreatic surface through the structure. This level of examination would determine the need for any additional drainage and/or filter systems for the structure. Inspection reports for the structure do not indicate that there has been active seepage through the embankment.

Seismic effects on the stability of the structure were considered by utilizing the USGS Unified Hazard Tool. Based upon the structure's location in relation to seismic faults, it was determined that the structure's performance would not be affected by expected seismic activity. Seismic activity documentation is provided in Appendix D.

8 FAILURE AND RISK INDICES

The population at risk (PAR) value is based upon the number of structures and businesses potentially impacted by a breach of the dam and the number of people that would be at risk while driving on a road that is overtopped by the breach flow. For English Coulee Dam, a breach results in inundation of the majority of the city of Grand Forks. The actual number of structures was not determined due to the extensive area effected by the breach inundation. In lieu of this, it was assumed that approximately 50% of the population of Grand Forks would be at risk. Grand Forks has a population of approximately 57,000 people. Therefore, the PAR was assumed to be 28,500 for the breach resulting from the PMF. For the sunny-day breach, it was determined that no individuals were at risk.

The failure and risk index spreadsheets can be found in Appendix F. Input was based upon design parameters, as-built conditions, and the PARs summarized above. As previously discussed, the majority of the structures within Grand Forks are inundated to a depth greater than 1 foot when considering the PMF breach condition. This condition is used for both the static and hydrologic failure conditions. For the seismic failure condition, the sunny day breach is utilized which resulted in no population at risk.

The failure index was computed to be 85 and risk index was computed to be 16,958.

If modifications are made to the structure, or if pertinent changes are made to state or agency governing policies, the applicability of this document may need to be re-evaluated and completed in order to determine the appropriate failure and risk indices.

9 POTENTIAL REHABILITATION ALTERNATIVES

Based on available information, English Coulee Dam appears to meet both NRCS and ND SWC high hazard dam criteria relating to overtopping of the dam, as well as activation and proportioning of the principal and auxiliary spillways. Therefore, no major rehabilitation of the dam is proposed at this time.

It is important to note, however, that some features of the structure do not meet current design standards as outlined in Section 7. In the event that agency or state policy changes such that the structure no longer meets pertinent dam safety criteria, rehabilitation efforts should be considered. A comprehensive assessment of slope stability, drain/filter compatibility, and seepage control in respect to current design standards was outside the scope of this assessment and would require a calibrated phreatic surface model.

10 CONCLUSIONS AND RECOMMENDATIONS

Although English Coulee meets high hazard dam criteria in terms of hydraulic performance, it does have maintenance concerns and items that do not meet current design standards. In addition, there are limitations to the scope of this assessment.

Maintenance Items: Based upon the most recent inspection report (dated September 10, 2020), the following maintenance items are noted as needing to be addressed. A full list of maintenance items can be found in the most recent inspection report in Appendix A. These include:

- Clearing dense vegetation growing within the structure outlet channels. Excessive tailwater conditions due to ineffective flow in the outlet channels can limit the functions of the principal and auxiliary spillways. *During high flow events, the discharge from either spillway could be impeded enough to threaten the toe of the downstream embankment.*
- Remove vegetation that is established in the floor joints of the auxiliary spillway outlet chute. These joints should then be sealed with an appropriate joint sealant to prevent water infiltration beneath the structure. *Seepage paths could develop beneath the floor of the AS and potentially exceed the capacity of the existing drainage system. This could lead to hydrostatic pressures developing beneath the spillway.*
- The concrete patch on floor of the auxiliary spillway inlet is delaminated/detached from surrounding concrete. This patch should be completely removed, and the surrounding edges of the existing concrete should be properly coated with an appropriate bonding liquid prior to pouring new concrete. *Failure of this patch during a flow event could lead to hydrostatic pressures developing beneath the spillway if the flow exceeds the capacity of the existing drainage system.*

Current Design Criteria Not Met: Items not meeting current design standards, originating from the difference in current TR-60 design criteria versus those in place at the time of the design, were found during this assessment. These include:

- The structure lacks internal drainage features in the embankment throughout the length of the structure as required by current criteria (TR-60 Part 5 – Earth Embankments and Foundations, Design Requirements). The appropriate design and installation of a chimney filter, a blanket drain, or a toe drain for the entire length of the embankment would provide the required protection.

Assessment Limitations: The scope of a dam assessment precludes consideration of certain factors that could be relevant to performance of the structure. These include:

- Seepage paths and slope stability were not evaluated as part of this assessment. These analyses were beyond the scope of this assessment. These would need to be evaluated if changes or modifications to the structure are considered in the future (TR-60 Part 5 – Earth Embankments and Foundations, Seepage).
- Actual sediment accumulation upstream of the structure, versus that which was predicted from the design, was not evaluated.

Prepared By:


Digitally signed by
NICHOLAS REYNOLDS
Date: 2021.12.02 13:37:02
-06'00'

Nicholas Reynolds, P.E.
State Design Engineer
North Dakota NRCS


Digitally signed by
JONATHAN PETERSEN
Date: 2021.12.02
13:47:14 -06'00'

Jon Petersen, P.E.
State Hydraulic Engineer
North Dakota NRCS

Approved By:



Christi Fisher, P.E.
State Conservation Engineer
North Dakota NRCS



Appendix A
Site Inspection Report



Natural Resources
Conservation Service

Bismarck State Office
PO Box 1458
Bismarck, ND
58502-1458

Voice 701.530.2000
Fax 855-813-7556

October 30, 2020

Richard Axvig, Chairman
Grand Forks County Water Resource Board
151 South 4th Street
Suite 348
Grand Forks, ND 58201

RE: Annual NRCS Inspection of English Coulee Dam - 2020

Dear Mr. Axvig:

On September 10, 2020, NRCS engineering staff performed an annual dam inspection on English Coulee Dam located in Sec 10-13, 24, 25 T150N, R52W. NRCS staff were met onsite by Tom Purdue with the Grand Forks County Water Resource Board.

Background

English Coulee Dam is a high hazard structure located 15 miles southwest of Grand Forks, ND. English Coulee Dam is listed in the National Inventory of Dams as ND00425. Construction of the structure was completed in 1990 and an O&M agreement between NRCS and Grand Forks WRB remains active until 2040. The rolled earthfill dam is 6 miles long and has a maximum height of 27 feet. The embankment has a 14-foot top width with a 3.5:1 upstream slope and 2.5:1 downstream slope. The principle spillway is a 66-inch diameter reinforced concrete pipe with reinforced concrete outlet and inlet structures. The auxiliary spillway is a 200-foot wide baffled chute located over the embankment. Both spillways are located near the northeast corner of Sec 13, T150N, R52W. The dam was designed to contain the 100-year flood before the auxiliary spillway would flow.

A dam assessment is currently being completed by the NRCS for this structure to ensure that the dam meets current applicable safety and performance standards.

Inspection

On September 10, 2020, NRCS staff members Nick Reynolds, Brian Mager, and Paul Bjorg met Tom Purdue with the Grand Forks County Water Resource Board at English Coulee Dam. At the time of inspection, the reservoir water surface elevation was at 888.4 feet (NAVD 88). It was noted that heavy rainfall during the summer of 2020 resulted in the reservoir rising to approximately 4-inches below the crest of the auxiliary spillway. The visible high water mark was surveyed at an elevation of 906.1 feet (NAVD88), approximately 7-inches below the AS crest. Water board personnel had closely monitored the functioning of the dam during this event and followed the protocol identified in the Emergency Action Plan for this structure. By the date of inspection, the reservoir had been lowered through the principle spillway and operation of the low-level drawdown gate. During the inspection, GPS survey data of the structure and photos were collected.

Helping People Help the Land

Upstream Slope and Crest

The upstream slope and crest appeared to have adequate establishment of vegetative cover throughout other than the vehicle damage noted below.

Several trees/shrubs were discovered and should be removed. The root systems of trees can be a potential hazard by allowing seepage pathways to develop through a dam that can lead to internal erosion problems. The locations of these trees are shown in the attachments but should not be considered as all inclusive. Any other trees or shrubs found along the embankment should be removed during regular maintenance of the structure.

Vehicle activity on the structure was identified at different locations of the structure. In some locations, this activity has resulted in tracking and rutting of the surface (see photos 30-34). Vegetative cover provides erosion protection from overtopping events as well as general rain/runoff events. Lack of vegetative cover can lead to accelerated erosion during these conditions. These areas should be repaired and seeded to reestablish the vegetation.

Vehicle rutting was identified along the crest of the embankment in a singular area (see photo 35). Rutting or other cavities on the crest of the dam can provide the potential for water collection during rain events. That water collection can provide potential seepage through the crest or surface erosion when overflowing. Ruts/potholes/cavities should be filled and graded to existing embankment.

There are some vehicle crossings over the embankment that are maintained as roads to provide access to the reservoir side of the embankment. These crossings are cut into the embankment such that the gravel surface is lower than the earthen crest of the structure (see photos 37-41). In potential overtopping events, these areas would overtop prior to rest of the dam. This could lead to accelerated erosion of this area. Additionally, the gravel surface would likely erode at a faster pace than the surrounded vegetated ground. If these crossings are required to remain, they should be brought to grade to match the crest of the earth embankment. Also, consider installing geocell reinforcement beneath gravel to provide added erosion protection while raising the gravel surface above the embankment elevation.

Animal burrows were also identified at points along the crest (see photo 42).

Concrete traffic barriers have been placed at locations along the dam crest to prevent/discourage vehicular traffic (see photos 19 and 38). In discussing with Tom Purdue, these are considered to have been effective. It should be noted that during an overtopping event, these barriers would create areas of turbulence and concentrated flow.

Photos of these discussed conditions are provided in the attachments of this report.

Downstream Slope

As indicated in the upstream slope, vehicle activity has resulted in worn tracks and rutting in certain locations. Near the left wall of the auxiliary spillway, active erosion has begun to occur (see photo 30). This eroded area would continue to erode at an accelerated rate during any type of flow event. This area should be filled to grade and seeded to reestablish vegetation.

Trees/shrubs were identified in locations along the downstream face of the embankment and should be removed. The root systems of trees can be a potential hazard by allowing seepage pathways to develop through a dam that can lead to internal erosion problems. Additionally, these trees and shrubs can induce local turbulence and scouring during an overtopping event.

Given that the reservoir area is still used as pasture for livestock operations, there are locations of fencing across the embankment (see photos 36 and 39). Though these perform their

intended purposes of managing cattle and preventing vehicle access, fences can have detrimental effects on the performance of the dam such as trapping debris that would normally flow over the structure. The fence posts can also induce local turbulence and concentrated flow during an overtopping event.

Abutments

The abutments appeared to be in adequate condition with no cracking, settlement, or other degradation identified.

Auxiliary Spillway

The baffled concrete chute and associated drains and walls were inspected. Overall, the concrete is on good condition.

The bottom of the auxiliary spillway, the lower access manholes, and outlet drains were submerged at the time of inspection (see photos 6, 11, 12, and 17). The stilling basin does not appear to be properly draining due to excessive growth of cattails at the outlet. This area should be cleared in a manner that promotes proper drainage.

A concrete patch had been applied to the left wall near Joint #5 (numbered from as-builts; wall section located in the spillway inlet) (see photo 3). In reviewing older inspections, this area had been patched before but still experienced cracking. The new patch appears to be adequately applied but should be monitored for any issues.

There is a concrete patch in the floor of the spillway inlet that did not have good adherence to the surrounding structure (see photo 4). By inspection, the patch was hollow underneath. This patch should be removed and replaced in a manner that ensures a good bond to surrounding concrete. If the patch is not properly bonded, this would create potential for water to flow beneath the structure in manner that it was not designed for.

In discussions with Tom Purdue, it was mentioned that although the auxiliary spillway did not flow during the high-water event this summer, there was a noticeable saturated area in the middle of the chute spillway. This may indicate potential issues with the drainage system beneath the spillway. Consider having the drain lines inspected via camera using the cleanout access points located in the manholes on either side of the structure.

Some of the concrete baffles did have chipped/damaged concrete edges (see photos 7-9). This is likely due to shooting that is noted to be a continual problem in the area. The damage appeared to be superficial and would not affect the performance of the spillway. This issue should be monitored for any progressive degradation.

Excessive vegetation is currently growing in the floor joints of chute spillway (see photos 5 and 16). The establishment of roots in these areas can lead to potential issues with water infiltration and hydraulic pumping should the spillway be activated. Although the as-builts indicate that waterstops are present along the lengths of these floor joints, vegetation should still be removed, and joints sealed to prevent issues associated with freeze-thaw cycles.

The drain cleanout in manhole (right side, second from bottom) is broken; likely due to vandalism by dropping rocks into the manhole (see photos 14-15). The drain cleanout also appears to be misaligned with the actual drainpipe below the manhole. This cleanout should be repaired with new pipe, properly aligned with the drainpipe.

The staff gauge located on the right wall of the spillway was noted to be difficult to read from the opposite side during high water events (see photo 10). The gauge readings are extremely useful in documenting accurate water levels that may precipitate emergency actions in

accordance with the Emergency Action Plan. This gauge should be replaced and/or adequately updated to ensure easy visibility.

Principal Spillway

The principal spillway intake structure was not currently flowing at the time of inspection. The reservoir had a water surface elevation of 888.4 feet (NAVD88). The crest of the principal spillway inlet weir was surveyed at an elevation of 899.7 feet (NAVD88).

The weir crests had some algae growth (see photo 20). Other than the algae presences, the weir crests appeared to be in good condition.

The low-level drawdown was closed but had been operated recently in order to draw the reservoir down below the PS weir inlets. The handwheel was not in place but is stored offsite by the Grand Forks WRB.

The PS conduit was physically inspected, and the conduit joint gaps were measured. It was visually noted that the conduit did not have a constant grade (see photo 26). Review of the as-builts and discussions with the construction inspector, John Suchor, confirmed that initial conduit cradle sections at either end had been placed without accounting for the necessary camber designed for the conduit sections. These sections were left in place with the final sections being installed as a straight-line grade between the end sections. The conduit grade is consistently downhill with no reverse grade. Thus, there is no issue with the conduit grade. The joint gaps were measured as follows (position reference looking upstream, joints numbered in accordance with as-builts):

Table 1 - Principal Spillway Pipe Joint Gaps

Joint Number	Top	Left	Bottom	Right	Date
5	¾"	½"	0"	7/8"	11/26/1990
	½"	½"	½"	¼"	9/10/2020
6	5/8"	1 ¼"	1 ¼"	1"	11/26/1990
	½"	¾"	1 ½"	1"	9/10/2020
7	1 1/8"	1 7/8"	2 ¾"	1 ¾"	11/26/1990
	¾"	1 ¾"	3 3/8"	1 ½"	9/10/2020
8	2 ½"	2 1/8"	1 ¾"	2 1/8"	11/26/1990
	2 ½"	2 ¼"	2 1/8"	2 ½"	9/10/2020
9	1"	1 1/8"	¾"	7/8"	11/26/1990
	1 7/8"	1 ¾"	1 ¾"	1 7/8"	9/10/2020
10	¾"	1"	5/8"	¾"	11/26/1990
	1 7/8"	1 ¾"	1 7/16"	1 7/8"	9/10/2020
11	1 1/8"	1 1/8"	1 ¼"	1 ½"	11/26/1990
	1 ½"	1 3/8"	1 ½"	1 1/8"	9/10/2020

The joints in the principal spillway outlet wall were identified as having noticeable separation at the top. They had separated beyond the thickness of the expansion foam filler (see photo 25). The installed waterstops appeared to be intact and functioning properly.

As noted for the auxiliary spillway outlet, the plunge pool of the principal spillway outlet also appears to have flow restricted by heavy cattail growth and potential sedimentation of the outlet channel. Tom Purdue with the Water Board did indicate that there are current plans to clear the outlet channel for the principal spillway to promote proper drainage.

Reservoir

The reservoir level was surveyed at an elevation of 888.4 ft. Given the relatively large reservoir area that exists beyond the extents of the permanent pool, much of the land is still being used as pasture for cattle herds. In association with this activity, there is fencing, livestock, and other cattle equipment located within the reservoir area. It should be noted that in a flood event, some of this equipment could potentially be carried to the outlet works of the structure and cause potential damage and/or obstruction of flow.

One of the borrow areas located within the reservoir extents is currently being developed as a fishing attraction. As part of this development, a dock is planned to be installed. This dock and any other infrastructure associated with this development should be adequately anchored and/or removed from the site when not in use to prevent the potential of these items being carried to the outlet works of the structure.

Instrumentation

Near the left wall of the auxiliary spillway, just downstream of the embankment crest, a settlement rod is still accessible and is housed within a galvanized pipe casing. The casing was removed and the elevation of the settlement rod was captured using survey grade GPS. The measurement results are as follows:

Table 2 - Settlement Plate Monitoring

Date	Elevation (ft)	Settlement (ft)
8/24/1990	917.06	
9/10/2020	916.82	0.24
Total		0.24

**Note: As-built rod elevation converted by surveyed elevation of BM set in AS retaining wall*

Recommendations

Based upon the findings of the inspection listed above, it is recommended to address the following items:

- Fill and grade the tire ruts on the dam crest
- Remove all trees and shrubs present on the embankment (upstream face, downstream face, and crest)
- Remove burrowing animals from the site; fill and grade animal burrows near right abutment
- Repair erosion on downstream face of embankment near left wall of auxiliary spillway; grade and seed area to reestablish vegetative cover

- Seed and reestablish vegetation in areas where vehicle activity has worn away the vegetative cover of the embankment
- Repair the damaged drain cleanout (manhole located on right side of auxiliary spillway, second from bottom)
- Clear cattail growth and potential sedimentation from the principal spillway channel and the auxiliary spillway channel
- Repair concrete patch in floor of auxiliary spillway
- Remove general debris from the auxiliary spillway
- Clear vegetation from auxiliary spillway floor joints; consider sealing joints
- At vehicle crossings over the embankment, ensure that the surface is flat and graded to match the elevations and slopes of the crest and embankment slopes; consider installing geocell reinforcement
- Monitor the concrete patch that has been applied to the left wall of the auxiliary spillway at Joint 5
- Coat all metal surfaces of the principal spillway intake structure with appropriate corrosion protective coatings
- Replace/update staff gauge located on right wall of auxiliary spillway; ensure adequate sizing of gauge readings and markers for visibility from opposite side of spillway
- Monitor the joint separations occurring on the walls of the principal spillway chute outlet
- Ensure that existing and planned equipment and infrastructure located in the reservoir area are removed or anchored as appropriate

If you should have any questions or comments regarding this inspection, please contact myself at Nicholas.Reynolds@usda.gov or 701-530-2088.

Sincerely,



Nick Reynolds, P.E.
State Design Engineer
NRCS Bismarck State Office

Enclosures (3)

1. ND-ENG-4 Inspection Checklist
2. Structure Sketch
3. Photo Layout & Inventory

Cc: Karen Goff (electronic) – State Water Commission, Bismarck Office
Chris Nelson (electronic) – CDU Supervisor, NRCS Park River Field Office
Kevin Gietzen (electronic) – District Conservationist, NRCS Grand Forks Field Office
Kate Sobolik (electronic) – Lead Engineer, NRCS Devils Lake Field Office
Christi Fisher (electronic) – State Conservation Engineer, NRCS Bismarck State Office

U.S. DEPARTMENT OF AGRICULTURE Natural Resource Conservation Service				ANNUAL DAM INSPECTION CHECKLIST		ND-ENG-4 Rev. 08/20
Name of Dam	English Coulee	NRCS Hazard Class	High	NID#	ND00425	Action (R) REPAIR (M) MONITOR (I) INVESTIGATE
Location:	Sec. 13 Township 150N	Range 52W	Inspection Date 9/10/2020			
County	Grand Forks	Weather Cleay, sunny, 40°-72° F				
Inspectors & Guests	Nick Reynolds - NRCS Brian Mager - NRCS		Paul Bjorg - NRCS Tom Purdue - GF County WRB			
"YES" responses need explanation added to "Remarks" section (i.e.: What? Where? Extent?). "NO" responses indicate no problems observed during						

ITEM	Y	N	N/A	REMARKS			
1. General Conditions							
a. Alterations to Dam	☐	☒	☐		☐	☐	☐
b. Alterations to ASW	☒	☐	☐	concrete patch repair to left wing wall	☐	☒	☐
c. Recent high water marks	☒	☐	☐	this summer; approx 4" below AS crest	☐	☐	☐
d. Fencing adequate	☒	☐	☐		☐	☐	☐
e. Grass Cover adequate	☒	☐	☐		☐	☐	☐
2. Upstream Slope/Crest							
a. Erosion	☐	☒	☐		☐	☐	☐
b. Cracks or settlements	☒	☐	☐	road crossings at lower elevation than crest	☒	☐	☐
c. Seepage or boils	☐	☒	☐		☐	☐	☐
d. Distinct Vegetation Change	☐	☒	☐		☐	☐	☐
e. Vehicle ruts or animal trails	☒	☐	☐	vehicle ruts on crest and US slope by public	☒	☐	☐
f. Trees	☒	☐	☐	see photo inventory	☒	☐	☐
g. Rodent holes	☒	☐	☐		☒	☐	☐
h. Adequate and sound riprap	☒	☐	☐		☐	☐	☐
3. Downstream Slope							
a. Erosion	☒	☐	☐	left of AS wing wall; likely due to prior vehicular traffic	☒	☐	☐
b. Cracks or settlements	☐	☒	☐		☐	☐	☐
c. Seepage or boils	☐	☒	☐		☐	☐	☐
d. Distinct Vegetation Change	☐	☒	☐		☐	☐	☐
e. Vehicle ruts or animal trails	☒	☐	☐	vehicle ruts on downstream slope; see photos	☒	☐	☐
f. Trees	☒	☐	☐	see photo inventory	☒	☐	☐
g. Rodent holes	☒	☐	☐	see photo inventory	☒	☐	☐
h. Drains or wells flowing	☐	☐	☒		☐	☐	☐
i. Adequate and sound riprap	☐	☐	☒		☐	☐	☐
4. PSW Intake Structure	☒	Concrete	☐	Metal	888.37	WSE	
a. Spalling, cracking, & scaling	☐	☒	☐		☐	☐	☐
b. Exposed reinforcement	☐	☒	☐		☐	☐	☐
c. Corrosion present	☒	☐	☐		☒	☐	☐
d. Manhole cover present	☐	☐	☒		☐	☐	☐
e. Leakage	☐	☒	☐	Est. GPM	☐	☐	☐
f. Trash rack adequate	☒	☐	☐		☐	☐	☐
g. Inlet or trash rack obstructed	☐	☒	☐		☐	☐	☐
h. Drawdown operative	☒	Closed	☐	Open			
i. Ladder intact	☐	☐	☒		☐	☐	☐
j. Pedestal securely fastened	☒	☐	☐		☐	☐	☐
k. Stem bent	☐	☒	☐		☐	☐	☐
l. Stem guides operational	☒	☐	☐	operated this summer to draw down reservoir	☐	☐	☐
m. Stem handwheel present	☐	☒	☐	Grand Forks Water Board stores offsite	☐	☐	☐
n. Do metal parts require painting	☒	☐	☐	Paint all exposed and surface rusted metal	☒	☐	☐

English Coulee Annual Dam Inspection

9/10/2020

ITEM	Y	N	N/A	REMARKS	R	M	I
5. Abutment Contacts							
a. Erosion, cracks, or slips	☐	☒	☐		☐	☐	☐
b. Seepage	☐	☒	☐		☐	☐	☐
c. Gutters intact	☐	☐	☒		☐	☐	☐
d. Trees encroaching	☐	☐	☒		☐	☐	☐
6. Auxiliary Spillway				bottom of AS submerged			
a. Obstructions	☐	☒	☐		☐	☐	☐
b. Erosion, cracks, or slips	☒	☐	☐	patch on approach floor needs repair; vegetation in slab joints	☒	☐	☐
c. Rodent holes	☐	☐	☒		☐	☐	☐
d. Roads, ruts, or animal trails	☐	☐	☒		☐	☐	☐
e. Low areas or ditches	☐	☐	☒		☐	☐	☐
f. Seepage/Saturation	☐	☒	☐	no water from drains in ASW; cleanout needs repair	☒	☐	☐
7. PSW Conduit	☒			Concrete	☐		
a. Spalling, cracking, & scaling	☐	☒	☐		☐	☐	☐
b. Exposed reinforcement	☐	☒	☐		☐	☐	☐
c. Joints displaced or offset	☒	☐	☐	outlet wall joints separating; conduit joints measured	☐	☒	☐
d. Joint material lost	☐	☒	☐		☐	☐	☐
e. Leakage	☐	☒	☐		☐	☐	☐
f. Conduit misaligned	☐	☒	☐		☐	☐	☐
8. Stilling Basin/Plunge Pool	☒			Stilling Basin	☒		
a. Spalling, cracking, & scaling	☐	☒	☐		☐	☐	☐
b. Exposed reinforcement	☐	☒	☐		☐	☐	☐
c. Joints displaced or offset	☐	☒	☐		☐	☐	☐
d. Joint material lost	☐	☒	☐		☐	☐	☐
e. Joints leak	☒	☐	☐	Tom mentioned a wet area in middle of ASW during high water event	☐	☐	☒
f. Dissipater deteriorating	☐	☒	☐		☐	☐	☐
g. Dissipater clean of debris	☐	☒	☐	general debris located in AS	☒	☐	☐
h. Toe drains visible	☒	☐	☐		☐	☐	☐
i. Toe drains flowing	☐	☒	☐		☐	☐	☐
j. Toe drain animal guards	☒	☐	☐		☐	☐	☐
k. Toe drains damaged	☐	☒	☐		☐	☐	☐
l. Earth erosion	☐	☒	☐		☐	☐	☐
m. Adequate and sound riprap	☒	☐	☐		☐	☐	☐
n. Outlet channel obstructed	☒	☐	☐	Owner to regrade PSW outlet channel	☒	☐	☐
9. Reservoir							
a. Buildings in floodpool	☐	☒	☐		☐	☐	☐
b. Slips or erosion on banks	☐	☒	☐		☐	☐	☐
c. Debris	☒	☐	☐	cattle equipment	☐	☒	☐
d. Unsecured boats/docks	☒	☐	☐	planned dock in reservoir; requires adequate anchoring	☐	☒	☐
e. Sediment deposits	☐	☒	☐		☐	☐	☐
10. Instruments							
a. Structure instrumented	☒	☐	☐	single settlement plate left of AS	☐	☐	☐
b. Monitoring performed	☒	☐	☐	elevation of settlement plate surveyed	☐	☒	☐

REMARKS: 1.b. On the left wing wall of the auxiliary spillway, a repair has been applied at J#5. The repair appears to be in good condition. Continue to monitor.

2.b. Access roads that cross the dam embankment should be brought to grade with the crest of the dam. It was noted that the access roads were at a lower elevation than the dam crest which could lead to serious erosion and potential breach conditions if the reservoir level were to exceed the road elevation while remaining below the dam crest elevation.

2f., 3.f. A number of trees were present along the dam embankment. Locations are indicated in the associated plan views of the inspection report. Remove trees.

2.g., 3.g. Gopher activity was noted along the crest of the dam towards the right abutment. Rodent holes create potential water pathways that could undermine the structural integrity of the embankment. Rodent activity should be managed to ensure that burrows are not bring created through the length of the embankment.

6. The lower manholes on either side of the auxiliary spillway were submerged and unable to be inspected.

6.b. On the concrete approach to the auxiliary spillway, a couple of floor patches have been installed. One of the patches does not have a good bond to the structure and needs to be repaired/replaced.

6.b. Superficial spalling or damage due to gunfire was noted along the walls and structural baffels of the auxiliary spillway chute. No reinforcing steel was exposed. Continue to monitor.

6.b. The floor joints in the auxiliary spillway chute have vegetation growing. The establishment of roots in these areas can lead to potential issues with water infiltration and hydraulic pumping should the spillway be activated. Although the as-builts indicate that waterstops are present along the lengths of these float joints, vegetation should be still be removed and joints sealed to prevent issues associate with freeze-thaw cycles.

6.f. Drain cleanout in manhole (right side, second from bottom) is broken (likely due to vandalism by dropping rocks into manhole). It also appears to be misaligned with drain pipe below manhole. This cleanout should be repaired with new pipe, properly aligned with drain pipe.

8.n. The outelt channel appeared to be obstructed (vegetation and potential sediment) such that the principle and auxiliary spillways were not adequately draining. The dam owner indicated that there are already plans to clean out the channel to allow proper drainage of these features.

NRCS ENGINEER

Nicholas Reynolds, PE

Signature



Date

10/30/2020

Attachment 2: Structure Sketch





Inspected	NR, BM, PB	Date
		9/10/20
		1987
Designed	NRCS	1987
Construction Completed		1990

STRUCTURE SKETCH		
ANNUAL ENGLISH COULEE DAM INSPECTION		
OWNER:	GRAND FORKS COUNTY	WRD
COUNTY:	GRAND FORKS	



Natural Resources Conservation Service

File Name
English Coulee Dam.dwg
Date
10/29/2020
Sheet 1 of 1

Attachment 3: Photo Inventory





Photo 1 Auxiliary spillway weir crest and baffled chute



Photo 2 Auxiliary spillway inlet crest



Photo 3 Left, upstream wall of auxiliary spillway; concrete patch located at Joint 5 of wall



Photo 4 Concrete patch in floor of AS approach; patch is hollow and not adhered to surrounding concrete



Photo 5 Heavy vegetation in floor joint of auxiliary spillway



Photo 6 Bottom of auxiliary spillway is continuously submerged due to cattail growth impeding proper flow



Photo 7 Superficial damage to baffle likely due to shooting



Photo 8 Superficial damage to baffle likely due to shooting



Photo 9 Damaged edge of auxiliary spillway crest weir



Photo 10 Staff gauge on right wall of AS; board members noted gauge is difficult to read from opposite side during high water events



Photo 11 Auxiliary spillway stilling basin; bottom of spillway and drain access manhole submerged



Photo 12 Drain access manhole submerged in stilling basin of auxiliary spillway



Photo 13 Inside of drain access manhole (typical)



Photo 14 Drain cleanout broken due to vandalism by dropping rocks into manhole



Photo 15 Broken drain cleanout dislodged from foundation drain pipe



Photo 16 Auxiliary spillway foundation drains functioning; heavy vegetative growth



Photo 17 Lower auxiliary spillway foundation drains submerged due to improper drainage of stilling basin



Photo 18 Auxiliary spillway foundation drain outlet (either side)



Photo 19 Principle spillway inlet structure; concrete barrier on top of dam to discourage vehicle activity



Photo 20 Principle spillway inlet: weir invert and low level drawdown gate



Photo 21 Principle spillway inlet: entrance to conduit



Photo 22 Low level drawdown gate operation mechanism; wheel is stored offsite



Photo 23 Plunge pool at the PS outlet; proper drainage is impeded by sediment and vegetative growth



Photo 24 Principle spillway chute outlet



Photo 25 Joint separation of PS outlet wall; waterstops appear to be intact



Photo 26 Looking down the principle spillway conduit



Photo 27 Downstream face of North/South right embankment



Photo 28 Crest of North/South right embankment



Photo 29 Crest of North/South right embankment



Photo 30 Erosion on downstream face of embankment near left wall of auxiliary spillway



Photo 31 Worn vehicle tracks on downstream face of embankment



Photo 32 Vehicle tracks on upstream face of embankment



Photo 33 Vehicle tracks and rutting on downstream face of embankment



Photo 34 Vehicle tracks and rutting on downstream face of embankment



Photo 35 Vehicle rut on crest of dam



Photo 36 Fencing across embankment



Photo 37 Access road across embankment for powerline causeway



Photo 38 Graveled vehicle access across embankment of dam



Photo 39 Tracks and rutting on downstream face of embankment; fencing across embankment for cattle access



Photo 40 Graveled access across embankment of dam



Photo 41 Graveled vehicle access across embankment of dam



Photo 42 Animal burrow on crest of dam

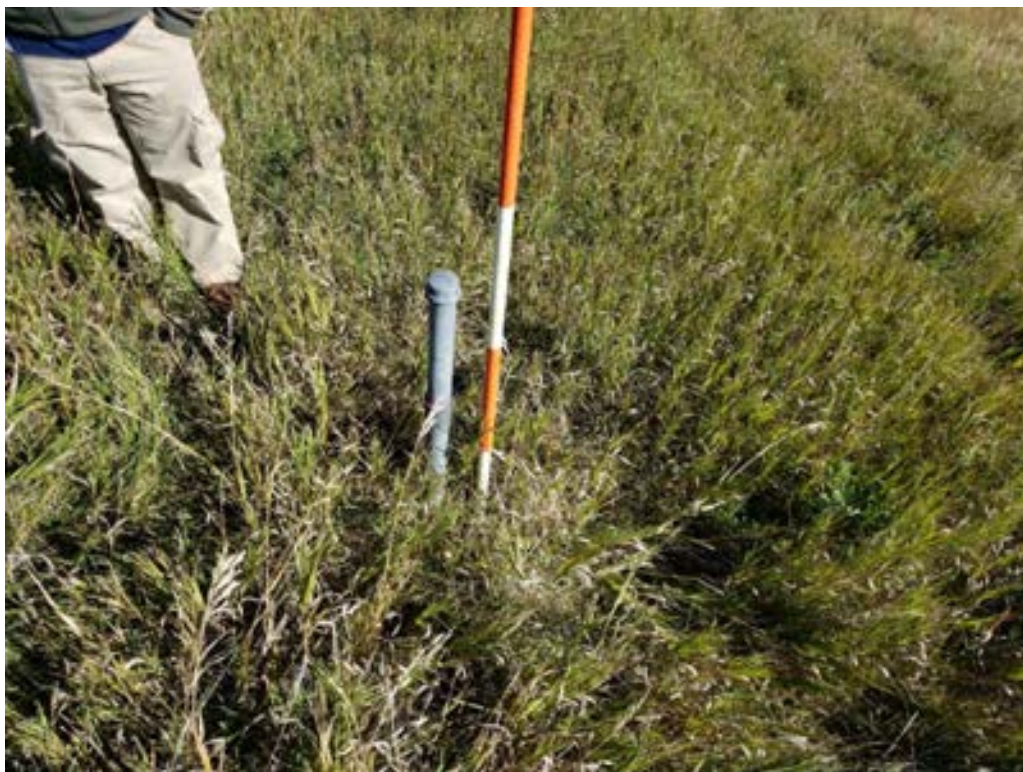


Photo 43 Settlement rod located on downstream face of embankment near left wall of auxiliary spillway





PHOTO LAYOUT - 2
ANNUAL ENGLISH COULEE DAM INSPECTION

OWNER: GRAND FORKS COUNTY WRD
COUNTY: GRAND FORKS



File Name
English Coulee Dam.dwg

Date
10/29/2020

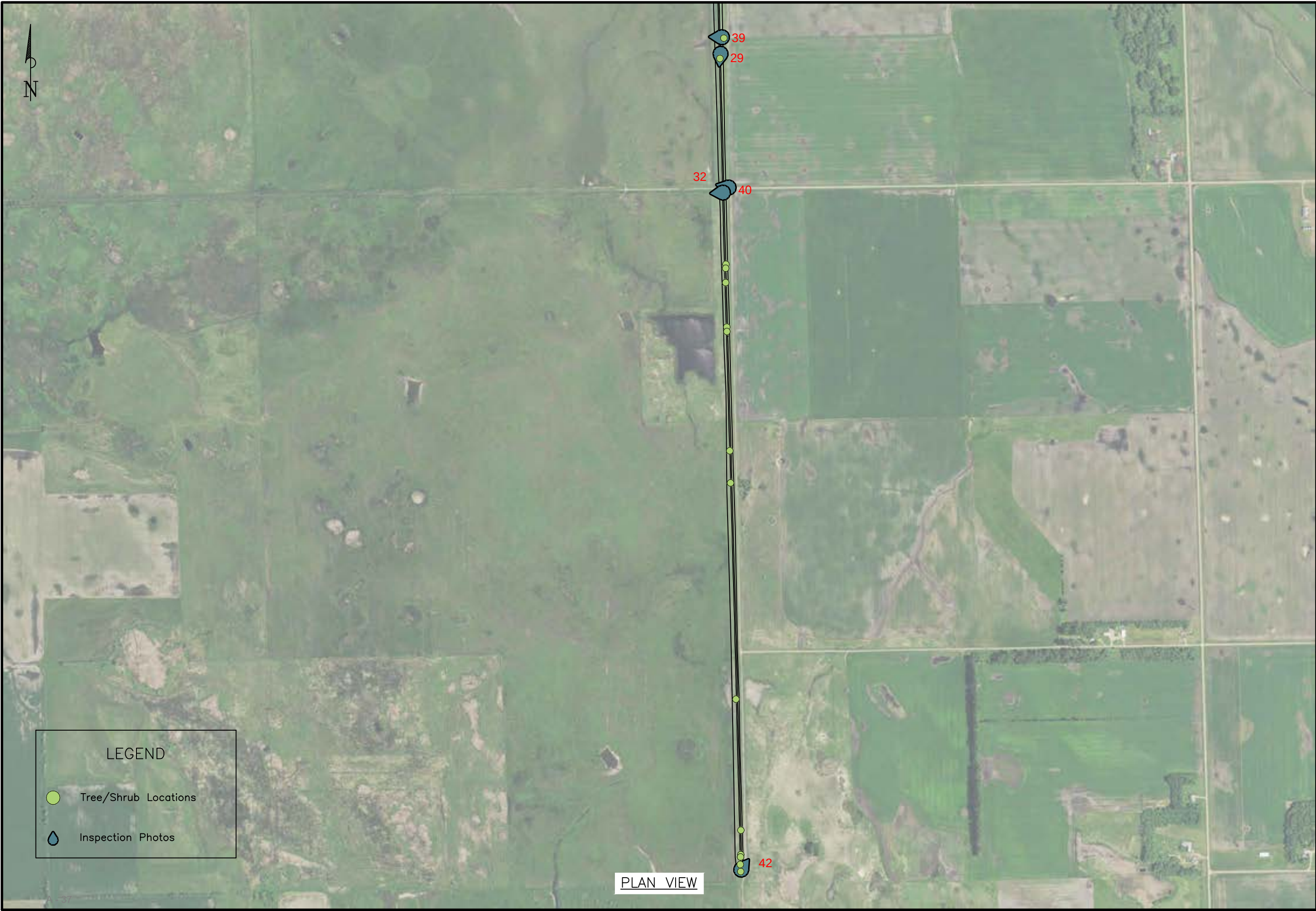
Sheet 2 of 3

Inspected	NR, BM, PB	Date
Designed	NRCS	9/10/20
Construction Completed		1987
		1990

LEGEND

- Tree/Shrub Locations
- Inspection Photos

PLAN VIEW



LEGEND

Tree/Shrub Locations

Inspection Photos

PLAN VIEW

PHOTO LAYOUT – 3

ANNUAL ENGLISH COULEE DAM INSPECTION

OWNER: GRAND FORKS COUNTY WRD

COUNTY: GRAND FORKS



File Name
English Coulee Dam.dwg

Date
10/29/2020

Sheet 3 of 3

Inspected	NR, BM, PB	Date
Designed	NRCS	9/10/20
Construction Completed		1987
		1990



Appendix B
Original Operation and Maintenance Plan

ENGLISH COULEE WATERSHED
FLOOD WATER RETARDING STRUCTURE
PLAN OF OPERATION AND MAINTENANCE

Prepared by
U.S. Department of Agriculture
Soil Conservation Service

Revised July 1989

INTRODUCTION

This is a plan for the operation and maintenance of measures installed for the English Coulee Flood Water Retarding Structure located in Grand Forks County, North Dakota. The English Coulee Watershed was planned and developed under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666). This project includes land treatment measures for watershed protection and structural measures for flood prevention. This plan provides the basis for a permanent and continuous case history of all operation and maintenance activities.

The work set forth in this plan will be carried out in compliance with the O&M agreement signed by the Grand Forks County Water Resource District and Soil Conservation Service.

OPERATION

Inspection

Structural measures have two types of inspection. First, is the routine annual inspection which is directed at observing changes from the as-built condition. Second, is the post storm inspection which is directed at surveying storm damages.

The annual inspection will be made jointly by the sponsors and the SCS for a period of 3 years after the project is completed. After this 3 year period, the sponsors will continue the annual and post storm inspections. SCS assistance may be provided after the 3 year establishment period if requested by the sponsors and if SCS resources permit. All inspections will be accomplished by properly trained people. A qualified engineer will assist with inspections at least every 5 years. The following is a list of the kinds of items to be inspected:

- a. Vegetation - types, size, age, deficiencies
- b. Embankment - slope stability, rodent damage, erosion, settlement, tree growth
- c. Principal Spillway - concrete condition, joint displacement or leakage, drain outlets, trash racks, slide gate operation, debris accumulation, safety fence, outlet erosion, ice damage
- d. Chute Spillway - concrete condition, joint displacement or leakage, drain outlets and animal guards, drain cleanouts, debris accumulation, staff gages, safety fence
- e. Rock Riprap - displacement, loss of bedding
(dams, dikes, structures)

Inspections following severe storms will also be conducted jointly by the sponsor and the SCS. The following key items need to be checked:

- a. Vegetation - high flow damage
- b. Embankment - slope stability or erosion
- c. Principal Spillway - outlet erosion, debris accumulation, joint displacement
- d. Chute Spillway - outlet erosion, debris accumulation, slope stability/structure movement
- e. Rock Riprap - replacement/reinforcement

Funding

Structural measures will require periodic repair and replacement. The funding for this will be provided by the Water Resource District as agreed to in the work plan. Table 4 of the work plan indicates the Board should anticipate annual O&M cost of \$11,900 for the entire watershed.

Operation Activity Summary

1. Provide properly trained personnel to carry out thorough inspection.
2. Insure financial capability to carry out O&M activities in a timely manner.
3. Insure that quality of repair is consistent with original components.
4. Adapt to changing needs and conditions during project life.
5. Maintain necessary operation and maintenance cost records.
6. Do not permit vehicle travel on the embankment.

MAINTENANCE

The as-built plans provide details of construction dimensions. The design report has the specifications and materials that should be used for replacement. Additional detailed information will be listed below.

Since land treatment in the watershed is an integral part of this project, it is necessary to evaluate this from time to time. It is important to consider the impact of changing land management practices on the project.

Maintenance Activity Summary

1. Vegetation

- a. Reseed with adapted species, resod, and fertilize areas of poor stand or areas destroyed by erosion. If necessary, reshape eroded areas before revegetating.
- b. Cut or spray with approved herbicide and remove undesirable vegetation. Observe local ordinances regarding spraying and burning.
- c. Fertilize vegetation as required to maintain a vigorous stand.
- d. Control grazing or mow occasionally to insure vigor of vegetative cover.
- e. Fill and revegetate eroded area.

2. Earth Embankment

- a. Remove and/or stabilize slide material as soon as practical. It may be necessary to construct a berm or flatten the slope.
- b. Restore areas that have settled.
- c. Fill and revegetate eroded areas. Construct diversions to direct water away from the embankment toes.
- d. Maintain fences in good condition.
- e. Maintain features beneficial to fish and wildlife.
- f. Repaint, as needed, all surfaces requiring protection by paint.
- g. Repair and repaint or replace signs and plaques to keep them sightly and functional.

3. Principal Spillway

- a. Replace or reinforce riprap in outlet channel to control erosion.
- b. Remove debris accumulation around the inlet structure and in the outlet structure.
- c. Repair areas of damaged concrete.
- d. Replace and revegetate eroded earthfill adjacent to structure.
- e. Maintain protective fencing around outlet structure.

f. Maintain inlet slide gate in accordance with manufacturer's recommendation.

g. Repair or replace damaged trash racks.

4. Chute Spillway

a. Replace or reinforce riprap adjacent to structure.

b. Remove debris accumulation in structure.

c. Repair areas of damaged concrete.

d. Replace and revegetate eroded earthfill adjacent to structure.

e. Maintain protective fencing.

f. Clean and/or replace drain outlet animal guards. Clean out blocked drain pipe as necessary.

g. Replace missing joint filler. Caulk open joints as necessary.

5. Material

a. Materials for placement shall be equal to those used in the original installation. Consult the SCS engineering staff and the project design folder for material requirements.

b. Seeding and Fertilizing - The seed and fertilizer rate will be determined by consultation with the SCS District Conservationist.

Fertilizer will be applied by the sponsors one year after acceptance of the project and every three years thereafter.

6. Photograph for documentation any repairs made.

MODIFICATION

This plan may be modified by mutual consent of the sponsors and the SCS in keeping with the O&M agreement. As further agreements are signed, a plan of O&M of the respective measures will be developed and added to this document.



Appendix C
Hydrologic and Hydraulic Modeling

SITES XEQ 01/07/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 08:47:34

***** 80-80 LIST OF INPUT Data *****

SITES	01/01/20051	English Coulee Dam	54.7	A1
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	English Coulee Existing		
		899.6 0	286	
		901.2 201	682	
		903.2 432	1973	
		905.2 469	3975	
		907.2 503	6648	
		909.2 2289	10232	
		911.2 5526	14765	
		913.2 9706	20128	
		915.2 14651	26604	
		916.2 17375	30289	
ENDTABLE				
WSDATA	5C 1	72.46 54.7 37	1.5	
BASEFLOW		0		
PDIRECT	1.18	6.04 8.44		
POOLDATA	ELEV	899.6 892.8		
GRAPHICS	I			
GO,DESIGN	LCPN			
SAVMOV	2 101 1	1		
ENDJOB				

1SITES -----
 XEQ 01/07/2021 English Coulee Dam WSID= 1
 VER 2005.1.8 English Coulee Existing SUBW= 1
 TIME 08:47:34 SITE = 1 PASS= 1 PART= 1

***** BASIC Data *****

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION PSH..10 DAY NRCS DESIGN STORM (CHAPTER 21, NEH4 & TR-60).

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;
 NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

PRECIP. - P-PS,1-DAY	P-PS,10-DAY	Q-SD	Q-FB	
6.04	8.44	0.00	0.00	
WSDATA - CN	DA-SM	TC/L	-/H	QRF
72.46	54.70	37.00	0.00	1.50
SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
0.00	899.60	892.80	0.00	NO
BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE	
0.00	0.00	0.00	DESIGN	
PSDATA - NO. COND	COND L	DIA/W	-/H	
0.00	0.00	0.00	0.00	
PS N	KE	WEIR L	TW EL	
0.000	0.00	0.00	0.00	
2ND STG	ORF H	ORF L	START AUX.	
0.00	0.00	0.00	0.00	
ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
0.00	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH	
0	0.00	0.00	0	
AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.000	0.00	0.000	0.000	NO
BTM WIDTH - BW1	BW2	BW3	BW4	BW5
0.00	0.00	0.00	0.00	0.00

1***** DETAILED LIST OF BASIC Data *****

WEIR COEF. FOR ORIFICES..... 3.10	RATIO OF Ia TO S (CH.10,NEH4). 0.20
WEIR COEF. FOR DROP INLET..... 3.10	TIME INCS TO PEAK OF UNIT HYD. 10.
DISCHARGE COEF. FOR ORIFICES..... 0.60	NO. POINTS FOR DESIGN HYD. ... 5000
HOOD, WEIR INLET COEF. 0.60	DRAWDOWN TIME LIMIT - DAYS... 10.0
HOOD, PIPE ENTRANCE COEF. 0.60	DRAWDOWN RATIO STORAGE LIMIT.. 0.15
HOOD, SLUG FLOW COEF. 0.00	OTHER DRAWDOWN RATIOS APPLY ?. NO
PS ACCURACY OF FULL FLOW CALC.,FT 0.01	WSP ALLOWABLE FSS VEL. CHANGE. 0.05
FILLET SIZE FOR BOX CONDUITS..... 6.00	WSP FSS CALC. PRECISION, FT.. 0.005
GRAVITATIONAL CONSTANT..... 32.16	AUX. SPILLWAY MIN. CAP. COEF. 237.0
MIN. NHCP378 PS PIPE AREA SQFT.. 0.545	AUX. SPILLWAY MIN. CAP. EXP. 0.493
MIN. TR60 DEPTH AUX. TO TOP DAM.. 3.00	MIN. AUX. BW IN BW SOLUTION,FT 20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM 2.00	PRECISION OF BW SOLUTION..... 1.0
MIN. NHCP378 DEPTH PS - AUX.CREST 1.00	OLD TR60 CRITERIA USED NO
MIN. NHCP378 DEPTH DESIGN Q - TOD 1.00	OLD NHCP378 CRITERIA USED NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE	WAVE BERM	MULTIPLE STABILITY BERMS	SEPARATE STABILITY BERMS
RATIOS	WIDTH	U&D/S WIDTHS	DELTA H
U/S D/S	ft	ft	ft
2.50 2.50	10.0	0.0	0.00
			0.00 0.00 0.00 0.00

DIMENSIONLESS UNIT HYDROGRAPH
 STANDARD DIMENSIONLESS UNIT HYDROGRAPH
 PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
 VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

1SITES -----

XEQ 01/07/2021	English Coulee Dam	WSID= 1
VER 2005.1.8	English Coulee Existing	SUBW= 1

TIME 08:47:34

SITE = 1

PASS= 1 PART= 2

Principal Spillway Runoff Distribution

Hour	1	2	3	4	5	6	7	8	9	10
1.	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
11.	0.0001	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
21.	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004
31.	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
41.	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	0.0007	0.0007
51.	0.0007	0.0008	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0009
61.	0.0010	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0012
71.	0.0012	0.0012	0.0013	0.0013	0.0013	0.0013	0.0014	0.0014	0.0014	0.0015
81.	0.0015	0.0015	0.0016	0.0016	0.0017	0.0017	0.0017	0.0018	0.0018	0.0019
91.	0.0019	0.0020	0.0020	0.0021	0.0021	0.0022	0.0022	0.0023	0.0023	0.0024
101.	0.0025	0.0026	0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0034
111.	0.0035	0.0037	0.0038	0.0041	0.0043	0.0046	0.0050	0.0056	0.0067	0.00921
121.	0.0939	0.0947	0.0952	0.0955	0.0958	0.0961	0.0962	0.0964	0.0966	0.0967
131.	0.0968	0.0969	0.0971	0.0971	0.0972	0.0973	0.0974	0.0975	0.0976	0.0976
141.	0.0977	0.0977	0.0978	0.0979	0.0979	0.0980	0.0980	0.0981	0.0981	0.0982
151.	0.0982	0.0982	0.0983	0.0983	0.0984	0.0984	0.0984	0.0985	0.0985	0.0985
161.	0.0986	0.0986	0.0986	0.0987	0.0987	0.0987	0.0987	0.0988	0.0988	0.0988
171.	0.0989	0.0989	0.0989	0.0989	0.0990	0.0990	0.0990	0.0990	0.0991	0.0991
181.	0.0991	0.0991	0.0991	0.0992	0.0992	0.0992	0.0992	0.0992	0.0993	0.0993
191.	0.0993	0.0993	0.0993	0.0994	0.0994	0.0994	0.0994	0.0994	0.0994	0.0995
201.	0.0995	0.0995	0.0995	0.0995	0.0995	0.0996	0.0996	0.0996	0.0996	0.0996
211.	0.0996	0.0996	0.0997	0.0997	0.0997	0.0997	0.0997	0.0997	0.0997	0.0998
221.	0.0998	0.0998	0.0998	0.0998	0.0998	0.0998	0.0998	0.0999	0.0999	0.0999
231.	0.0999	0.0999	0.0999	0.0999	0.0999	1.0000	1.0000	1.0000	1.0000	1.0000

CREST PS 899.60 FT 286.0 ACFT 0.00 AC 0.0 CFS

SED ACCUM 899.60 FT 286.0 ACFT 0.00 AC 0.0 CFS

START ELEV 899.60 FT 286.0 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 6.04 IN 10-DAY = 8.44 IN DA = 54.70 SM
 RUNOFF 1-DAY = 3.07 IN 10-DAY = 3.09 IN

CLIMATIC INDEX = 1.18 CN 10-DAY = 55. CN 1-DAY = 72.
 QRF = 147.69 CFS 900.78 FEET, FROM CLIMATIC INDEX COMPUTATION.

PEAK = 3467.8 CFS, AT 142.6 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
 NRCS-PSH 907.31 FT 6843.9 ACFT 0.00 AC 600.6 CFS

PS STORAGE 6557.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 902.11 FT 1269.7 ACFT 306.15 CFS
 CONTROL IS 0.150 DETENTION STORAGE

TIME TO DDT TEST DISCHARGE IS 9.64 DAYS - DRAWDOWN CONTINUING.

TIME LIMIT = 10.00 DAYS; FLOW WAS 281.96 CFS, ELEV = 901.90 FT

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH, 1 INCH=							500. CFS	1000.	1500.	2000.	2500.	3000.	3500.
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I
0.00	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
2.34	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
4.67	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
7.01	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
9.35	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
11.68	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
14.02	0	0	899.6	286.0	0.0	.	.	.	.	.	.	.	.
16.36	0	0	899.6	286.1	0.0	.	.	.	.	.	.	.	.
18.70	0	0	899.6	286.1	0.0	.	.	.	.	.	.	.	.
21.03	0	0	899.6	286.2	0.0	.	.	.	.	.	.	.	.
23.37	1	0	899.6	286.3	0.0	.	.	.	.	.	.	.	.
25.71	1	0	899.6	286.3	0.0	.	.	.	.	.	.	.	.
28.04	1	0	899.6	286.4	0.0	.	.	.	.	.	.	.	.
30.38	1	0	899.6	286.5	0.0	.	.	.	.	.	.	.	.
32.72	1	0	899.6	286.7	0.0	.	.	.	.	.	.	.	.
35.06	1	0	899.6	286.8	0.0	.	.	.	.	.	.	.	.
37.39	1	0	899.6	286.9	0.0	.	.	.	.	.	.	.	.
39.73	1	1	899.6	287.0	0.0	.	.	.	.	.	.	.	.
42.07	1	1	899.6	287.1	0.0	.	.	.	.	.	.	.	.
44.40	1	1	899.6	287.3	0.0	.	.	.	.	.	.	.	.
46.74	1	1	899.6	287.4	0.0	.	.	.	.	.	.	.	.
49.08	1	1	899.6	287.5	0.0	.	.	.	.	.	.	.	.
51.41	1	1	899.6	287.6	0.0	.	.	.	.	.	.	.	.
53.75	1	1	899.6	287.7	0.0	.	.	.	.	.	.	.	.
56.09	2	1	899.6	287.9	0.0	.	.	.	.	.	.	.	.
58.42	2	1	899.6	288.0	0.0	.	.	.	.	.	.	.	.
60.76	2	1	899.6	288.1	0.0	.	.	.	.	.	.	.	.
63.10	2	1	899.6	288.2	0.0	.	.	.	.	.	.	.	.
65.44	2	1	899.6	288.3	0.0	.	.	.	.	.	.	.	.
67.77	2	1	899.6	288.4	0.0	.	.	.	.	.	.	.	.
70.11	2	1	899.6	288.6	0.0	.	.	.	.	.	.	.	.
72.45	2	1	899.6	288.7	0.0	.	.	.	.	.	.	.	.
74.78	2	1	899.6	288.8	0.0	.	.	.	.	.	.	.	.
77.12	2	1	899.6	288.9	0.0	.	.	.	.	.	.	.	.
79.46	2	2	899.6	289.0	0.0	.	.	.	.	.	.	.	.
81.79	2	2	899.6	289.2	0.0	.	.	.	.	.	.	.	.
84.13	2	2	899.6	289.3	0.0	.	.	.	.	.	.	.	.
86.47	2	2	899.6	289.4	0.0	.	.	.	.	.	.	.	.
88.81	3	2	899.6	289.6	0.0	.	.	.	.	.	.	.	.
91.14	3	2	899.6	289.7	0.0	.	.	.	.	.	.	.	.
93.48	3	2	899.6	289.9	0.0	.	.	.	.	.	.	.	.
95.82	3	2	899.6	290.1	0.0	.	.	.	.	.	.	.	.
98.15	3	2	899.6	290.2	0.0	.	.	.	.	.	.	.	.
100.49	3	2	899.6	290.4	0.0	.	.	.	.	.	.	.	.
102.83	4	2	899.6	290.6	0.0	.	.	.	.	.	.	.	.
105.16	4	2	899.6	290.9	0.0	.	.	.	.	.	.	.	.
107.50	4	3	899.6	291.1	0.0	.	.	.	.	.	.	.	.
109.84	4	3	899.6	291.4	0.0	.	.	.	.	.	.	.	.
112.18	5	3	899.6	291.7	0.0	.	.	.	.	.	.	.	.
114.51	5	3	899.6	292.1	0.0	.	.	.	.	.	.	.	.
116.85	6	3	899.6	292.6	0.0	.	.	.	.	.	.	.	.
119.19	26	5	899.6	294.9	0.0	.	I	.	.	.	.	.	.
121.52	157	13	899.7	310.9	0.0	.	I	.	.	.	.	.	.
123.86	413	38	899.9	361.0	0.0	.	P	I	.	.	.	.	.
126.20	744	89	900.3	460.5	0.0	.	P	.	I	.	.	.	.
128.53	1187	171	901.0	621.9	0.0	.	P	.	I	.	.	.	.
130.87	1761	234	901.5	867.5	0.0	.	.	P	.	I	.	.	.
133.21	2399	297	902.0	1217.9	0.0	.	.	P	.	.	I	.	.
135.55	2921	377	902.7	1666.6	0.0	.	.	.	P	.	.	I	.
137.88	3270	436	903.4	2185.9	0.0	.	.	.	P	.	.	.	I
140.22	3446	446	904.0	2749.3	0.0	.	.	.	P	.	.	.	I
142.56	3468	457	904.6	3329.7	0.0	.	.	.	P	.	.	.	X
144.89	3401	468	905.1	3903.7	0.0	.	.	.	P	.	.	.	I
147.23	3187	475	905.6	4448.8	0.0	.	.	.	P	.	.	I	.
149.57	2938	481	905.9	4947.9	0.0	.	.	.	P	.	.	.	.
151.90	2647	487	906.3	5393.7	0.0	.	.	.	P	.	.	.	.
154.24	2288	492	906.5	5775.7	0.0	.	.	.	P	.	.	.	.
156.58	1885	496	906.8	6083.3	0.0	.	.	.	P	.	.	.	.
158.92	1558	499	907.0	6319.7	0.0	.	.	.	P	.	.	.	.
161.25	1321	501	907.1	6501.1	0.0	.	.	.	P	.	.	.	.
163.59	1119	503	907.2	6639.9	0.0	.	.	.	P	.	.	.	.
165.93	953	548	907.3	6738.4	0.0	.	.	.	P	.	.	.	.
168.26	820	579	907.3	6800.8	0.0	.	.	.	P	I	.	.	.
170.60	703	596	907.3	6834.4	0.0	.	.	.	P	I	.	.	.
172.94	592	601	907.3	6843.9	0.0	.	.	.	.	X	.	.	.
175.27	502	596	907.3	6833.9	0.0	.	.	.	I	P	.	.	.
177.61	430	584	907.3	6810.0	0.0	.	.	.	I	P	.	.	.
179.95	366	567	907.3	6775.8	0.0	.	.	.	I	P	.	.	.
182.29	311	546	907.2	6733.7	0.0	.	.	.	I	P	.	.	.

NRCS PSH Criteria for SDH/FBH Pool Elevation

184.62	264	522	907.2	6686.2	0.0	.	I	P
186.96	226	503	907.2	6634.6	0.0	.	I	P
189.30	190	502	907.1	6577.6	0.0	.	I	P
191.63	162	501	907.1	6514.7	0.0	.	I	P
193.97	148	500	907.1	6447.9	0.0	.	I	P
196.31	148	500	907.0	6379.9	0.0	.	I	P
198.64	148	499	906.9	6312.0	0.0	.	I	P
200.98	148	498	906.9	6244.3	0.0	.	I	P
203.32	148	497	906.8	6176.7	0.0	.	I	P
205.66	148	496	906.8	6109.3	0.0	.	I	P
207.99	148	495	906.7	6042.1	0.0	.	I	P
210.33	148	494	906.7	5975.1	0.0	.	I	P
212.67	148	494	906.6	5908.2	0.0	.	I	P
215.00	148	493	906.6	5841.4	0.0	.	I	P
217.34	148	492	906.5	5774.9	0.0	.	I	P
219.68	148	491	906.5	5708.5	0.0	.	I	P
222.01	148	490	906.4	5642.3	0.0	.	I	P
224.35	148	489	906.4	5576.2	0.0	.	I	P
226.69	148	489	906.3	5510.3	0.0	.	I	P
229.03	148	488	906.3	5444.5	0.0	.	I	P
231.36	148	487	906.3	5378.9	0.0	.	I	P
233.70	148	486	906.2	5313.5	0.0	.	I	P
236.04	148	485	906.2	5248.2	0.0	.	I	P
238.37	148	484	906.1	5183.1	0.0	.	I	P
240.71	148	484	906.1	5118.2	0.0	.	I	P
243.05	148	483	906.0	5053.4	0.0	.	I	P
245.38	148	482	906.0	4988.8	0.0	.	I	P
247.72	148	481	905.9	4924.3	0.0	.	I	P
250.06	148	480	905.9	4860.0	0.0	.	I	P
252.40	148	479	905.8	4795.8	0.0	.	I	P
254.73	148	479	905.8	4731.8	0.0	.	I	P
257.07	148	478	905.7	4668.0	0.0	.	I	P
259.41	148	477	905.7	4604.3	0.0	.	I	P
261.74	148	476	905.6	4540.8	0.0	.	I	P
264.08	148	475	905.6	4477.4	0.0	.	I	P
266.42	148	475	905.5	4414.2	0.0	.	I	P
268.75	148	474	905.5	4351.2	0.0	.	I	P
271.09	148	473	905.4	4288.2	0.0	.	I	P
273.43	148	472	905.4	4225.5	0.0	.	I	P
275.77	148	471	905.3	4162.9	0.0	.	I	P
278.10	148	471	905.3	4100.5	0.0	.	I	P
280.44	148	470	905.2	4038.2	0.0	.	I	P
282.78	148	469	905.2	3976.0	0.0	.	I	P
285.11	148	468	905.1	3914.1	0.0	.	I	P
287.45	148	467	905.1	3852.4	0.0	.	I	P
289.79	148	466	905.0	3790.8	0.0	.	I	P
292.13	148	464	905.0	3729.6	0.0	.	I	P
294.46	148	463	904.9	3668.5	0.0	.	I	P
296.80	148	462	904.8	3607.6	0.0	.	I	P
299.14	148	461	904.8	3547.0	0.0	.	I	P
301.47	148	460	904.7	3486.6	0.0	.	I	P
303.81	148	459	904.7	3426.4	0.0	.	I	P
306.15	148	458	904.6	3366.4	0.0	.	I	P
308.48	148	457	904.5	3306.6	0.0	.	I	P
310.82	148	456	904.5	3247.0	0.0	.	I	P
313.16	148	454	904.4	3187.7	0.0	.	I	P
315.49	148	453	904.4	3128.5	0.0	.	I	P
317.83	148	452	904.3	3069.6	0.0	.	I	P
320.17	148	451	904.2	3010.9	0.0	.	I	P
322.51	148	450	904.2	2952.4	0.0	.	I	P
324.84	148	449	904.1	2894.1	0.0	.	I	P
327.18	148	448	904.1	2836.0	0.0	.	I	P
329.52	148	447	904.0	2778.1	0.0	.	I	P
331.85	148	446	903.9	2720.4	0.0	.	I	P
334.19	148	445	903.9	2662.9	0.0	.	I	P
336.53	148	444	903.8	2605.6	0.0	.	I	P
338.86	148	443	903.8	2548.6	0.0	.	I	P
341.20	148	442	903.7	2491.7	0.0	.	I	P
343.54	148	441	903.7	2435.0	0.0	.	I	P
345.88	148	439	903.6	2378.6	0.0	.	I	P
348.21	148	438	903.5	2322.3	0.0	.	I	P
350.55	148	437	903.5	2266.3	0.0	.	I	P
352.89	148	436	903.4	2210.4	0.0	.	I	P
355.22	148	435	903.4	2154.7	0.0	.	I	P
357.56	148	434	903.3	2099.3	0.0	.	I	P
359.90	148	433	903.3	2044.0	0.0	.	I	P
362.23	148	432	903.2	1989.0	0.0	.	I	P
364.57	148	425	903.1	1934.7	0.0	.	I	P
366.91	148	416	903.1	1882.0	0.0	.	I	P
369.25	148	407	903.0	1831.1	0.0	.	I	P
371.58	148	398	902.9	1782.0	0.0	.	I	P
373.92	148	389	902.8	1734.5	0.0	.	I	P

[illegible]

NRCS PSH Criteria for SDH/FBH Pool Elevation

376.26	148	381	902.8	1688.6	0.0	.	I	P											
378.59	148	373	902.7	1644.3	0.0	.	I	P											
380.93	148	366	902.6	1601.5	0.0	.	I	P											
383.27	148	358	902.6	1560.1	0.0	.	I	P											
385.60	148	351	902.5	1520.1	0.0	.	I	P											
387.94	148	344	902.4	1481.6	0.0	.	I	P											
390.28	148	337	902.4	1444.3	0.0	.	I	P											
392.62	148	331	902.3	1408.3	0.0	.	I	P											
394.95	148	325	902.3	1373.5	0.0	.	I	P											
397.29	148	319	902.2	1339.8	0.0	.	I	P											
399.63	148	313	902.2	1307.4	0.0	.	I	P											
401.96	148	307	902.1	1276.0	0.0	.	I	P											
404.30	148	302	902.1	1245.7	0.0	.	I	P											
406.64	148	297	902.0	1216.4	0.0	.	I	P											
408.97	148	292	902.0	1188.2	0.0	.	I	P											
411.31	148	287	901.9	1160.8	0.0	.	I	P											
413.65	148	282	901.9	1134.5	0.0	.	I	P											
415.99	148	277	901.9	1109.0	0.0	.	I	P											
418.32	148	273	901.8	1084.3	0.0	.	I	P											
420.66	148	269	901.8	1060.5	0.0	.	I	P											
423.00	148	265	901.8	1037.6	0.0	.	I	P											
425.33	148	261	901.7	1015.4	0.0	.	I	P											
427.67	148	257	901.7	993.9	0.0	.	I	P											
430.01	148	253	901.7	973.2	0.0	.	I	P											
432.34	148	250	901.6	953.2	0.0	.	I	P											
434.68	148	246	901.6	933.9	0.0	.	I	P											
437.02	148	243	901.6	915.2	0.0	.	I	P											
439.36	148	239	901.5	897.1	0.0	.	I	P											
441.69	148	236	901.5	879.7	0.0	.	I	P											
444.03	148	233	901.5	862.9	0.0	.	I	P											
446.37	148	230	901.5	846.6	0.0	.	I	P											
448.70	148	228	901.4	830.9	0.0	.	I	P											
451.04	148	225	901.4	815.7	0.0	.	IP												
453.38	148	222	901.4	801.0	0.0	.	IP												
455.71	148	220	901.4	786.9	0.0	.	IP												
458.05	148	217	901.3	773.2	0.0	.	IP												
460.39	148	215	901.3	760.0	0.0	.	IP												
462.73	148	213	901.3	747.2	0.0	.	IP												
465.06	148	210	901.3	734.9	0.0	.	IP												
467.40	148	208	901.3	723.0	0.0	.	IP												
469.74	148	206	901.2	711.4	0.0	.	IP												
472.07	148	204	901.2	700.3	0.0	.	IP												
474.41	148	202	901.2	689.6	0.0	.	IP												
476.75	148	200	901.2	679.3	0.0	.	IP												
479.08	148	195	901.2	669.7	0.0	.	IP												
481.42	148	190	901.1	661.1	0.0	.	IP												
483.76	148	186	901.1	653.2	0.0	.	IP												
486.10	148	183	901.1	646.1	0.0	.	IP												
488.43	148	179	901.0	639.6	0.0	.	IP												
490.77	148	177	901.0	633.8	0.0	.	IP												
493.11	148	174	901.0	628.5	0.0	.	P												
495.44	148	171	901.0	623.6	0.0	.	P												
497.78	148	169	900.9	619.3	0.0	.	P												
500.12	148	167	900.9	615.3	0.0	.	P												
502.45	148	165	900.9	611.7	0.0	.	P												
504.79	148	164	900.9	608.5	0.0	.	P												
507.13	148	162	900.9	605.5	0.0	.	P												
509.47	148	161	900.9	602.9	0.0	.	P												
511.80	148	160	900.9	600.5	0.0	.	P												
514.14	148	158	900.9	598.3	0.0	.	P												
516.48	148	157	900.9	596.3	0.0	.	P												
518.81	148	157	900.8	594.5	0.0	.	P												
521.15	148	156	900.8	592.8	0.0	.	P												
523.49	148	155	900.8	591.3	0.0	.	P												
525.82	148	154	900.8	590.0	0.0	.	P												
528.16	148	154	900.8	588.8	0.0	.	P												
530.50	148	153	900.8	587.7	0.0	.	P												
532.84	148	153	900.8	586.7	0.0	.	P												
535.17	148	152	900.8	585.8	0.0	.	P												
537.51	148	152	900.8	585.0	0.0	.	P												
539.85	148	151	900.8	584.2	0.0	.	P												
542.18	148	151	900.8	583.5	0.0	.	P												
544.52	148	151	900.8	582.9	0.0	.	P												
546.86	148	150	900.8	582.4	0.0	.	P												
549.19	148	150	900.8	581.9	0.0	.	P												
551.53	148	150	900.8	581.4	0.0	.	P												
553.87	148	150	900.8	581.0	0.0	.	P												
556.21	148	150	900.8	580.6	0.0	.	P												
558.54	148	149	900.8	580.3	0.0	.	P												
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I												
							0.		500.		1000.		1500.		2000.		2500.		3000.
																			3500.
END NRCS-PSH PLOT																			

RATING TABLE DEVELOPED, SITE = 1 :
WITH PS GIVEN AND NO AUX. DATA GIVEN.

RATING TABLE NUMBER 1						
	ELEV.	Q-TOTAL	Q-PS	Q-AUX.	VOLUME	AREA
	FEET	CFS	CFS	CFS	AC-FT	ACRE
1	899.60	0.00	0.00	0.00	286.00	0.00
2	901.20	201.00	201.00	0.00	682.00	0.00
3	903.20	432.00	432.00	0.00	1973.00	0.00
4	905.20	469.00	469.00	0.00	3975.00	0.00
5	907.20	503.00	503.00	0.00	6648.00	0.00
6	909.20	2289.00	2289.00	0.00	10232.00	0.00
7	911.20	5526.00	5526.00	0.00	14765.00	0.00
8	913.20	9706.00	9706.00	0.00	20128.00	0.00
9	915.20	14651.00	14651.00	0.00	26604.00	0.00
10	916.20	17375.00	17375.00	0.00	30289.00	0.00

1SITES -----

XEQ 01/07/2021	English Coulee Dam	WSID= 1
VER 2005.1.8	English Coulee Existing	SUBW= 1
TIME 08:47:34	SITE = 1	PASS= 1 PART= 3

AUX. CREST 907.31 FT 6843.9 ACFT 0.00 AC 600.6 CFS

PS STORAGE 6557.9 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 901.90 FT 1134.4 ACFT 0.00 AC 282.0 CFS

ELEVATION OF LOW POINT IS ZERO. NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.

**** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
BOTTOM WIDTH. NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.

Inflow Hyd 1 PSH-Peak = 600.60 CFS at 170.60 hrs., Location Point
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

1 English Coulee Dam

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

SITES....COMPUTATIONS COMPLETE

SUMMARY TABLE 1 SITES VERSION 2005.1.8

DATED 01/01/2005

WATERSHED ID			RUN DATE			RUN TIME			
-----			-----			-----			
1			01/07/2021			08:47:34			
>>>	SITE	SUBWS	SUBWS DA	CURVE	TC	TOTAL DA	TYPE	STRUC	<<<
	ID	ID	(SQ MI)	NO.	(HRS)	(SQ MI)	DESIGN	CLASS	
	-----	-----	-----	-----	-----	-----	-----	-----	
	1	1	54.70	72.	37.00	54.70	TR60	C	
PASS	DIA./	AUX.CREST	BTM.	MAX.	MAX.	EMB.	INTEGR.*	EXIT*	TYPE
NO.	WIDTH	ELEV	WIDTH	HP	ELEV	VOL.	DIST.	VEL.	HYD
	(IN/FT)	(FT)	(FT)	(FT)	(FT)	(CY)	(FT)	(FT/SEC)	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.8 ,01/01/2005
1 FILES

INPUT = S:\NRCS\ENG\Watershed Rehabilitation\Assessments\NRCS Dam Assessments 2020\English_Coulee_Dam\Hydraulic
Analysis\SITES\EnglishCouleeDam\EC_Dam_PSH2D2C.D2C
OUTPUT = S:\NRCS\ENG\Watershed Rehabilitation\Assessments\NRCS Dam Assessments 2020\English_Coulee_Dam\Hydraulic
Analysis\SITES\EnglishCouleeDam\EC_Dam_PSH2D2C.OUT
DATED 01/07/2021 08:47:34

GRAPHICS FILES GENERATED

OPTION "L" = S:\NRCS\ENG\Watershed Rehabilitation\Assessments\NRCS Dam Assessments 2020\English_Coulee_Dam\Hydraulic
Analysis\SITES\EnglishCouleeDam\EC_Dam_PSH2D2C.DRG DATED 01/07/2021 08:47:34

OPTION "P" = S:\NRCS\ENG\Watershed Rehabilitation\Assessments\NRCS Dam Assessments 2020\English_Coulee_Dam\Hydraulic
Analysis\SITES\EnglishCouleeDam\EC_Dam_PSH2D2C.DHY DATED 01/07/2021 08:47:34

OPTION "E" = S:\NRCS\ENG\Watershed Rehabilitation\Assessments\NRCS Dam Assessments 2020\English_Coulee_Dam\Hydraulic
Analysis\SITES\EnglishCouleeDam\EC_Dam_PSH2D2C.DEM DATED 01/07/2021 08:47:34

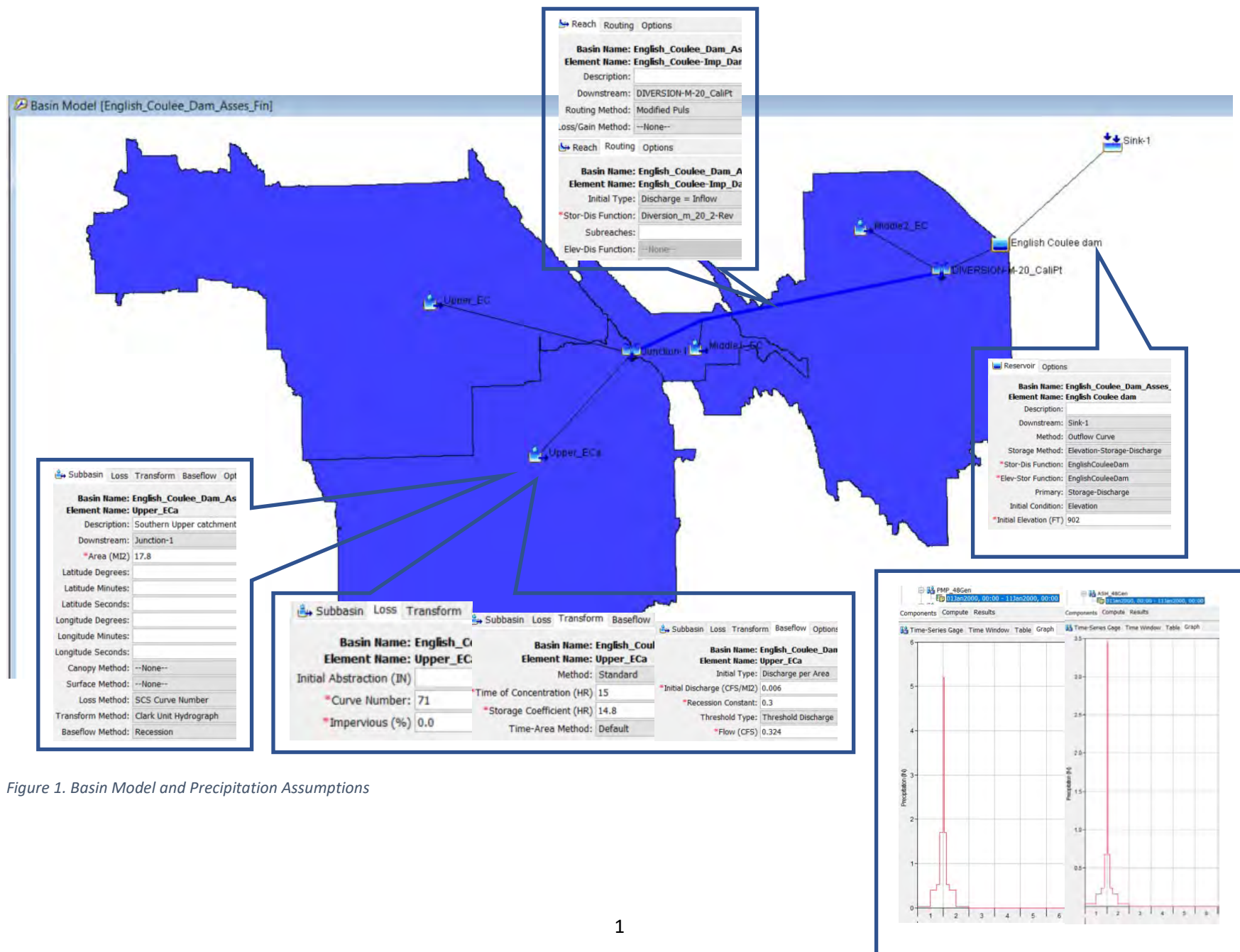


Figure 1. Basin Model and Precipitation Assumptions

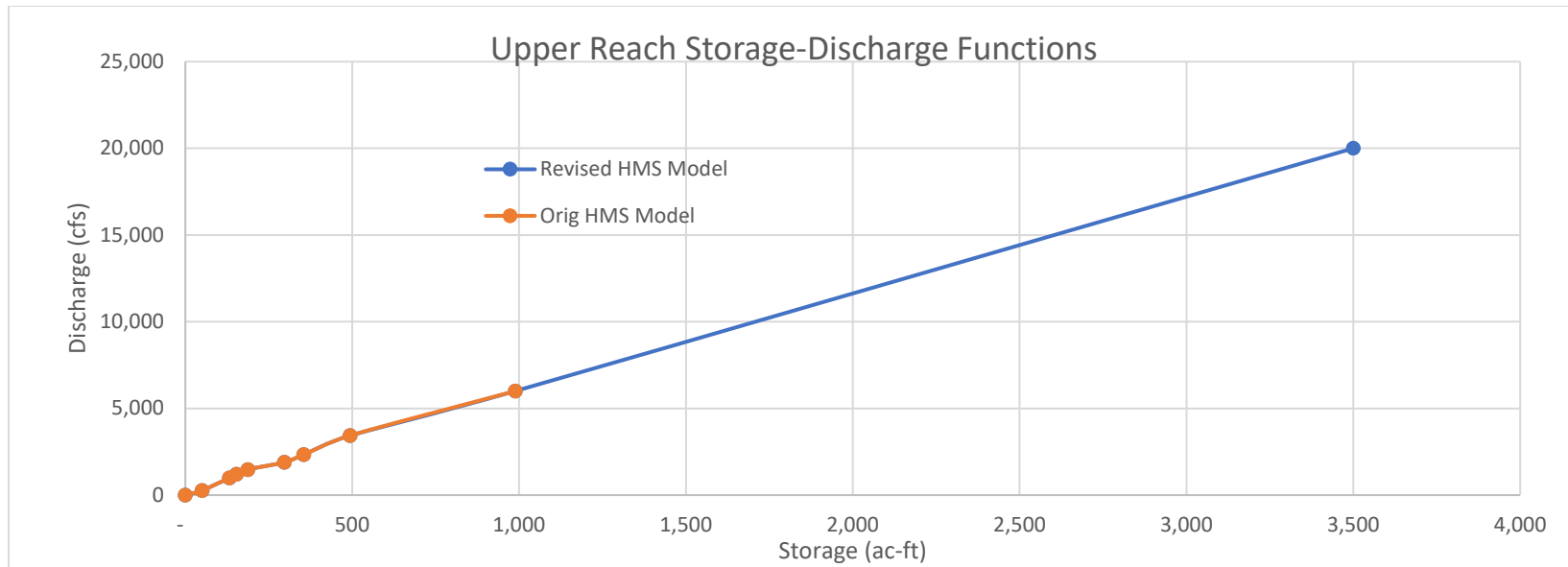


Figure 2. Upper Reach Storage-Discharge Functions

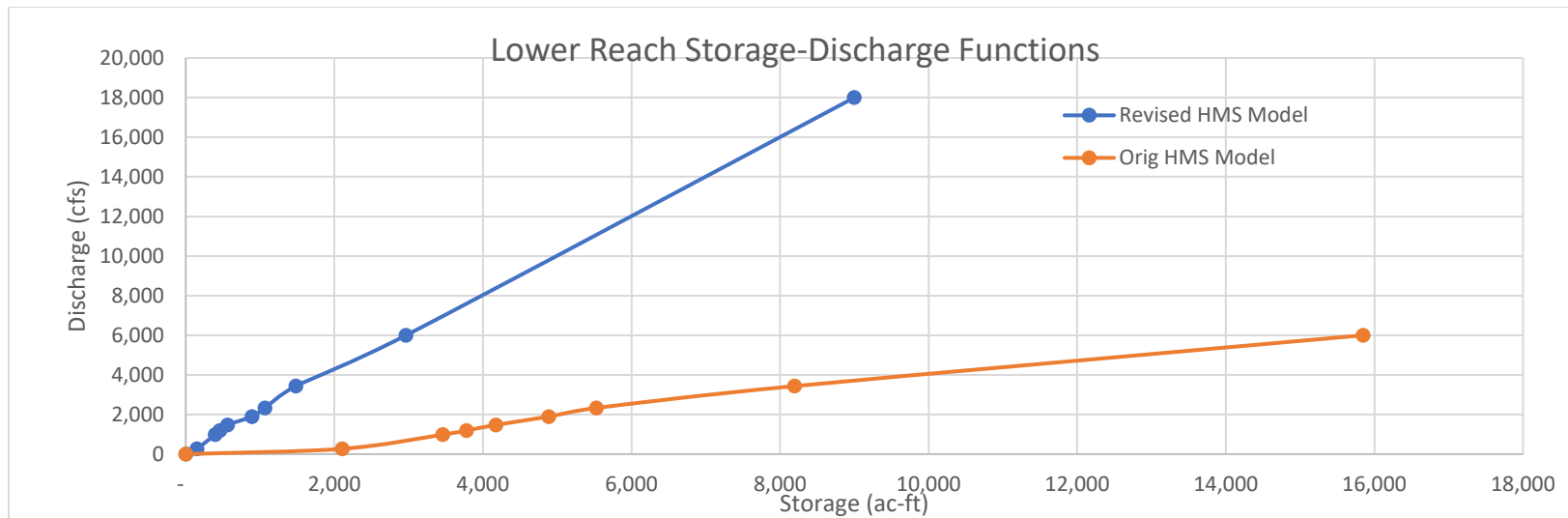


Figure 3. Lower Reach Storage-Discharge Functions

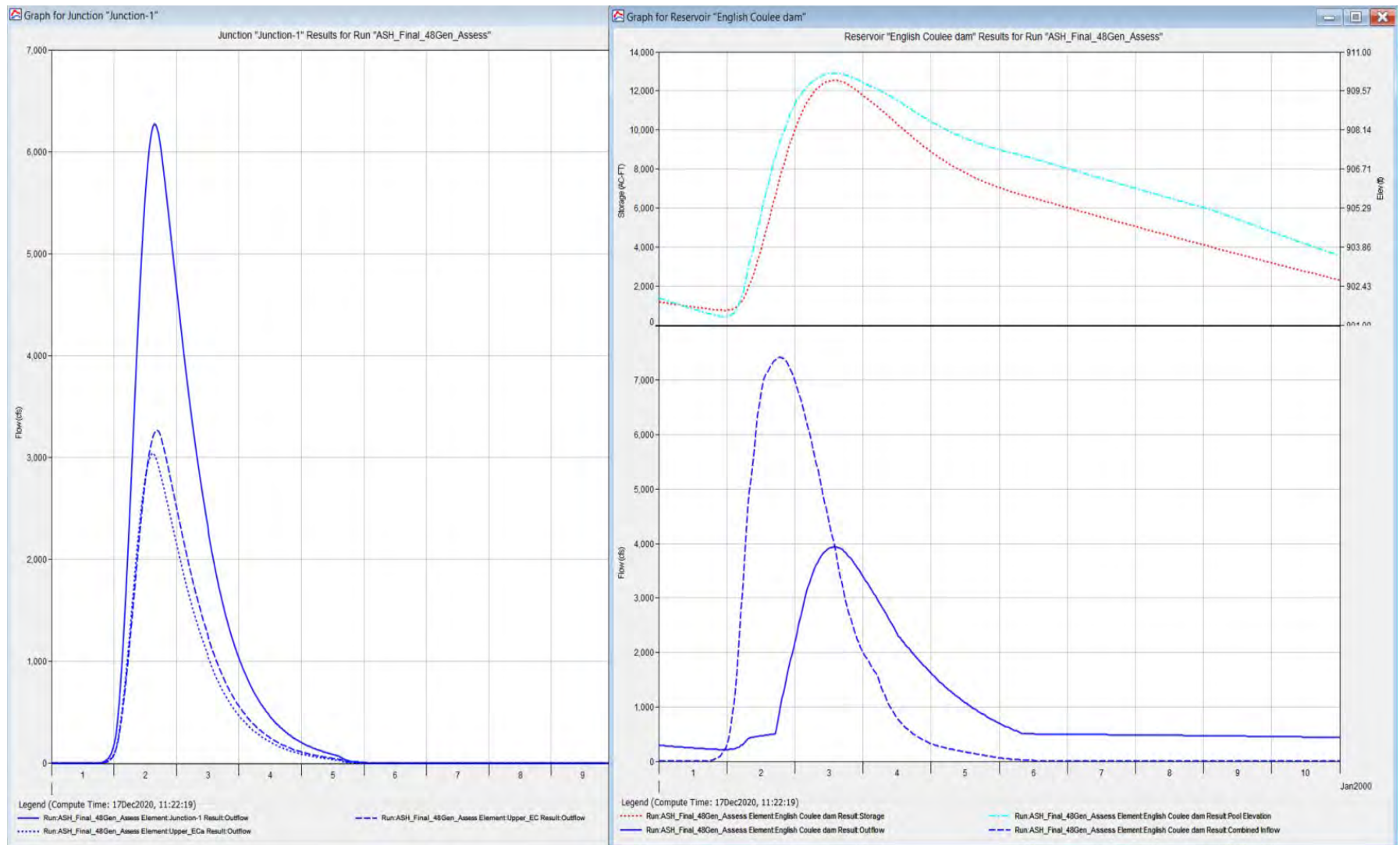


Figure 4. ASH Results for Junction-1 (Left) and English Coulee Dam (Right)

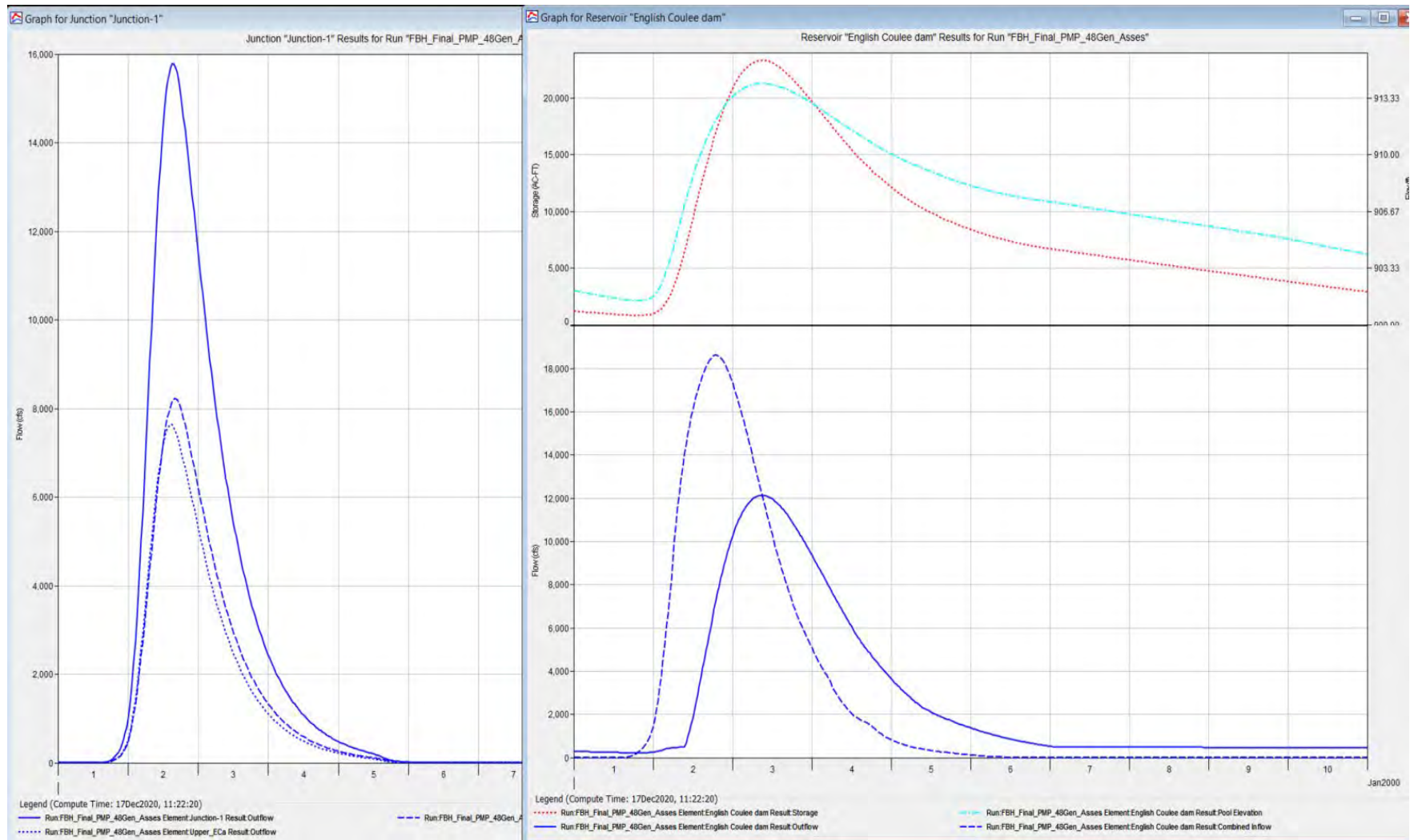


Figure 5. FBH Results for Junction-1 (Left) and English Coulee Dam (Right)

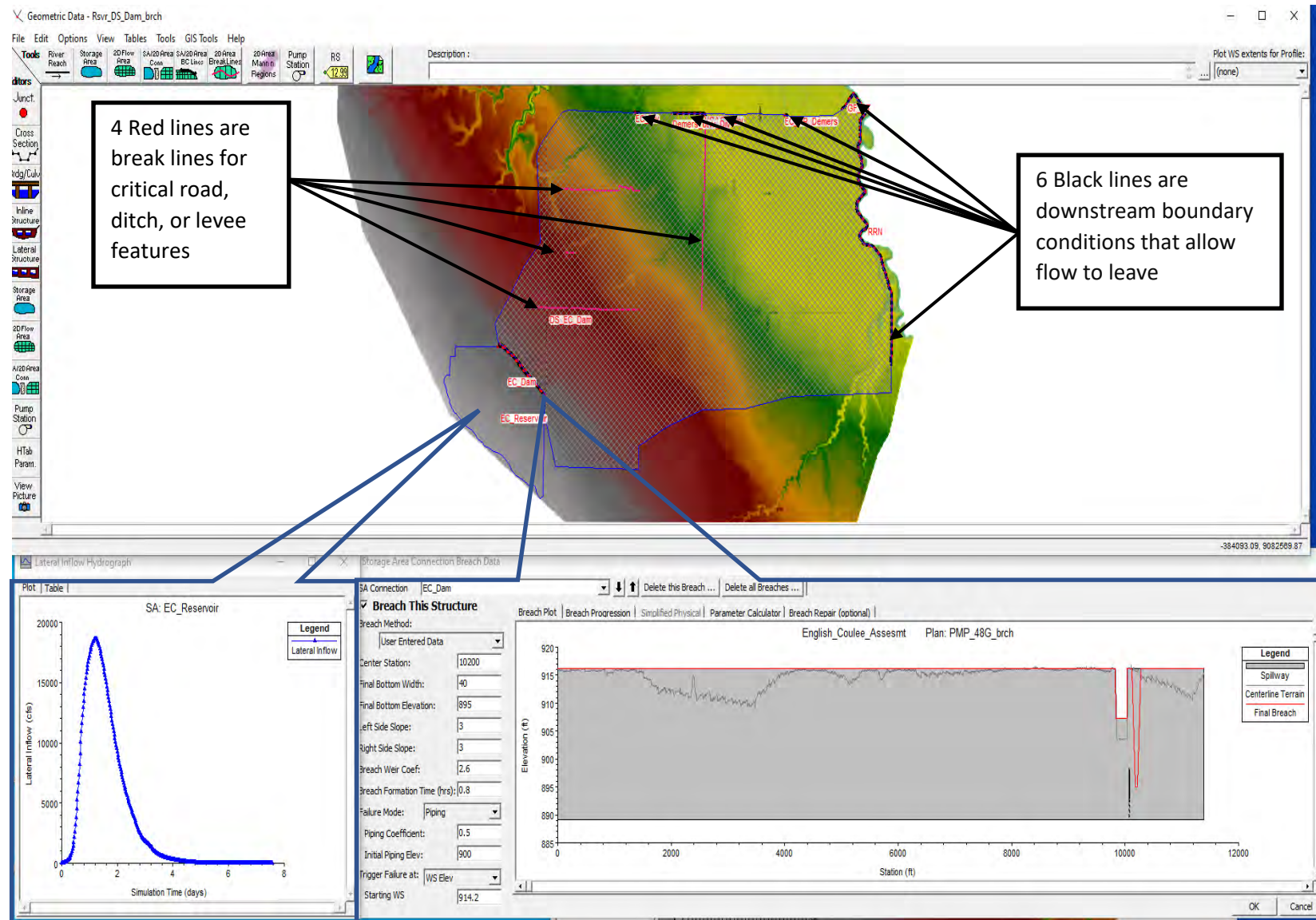


Figure 1. HEC-RAS Model Setup

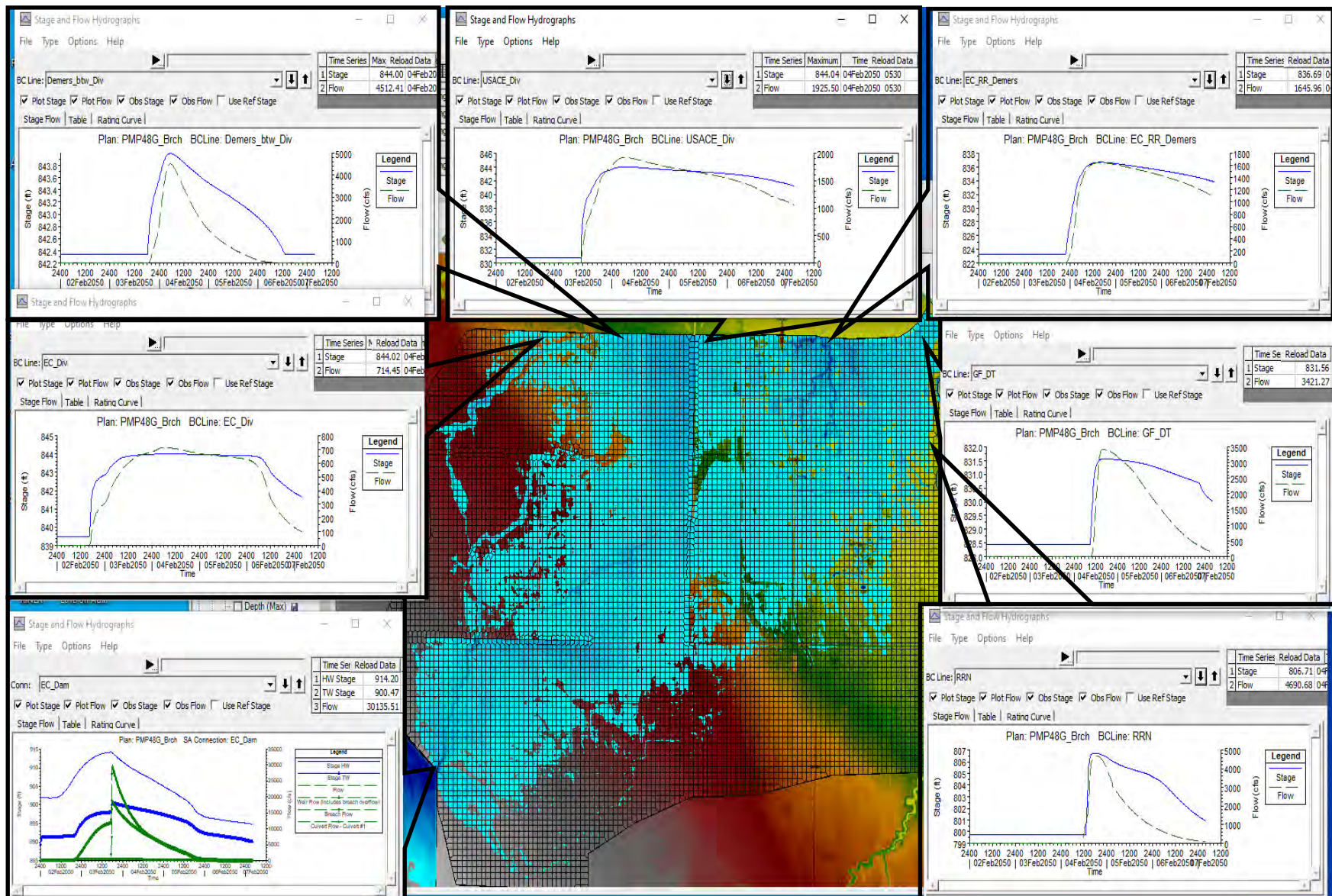


Figure 2. FBH/PMF Breach - Maximum Depth with Boundary Condition Hydrographs



Appendix D
Supplemental Computations

PS Analysis: 11 x 16 R.C. Box w/ 66" Diameter R.C. Conduit**Weir Riser Crest**

PS Crest Elev: 899.6 ft
 Wall Length: 16 ft
 Weir Length: 32 ft
 Weir Coeff: 3.1

$$Q_{weir} = CLH^{3/2}$$

Conduit Flow

CL Outlet: 891.95 **tailwater elevation assumed at conduit centerline*
 Diameter: 66 in
 Area: 23.76 ft²
 n: 0.012 **Manning coefficient for concrete pipe*
 Kp: 0.002746 **Circular pipe flowing full*
 Lp: 131.85 **Conduit length*
 Hood Length: 4.08 ft
 H/D: 0.74 ** Hood length is approx 3D/4*
 tp: 6.5 in **pipe wall thickness*
 tp/D: 0.098485
 Ke: **0.825** **Entrance loss coeff hooded inlet*

"Hydraulics of Closed Conduit Spillways, Part X: The Hood Inlet"
St. Anthony Falls Hydraulic Laboratory, 1958
Ke is based upon hood length (Eqs X-7a, X-7b)

For Hood Length = 3D/4

$$K_e = 1.08 - 0.6 \left(\frac{t_p}{D} \right) \text{ for } \frac{t_p}{D} < 0.04 \quad \text{Eqn X-7a}$$

$$K_e = 0.825 \text{ for } \frac{t_p}{D} > 0.04 \quad \text{Eqn X-7b}$$

$$Q_{conduit} = A \sqrt{\frac{2gH}{1 + K_e + K_p L}} \quad \text{EFH Chapter 3 Eqn 3-12}$$

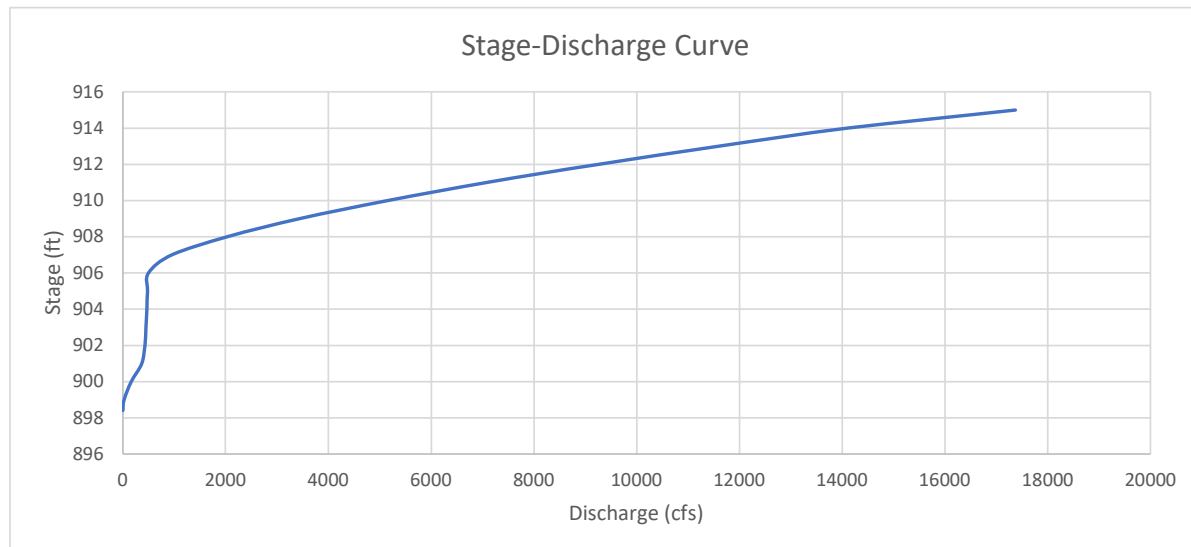
<u>Elev</u>	<u>H</u>	<u>Q</u>
899.6	0	0.00
900	0.4	25.10
901	1.4	164.33
902	2.4	368.83
903	3.4	621.91
904	4.4	915.57
905	5.4	1244.81
906	6.4	1606.13
907	7.4	1996.91
908	8.4	2415.07
909	9.4	2858.93
910	10.4	3327.07
911	11.4	3818.29
912	12.4	4331.56
913	13.4	4865.96
914	14.4	5420.70
915	15.4	5995.05
916.2	16.6	6709.25

<u>Elev</u>	<u>H</u>	<u>Q</u>	<u>Qt PS</u>	<u>Control</u>
899.6	0	0.00	0	N/A
900	8.05	365.78	25	Weir Flow
901	9.05	387.83	164	Weir Flow
902	10.05	408.70	369	Weir Flow
903	11.05	428.55	429	Full Pipe Flow
904	12.05	447.52	448	Full Pipe Flow
905	13.05	465.72	466	Full Pipe Flow
906	14.05	483.24	483	Full Pipe Flow
907	15.05	500.14	500	Full Pipe Flow
908	16.05	516.49	516	Full Pipe Flow
909	17.05	532.33	532	Full Pipe Flow
910	18.05	547.72	548	Full Pipe Flow
911	19.05	562.69	563	Full Pipe Flow
912	20.05	577.27	577	Full Pipe Flow
913	21.05	591.49	591	Full Pipe Flow
914	22.05	605.38	605	Full Pipe Flow
915	23.05	618.95	619	Full Pipe Flow
916.2	24.25	634.86	635	Full Pipe Flow

AS Analysis: 200' Wide Structural Spillway Weir**AS Weir Crest**

AS Crest Elev: 907.2 ft
 Weir Length 1: 200 ft
 Weir Coeff: 3.1

<u>Elev</u>	<u>H</u>	<u>Qt AS</u>	<u>Qt Structure</u>
899.6	0	0	0
900	0	0	25
901	0	0	164
902	0	0	369
903	0	0	429
904	0	0	448
905	0	0	466
906	0	0	483
907	0	0	500
908	0.8	444	960
909	1.8	1497	2030
910	2.8	2905	3453
911	3.8	4593	5155
912	4.8	6520	7097
913	5.8	8660	9252
914	6.8	10994	11599
915	7.8	13506	14125
916.2	9	16740	17375



The auxiliary spillway for English Coulee Dam is a baffled chute spillway with a Fugimoto entrance. The chute was designed based upon hydrologic and hydraulic parameters determined in the original design of the structure. The existing baffled chute will be analyzed based upon updated hydrologic parameters and revised agency policy to determine the adequacy of the structure.

The following references will be used for the evaluation:

1. Technical Release 210-60 "Earth Dams and Reservoirs, Natural Resources Conservation Service, 2019
2. "Hydraulic Design of Stilling Basins and Energy Dissipators", Engineering Monograph 25, Bureau of Reclamation, 1978
3. Rhone, T.J., "A Baffled Apron as a Spillway Energy Dissipator", Bureau of Reclamation, 1976
4. Rhone, T.J., "Studies to Determine the Feasibility of a Baffled Apron Drop as a Spillway Energy Dissipator, Conocully Dam Spillway", Bureau of Reclamation, 1971
5. "T or C Baffled Apron Spillway", Bureau of Reclamation, 1979

DAM & SPILLWAY DATA

TOP OF DAM.....916.2 MSL
 CREST OF CHUTE.....907.2 MSL
 WIDTH OF CHUTE.....200 FT
 CHUTE FLOOR SLOPE.....4H:1V
 OUTLET CHANNEL.....887.2 +/- MSL
 PEAK DISCHARGE THRU CHUTE (FBH).....11,700 CFS

Prior versions of TR60 allowed the baffle blocks to be proportioned for 2/3 the maximum discharge (FBH), with the inlet and chute sidewalls being proportioned for the total peak discharge. This was reflected in the original design of the structure. The original FBH discharge was assumed to be at top of dam and resulted in a flow of 16,740 CFS. The current version of TR60 does not allow for the reduced discharge to be used in hydraulic proportioning of the structure. The structure will be analyzed based upon the updated FBH.

$$cfs := \frac{ft^3}{s} \quad \text{Define CFS as a unit to be used through the analysis}$$

EXISTING STRUCTURE

$$W_{chute_existing} := 200 \text{ ft} \quad \text{width of the baffled chute spillway}$$

$$Q_{FBH} := 11700 \text{ cfs} \quad \text{Peak discharge through chute due to FBH}$$

$$q := \frac{Q_{FBH}}{W_{chute_existing}} = 58.5 \frac{cfs}{ft} \quad \text{Unit design discharge; should be restricted to 60 CFS (Ref2, Pg 172)}$$

$$d_c := \left(\frac{q^2}{g} \right)^{\frac{1}{3}} = 4.738 \text{ ft} \quad \text{Critical depth of flow}$$

BAFFLED CHUTEBlock Height See Ref 3, Figure 2

$$H := 0.8 \cdot d_c = 3.79 \text{ ft}$$

$$H_{const} := 3 \text{ ft} + 8 \text{ in}$$

$$H_{const} \geq H = 0$$

From original design, the critical depth for 2/3 FBH (11,160 CFS) was determined to be 4.59 ft. This accounts for the block height not meeting the proportioning limits established in the reference documents. However, the difference is rather negligible.

$$H - H_{const} = 1.486 \text{ in}$$

Block Width 1 to 1.5 times H; See Ref 2, Pg 186

$$1 \cdot H = 3.79 \text{ ft}$$

$$1.5 \cdot H = 5.686 \text{ ft}$$

$$W_{const} := 5 \text{ ft} + 6 \text{ in}$$

$$1 \cdot H \leq W_{const} \leq 1.5 \cdot H = 1$$

Spacing Between Block Rows See Ref 2, Pg 187

'row spacing may be increased to provide the same vertical differential between rows as expressed by the spacing for a 2:1 slope' (2*H); for the design slope of 4:1, a ratio of 4*H is permitted

$$Sp := 4 \cdot H = 15.162 \text{ ft}$$

$$Sp_{const} := 14 \text{ ft} + 3 \text{ in}$$

$$Sp_{const} \leq Sp = 1$$

Sidewall Height See Ref 3, Figure 8

$$SH := 3 \cdot H = 11.371 \text{ ft} \quad \text{sidewall height normal to the chute floor}$$

$$\phi := \text{atan}\left(\frac{4 \text{ ft}}{1 \text{ ft}}\right) = 75.964 \text{ deg} \quad \text{angle from vertical of sloped chute floor}$$

$$SH_{vert} := \frac{SH}{\sin(\phi)} = 11.721 \text{ ft} \quad \text{sidewall height measured vertically}$$

$$SH_{const} := 14 \text{ ft} + 8 \text{ in}$$

$$SH_{const} \geq SH_{vert} = 1$$

Sidewall Height Above Inlet Crest

$$SH_{crest} := 1.5 \cdot d_c = 7.107 \text{ ft}$$

$$SH_{crest_const} := 915 \text{ ft} - 906 \text{ ft} = 9 \text{ ft}$$

$$SH_{crest_const} \geq SH_{crest} = 1$$

Entrance Velocity Eng. Monograph 25 states that entrance velocities should be well below critical velocity, preferably $V_c - 5$

$$V_c := \sqrt[3]{g \cdot q} = 12.347 \frac{\text{ft}}{\text{s}} \quad \text{Critical velocity} \quad V_a := V_c - 5 \frac{\text{ft}}{\text{s}} = 7.347 \frac{\text{ft}}{\text{s}} \quad \text{Approach velocity; ideal}$$

$$d_A := \frac{q}{V_a} = 7.963 \text{ ft} \quad \text{Approach depth}$$

$$Floor_{recess} := d_A - d_c = 3.225 \text{ ft} \quad \text{Recess floor below crest}$$

$$Floor_{recess_const} := 3 \text{ ft} + 3 \text{ in}$$

$$Floor_{recess_const} \geq Floor_{recess} = 1$$

Spillway Crest Type Fugimoto entrance as detailed in Reference 3, Figure 12

$$L_{long_crest} := 1.25 \cdot H = 4.738 \text{ ft}$$

$$L_{short_crest} := 0.625 \cdot H = 2.369 \text{ ft}$$

$$L_{long_crest_const} := 4 \text{ ft} + 8 \text{ in}$$

$$L_{short_crest_const} := 2 \text{ ft} + 4 \text{ in}$$

$$L_{long_crest_const} \geq L_{long_crest} = 0$$

$$L_{short_crest_const} \geq L_{short_crest} = 0$$

$$L_{long_crest} - L_{long_crest_const} = 0.857 \text{ in}$$

$$L_{short_crest} - L_{short_crest_const} = 0.428 \text{ in}$$

$$W_{crest} := 1.5 \cdot H = 5.686 \text{ ft}$$

$$W_{crest_at_wall} := 0.5 \cdot H = 1.895 \text{ ft}$$

$$W_{crest_const} := 5 \text{ ft} + 6 \text{ in}$$

$$W_{crest_at_wall_const} := 3 \text{ ft} + 9 \text{ in}$$

$$W_{crest_const} \geq W_{crest} = 0$$

$$W_{crest_at_wall_const} \geq W_{crest_at_wall} = 1$$

$$W_{crest} - W_{crest_const} = 2.228 \text{ in}$$

As discussed for the evaluation of block height (H), the proportioning does not quite meet the guidelines provided in the references. However, the differences are again rather negligible

CONCLUSION: In the text of Engineering Monograph 25 (Pg 173-174), it is documented that baffled chutes have been operated at estimated unit discharge values up to 120 CFS for short periods without excessive erosion or spillage over the walls. Given the estimated design frequency of the auxiliary spillway discharge, it is reasonable to assume that the negligible differences between the constructed spillway and the proportioned dimensions are within an acceptable range of operation.

In accordance with TR-60, the estimated wave height should be determined in relation to the reservoir pool elevation that corresponds to the Auxiliary Spillway Hydrograph (ASH). The dam crest should be sufficient to contain the ASH and the freeboard associated with the wave height.

The following references will be used for the evaluation:

1. Technical Release 210-56 "A Guide for Design and Layout of Vegetated Wave Protection for Earthen Embankments and Shorelines", Natural Resources Conservation Service, 2014

DESIGN DATA

CREST OF DAM.....916.2 MSL

POOL ELEV @ ASH.....910.2 MSL

In accordance with TR-56, a minimum of three trials should be examined to determine the largest effective fetch.

TRIAL 1

α (deg)	$\cos, \alpha$	$Distance_1$ (ft)
42	0.743	132
36	0.809	204
30	0.866	445
24	0.914	9491
18	0.951	10862
12	0.978	12860
6	0.995	15965
0	1.000	15726
6	0.995	12090
12	0.978	10482
18	0.951	8897
24	0.914	8374
30	0.866	7300
36	0.809	6871
42	0.743	6840

$$\sum Distance_1 \cdot \cos, \alpha = 119199.661 \text{ ft}$$

$$\sum \cos, \alpha = 13.512$$

Effective Fetch Length (Eq 1)

$$F_{e1} := \frac{\sum Distance_1 \cdot \cos, \alpha}{\sum \cos, \alpha} = 8821.763 \text{ ft}$$

TRIAL 2

α	$\cos_2 \alpha$	$Distance_2$
(deg)		(ft)
42	0.743	3183
36	0.809	3939
30	0.866	5241
24	0.914	8958
18	0.951	11324
12	0.978	12628
6	0.995	14450
0	1.000	17036
6	0.995	16246
12	0.978	11555
18	0.951	9009
24	0.914	7648
30	0.866	6516
36	0.809	6212
42	0.743	5635

$$\sum Distance_2 \cdot \cos_2 \alpha = 130689.556 \text{ ft}$$

$$\sum \cos_2 \alpha = 13.512$$

Effective Fetch Length (Eq 1)

$$F_{e2} := \frac{\sum Distance_2 \cdot \cos_2 \alpha}{\sum \cos_2 \alpha} = 9672.11 \text{ ft}$$

$$F_e := \max(F_{e1}, F_{e2}, F_{e3}) = 10009.65 \text{ ft}$$

$$F_e = 1.896 \text{ mi}$$

TRIAL 3

α	$\cos_3 \alpha$	$Distance_3$
(deg)		(ft)
42	0.743	6255
36	0.809	7209
30	0.866	8705
24	0.914	11476
18	0.951	13727
12	0.978	14809
6	0.995	16269
0	1.000	18266
6	0.995	16199
12	0.978	8431
18	0.951	6124
24	0.914	5524
30	0.866	4420
36	0.809	4079
42	0.743	3214

$$\sum Distance_3 \cdot \cos_3 \alpha = 135250.39 \text{ ft}$$

$$\sum \cos_3 \alpha = 13.512$$

Effective Fetch Length (Eq 1)

$$F_{e3} := \frac{\sum Distance_3 \cdot \cos_3 \alpha}{\sum \cos_3 \alpha} = 10009.65 \text{ ft}$$

Determine significant wave height for maximum effective fetch length.

$$V_L := 80 \text{ mph} \quad \text{overland wind velocity; Figure 4}$$

$$Ratio := 1.2 \quad \text{wind ratio; Figure 5}$$

$$V_W := V_L \cdot Ratio = 96 \text{ mph} \quad \text{overwater wind velocity; Eq 2}$$

$$H_s := 0.0232 \left(\frac{1 \text{ ft}}{\text{mph}^{1.06} \cdot \text{mi}^{0.47}} \right) \cdot V_W^{1.06} \cdot F_e^{0.47} = 3.956 \text{ ft} \quad \text{significant wave height; Eq 3}$$

Determine required dam height based on ASH and calculated wave height.

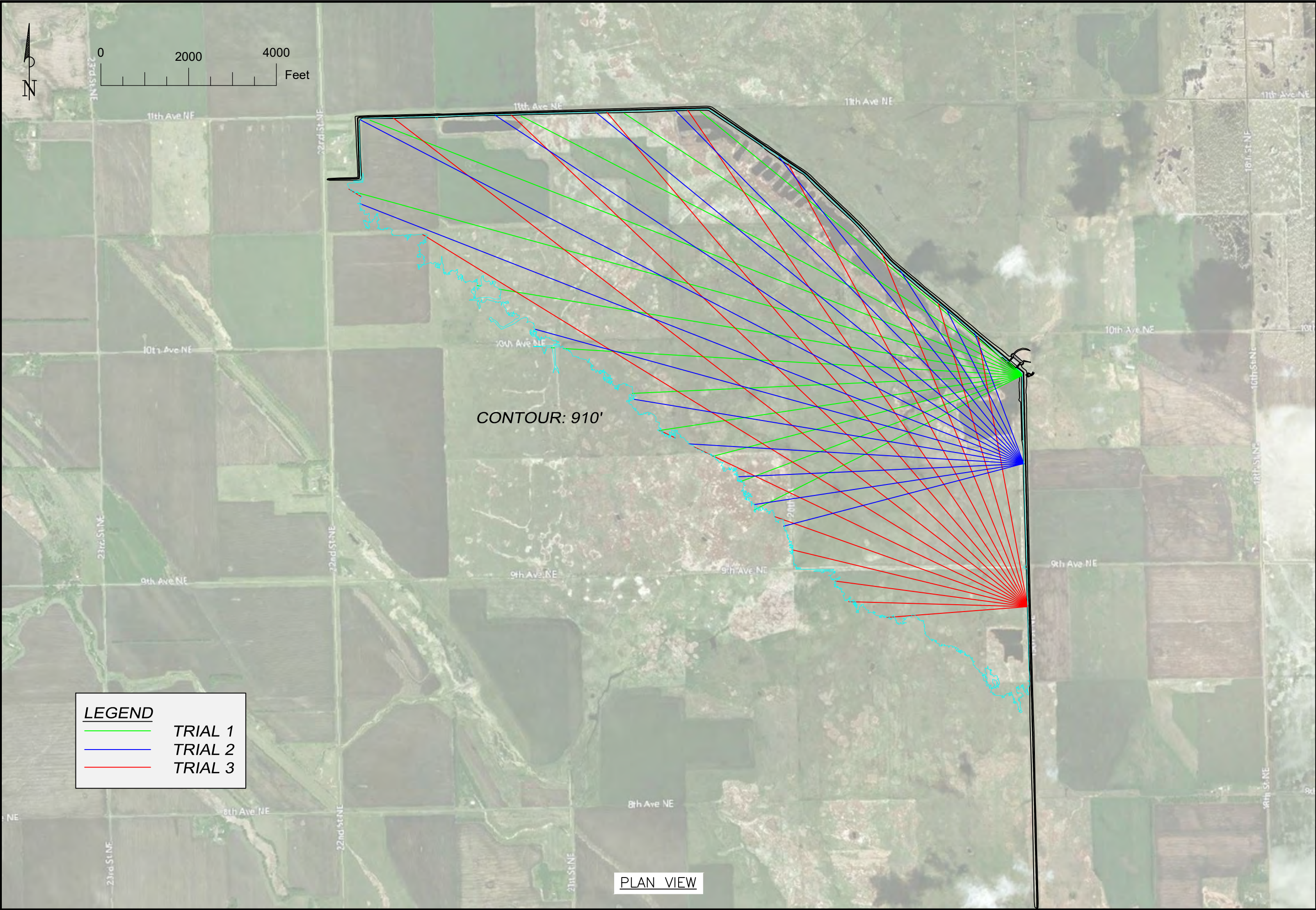
$$Crest_{existing} := 916.2 \text{ ft}$$

$$Pool_{ASH} := 910.2 \text{ ft}$$

$$Crest_{req} := Pool_{ASH} + H_s = 914.156 \text{ ft}$$

$$Freeboard := Crest_{existing} - Crest_{req} = 2.044 \text{ ft}$$

The existing top of dam elevation **is** sufficient to contain the ASH and corresponding wave height.



Date DESIGN BY <u>N REYNOLDS</u> 12/15/2020 CHECKED BY <u>T Schandore</u> 1/14/2021	
EFFECTIVE FETCH ENGLISH COULEE DAM ASSESSMENT OWNER: <u>GRAND FORKS COUNTY WRD</u> COUNTY: <u>GRAND FORKS</u>	
 Natural Resources Conservation Service	
File Name English Coulee Dam.dwg	
Date 12/16/2020	
Sheet 1 of 1	

In accordance with TR-60 requirements, the effects of earthquake loading is to be considered. As a minimum, the peak ground acceleration (PGA) resulting from the maximum design earthquake loading (MDE) corresponding to a prescribed annual exceedance probability should be used.

The following references will be used for the evaluation:

1. Technical Release 210-60 "Earth Dams and Reservoirs, Natural Resources Conservation Service, 2019
2. US Geological Survey - Earthquake Hazards Program

From TR-60, English Coulee Dam meets the description of a "Significant Consequence" structure.

Consequences from seismic failure based on a failure mode with the reservoir at the normal pool elevation are—

- **Low Consequence.**—Dams in rural or agricultural areas where seismic failure of the dam or appurtenance may result in damage to farm buildings, agricultural land, or township and country roads.
- **Significant Consequence.**—Dams in predominantly rural or agricultural areas where seismic failure of the dam or appurtenance may result in damage to isolated homes, main highways or minor railroads, and interrupt service of relatively important public utilities. For high hazard potential and significant hazard potential dams, significant consequence of a seismic failure of the dam or appurtenance may also include the loss of stored water from water supply dams where there is no other water supply source. For high hazard potential and significant hazard potential dams, significant consequence also includes the loss of the permanent pool where a seismic failure of the dam or appurtenance would have significant consequences such as the loss of important recreational facilities or environment damage.
- **High Consequence.**—Dams where seismic failure of the dam or appurtenance may cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads.

TR-60 Table 4-1: Table of Earthquake Loading

Consequence of a seismic failure	Exceedance probability for peak ground acceleration (PGA)	Return period (years)	Approximate probability of exceedance in 50 years
Low consequence	1×10^{-3}	1,000	5%
Significant consequence	4×10^{-4}	2,500	2%
High consequence	1×10^{-4}	10,000	0.5%

Results from the US Geological Survey - Earthquake Hazards Program:

Return Period = 2475 years

PGA := 2.1%

PGA < 7% = 1

TR-60 Part 5 provides a threshold of 0.07g (7%). Values equal to or less than this threshold require no additional seismic analysis

Unified Hazard Tool



Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the [U.S. Seismic Design Maps web tools](#) (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Spectral Period

Latitude

Decimal degrees

Time Horizon

Return period in years

Longitude

Decimal degrees, negative values for western longitudes

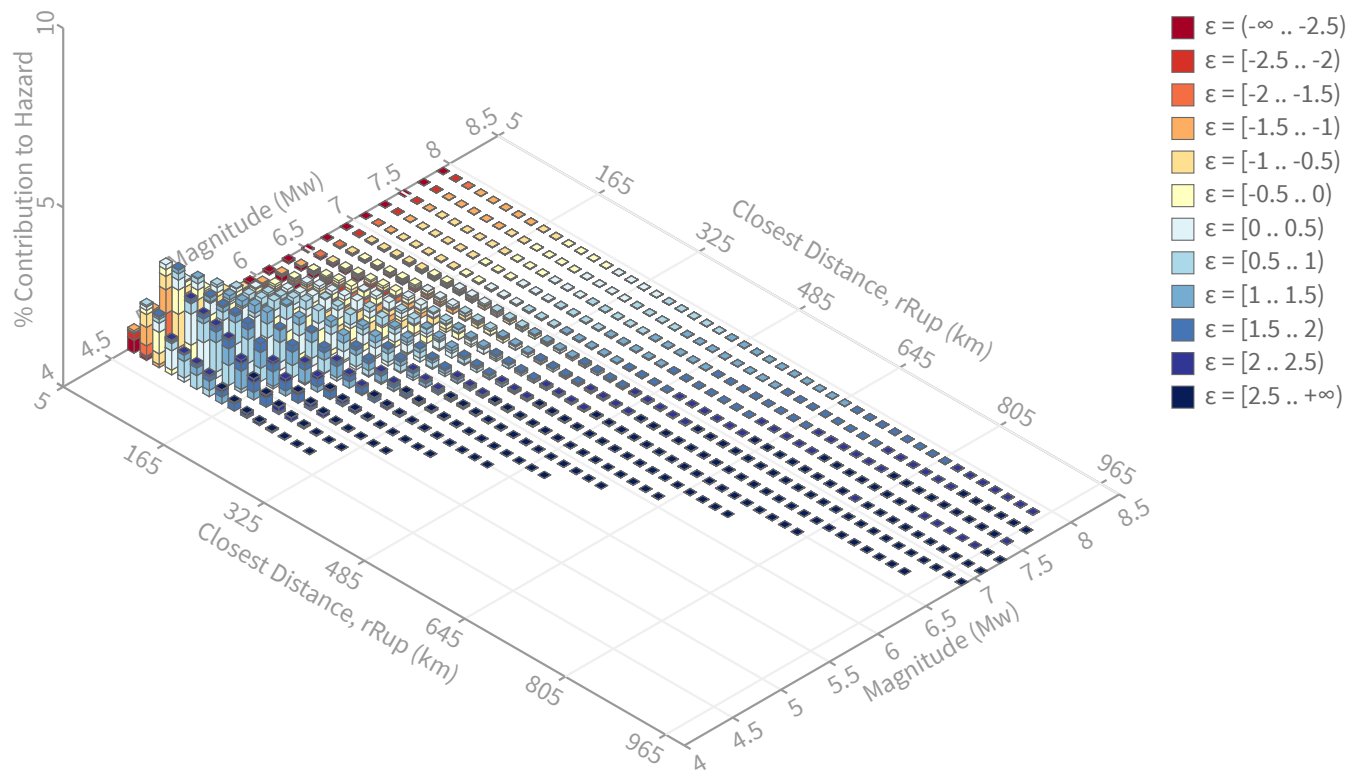
Site Class

Unified Hazard Tool

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs

Exceedance rate: 0.0004040404 yr⁻¹

PGA ground motion: 0.021055395 g

Recovered targets

Return period: 2468.2449 yrs

Exceedance rate: 0.00040514619 yr⁻¹

Totals

Binned: 100 %

Residual: 0 %

Trace: 3.16 %

Mean (over all sources)

m: 5.58

r: 140.57 km

ε₀: -0.04 σ

Mode (largest m-r bin)

m: 4.9

r: 49.68 km

ε₀: -0.35 σ

Contribution: 2.42 %

Mode (largest m-r-ε₀ bin)

m: 5.1

r: 70.35 km

ε₀: -0.23 σ

Contribution: 0.94 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km

m: min = 4.4, max = 9.4, Δ = 0.2

ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)

ε1: [-2.5 .. -2.0)

ε2: [-2.0 .. -1.5)

ε3: [-1.5 .. -1.0)

ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

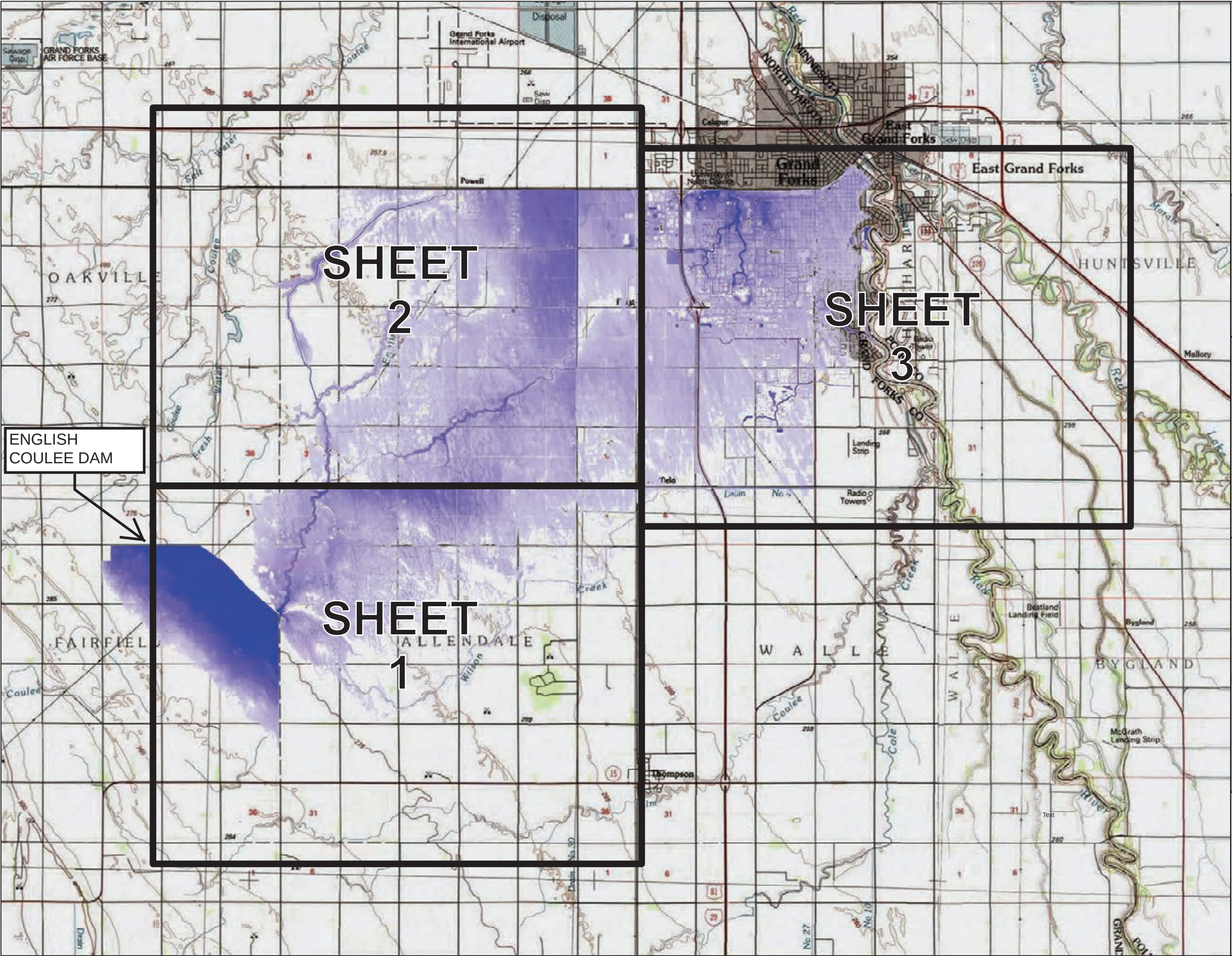
Unified Hazard Tool

Deaggregation Contributors

Source Set ↴	Source	Type	r	m	ϵ_0	lon	lat	az	%
	USGS Adaptive Smoothing Zone 1 (opt)	Grid							25.67
	SSCn Adaptive Smoothing Zone 1 (opt)	Grid							25.67
	USGS Fixed Smoothing Zone 1 (opt)	Grid							24.29
	SSCn Fixed Smoothing Zone 1 (opt)	Grid							24.29



Appendix E
Dam Failure Inundation Mapping



English Coulee Dam
Grand Forks County, ND

Breach Inundation

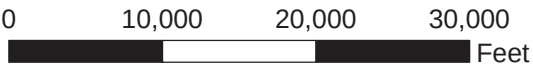
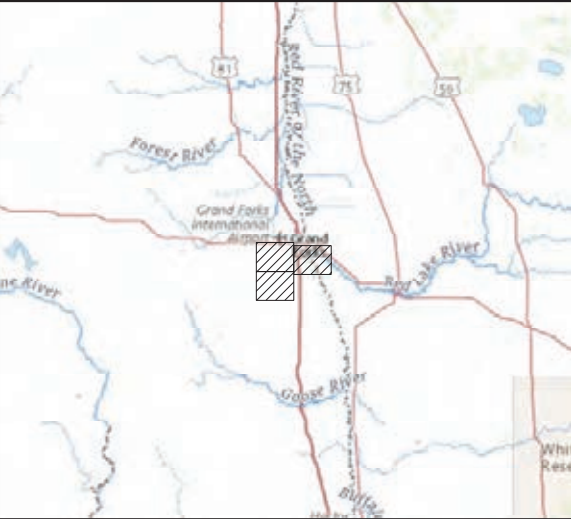
INDEX MAP



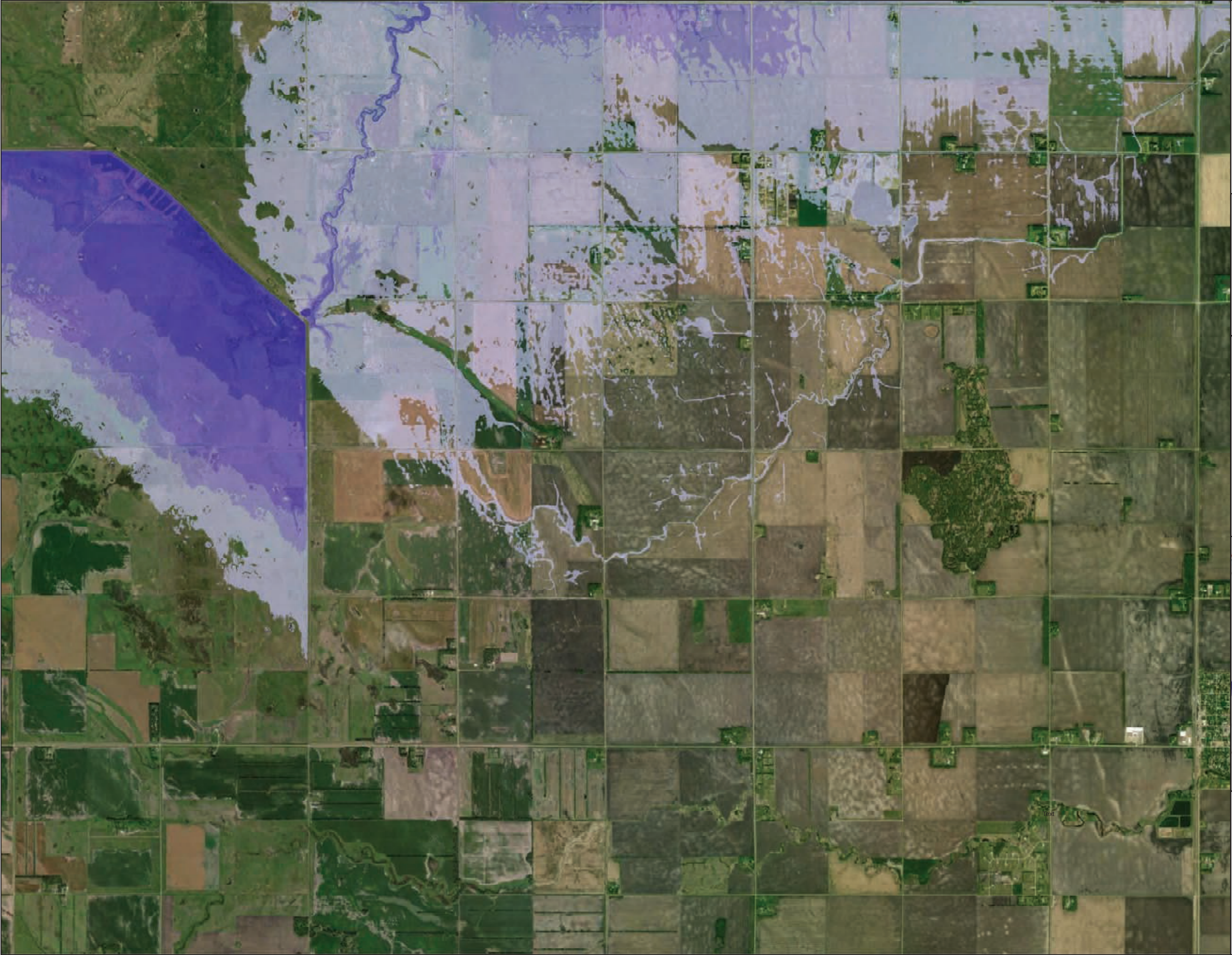
Legend

- Mapsheet Index Grid
- Breach Inundation Area

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.



December 2020



English Coulee Dam
Grand Forks County, ND

Breach Inundation Map

SHEET 1



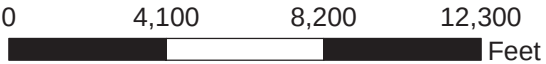
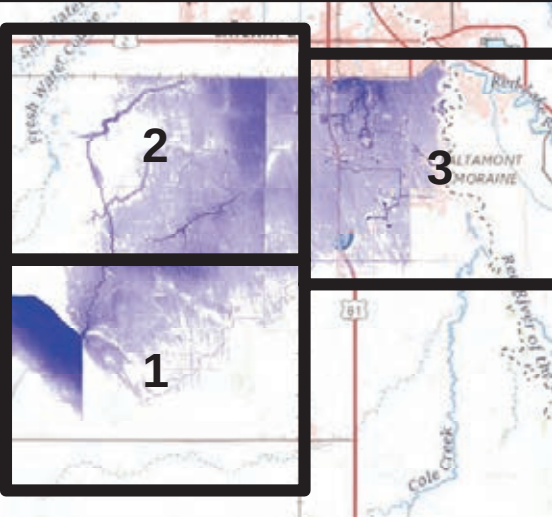
Legend

Breach Inundation Area

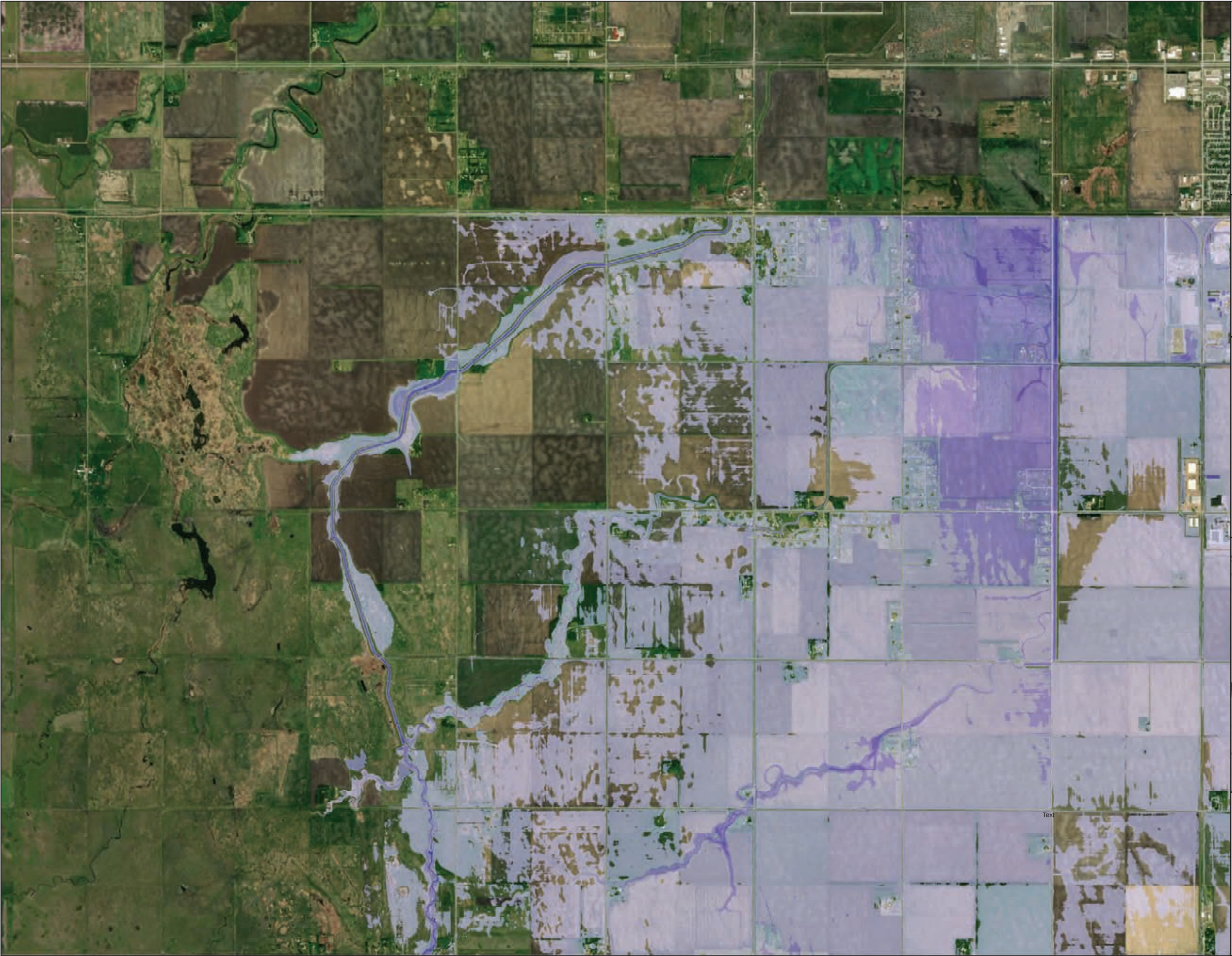
DEPTH

	< 3'
	3' - 5'
	5' - 10'
	10' - 15'
	15' - 20'

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.



December 2020



English Coulee Dam
Grand Forks County, ND

Breach Inundation Map

SHEET 2



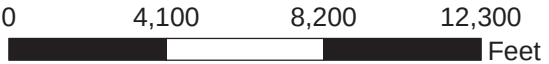
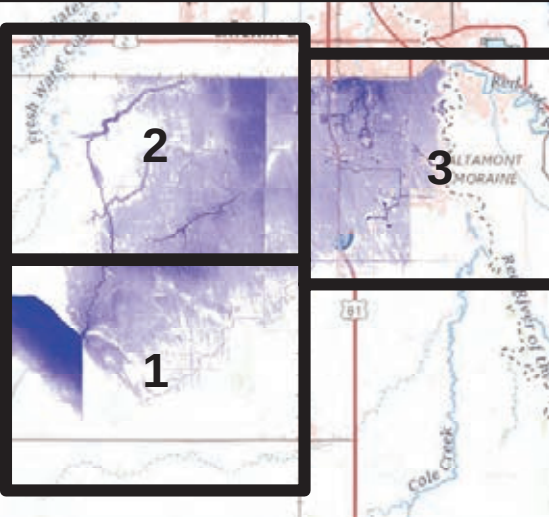
Legend

Breach Inundation Area

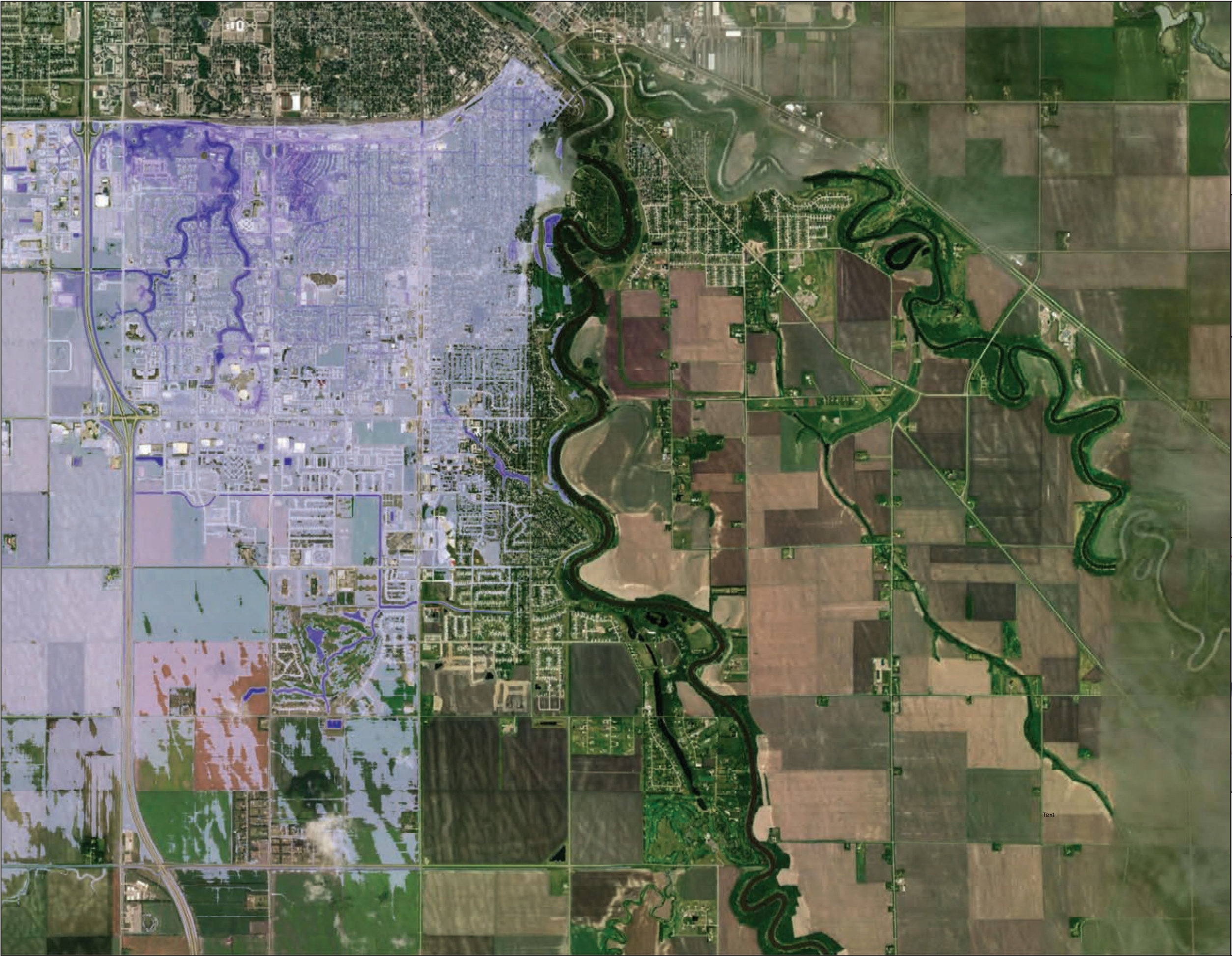
DEPTH

- < 3'
- 3' - 5'
- 5' - 10'
- 10' - 15'
- 15' - 20'

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.



December 2020



English Coulee Dam
Grand Forks County, ND

Breach Inundation Map

SHEET 3



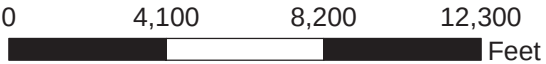
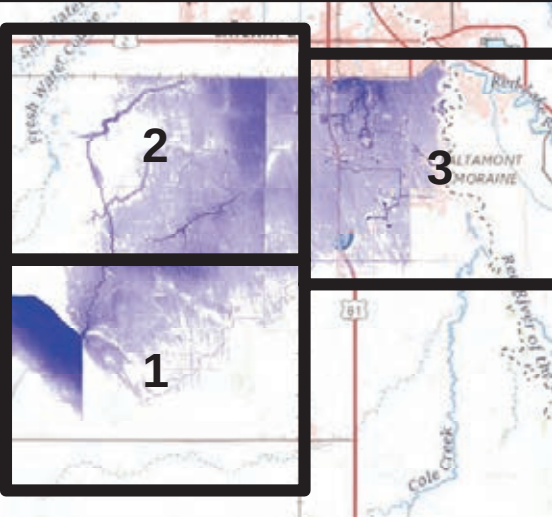
Legend

Breach Inundation Area

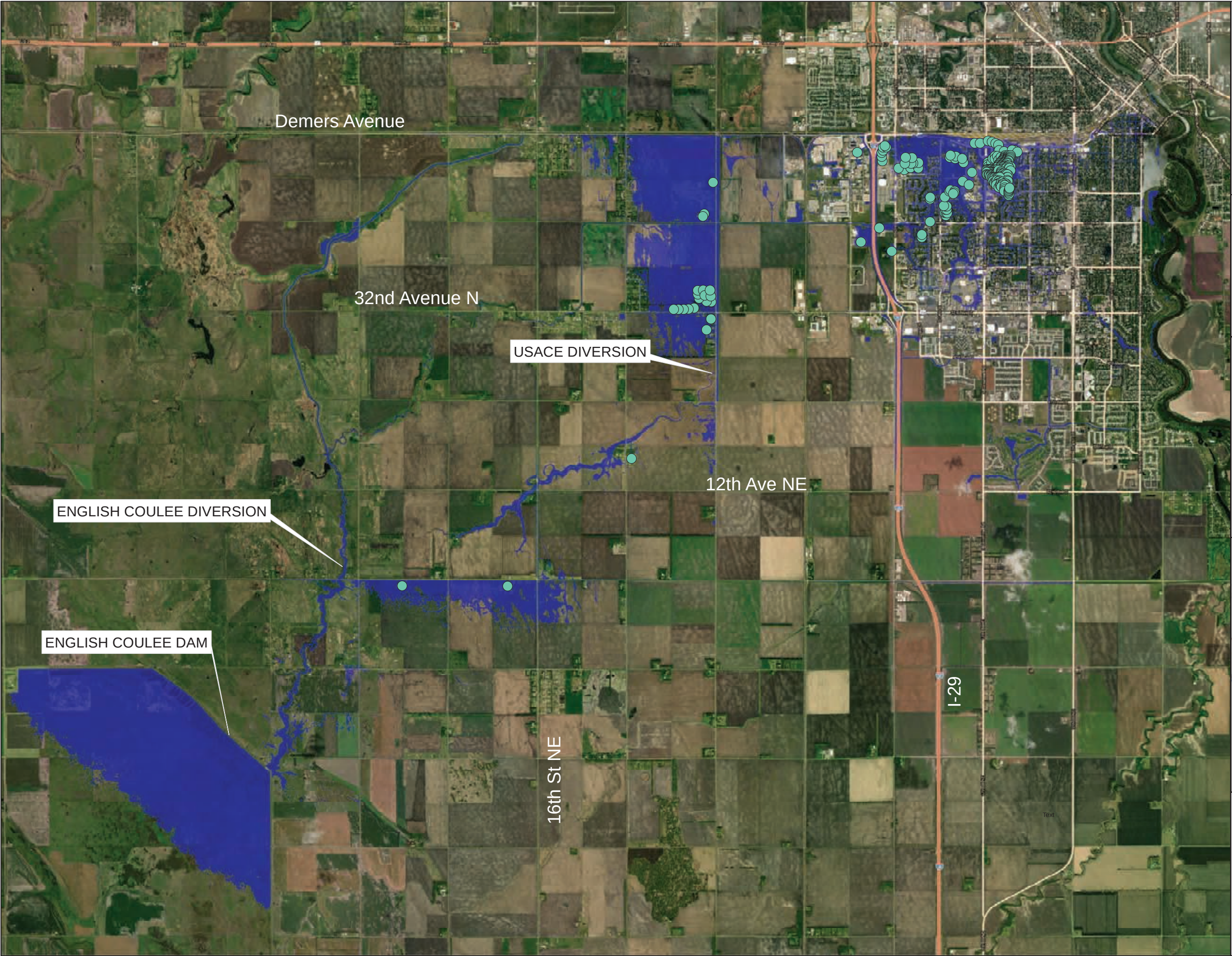
DEPTH

< 3'
3' - 5'
5' - 10'
10' - 15'
15' - 20'

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.



December 2020



English Coulee Dam
Grand Forks County, ND

Breach Inundation Map
Hazard Locations with Depth



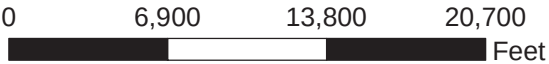
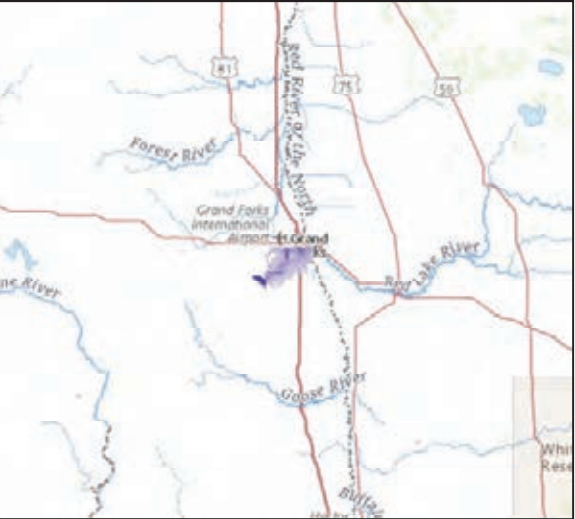
Legend

 Hazard_Locations

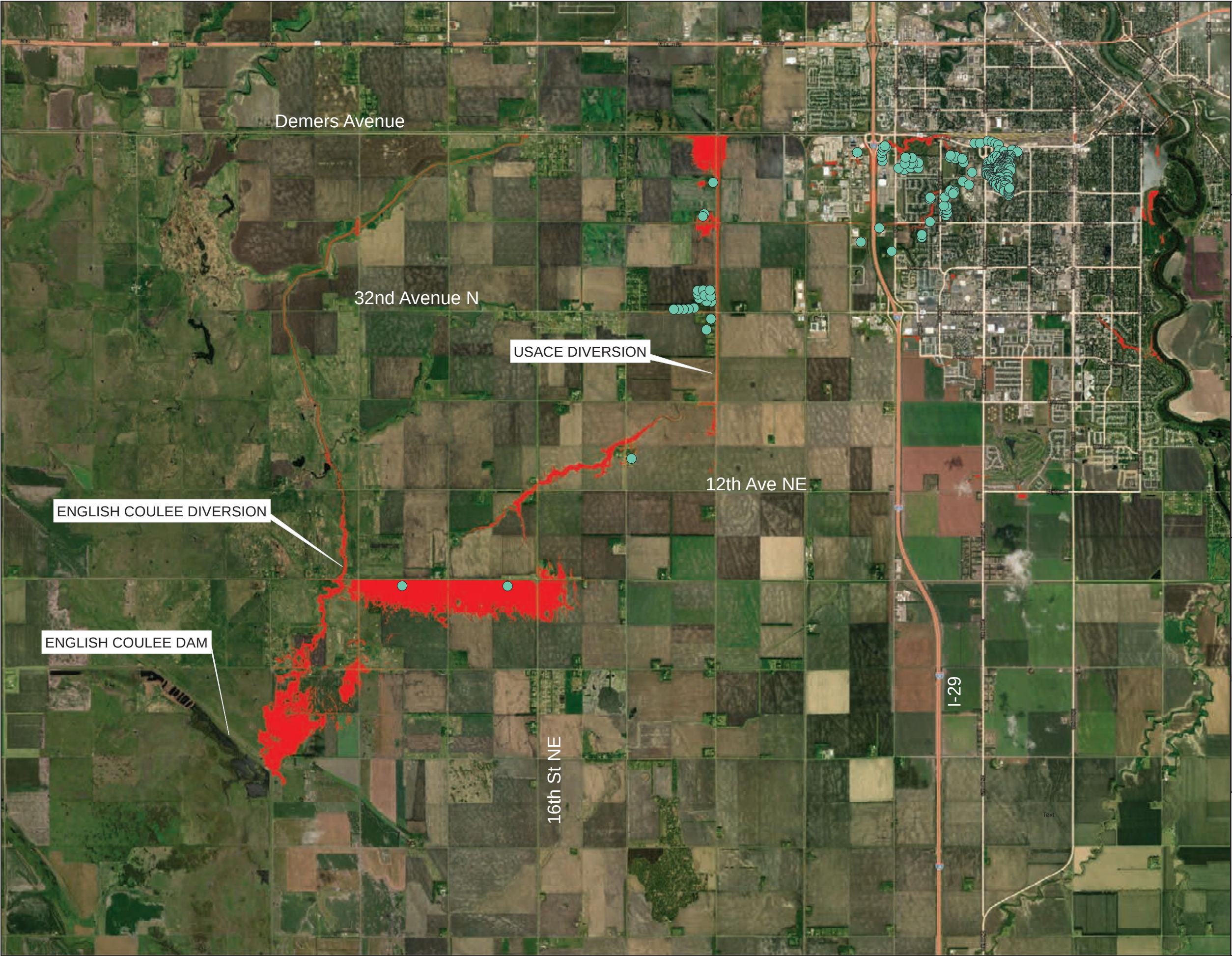
Depth (Max)
(ft)

 0' - 3'
 > 3'

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.



December 2020



English Coulee Dam
Grand Forks County, ND

Breach Inundation Map
Hazard Locations with Depth x Velocity



Legend

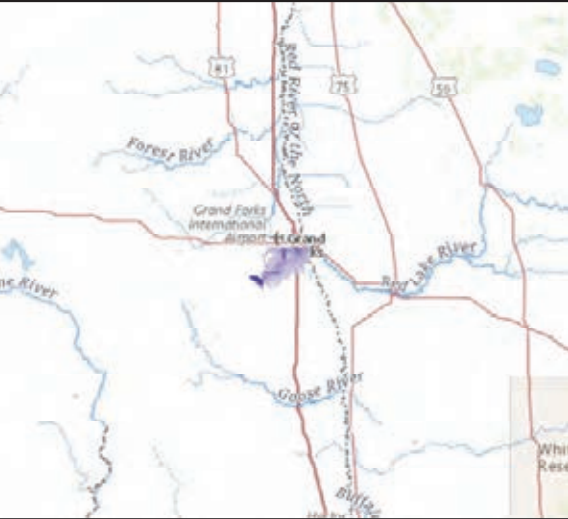
 Hazard_Locations

Depth x Velocity (Max)
(ft²/s)

	0 - 4
	> 4

THE INUNDATION LIMITS ARE THE RESULTS OF THE BREACH ANALYSIS CONDUCTED AS PART OF THIS 2020 DAM ASSESSMENT. NOTE THAT THE LIMITS OF THE FLOODING SHOWN ARE NOT ALL INCLUSIVE AS THIS MODELING WAS ONLY USED TO JUSTIFY THE HAZARD CLASSIFICATION OF THE STRUCTURE. NOTE THAT THIS IS THE RESULT OF MODELING USING BEST AVAILABLE DATA AND SCIENCE. ACTUAL INUNDATION AREA IN THE EVENT OF A DAM BREACH MAY VARY FROM THE EXTENTS SHOWN ON THIS MAP.





0 6,900 13,800 20,700
Feet

December 2020



Appendix F
Failure and Risk Index Spreadsheets

EVALUATION OF POTENTIAL REHABILITATION PROJECTS									
STATE	ND	DAM	English Coulee Dam		BY	NMR	DATE	11/24/2020	
YEAR BUILT		1990	DESIGN HAZARD CLASS		H	DRAINAGE AREA		53.5	mi ²
WORK PLAN DATE		1/1/1984	CURRENT HAZARD CLASS		H	DAM HEIGHT		27	ft
sht 1 of 5		CONSEQUENCES OF DAM FAILURE (ver. 2013-02)					NID ID	ND00425	
POTENTIAL DAM FAILURE:									
Total Failure Index								85	A
POTENTIAL LOSS OF LIFE:									
Maximum Population-at-Risk [PAR] *PAR assumed to be 50% of Grand Forks, ND population (number)								28,500	B
Total Risk Index								16,958	C
POTENTIAL LOSS OF PROPERTY:									
Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)									
Community		Grand Forks, ND				(H,M,L,-)	H	D	
Number of homes, businesses, major buildings						(number)	19,450	E	
POTENTIAL LIFELINE DISRUPTION:									
Water supply, identify community disrupted by dam failure, and estimate number/amount									
Municipal sole source		Grand Forks Public Works		Users	(number)	18,478	F		
Supplemental source		Well, Other		Users	(number)	973	G		
Irrigation water		N/A		Storage	(Ac-Ft)	0	H		
POTENTIAL INFRASTRUCTURE DISRUPTION:									
Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number									
Major/Interstate		Hwy 2, I-29		Roads	(number)	2	I		
Secondary/County		County		Roads	(number)	20	J		
POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:									
Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)									
Threatened & endangered species		Whooping Crane, Northern Long Eared Bat		(H,M,L,-)	L	K			
Sensitive riparian areas				(H,M,L,-)	L	L			
Contaminated reservoir sediment				(H,M,L,-)	L	M			
Wetland and wildlife habitat				(H,M,L,-)	L	N			
Other				(H,M,L,-)		O			
POTENTIAL ADVERSE SOCIAL IMPACTS:									
Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)									
Known cultural resources				(H,M,L,-)	L	P			
Historic preservation issues				(H,M,L,-)		Q			
Socially disadvantaged community				(H,M,L,-)		R			
POTENTIAL ADVERSE ECONOMIC IMPACTS:									
Average annual benefits attributed to this dam, updated workplan value						(\$)	365,700	S	
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)						(I,NC,D)	I	T	
Low income families impacted						(number)		U	
INPUT BY STATE DAM SAFETY AGENCY:									
State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N)						(Y,N)		V	
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)						(H,M,L,-)		W	
OTHER CONSIDERATIONS:									
Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)									
						(H,M,L,-)		X	
						(H,M,L,-)		Y	

EVALUATION OF POTENTIAL REHABILITATION PROJECTS																																									
STATE	ND	DAM	English Coulee Dam	BY	NMR	DATE 11/24/2020																																			
sht 2 of 5		FAILURE & RISK INDEXES				ver 2013-02																																			
Adopted from Bureau of Reclamation "Risk Based Profile System" see: http://www.usbr.gov/dsis/risk/rbppsdocumentation.pdf																																									
LIFE LOSS:																																									
Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)																																									
Estimate PAR for static loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway						28,500	A																																		
Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway						28,500	B																																		
Estimate PAR for seismic loading failure; typically assume water at or above invert of the lowest non-gated spillway (sunny day failure)						0	C																																		
Fatality Rates [FR] from dam breach Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06 see: http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft ² /sec) $DV = (\text{breach discharge} - \text{bank full discharge}) / \text{breach floodplain width}$ Warning Time [T] between failure warning and flood wave at population (minutes) Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude																																									
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Scenario</th> <th>Breach Discharge</th> <th>Bankfull Discharge</th> <th>Breach Floodplain Width</th> <th>DV</th> <th>Warning Time, T</th> <th>Understanding, U</th> </tr> <tr> <th></th> <th>(cfs)</th> <th>(cfs)</th> <th>(ft)</th> <th>(ft²/sec)</th> <th>(minutes)</th> <th>(N/A or Vague)</th> </tr> </thead> <tbody> <tr> <td>Static</td> <td>30,135</td> <td>124</td> <td>20000</td> <td>2</td> <td>12</td> <td>Vague</td> </tr> <tr> <td>Hydrologic</td> <td>30,135</td> <td>124</td> <td>20000</td> <td>2</td> <td>12</td> <td>Vague</td> </tr> <tr> <td>Seismic</td> <td>2,867</td> <td>124</td> <td>20000</td> <td>0</td> <td>12</td> <td>Vague</td> </tr> </tbody> </table>							Scenario	Breach Discharge	Bankfull Discharge	Breach Floodplain Width	DV	Warning Time, T	Understanding, U		(cfs)	(cfs)	(ft)	(ft ² /sec)	(minutes)	(N/A or Vague)	Static	30,135	124	20000	2	12	Vague	Hydrologic	30,135	124	20000	2	12	Vague	Seismic	2,867	124	20000	0	12	Vague
Scenario	Breach Discharge	Bankfull Discharge	Breach Floodplain Width	DV	Warning Time, T	Understanding, U																																			
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Seismic	2,867	124	20000	0	12	Vague																																			
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Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index																																			
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Seismic	0.00	#DIV/0!	0	0.007	0	0																																			
TOTAL=			85	TOTAL=		16,958																																			

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	ND	DAM	English Coulee Dam	BY	NMR	DATE	11/24/2020
sht 3 of 5	STATIC FAILURE INDEX						ver 2013-02
PRINCIPAL SPILLWAY SYSTEM (60 points max):				(total points)	10		A
Downstream filter or filter zone around conduit (yes=0 or no=10)					0		B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)					0		C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)					0		D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)					0		E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)					0		F
Conduit founded on competent bedrock (yes=0 or no=10)					10		G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)					0		H
RESERVOIR FILLING HISTORY (75 points max):				(total points)	50		I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)					63		J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)					50		K
SEEPAGE AND DEFORMATION (85 points max):				(total points)			L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)					0		M
Large amounts of seepage (no=0 or yes=6)					0		N
Visible and significant slope movement or sloughing (no=0 or yes=6)					0		O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)					0		P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)					0		Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)					0		R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)					0		S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)					0		T
FOUNDATION GEOLOGY (41 points max):				(total points)			U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)					0		V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)					0		W
Collapsible soils (no=0 or treated=3 or untreated=30)					0		X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)					0		Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)					0		Z
Coarse grained and highly permeable soils (no=0 or yes=3)					0		AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)					0		AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)					0		AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)					0		AD
EMBANKMENT DESIGN AND CONSTRUCTION (24 points max):				(total points)	8		AE
Filters for core or foundation or incompatibility between zones (no=4 or yes=0)					4		AF
Embankment or foundation drainage system (yes=0 or no=4)					4		AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)					0		AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)					0		AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)					0		AJ
Gate features to drain reservoir (yes=0 or no=4)					0		AK
EMBANKMENT MONITORING (15 points max):				(total points)	8		AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=4)					4		AM
Installed instruments routinely read and evaluated (yes=0 or no=4)					4		AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=4)					0		AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=4)					0		AP
STATIC FAILURE INDEX:				A+I+L+U+AE+AL	76		AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	ND	DAM	English Coulee Dam	BY	NMR	DATE	11/24/2020
sht 4 of 5	HYDROLOGIC FAILURE INDEX						ver 2013-02
HYDROLOGIC LOADING:							
Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)						28.5	A
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings							
100 year, 6hr rainfall [P100] (inches)						4.4	B
Probable Maximum Precipitation [PMP] (inches)						16.9	C
if Pfb <=	P100	=	4.44	enter	40		
if Pfb =	P100+0.2(PMP-P100)	=	6.94	enter	25		
if Pfb =	P100+0.4(PMP-P100)	=	9.43	enter	15		
if Pfb =	P100+0.6(PMP-P100)	=	11.93	enter	7		
if Pfb =	P100+0.8(PMP-P100)	=	14.42	enter	3		
if Pfb =>	PMP	=	16.92	enter	1		
Enter interpolated value						1	D
HYDROLOGIC UNCERTAINTY:							
Drainage Area [DA] (square miles)						53.5	E
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2						1.2	F
PIPE SPILLWAY PLUGGING:							
Pipe Diameter [D] (inches)						66	G
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9						0.9	H
Riser & trash rack type:							
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9						1.0	I
EARTH SPILLWAY FLOW:							
Earth spillway flow depth [Des] from top of dam to spillway crest (feet)(10' max)						9.0	J
DAM EROSION RESISTANCE:							
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8						1.7	K
Vegetal Cover Factor [Cf], see SITES or AH667						0.9	L
http://www.pswcrl.ars.usda.gov/ah667/ah667.htm							
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	M
EARTH SPILLWAY EROSION RESISTANCE:							
Low, can be excavated with hand tools, enter 2.0							
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps							
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2							
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps							
High, very hard ripping, requires drilling and blasting, enter 0.2							
moderately hard rock, Kh>10, seismic velocity>7000fps						0.2	N
Vegetal Cover Factor [Cf], see SITES or AH667						0.8	O
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	P
HYDROLOGIC FAILURE INDEX:							
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)						3	Q
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)						9	R
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300						9	S

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	ND	DAM	English Coulee Dam	BY	NMR	DATE	11/24/2020
sht 5 of 5	SEISMIC FAILURE INDEX						ver 2013-02
SEISMIC LOADING:							
Latitude (degrees.decimal)						47.815	A
Longitude (degrees.decimal)						-97.242	B
See "http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/" (MAP LINK)							
PGA [peak ground acceleration] for 2% chance in 50 years, see NSHM maps (%g)						2.11	C
if PGA is less than 10% g, enter 0							
if PGA is between 10% g and 19% g, enter 0.15							
if PGA is between 20% g and 39% g, enter 0.30							
if PGA is between 40% g and 59% g, enter 0.65							
if PGA is greater than 60% g, enter 1.0						0.00	D
FOUNDATION LIQUEFACTION:							
Select the following foundation conditions which best represents the site							
Loose alluvium, lacustrine, loess materials, enter 10							
Bedrock, glacial till, highly clayey materials, enter 5						5	E
EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:							
Dam height (ft)						27	F
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)						16.6	G
Freeboard percent of dam height (%)						61	H
if Freeboard is less than 25% of dam height, enter 10							
if Freeboard is 25% to 50% of dam height, enter 5							
if Freeboard is more than 50% of dam height, enter 1						1	I
EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:							
Freeboard is less than or equal to 15 feet (no=0 or yes=1)						0	J
EMBANKMENT CRACKING:							
Embankment contains self-healing filter zones (no=4 or yes=0)						4	K
SEISMIC FAILURE INDEX:							
IF E=10, L=(D)(E)(I) ; IF E=5, L=(D)(E)(J+1)(K+1) ; but less than 100						0	L
State Conservation Engineer's Signature concurring with technical content of sheets 2 thru 5							



Appendix G
Structure As-Built Drawings

AS-BUILT PLANS

ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

FLOODWATER RETARDING STRUCTURE

PHASE I

SPONSORING AGENCIES

EASTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
WESTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
GRAND FORKS COUNTY WATER RESOURCE DISTRICT
CITY OF GRAND FORKS
NORTH DAKOTA STATE WATER COMMISSION

WITH ASSISTANCE BY

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

CONTRACTOR: PLATTE VALLEY CONSTRUCTION
BOX 1445, GRAND ISLAND, NE 68802

CONTRACT NO. 50-6633-8-12

CONSTRUCTION STARTED: 12-21-87

CONSTRUCTION COMPLETED: 6-15-90

ENGINEERS: ROGER THOMPSON, P.E.
JODY KRAENZEL, A.E.

CHIEF INSPECTOR: JOHN SUCHOR JR.

INSPECTOR: JEFF DAVIS

INDEX TO DRAWINGS

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		25 and 26	Typical Cross Sections

Attachment: Soils Legend - Drwg. No. 5,8-10,000.47

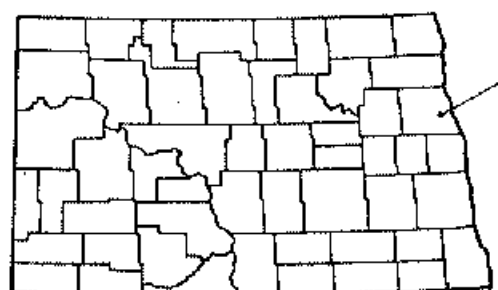
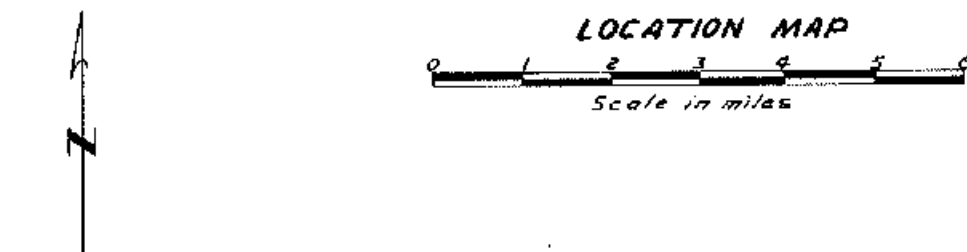
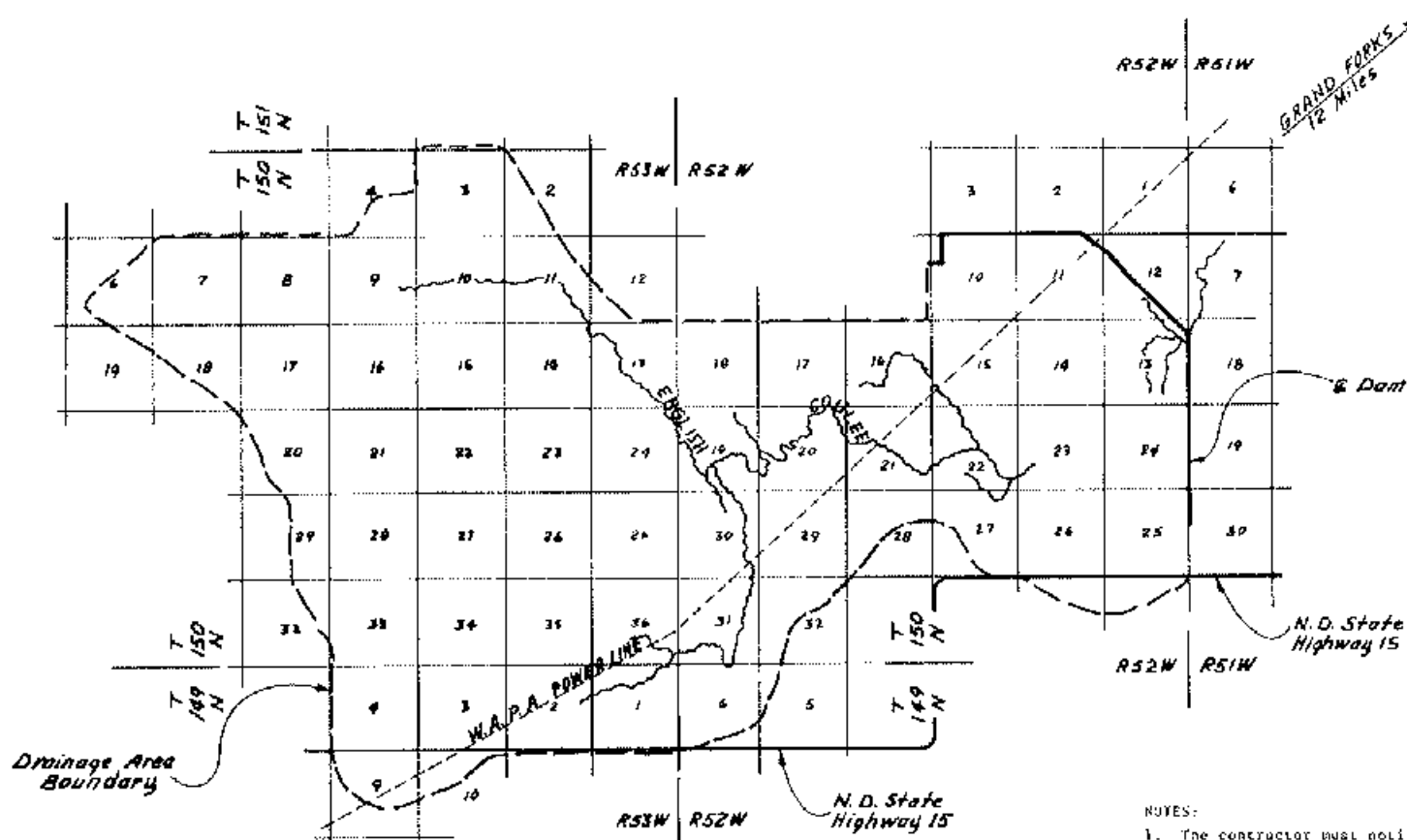


I CERTIFY THAT THE PLANS AND DETAILS SPECIFICATIONS
FOR THIS PROJECT WERE DEVELOPED BY THE SOIL CONSERVATION
SERVICE AND ARE APPROVED.

John Suchor, CET 12/11/90
STATE CONSERVATION ENGINEER

Robert E. Spatz
HEAD, ENGINEERING UNIT

SHEET 1 of 26



LOCATION IN GRAND FORKS COUNTY, NORTH DAKOTA

LABORATORY TEST INFORMATION ON TYPICAL MATERIALS

Location	Depth (ft.)	Unified Soil Classification	Max. Dry Density (pcf)	Optimum Moisture (%)	Natural Moisture (%)
TH 101	3'-8"	CL	107.5	18.0	--
TH 104	1.5'-8"	CL	112.5	15.5	--
TH 104	8'-13"	CL	111.0	16.0	--
TH 108	2'-10"	CL	108.5	17.5	--
TH 115	6'-8"	CL	113.0	15.0	18.2
TH 134	6'-8"	CL	114.0	15.0	18.3
TH 102	10'-12"	CL	--	--	19.4
TH 103	5'-7"	CL	--	--	20.5
TH 145	6'-8"	CL	--	--	17.8
TH 109A	2'-4.5"	CH	86.0	30.5	32.5
TH 105A	3'-5"	CL	--	--	30.5
TH 106A	1.5'-4.5"	CL	108.0	19.0	23.0
TH 107A	1'-2.5"	CL	108.5	17.5	22.5
TH 107A	2.5'-6"	ML	114.0	16.0	18.7
TH 108A	1.5'-4.5"	CL	114.5	15.5	23.8

LABORATORY TEST INFORMATION ON TYPICAL MATERIALS

Location	Depth (ft.)	Unified Soil Classification	Max. Dry Density (pcf)	Optimum Moisture (%)	Natural Moisture (%)
TH 109A	2'-6"	CL	--	--	20.8
TH 110A	2'-6"	CL	92.5	26.0	34.4
TH 111A	1.5'-2"	CL	114.0	15.0	21.7
TH 111A	2'-6.5"	CL	115.0	15.0	19.8
TH 112A	2'-3.5"	CL	--	--	27.2
TH 113A	2.5'-5"	CH	89.0	29.0	35.5
TH 114A	2'-2.5"	CL	--	--	21.5
TH 115A	1'-2"	CL	--	--	20.3
TH 116A	2'-4"	CL	--	--	21.1
TH 117A	3'-4"	CL	--	--	21.3
TH 118A	1.5'-3"	CL	--	--	21.1
TH 119A	1'-3"	CL	--	--	22.5
TH 119A	3'-5"	CL	--	--	20.3
TH 120A	2.5'-2.5"	CL	--	--	24.9
TH 120A	2.5'-4.5"	CL	112.5	16.0	24.0

NOTE: 1. Data for test holes 101 through 303 are from the August 1979 investigation.
2. Data for test holes 103A through 120A are from an October 1987 investigation.

TABLE OF QUANTITIES				AS BUILT
ITEM	UNIT	QUANTITY	QUANTITY	
Clearing and Grubbing	L U M P	S U M	L U M P	S U M
Structure Removal	L U M P	S U M	L U M P	S U M
Seeding (Includes Fertilizing and Mulching)	Ac.	170	231.9	
Removal of Water	L U M P	S U M	L U M P	S U M
Excavation, Common: Foundation Stripping - Dam	Cu. Yd.	226,230	434,225 *	
Excavation, Common: Foundation Stripping - Causeways	Cu. Yd.	6,378	5,344	
Excavation, Common: Cutoff Trench	Cu. Yd.	223,600	15,295	
Excavation, Common: Drainage Ditch	Cu. Yd.	12,800	454,864	
TOTAL		469,008	434,996 *	
Earth Fill, Class A: Cutoff Trench Backfill	Cu. Yd.	223,600	434,996 *	
Earth Fill, Class A: Foundation Stripping Backfill	Cu. Yd.	226,230	710,655	
Earth Fill, Class A: Dam Embankment	Cu. Yd.	212,049	1,148,667	
TOTAL		4,161,887		
Earth Fill, Class A, Powerline Causeways	Cu. Yd.	29,006	30,303	
Salvaging and Spreading Topsoil (3" depth)	Sq. Yd.	155,000	418,682	
24" Dia. C.M. Pipe	Lin. Ft.	250	100	
16" x 22" C.M. Pipe-Arch	Lin. Ft.	60	0	
85" x 54" C.M. Pipe-Arch	Lin. Ft.	40	40	
24" Dia. End Sections	Ea.	10	4	
36" x 22" C.M. Pipe-Arch End Sections	Ea.	2	0	
85" x 54" C.M. Pipe-Arch End Sections	Ea.	2	2	
Settlement Plates	Ea.	2	2	
Surface Monuments	Ea.	2	2	
Fencing	Lin. Ft.	33,250	32,547	
TEMPORARY SEEDING	Ac.	130	142.5	

*All quantities are estimated.

EARTH FIL. CLASS A, COM.
RAMPS 2426 CY.
RAMPS-BACKFILL 590 CY.

MODIFIED ITEM # 8
COMMON EXC. 7,802 CY.
WATERWAY

MODIFIED ITEM # 20
COMMON EXC. 3,475 CY.
DRAIN 5" A.298+60-369+00

Note:
The above modified items
not included in the table
of Quantities Totals

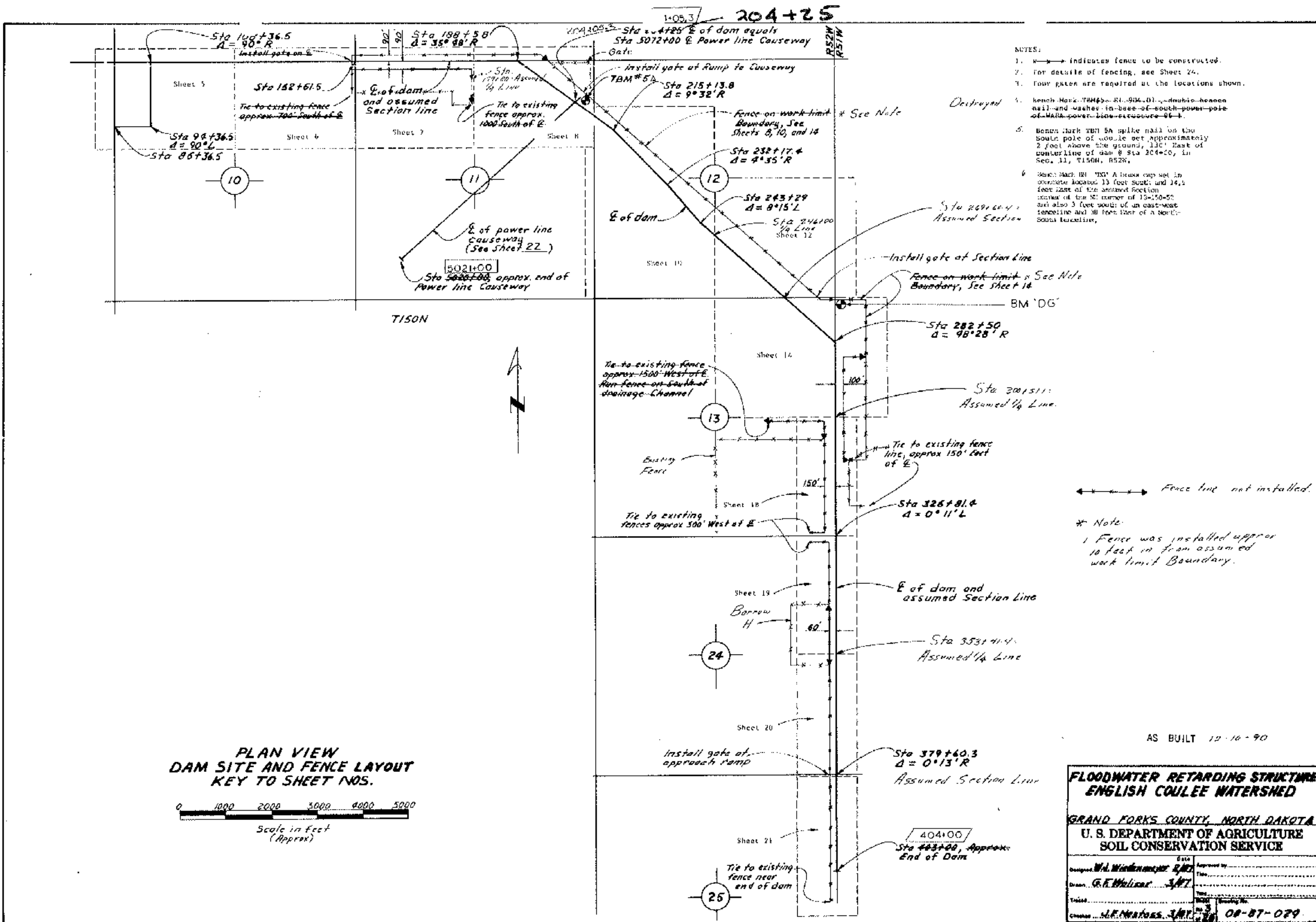
RESERVOIR STORAGE TABLE

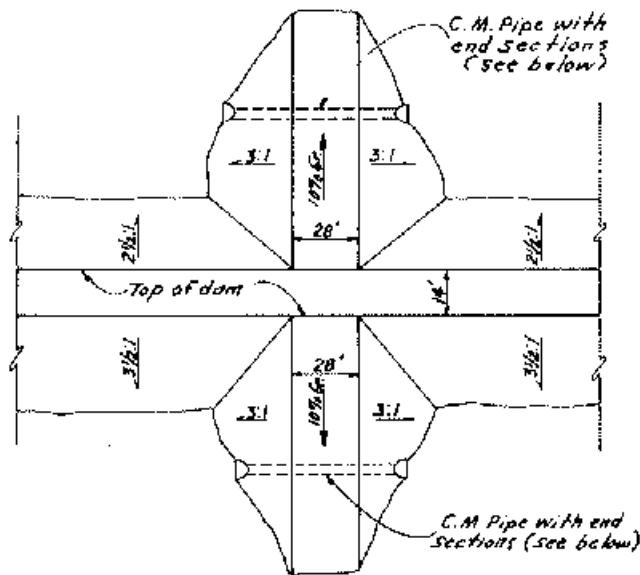
ELEV.	AREA (AC.)	ACCUMULATED STORAGE (AC.-FT.)	
888.0	0	0	
890.0	2.6	3	
892.0	7.8	13	
894.0	20.6	41	
896.0	47.1	109	
898.4	251.9	365	Permanent Pool
900.0	388.4	808	
902.0	771.5	1,968	
904.0	1041.1	3,780	
906.0	1432.4	6,254	Crest of Chute Spillway
908.0	1935.1	9,622	
910.0	2416.1	13,971	
912.0	2913.1	19,298	
914.0	3439.1	25,650	
915.0	--	29,200	Top of dam after settlement.

AS BUILT 12-10-90

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: W.L. Hordson, 12/86
Drawn by: G.E. Hordson, 3/87
Checked by: J.E. Hordson, 6/87
Date: 12-10-90





**TYPICAL PLAN VIEW OF APPROACH RAMPS
AT STATIONS 126+32, 326+83, AND 379+60**
(RAMP AT POWER LINE CAUSEWAY IS SIMILAR)
(NOT TO SCALE)

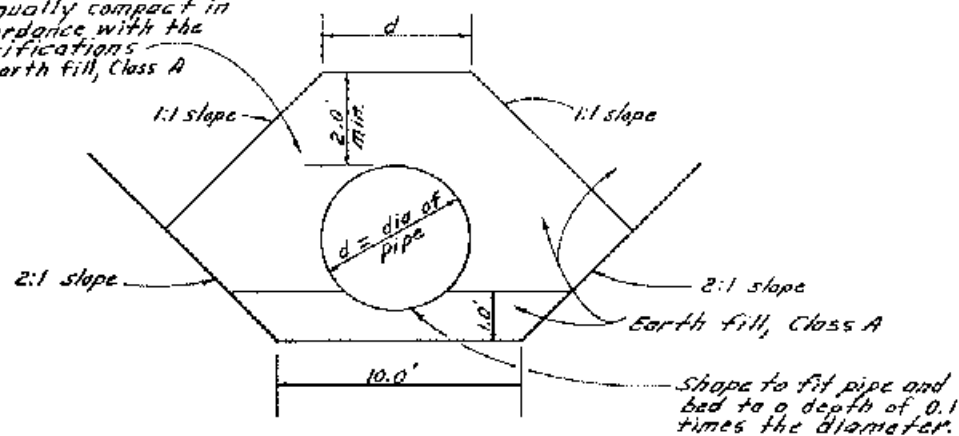
APPROACH RAMP PIPE DATA AS BUILT

STATION	PIPE SIZE X LENGTH		END SECTIONS
	UPSTREAM	DOWNSTREAM	
126+32	24" Dia x 50'	24" Dia x 50'	+ 2
326+83	85" x 54" P.A. x 40'	24" Dia x 50'	+ 1
379+60	24" Dia x 50'	24" Dia x 50'	+ 0

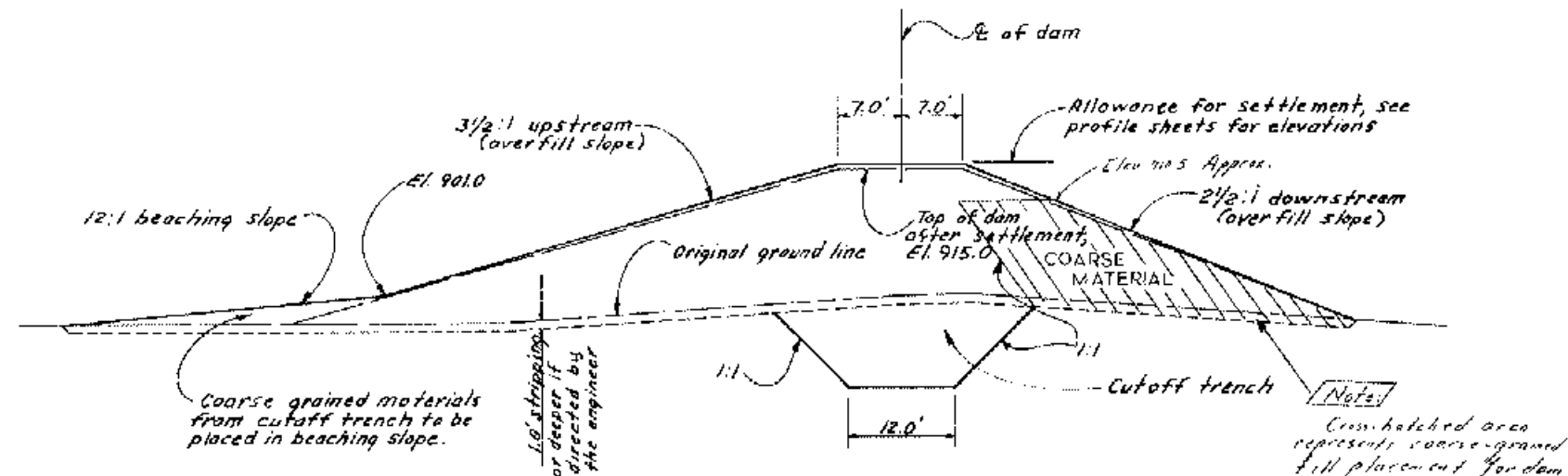
Notes:

1. Distance between dam and 24" dia pipe centerlines will be staked by the engineer.
2. The 85" x 54" c.w. pipe-arch at Sta 326+83 will be located at the drainage ditch 110' upstream of the dam centerline. For additional details, see sheet 18.
3. Minor shaping will be required to direct drainage to the pipe installation.

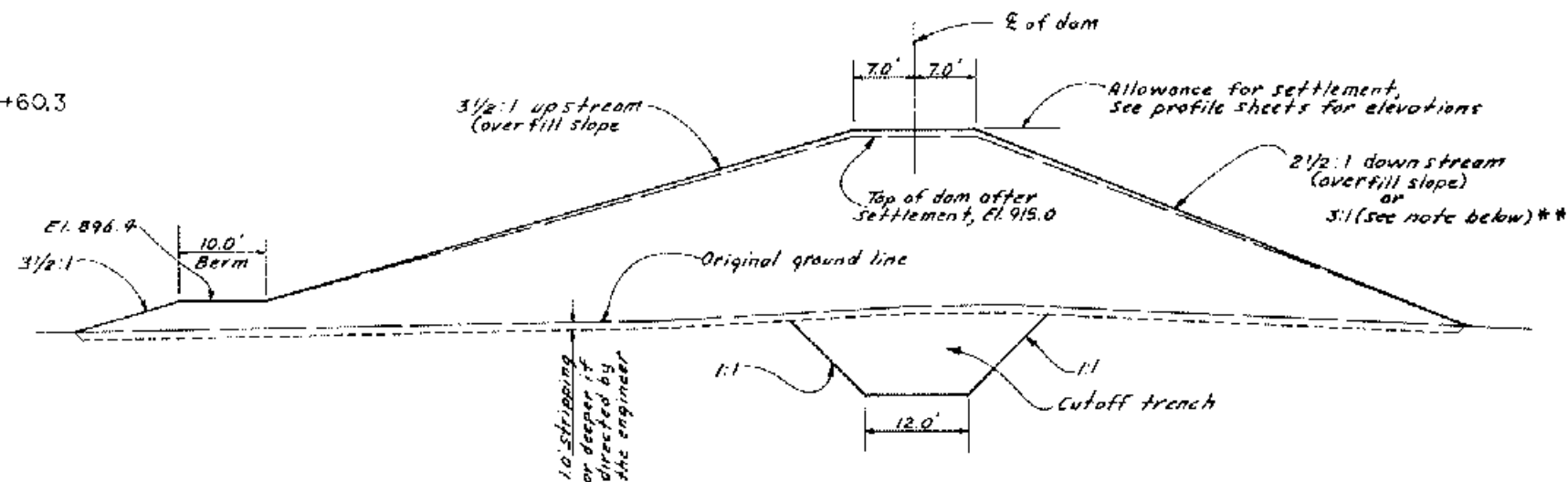
Manually compact in accordance with the specifications for earth fill, Class A



**DETAILS OF PIPE TRENCH EXCAVATION
AND BACKFILL**
(Not to Scale)



TYPICAL CROSS SECTION - STA 87+00 TO STA 275+50
(NOT TO SCALE)

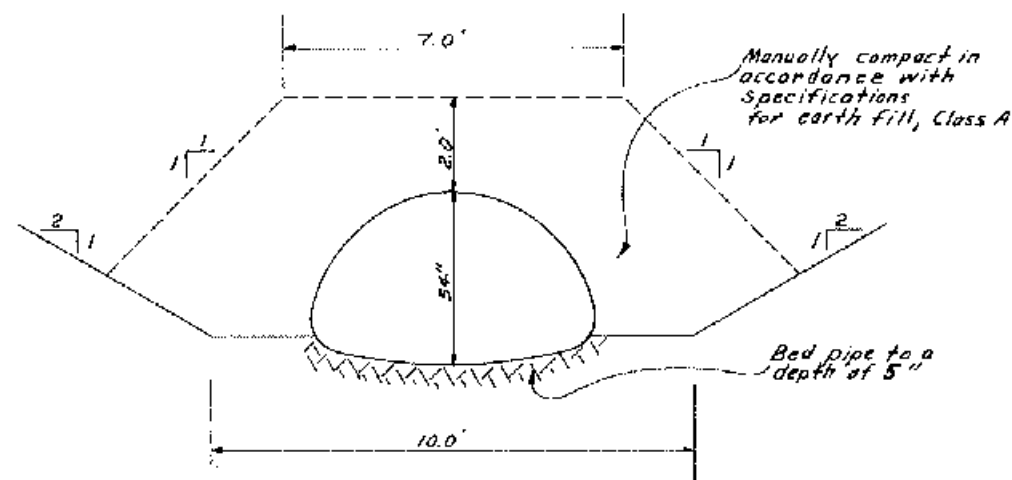


TYPICAL CROSS SECTION - STA 275+50 TO STA 403+00
(NOT TO SCALE)

* From Sta. 281+10 to Sta. 290+00, only the cutoff trench will be constructed. For details, see sheets 15-17.

** From Sta 276+50 to Sta 281+80, the downstream slope will be flattened to 3:1. For details, see sheet 16.

AS BUILT 12-10-90



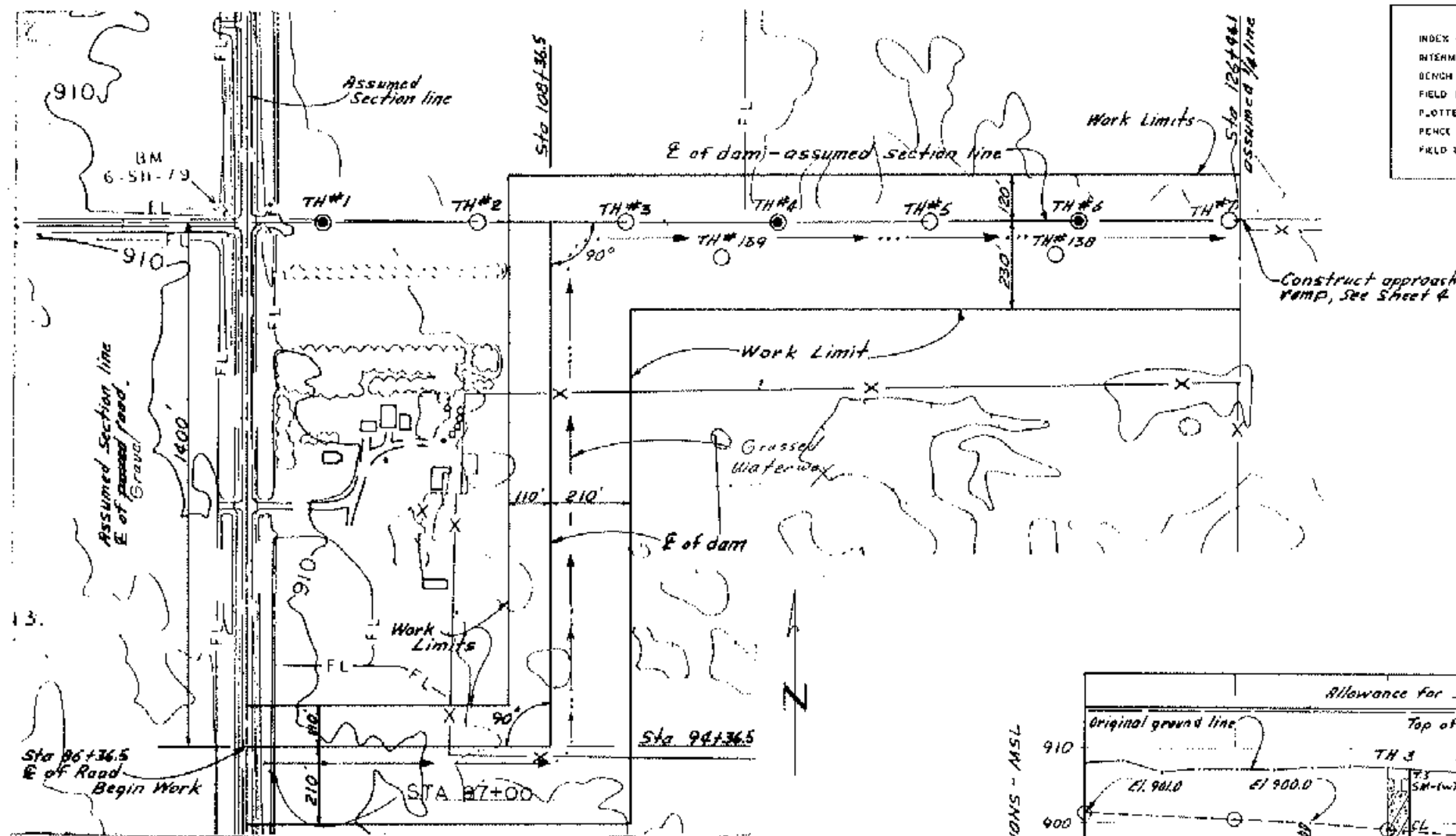
BACKFILL DIAGRAM FOR 85" X 54" C.M. PIPE-ARCH
(NOT TO SCALE)

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

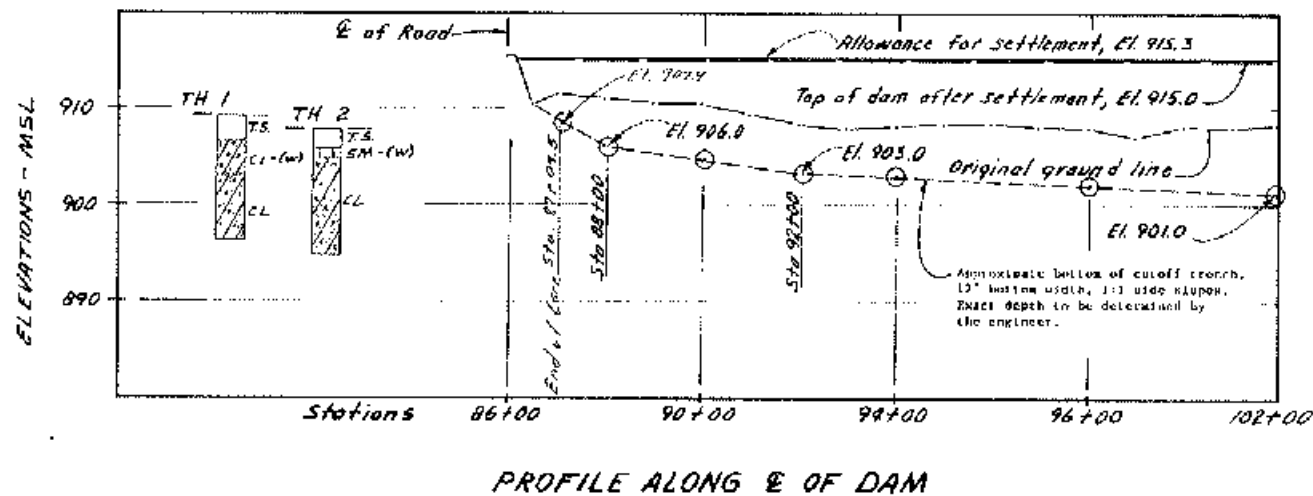
GRAND FORK COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DATA	
Designed: J.E. Newton	5/87
Drawn: G.F. Maliser	5/87
Checked: M.L. Windham	5/87
Approved by:	
Date:	
Project No:	08-87-020

Rev. 11/10/87



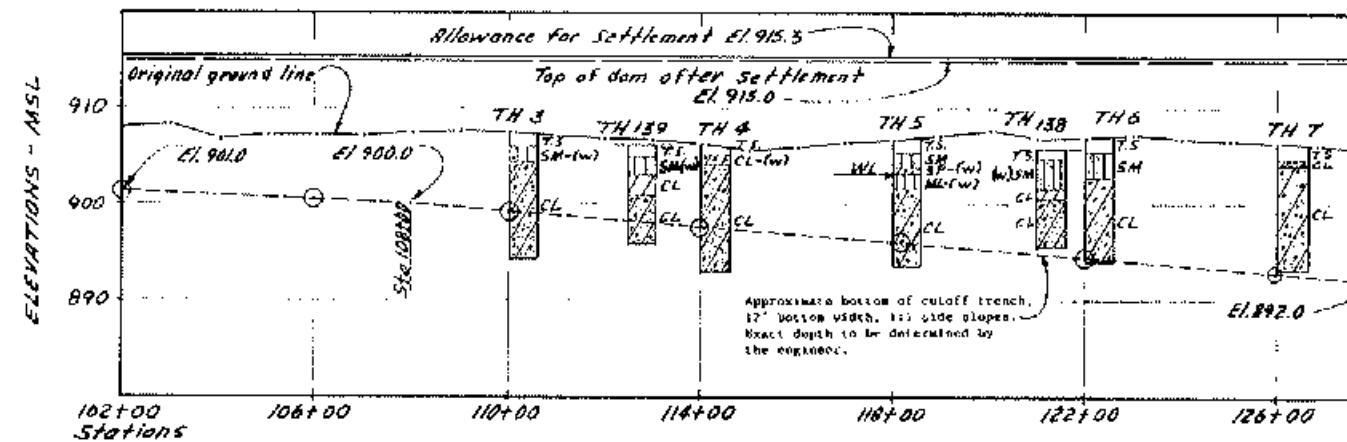
TOPOGRAPHIC MAP OF DAMSITE
Scale in feet
0 200 400 600 800 1000



PROFILE ALONG E OF DAM

INDEX		LEGEND	
INDEX CONTOUR	575	PAVED ROAD	=====
INTERMEDIATE CONTOUR	575.5	UNPAVED ROAD	=====
BENCH MARK	BM 5 X	TRAIL	-----
FIELD ELEVATION	575.23		
PLATTER ELEVATION	575.2		
PENCE	-----		
FIELD LINE	-----		
		WATER	=====
		TREES	=====
		CULVERT	-----
		BUILDING	=====
		POLE	-----
		BRIDGE	=====
		ROCK PILE	=====

- NOTES:
- For soils legend, see Standard Drawing 5, R-10,000, 47.
 - Soil Exploration Date: August 1979.
 - Groundwater and site conditions
 - W indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (W) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
 - The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory tests.
 - Records of the geologic investigation and laboratory test data can be reviewed at the SGS office in Grand Forks.
 - TS indicates topsoil on soils logs.
 - A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.



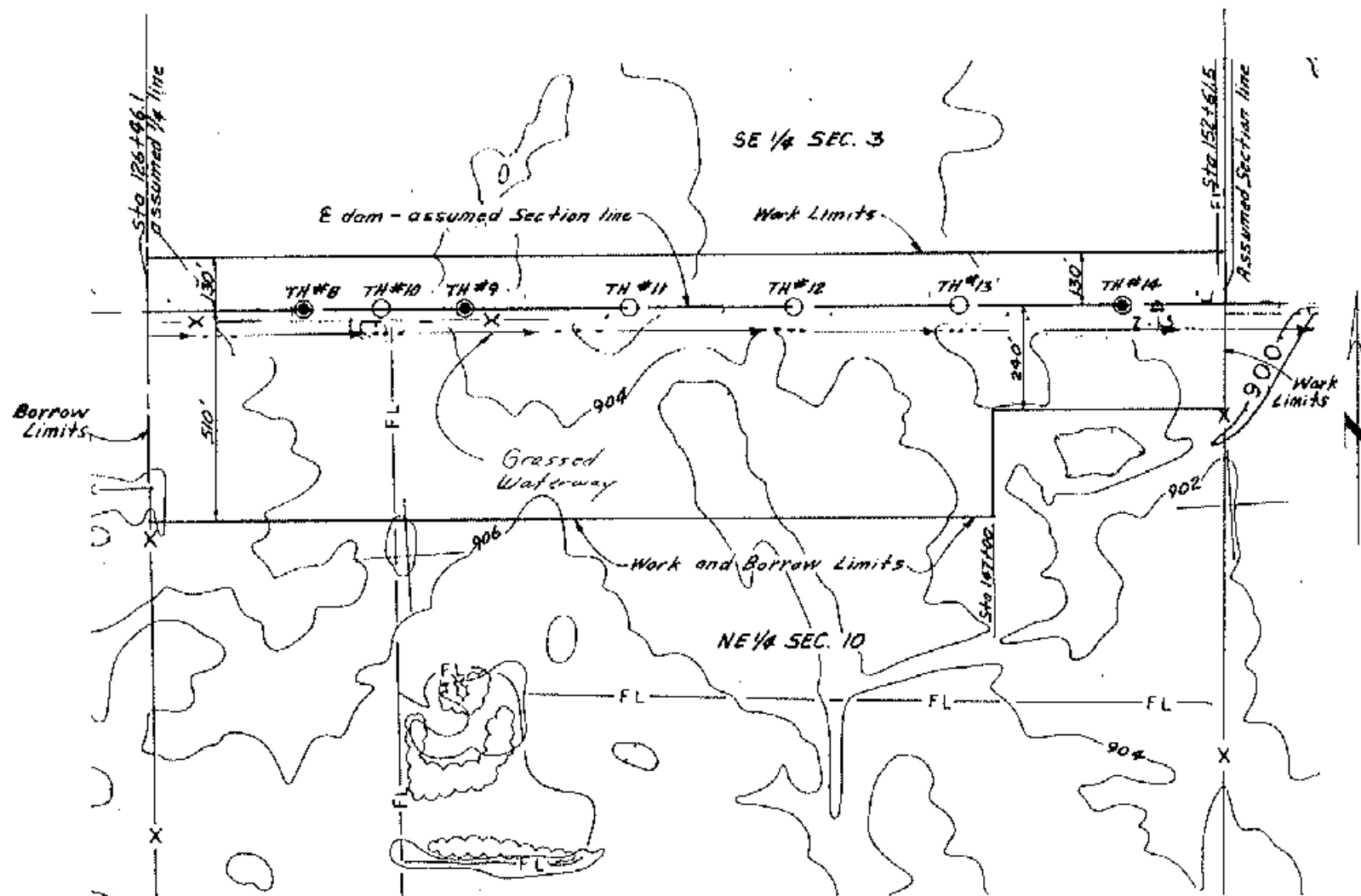
PROFILE ALONG E OF DAM

AS BUILT. 12-10-90

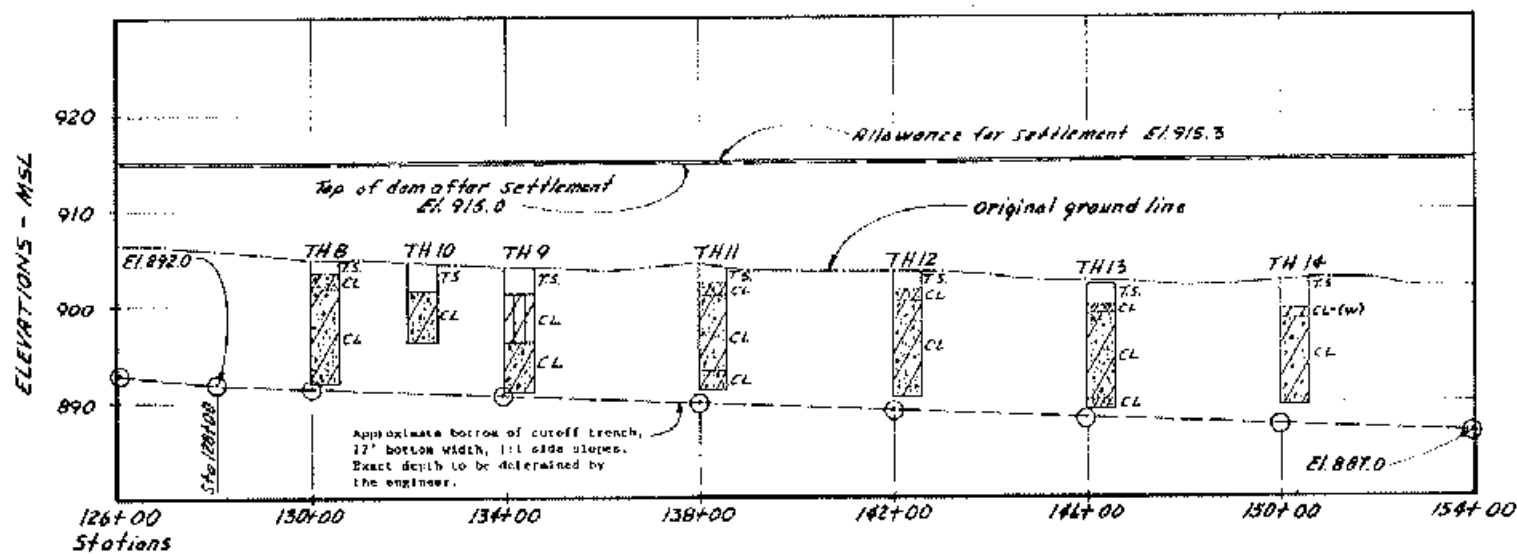
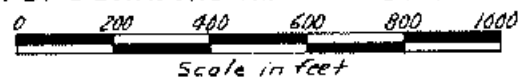
**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: M.J. Mendenhall 1/87	Approved by: _____
Drawn by: G.E. Waliser 2/87	Time: _____
Traced by: _____	Sheet: _____
Checked by: J.E. Norcross 3/87	Drawing No.: 08-87-029



TOPOGRAPHIC MAP OF DAMSITE



PROFILE ALONG CL OF DAM

LEGEND			
INDEX CONTOUR	— 575 —	PAVED ROAD	=====
INTERMEDIATE CONTOUR	— 575 —	UNPAVED ROAD	=====
BENCH MARK	BM 5 A	TRAIL	-----
FIELD ELEVATION	575 123		
PLOTTER ELEVATION	575 2		
FENCE	— X —		
FIELD LINE	— P —		
		WATER	~~~~~
		TREES	
		CULVERT	— X —
		BUILDING	□
		POLE	•
		BRIDGE	— X —
		ROCK PILE	— X —

NOTES:

1. For soils legend, see Standard Drawing S.R-10,000-47.
2. Soil Exploration Date: August 1979.
3. Groundwater and site conditions:
 - a. W indicates groundwater on the date of the soil exploration. Variation should be expected.
 - b. (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - c. In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - d. Scattered concentrations of cobbles and boulders are present on the dam site (foundation and borrow areas). These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
4. The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
5. Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
6. TS indicates topsoil on soils logs.
7. A 100 ft berms will be left between the upstream toe of the dam and all borrow areas.

AS BUILT PLANS
NO CHANGE

Comp. Date 12-11-90

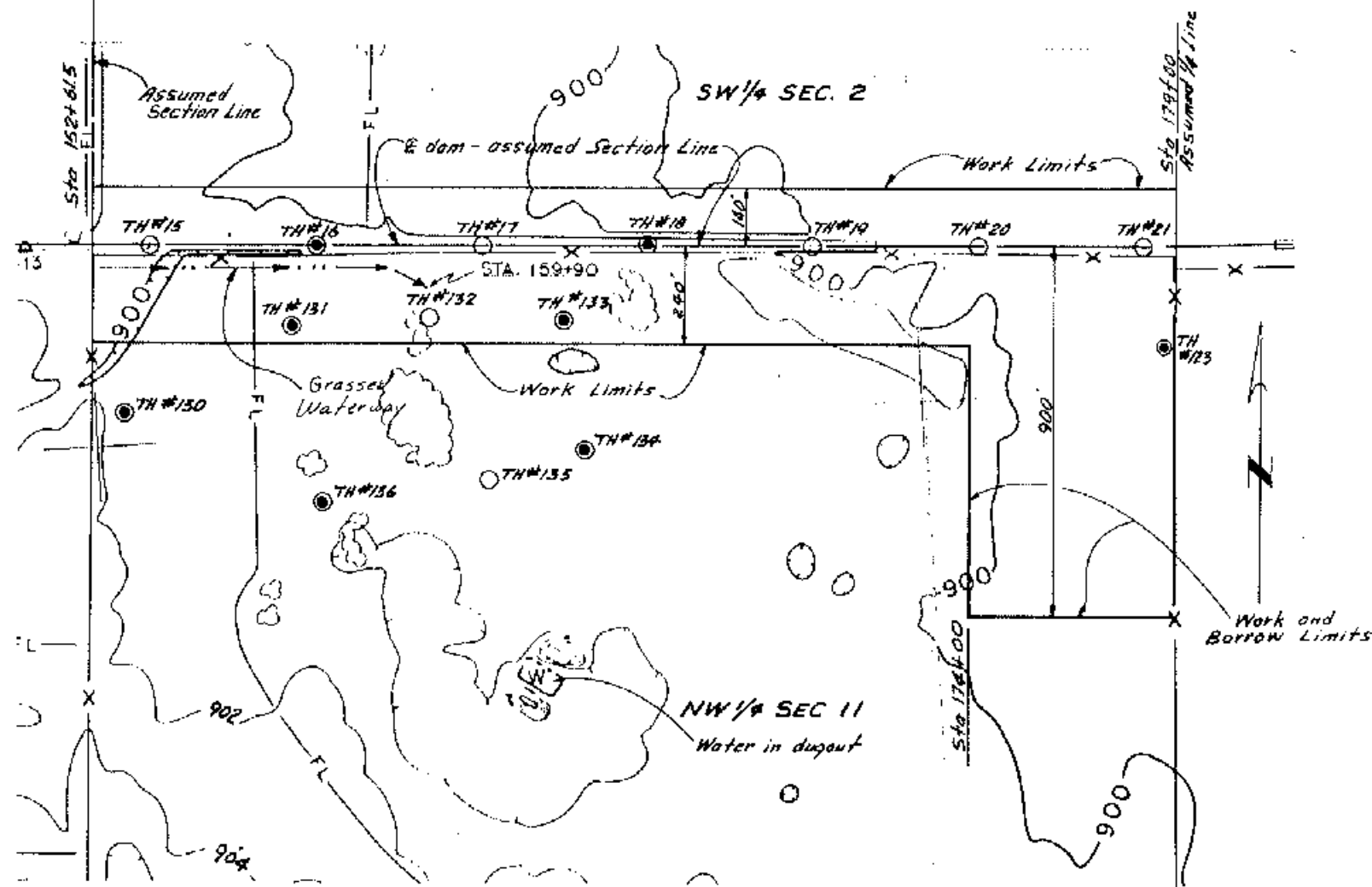
AS BUILT

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: <i>W.D. Mendenhall</i>	Drawn by: <i>GRW/1/1/1</i>	Checked by: <i>W.D. Mendenhall</i>	Approved by: <i>W.D. Mendenhall</i>
Date: <i>12-11-90</i>	Scale: <i>1" = 100'</i>	Sheet: <i>1 of 1</i>	Project: <i>12-11-90</i>

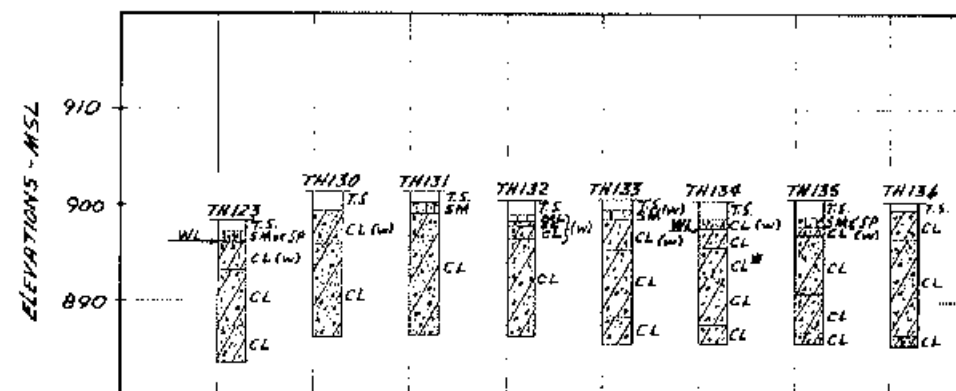


TOPOGRAPHIC MAP OF DAMSITE
Scale in feet

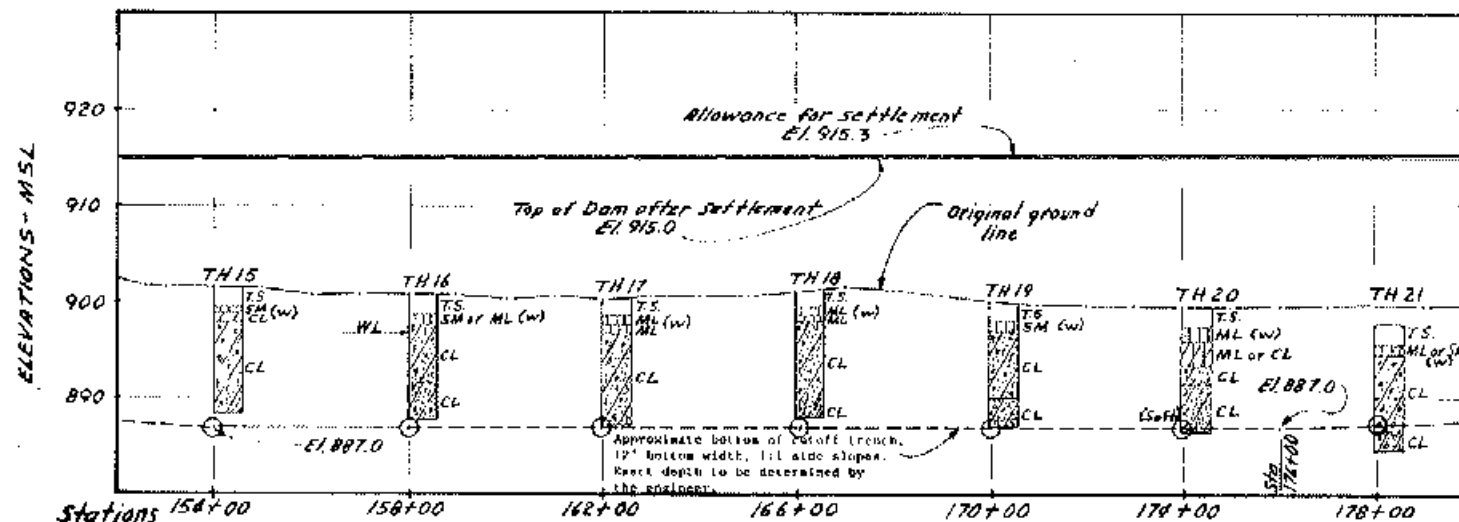
LEGEND			
INDEX CONTOUR	— 575 —	PAVED ROAD	=====
INTERMEDIATE CONTOUR	— 575 —	UNPAVED ROAD	=====
BRICK MARK	BM 5 X	TRAIL	-----
FIELD ELEVATION	575.23		
PLUTTER ELEVATION	575.2		
FENCE	— F —		
FIELD LINE	— FL —		
		WATER	~~~~~
		TREES	
		CULVERT	— C —
		BUILDING	— B —
		POLE	— P —
		BRIDGE	— BR —
		ROCK PILE	— RP —

NOTES:

- For soils legend, see Standard Drawing 5.6-10.000.47.
- Soil Exploration Date: August 1975.
- Groundwater and site conditions:
 - W_g indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 3 ft can be expected to be wet and soft with moist, firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
- The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
- Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
- TS indicates topsoil on soils logs.
- A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.



TEST HOLE DATA - BORROW AREA



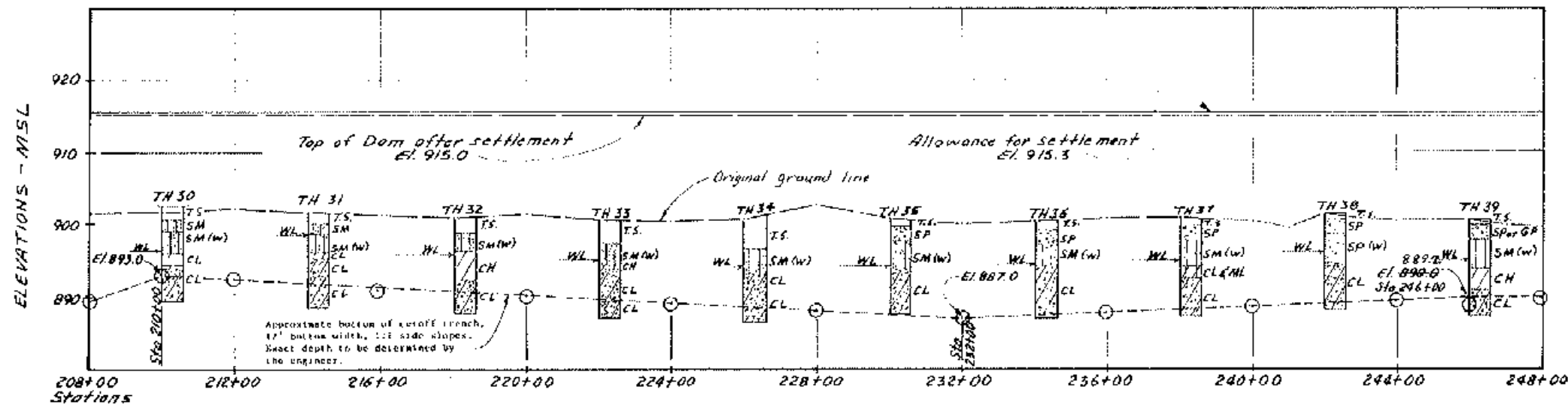
PROFILE ALONG & OF DAM

AS BUILT PLANS
NO CHANGE
Comp. Date 12-11-90

FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by M. J. Winkler 1/87
Checked by G. F. Walser 2/87
Traced by J. E. Kestoss 3/87
Checked by J. E. Kestoss 3/87
Approved by _____
Date _____
Scale _____
Drawing No. 08-87-029

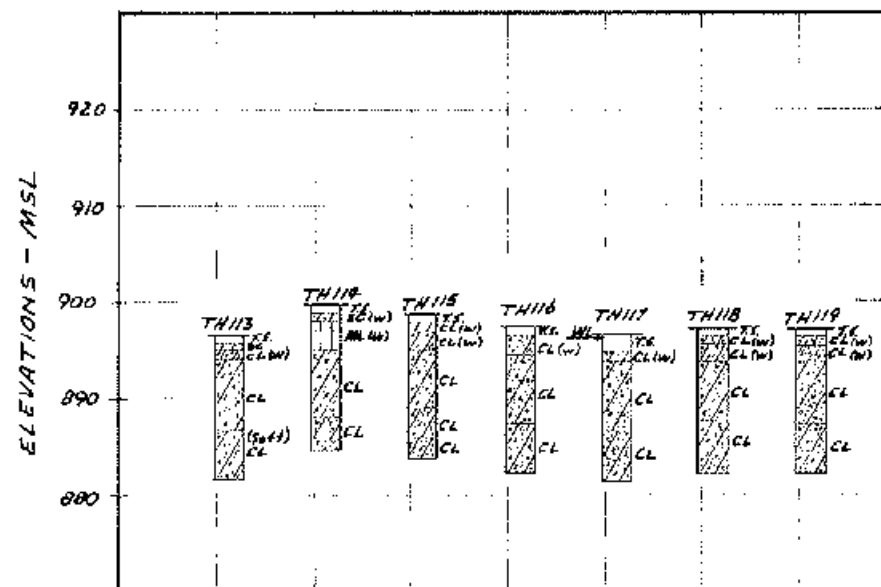


PROFILE ALONG E OF DAM

ENGLISH COULEE DAM PHASE I
AS-BUILT GEOLOGY IN THE CORE TRENCH

Job Diary Book No.	Report	Stations
1	54	122+00 to 125+00 desiccation cracks
2	77	131+00 to 139+00 minor desiccation cracks
3	112	139+00 to 143+00 desiccation cracks in unweathered gray material approx. 1/2" wide at design bottom grade
	115	151+00 to 153+00 SM material 3.5' from natural ground
	125	162+00 to 164+00 wet SM material below 1.5' of topsoil
	126	150+00 to 153+00 minor desiccation cracks in the gray unweathered material
	127	170+00 to 173+00 wet SM material below 1.5' to 1.8' of topsoil
	139	150+00 to 163+00 evidence of thin desiccation cracks, no gypsum visible, excavated 2.0' into the gray unweathered material
	142	163+00 to 169+50 desiccation cracks 1/4" to 3/8" wide with gypsum crystals, design bottom approx. 2.3' into the gray unweathered material
4	148	171+00 to 180+00 desiccation cracks 1/8" to 1/2" wide with gypsum along the sideslopes
		171+00 to 175+00 no desiccation cracks along the bottom
		175+00 to 180+00 desiccation cracks along the bottom, no gypsum visible, iron deposits 1/2" to 3" wide
	150	180+00 to 183+00 desiccation cracks along the sideslopes (1/8" wide, along the bottom 1/2" to 2" wide with evidence of manganese and iron deposits)
		183+00 gypsum filled desiccation cracks 1/16" to 1/8" wide
5	185	276+50 to 287+00 desiccation cracks along the bottom 3/8" to 1 1/2" wide, desiccation cracks along the sideslopes with gypsum deposits 1/8" to 1/4" wide, core excavated into gray unweathered material approx. 2.3'
	188	292+50 to 287+00 desiccation cracks
	191	278+00 to 273+00 desiccation cracks along the sideslopes 1/16" to 1/8" wide with isolated gypsum, core excavated into the gray unweathered material approx. 2.5'

- NOTES:
- For soils legend, see Standard Drawing 5.8-10,000.47.
 - Soil Exploration Date: August 1979.
 - Groundwater and site conditions:
 - W indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 3 ft can be expected to be wet and soft with minimal firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
 - The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
 - Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
 - Ts indicates topsoil on soils logs.
 - A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.



TEST HOLE DATA - BORROW AREA

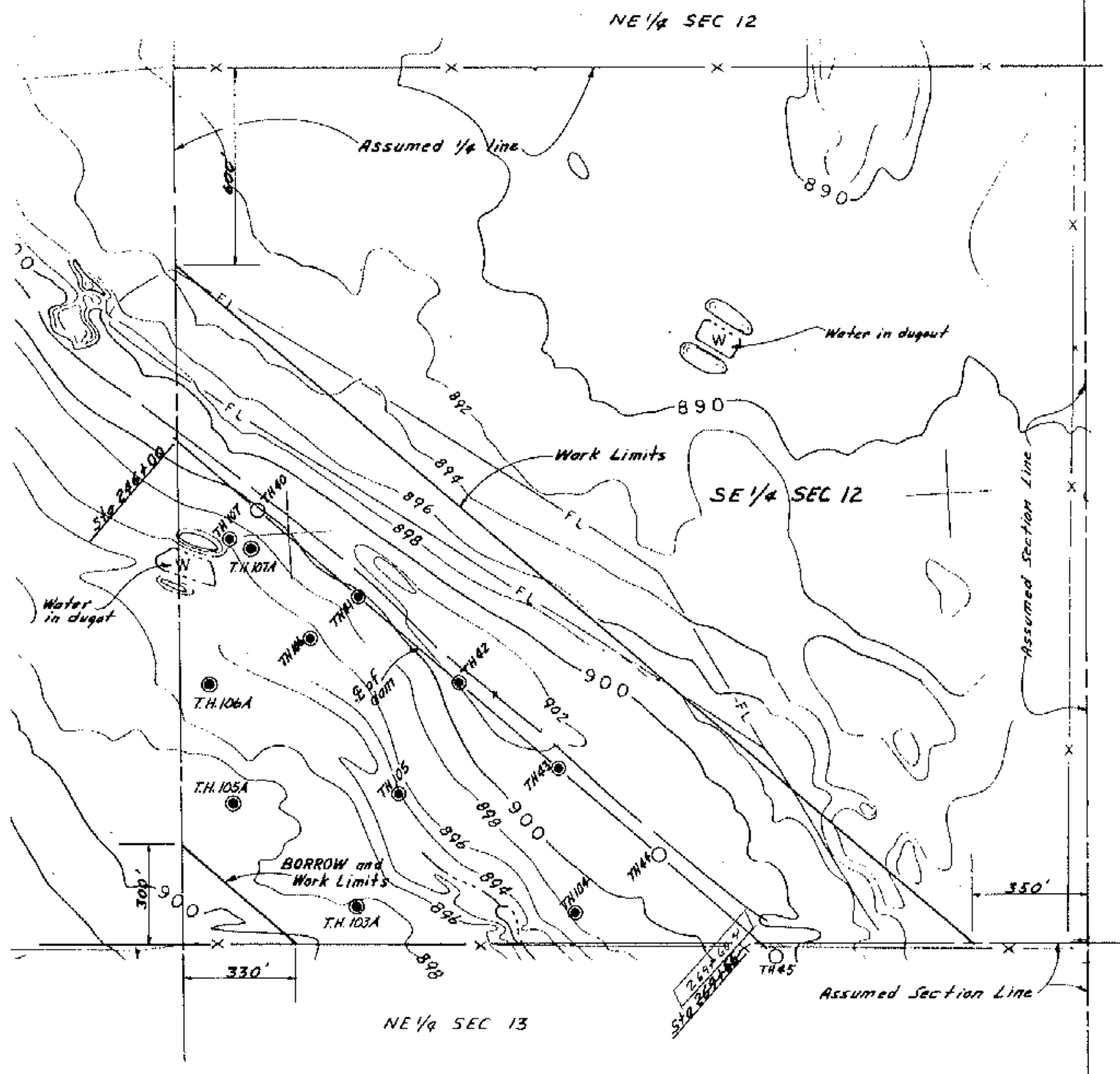
* Please Note: For further geology information refer to job diaries.

AS BUILT 12-11-90.

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: M. J. Winkler 1/87	Approved by: _____
Drawn: G. E. Wolter 2/87	Traced: _____
Checked: J. E. Nestess 3/87	Drawn by: _____
	Sheet: 11 of 11
	Drawing No: 08-87-029



LEGEND			
INDEX CONTOUR	— 875 —	PAVED ROAD	=====
INTERMEDIATE CONTOUR	— 875 —	UNPAVED ROAD	=====
BENCH MARK	B.M. 5 X	TRAIL	-----
FIELD ELEVATION	870.123		
PLUTYER ELEVATION	876.2		
FENCE	— FL —		
FIELD LINE	— FL —		
		WATER	~~~~~
		TREES	
		CULVERT	— X —
		BUILDING	□
		POLE	•
		BRIDGE	— X —
		ROCK PILE	⊗

NOTE: Test holes 103A, 105A, 106A, and 107A were logged and sampled on October 14, 1987, for the purpose of obtaining additional compaction and natural moisture data. Logs of the test holes are not shown. Test data from these samples are shown on sheet 2.

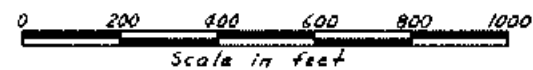
AS BUILT 12-11-90

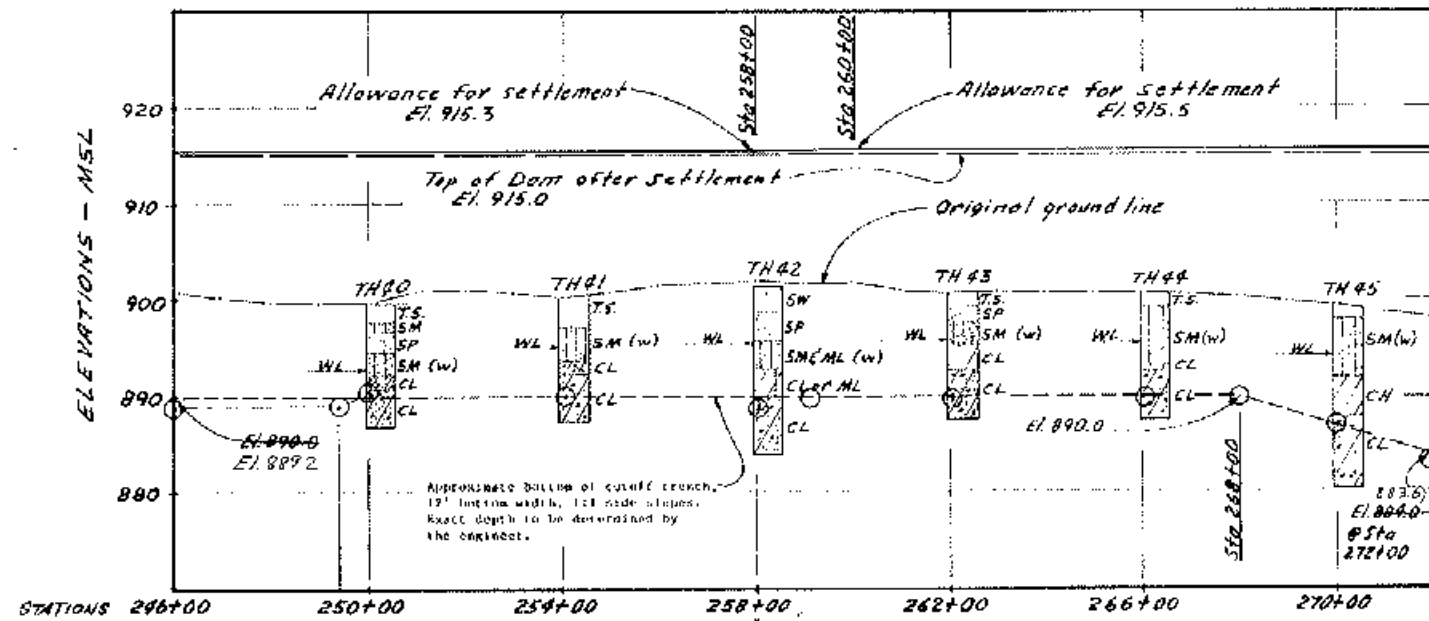
FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: M.J. Winkler 1/87	Date: 1/87	Approved by: _____
Drawn by: G.E. Haller 3/87	Date: 3/87	Checked by: _____
Checked by: M.R. Hartman 3/87	Date: 3/87	Project No: 08-87-029

TOPOGRAPHIC MAP OF DAM SITE

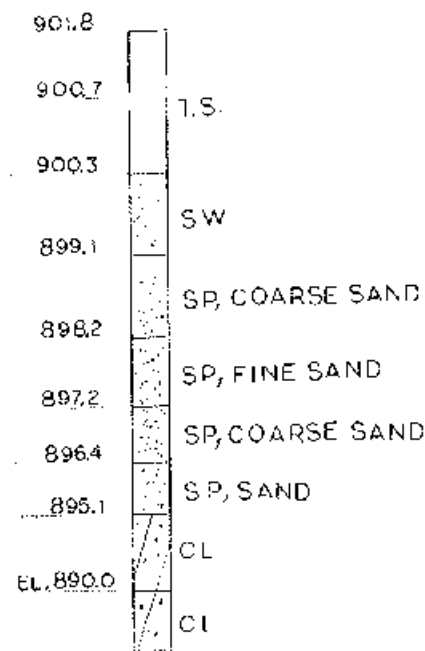




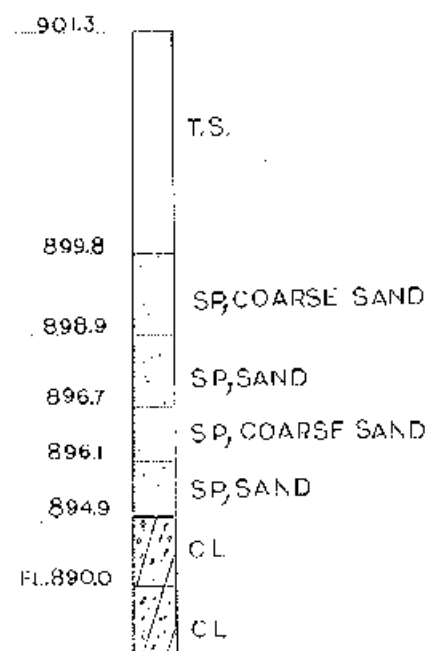
PROFILE ALONG E OF DAM

249+00

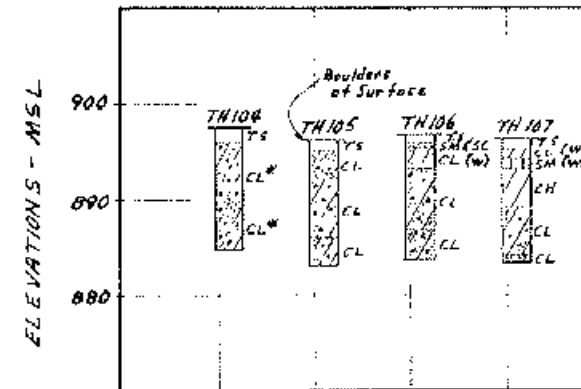
Engineer directed Contractor to excavate deeper to penetrate into CL material.



STA 258+00



STA 257+00



TEST HOLE DATA BORROW AREA

NOTES:

- For soil legend, see Standard Drawing S.R-10.000.07.
- Soil Exploration Date: August 1979.
- Groundwater and site conditions:
 - WL indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (W) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
- The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
- Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
- TS indicates topsoil on soils logs.
- A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.

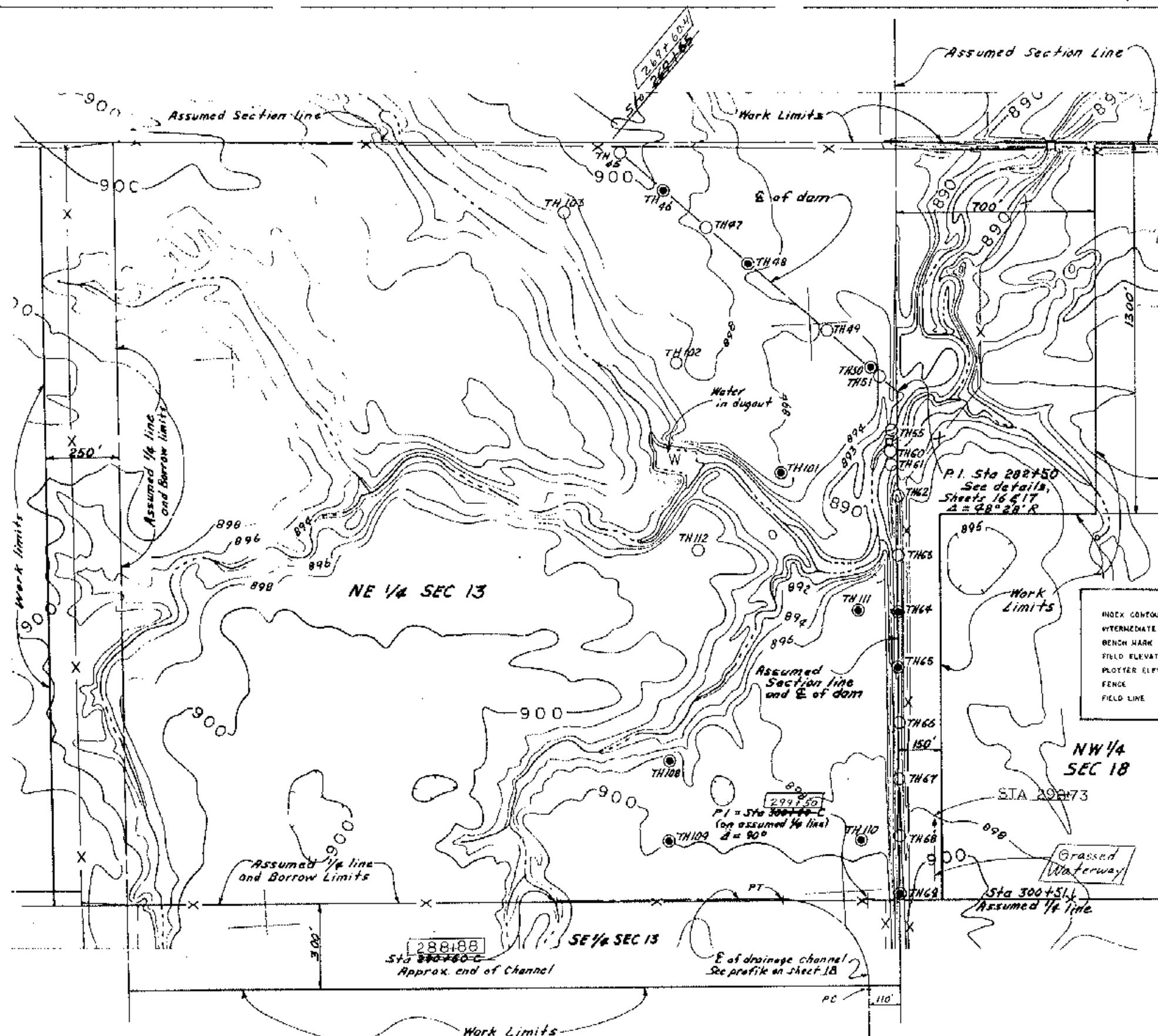
AS BUILT 12-11-90

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORK'S COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed: M. J. Wiedemeyer 2/87	Date: 2/87	Approved by: _____
Drawn: G. E. Muller 3/87	Date: 3/87	Title: _____
Traced: _____	Date: _____	Scale: _____
Checked: J. E. Nentress 3/87	Date: 3/87	Drawing No: 08-87-029



- NOTES:
1. A 100 ft. berm will be left between the borrow area and the drainage channel.
 2. Rocks in the west road ditch from approximately Sta. 290+00 to Sta. 326+00 will be removed and placed in disposal areas.

LEGEND			
INDEX CONTOUR	---	PAVED ROAD	=====
INTERMEDIATE CONTOUR	---	UNPAVED ROAD	-----
BENCH MARK	BM 5 X	TRAIL	- - - -
FIELD ELEVATION	575.23		
PLOTTER ELEVATION	576.2		
FENCE	---		
FIELD LINE	---		
		WATER	~~~~~
		TREES	
		CULVERT	- - - -
		BUILDING	□
		POLE	*
		BRIDGE	==
		ROCK PILE	* * *

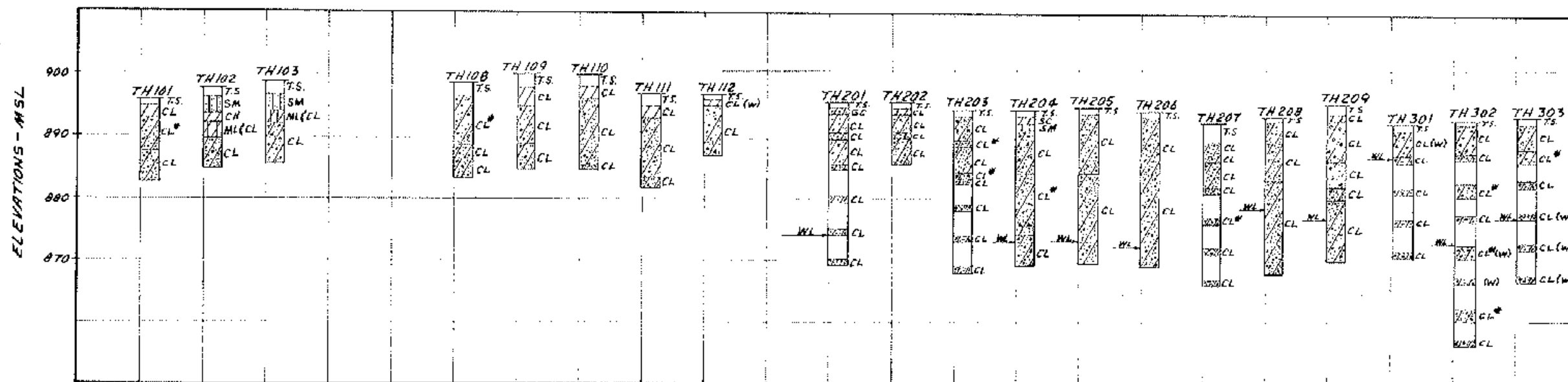
DRAINAGE CHANNEL CURVE DATA			
PI = 299+50	$\Delta = 90^\circ$		
D = 19'	R = 303'		
L = 97.4'	T = 203' 303"		
PC = 302+53	PT = 279+79		

AS BUILT 12-11-90

FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED			
GRAND FORKS COUNTY, NORTH DAKOTA			
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed by: <i>M. J. Winkelman</i>	Date: <i>1/87</i>	Approved by:	
Drawn: <i>G. F. Haller</i>	Scale: <i>3/4"</i>	Time:	
Typed:		Fee:	
Checked: <i>M. E. Nuss</i>	Drawn by:	Sheet:	<i>08-87-029</i>

TOPOGRAPHIC MAP OF DAMSITE

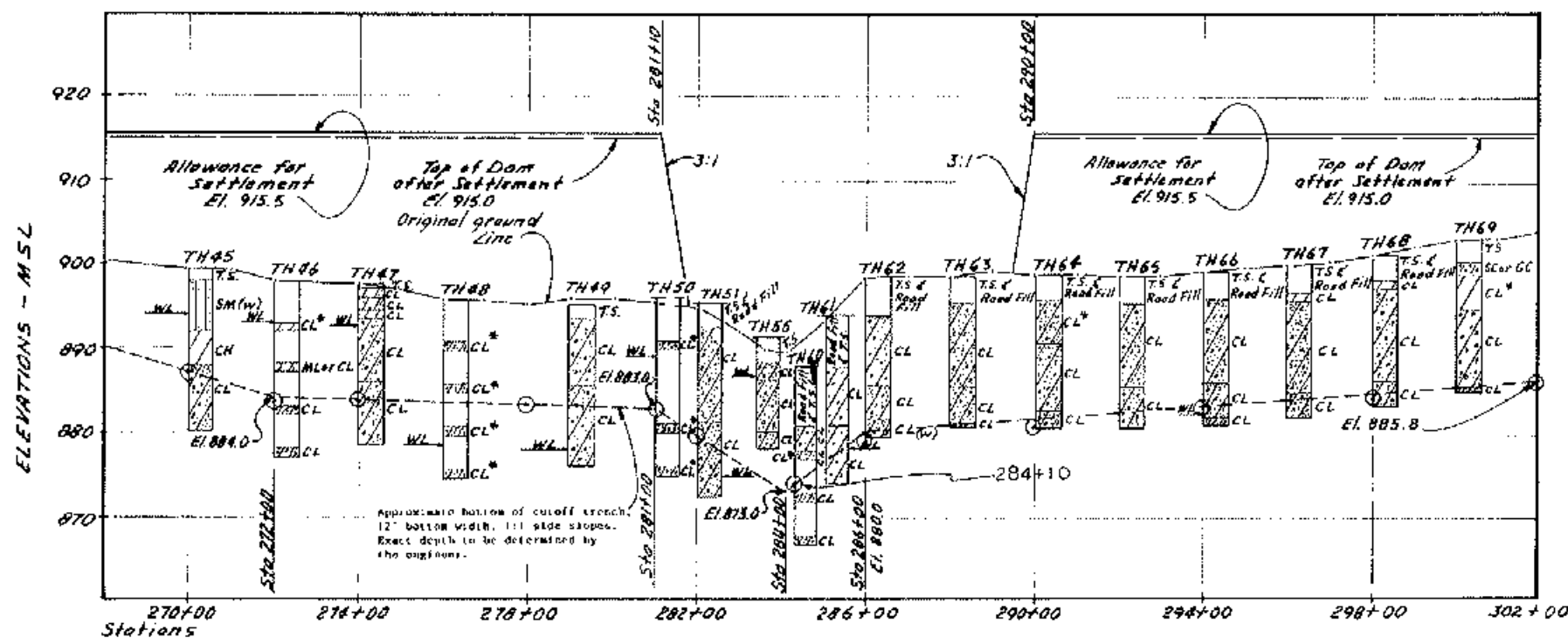
0 200 400 600 800 1000



TEST HOLE DATA - BORROW AREA

NOTES:

1. For soils legend, see Standard Drawing S, R-10,000, 47.
2. Soil Exploration Date: August 1979.
3. Groundwater and site conditions:
 - a. WL indicates groundwater on the date of the soil exploration. Variation should be expected.
 - b. (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - c. In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - d. Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
4. The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
5. Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
6. TS indicates topsoil on soils logs.
7. A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.
8. Between the bottoms of the 3:1 end slopes at Sta. 281+10 and Sta. 290+00, the cutoff trench will be excavated as shown and backfilled to the original ground surface.



PROFILE ALONG & OF DAM

AS BUILT 12-11-90

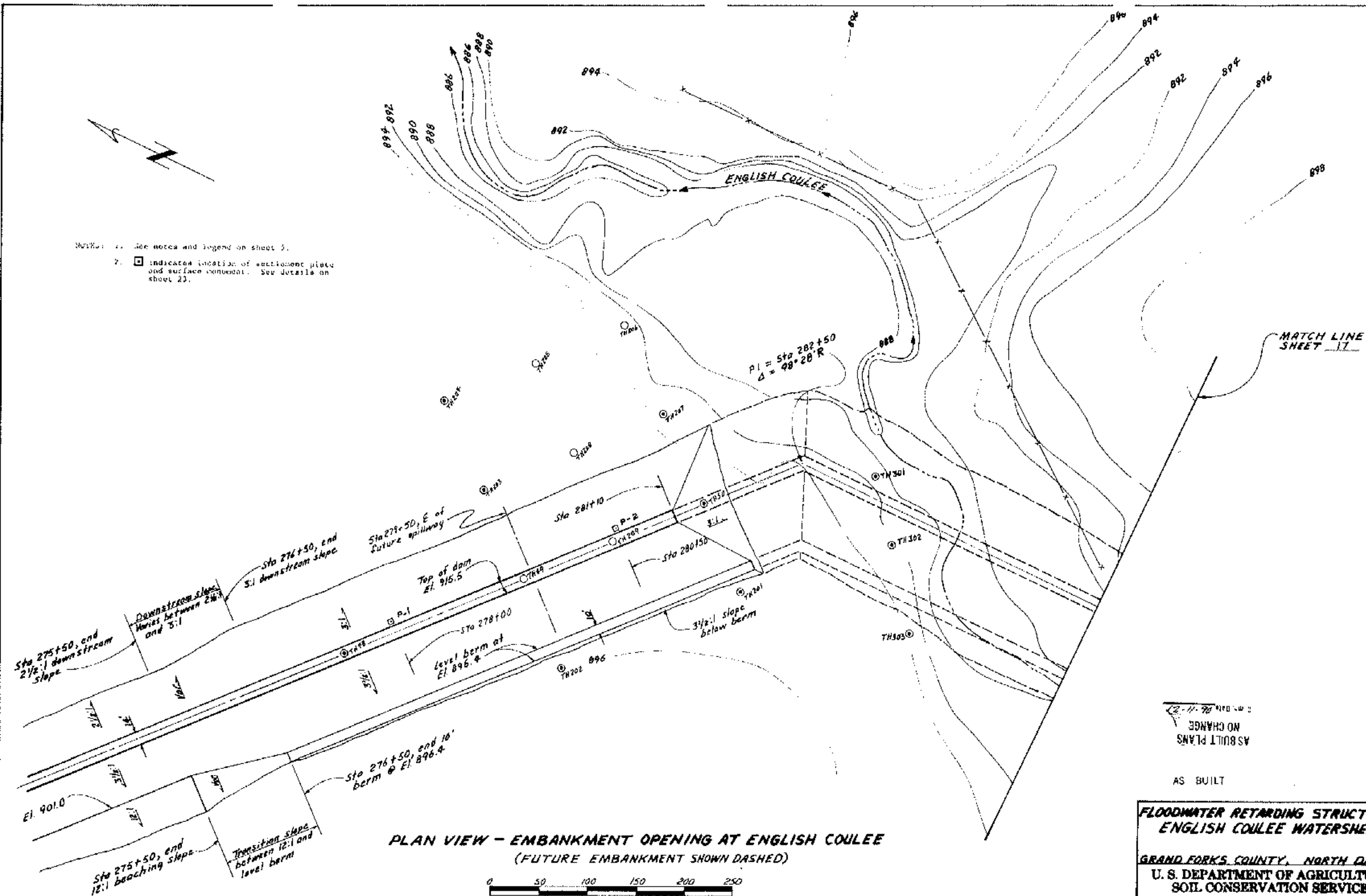
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: M. J. Winkler	Date: 11/87	Approved by: [Signature]
Drawn by: G. E. M. [Signature]	Date: 2/87	Title: [Blank]
Traced by: [Blank]	Date: [Blank]	Scale: [Blank]
Checked by: J. E. [Signature]	Date: 3/87	Drawing No: 08-87-029

- Notes: 1. See notes and legend on sheet 1.
2. $\square$ indicates location of section plate and surface contour. See details on sheet 23.



PLAN VIEW - EMBANKMENT OPENING AT ENGLISH COULEE
(FUTURE EMBANKMENT SHOWN DASHED)

0 50 100 150 200 250
Scale in feet

NO CHANGE
AS BUILT PLANS

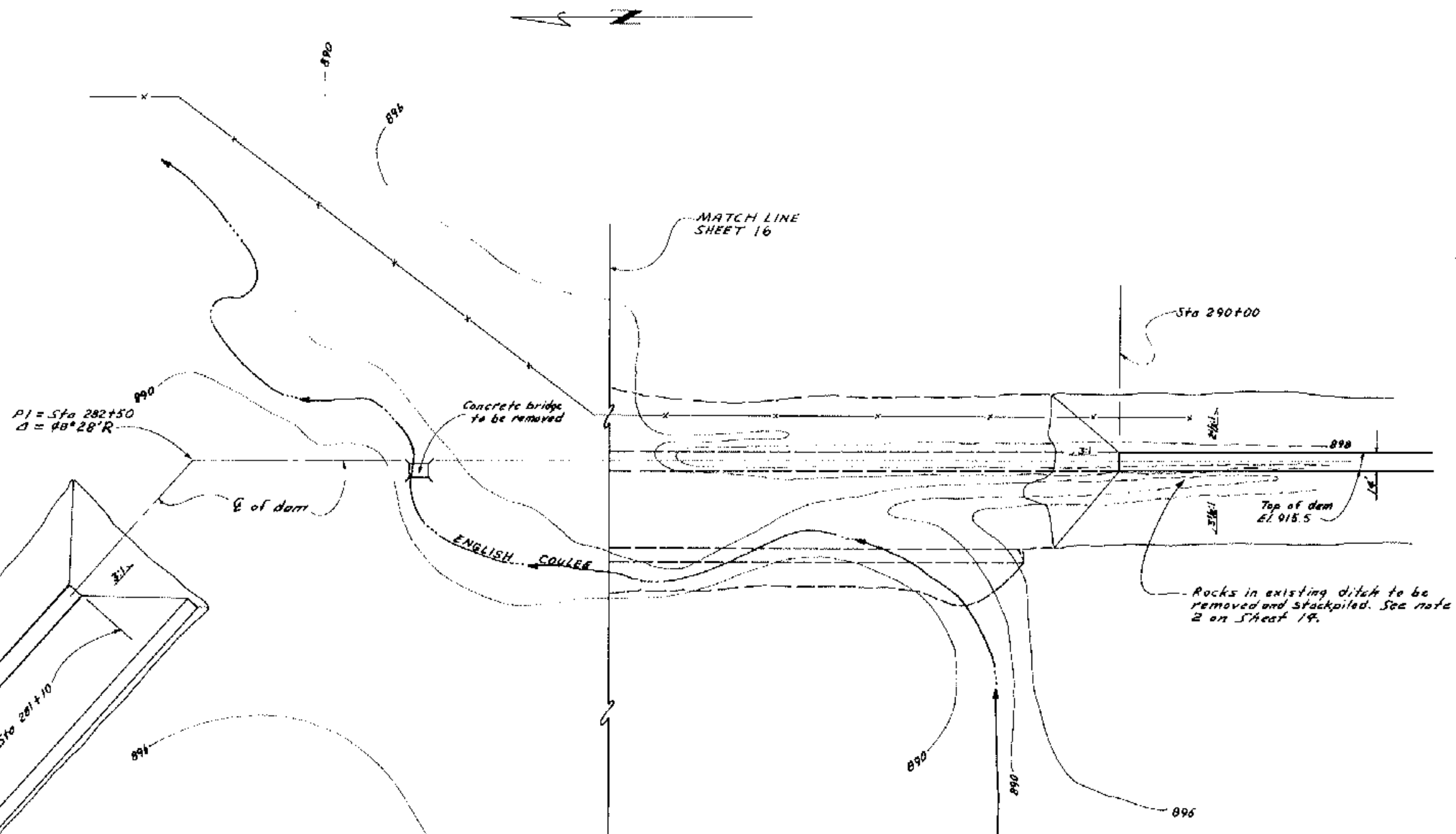
AS BUILT

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by	J. E. Nierman	Date	4/87
Drawn by	G. E. Nierman	Date	4/87
Checked by		Date	
Approved by		Date	
Project No.	W-11-78	Sheet No.	17

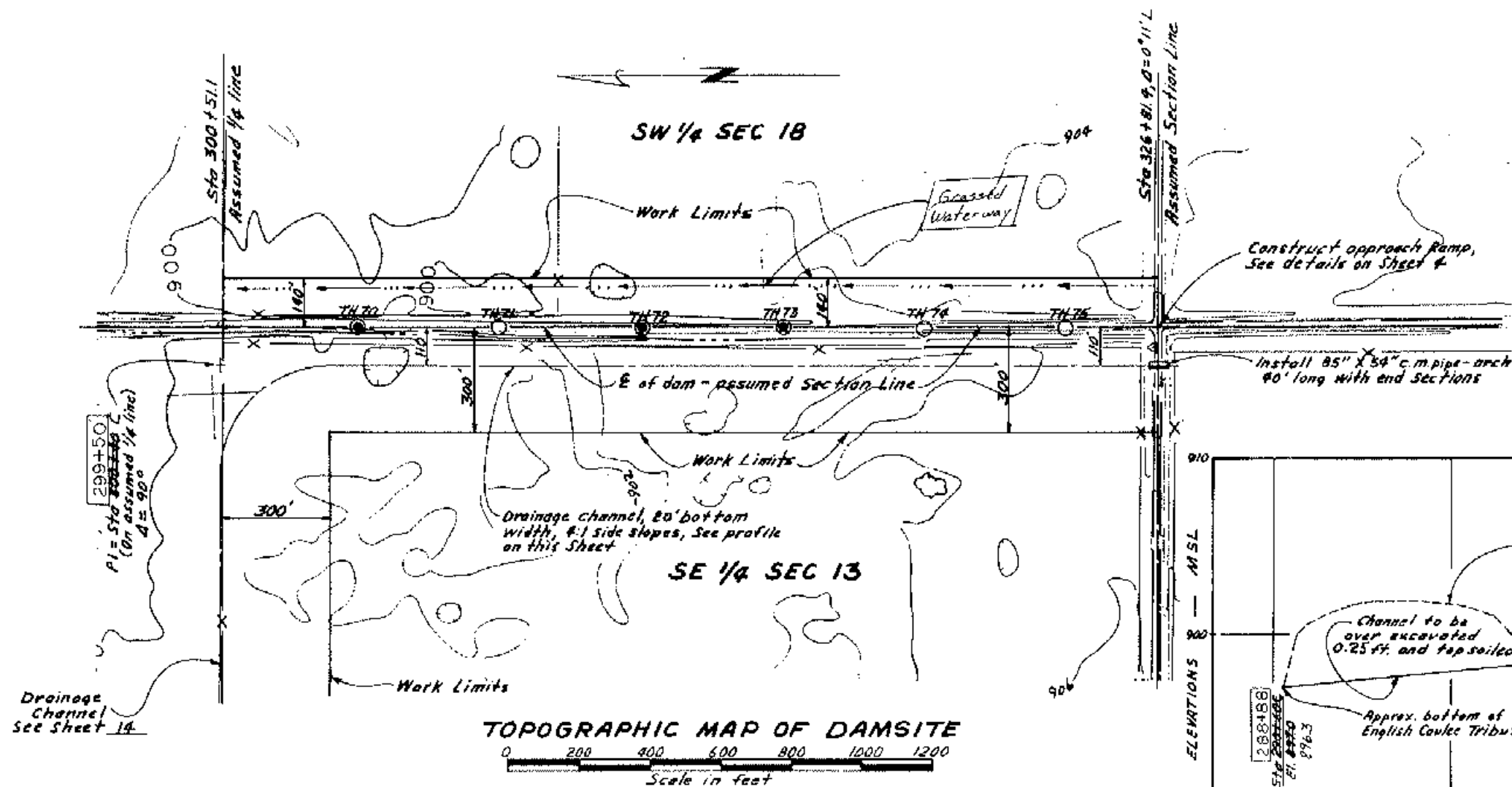
REV. 11/10/87



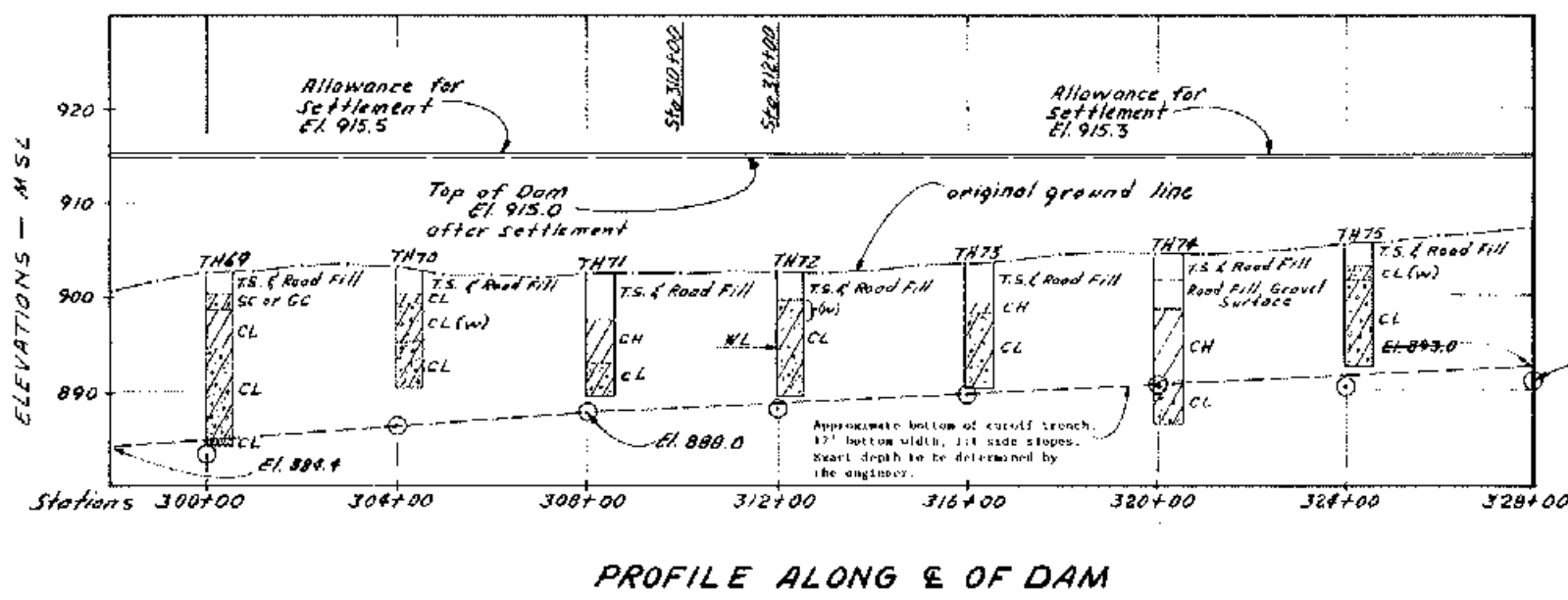
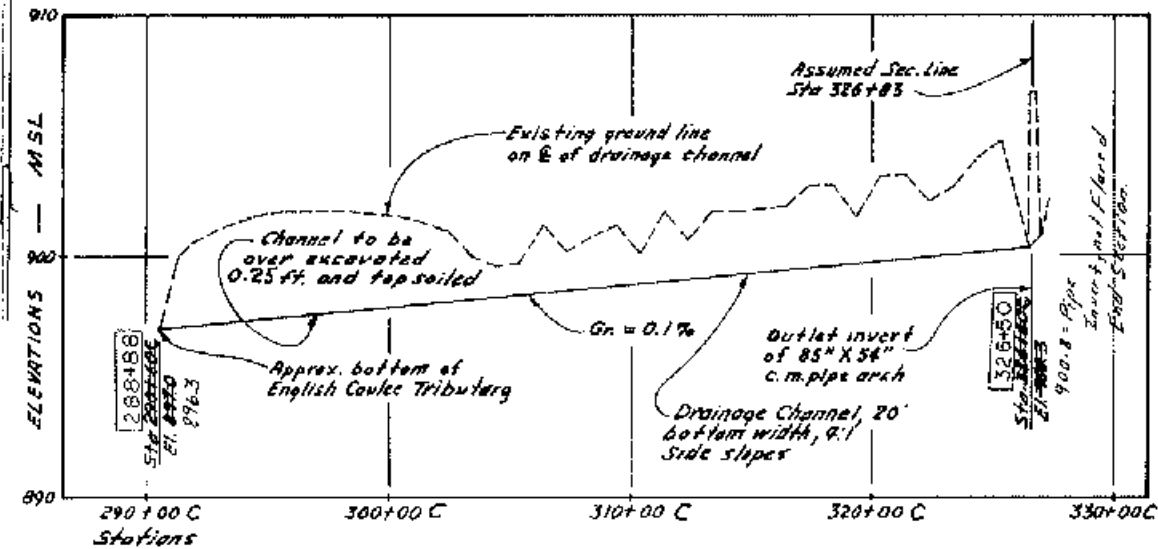
PLAN VIEW - EMBANKMENT OPENING AT ENGLISH COULEE
(FUTURE EMBANKMENT SHOWN DASHED)

0 50 100 150 200 250 300
Scale in feet

AS BUILT		AS BUILT PLANS NO CHANGE Comp. Date 12-11-90	
FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED			
GRAND FORK'S COUNTY, NORTH DAKOTA			
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed by J. E. HESTER 4/87	Drawn by G. P. HALL 6/87	Checked by M. J. WILSON 8/87	Approved by [Signature] 12-11-90
Title 08-47-034			Sheet No. 1 of 1



- NOTES:
1. For soils legend, see Standard Drawing S.R-10,000.47.
 2. Soil Exploration Date: August 1979.
 3. Groundwater and site conditions:
 - a. WL indicates groundwater on the date of the soil exploration. Variation should be expected.
 - b. (W) indicates either wet and soft or saturated and soft materials on soils logs on date of the soils exploration. Variation should be expected.
 - c. In general, the surface 2 ft to 3 ft can be expected to be wet and soft with moist, firm materials below.
 - d. Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
 4. The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
 5. Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
 6. TS indicates topsoil on soils logs.
 7. A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.
 8. Rocks in the west road ditch from approximately Sta. 290+00 to Sta. 326+00 will be removed and placed in disposal areas.



LEGEND	
INDEX CONTOUR	975
INTERMEDIATE CONTOUR	975.5
BENCH MARK	BM 5 A
FIELD ELEVATION	975.23
PROPERTY ELEVATION	975.2
FENCE	FL
FIELD LINE	FL
PAVED ROAD	---
UNPAVED ROAD	---
TRAIL	---
WATER	---
TREES	---
CULVERT	---
BUILDING	---
POLE	---
BRIDGE	---
ROCK PILE	---

AS BUILT

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Design: M. J. W. H. M. S. C. 1/87

Drawn: G. E. W. H. S. C. 3/87

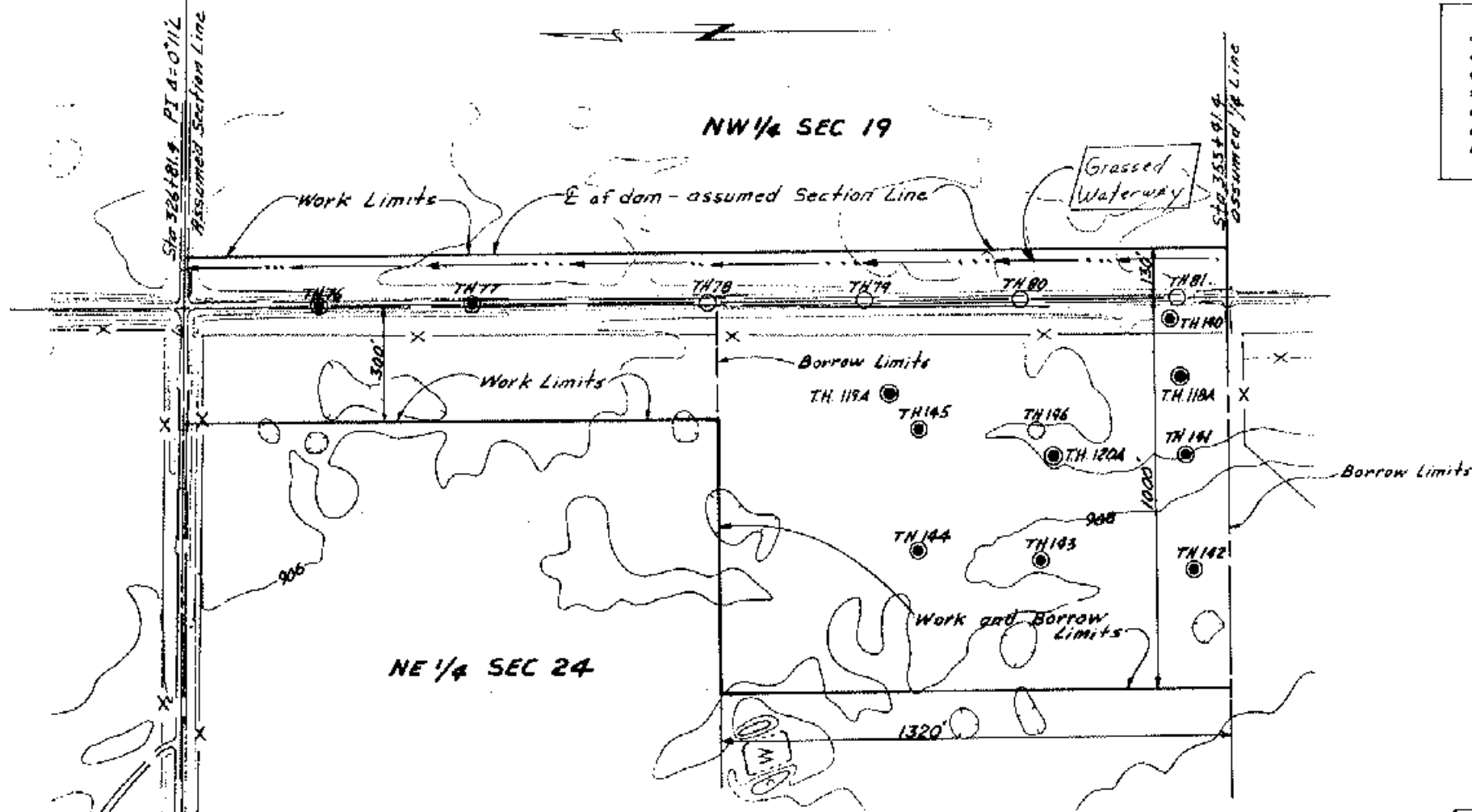
Checked: J. E. N. S. C. 3/87

Approved by: _____

Date: _____

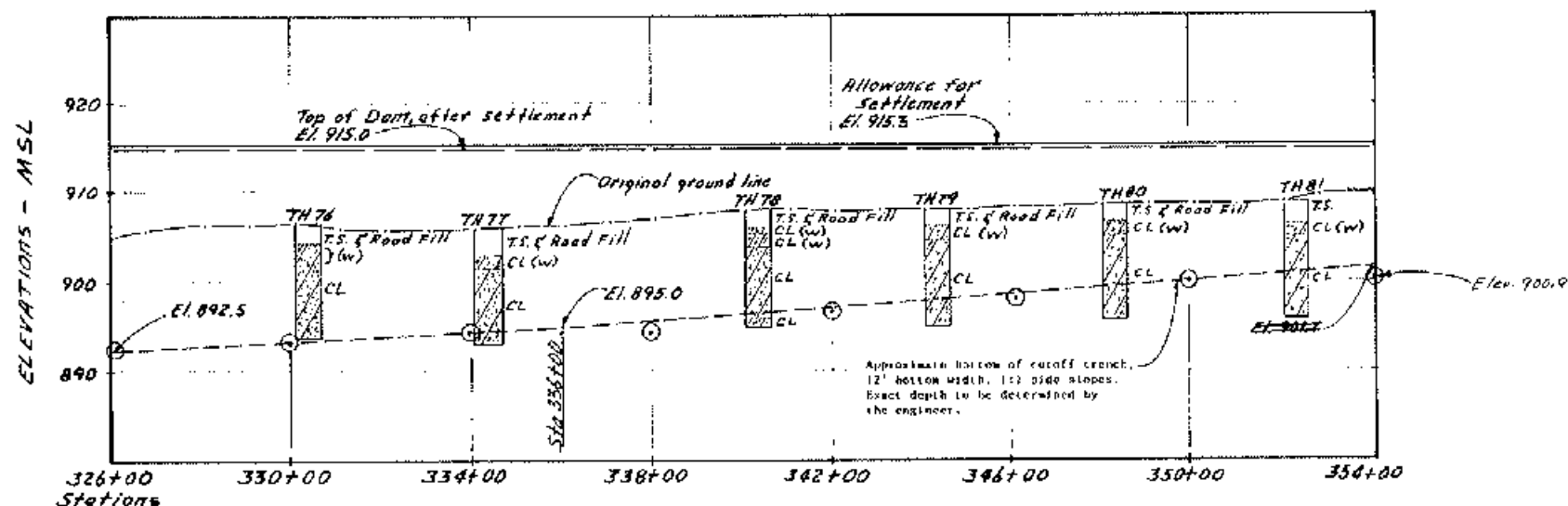
Scale: _____

Drawing No: 08-87-029



TOPOGRAPHIC MAP OF DAMSITE

0 200 400 600 800 1000
Scale in feet



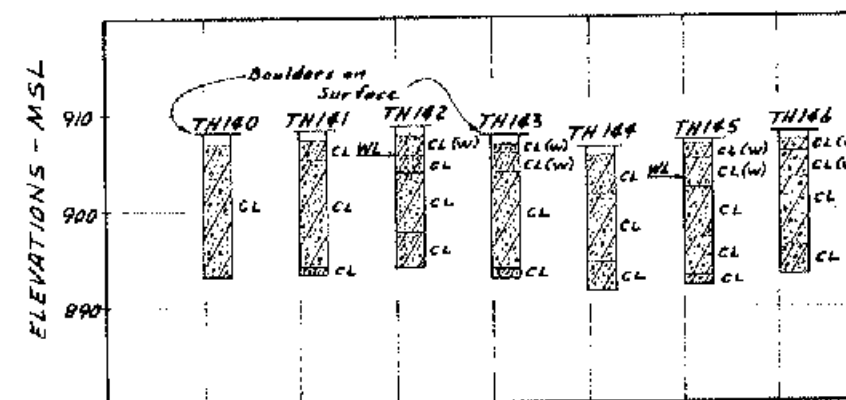
PROFILE ALONG $\bar{C}$ OF DAM

LEGEND	
INDEX CONTOUR	— 575 —
INTERMEDIATE CONTOUR	— 575 —
BENCH MARK	BM 5 X
FIELD ELEVATION	575.123
PLOTTER ELEVATION	575.2
FENCE	— F —
FIELD LINE	— FL —
PAVED ROAD	=====
UNPAVED ROAD	=====
TRAIL	— T —
WATER	~~~~~
TREES	
CULVERT	— C —
BUILDING	□
POLE	•
BRIDGE	— B —
ROCK PILE	— R.P. —

NOTES:

- For soils legend, see Standard Drawing S-10,000.47.
- Soil Exploration Date: August 1979.
- Groundwater and site conditions:
 - W₁ indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
- The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
- Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
- TS indicates topsoil on soils logs.
- A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.

NOTE: Test holes 118A, 119A, and 120A were logged and sampled on October 14, 1987, for the purpose of obtaining additional compaction and natural moisture data. Logs of the test holes are not shown. Test data from these samples are shown on sheet 2.



TEST HOLE DATA - BORROW AREA

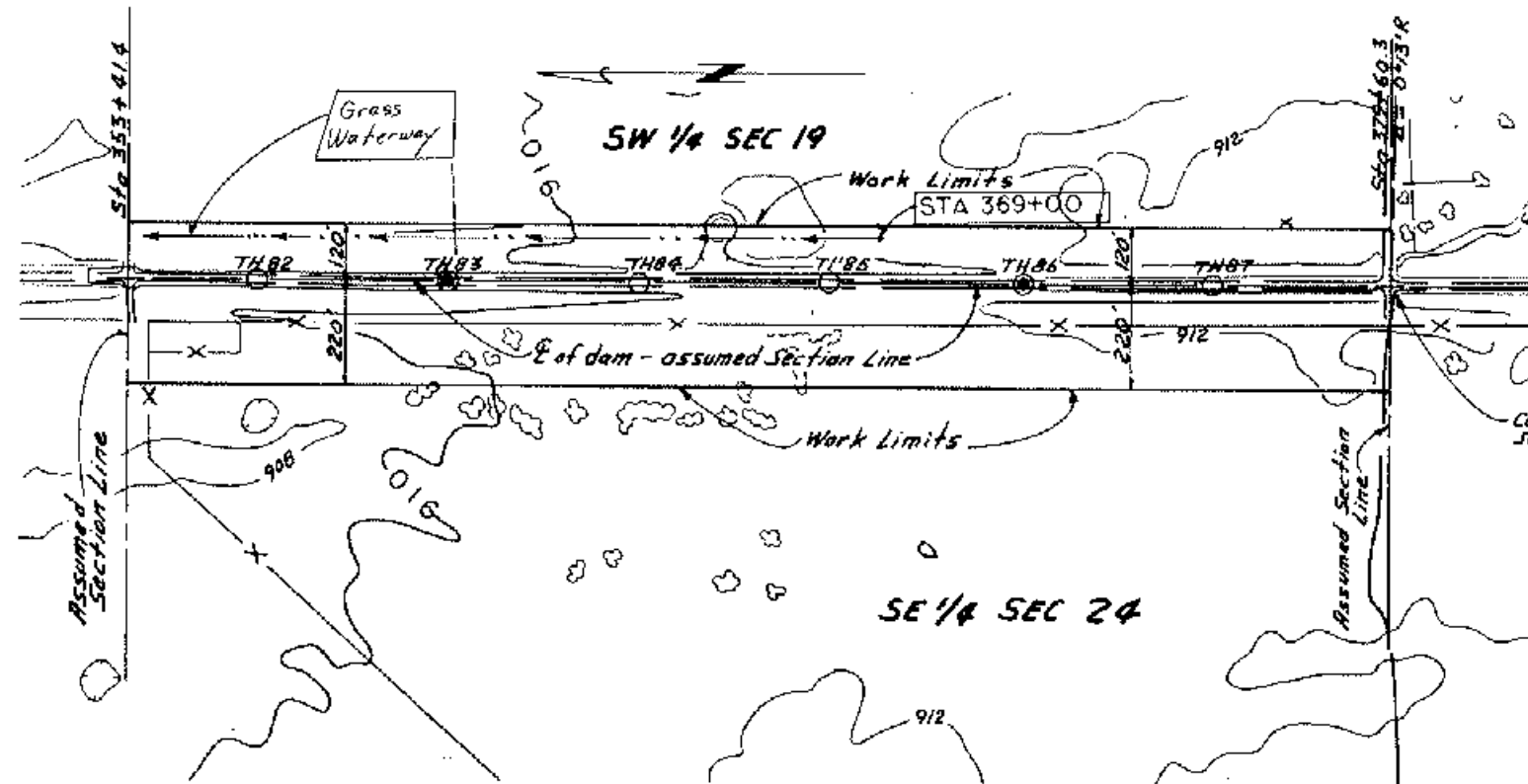
AS BUILT

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

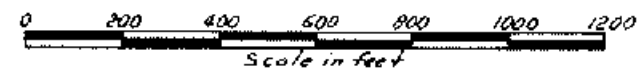
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: M.L. Nielsen, Jr. 1/87	Approved by: _____
Drawn by: G.F. Waliser 3/87	Checked by: _____
Traced by: _____	Scale: 1" = 40'
Checked by: J.E. Nielsen 3/87	Sheet: 19 of 26
	08-87-029



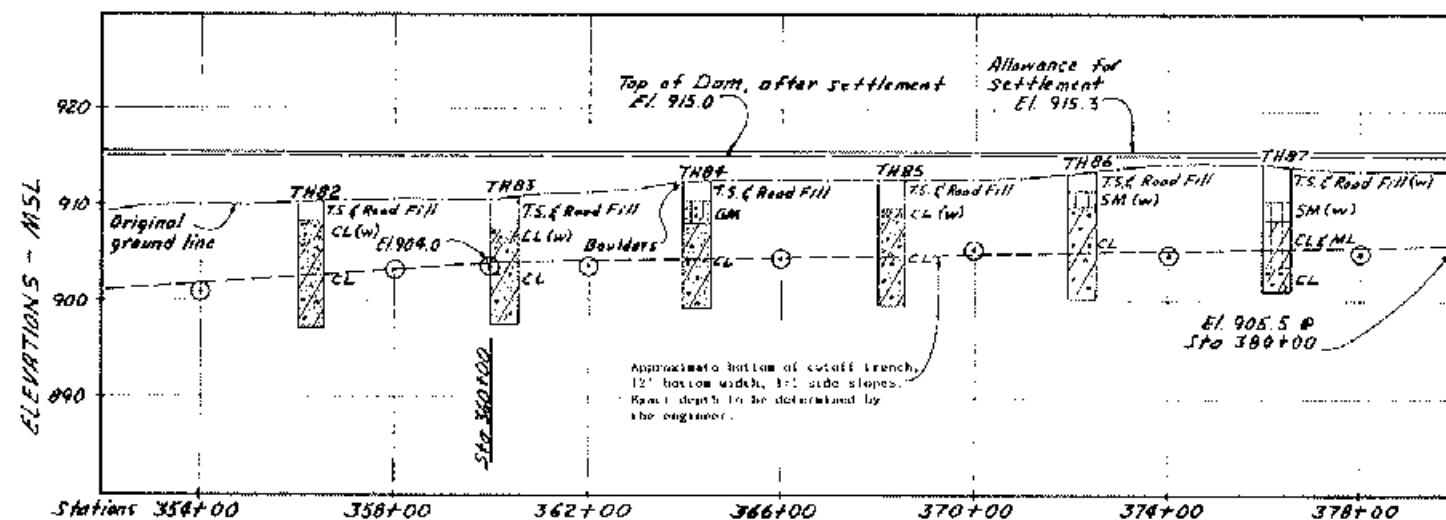
TOPOGRAPHIC MAP OF DAMSITE



LEGEND	
INDEX CONTOUR	— 575 —
INTERMEDIATE CONTOUR	— 575 X —
BENCH MARK	575.02
FIELD ELEVATION	576.2
PLOTTER ELEVATION	576.2
FENCE	— F —
FIELD LINE	— F —
PAVED ROAD	=====
UNPAVED ROAD	=====
TRAIL	— — — — —
WATER	~~~~~
TACE	=====
CULVERT	— — — — —
BUILDING	— — — — —
POLE	— — — — —
BRIDGE	— — — — —
ROCK PILE	— — — — —

NOTES:

- For soils legend, see Standard Drawing S.R-10,000.47.
- Soil Exploration Date: August 1979.
- Groundwater and site conditions:
 - M indicates groundwater on the date of the soil exploration. Variation should be expected.
 - (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
- The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
- Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
- FS indicates topsoil on soils logs.
- A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.
- The existing road discharges from approximately Sta. 366+00 to the south end of the dam presently trap water.



PROFILE ALONG CL OF DAM

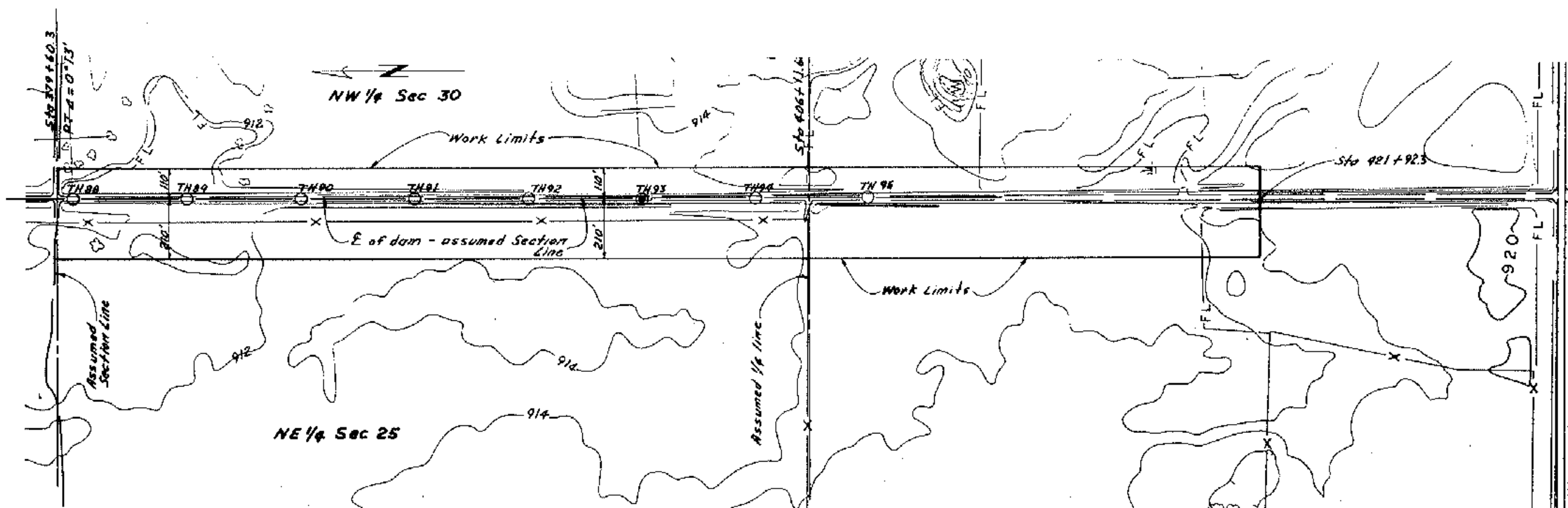
AS BUILT

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

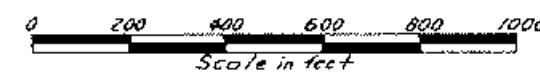
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by M. J. Winkler 1/87	Drawn by G. E. Holser 3/87	Checked by J. E. Nestor 3/87	Date 3/87	Sheet 20	Drawing No. 08-87-029
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TOPOGRAPHIC MAP OF DAMSITE

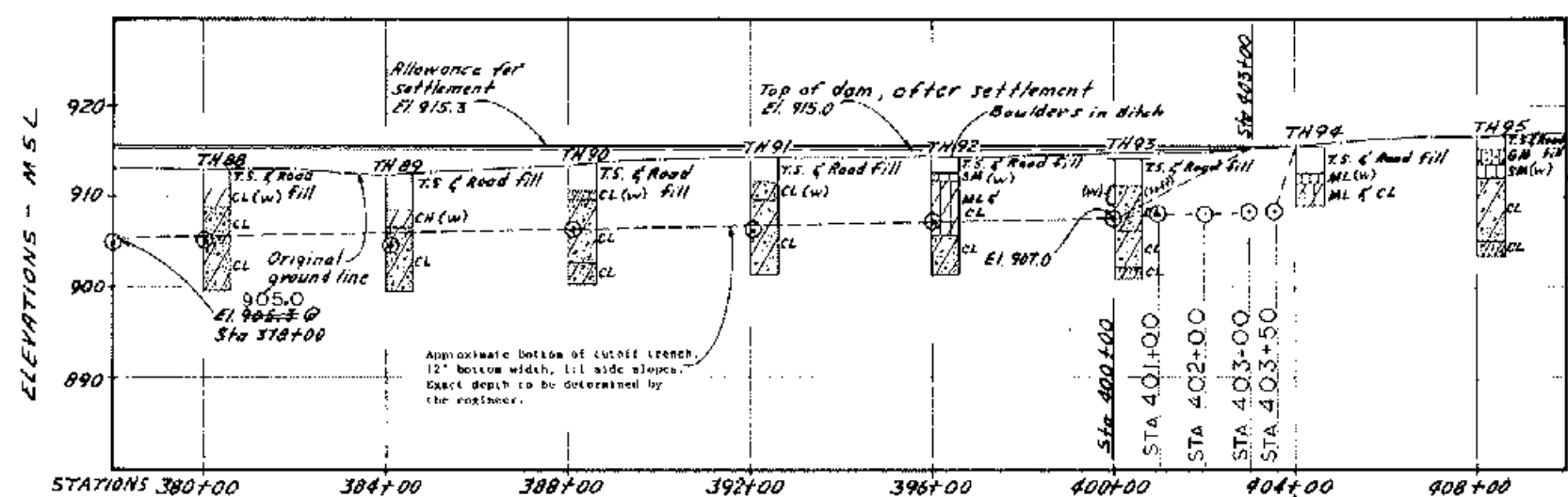


LEGEND	
INDEX CONTOUR	— 575 —
INTERMEDIATE CONTOUR	— 575 —
BENCH MARK	BM 5 X
FIELD ELEVATION	575.123
PLOTTER ELEVATION	576.2
FENCE	— X —
FIELD LINE	— F —
PAVED ROAD	— 575 —
UNPAVED ROAD	— 575 —
TRAIL	— 575 —
WATER	— 575 —
TREES	— 575 —
CULVERT	— 575 —
BUILDING	— 575 —
POLE	— 575 —
BRIDGE	— 575 —
ROCK PILE	— 575 —

NOTES:

1. For soils legend, see Standard Drawing S.R-10,000.47.
2. Soil Exploration Date: August 1979.
3. Groundwater and site conditions:
 - a. H₁ indicates groundwater on the date of the soil exploration. Variation should be expected.
 - b. (U) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - c. In general, the surface 2 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - d. Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
4. The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory test.
5. Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
6. TS indicates topsoil on soils logs.
7. A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.

AS BUILT



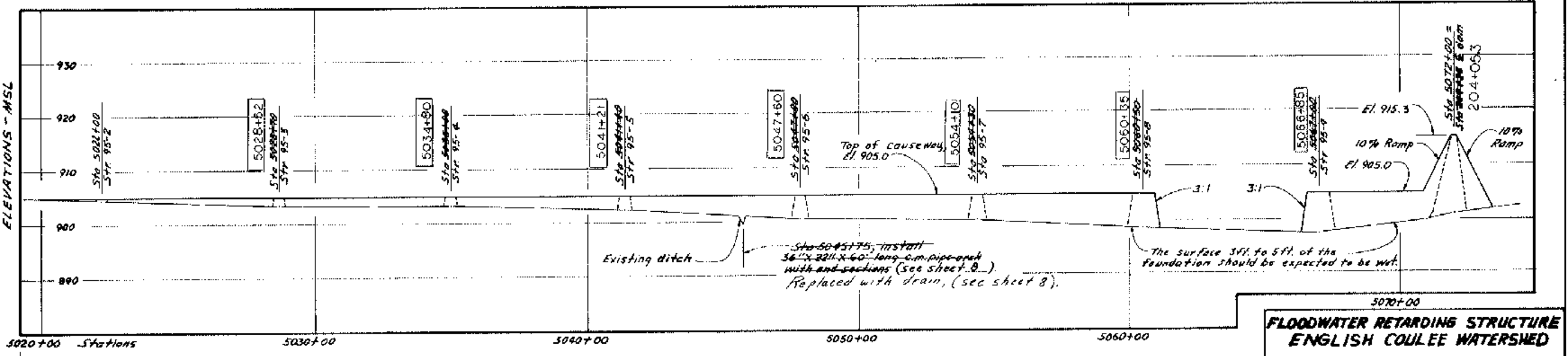
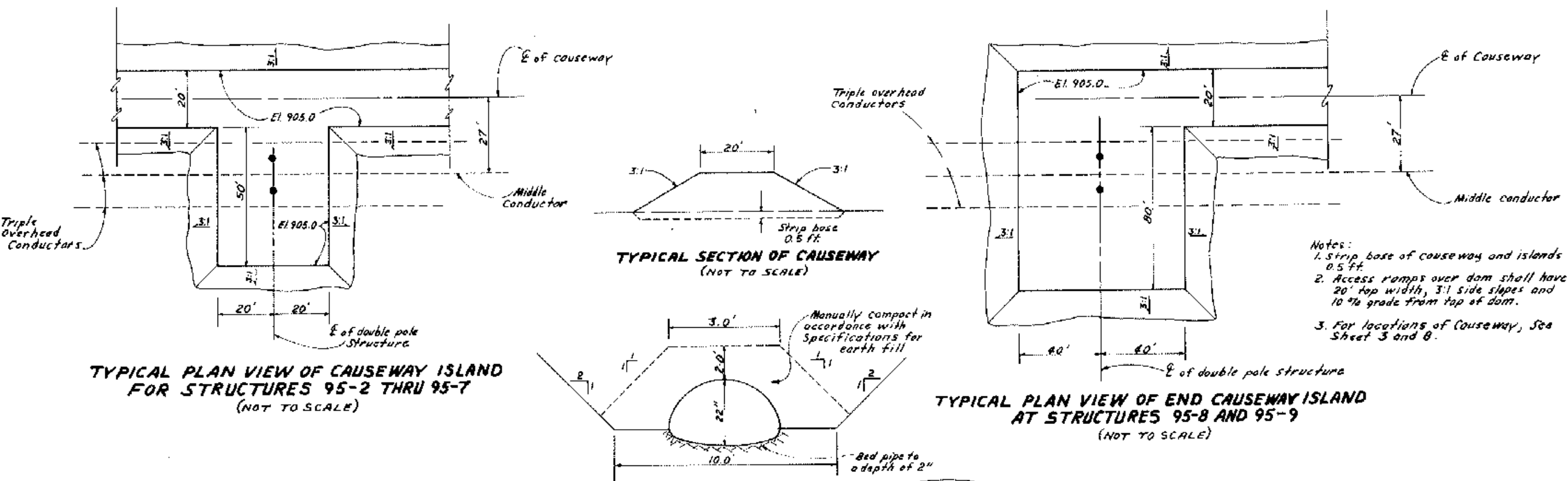
PROFILE ALONG E OF DAM

END OF DAM

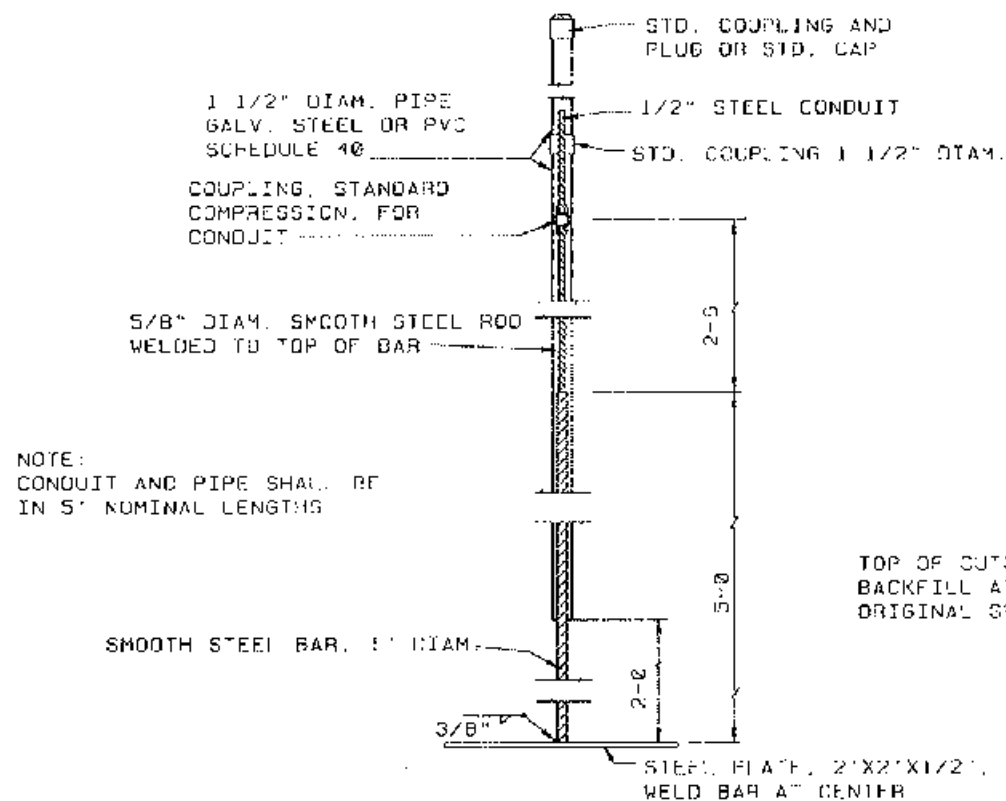
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORK COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

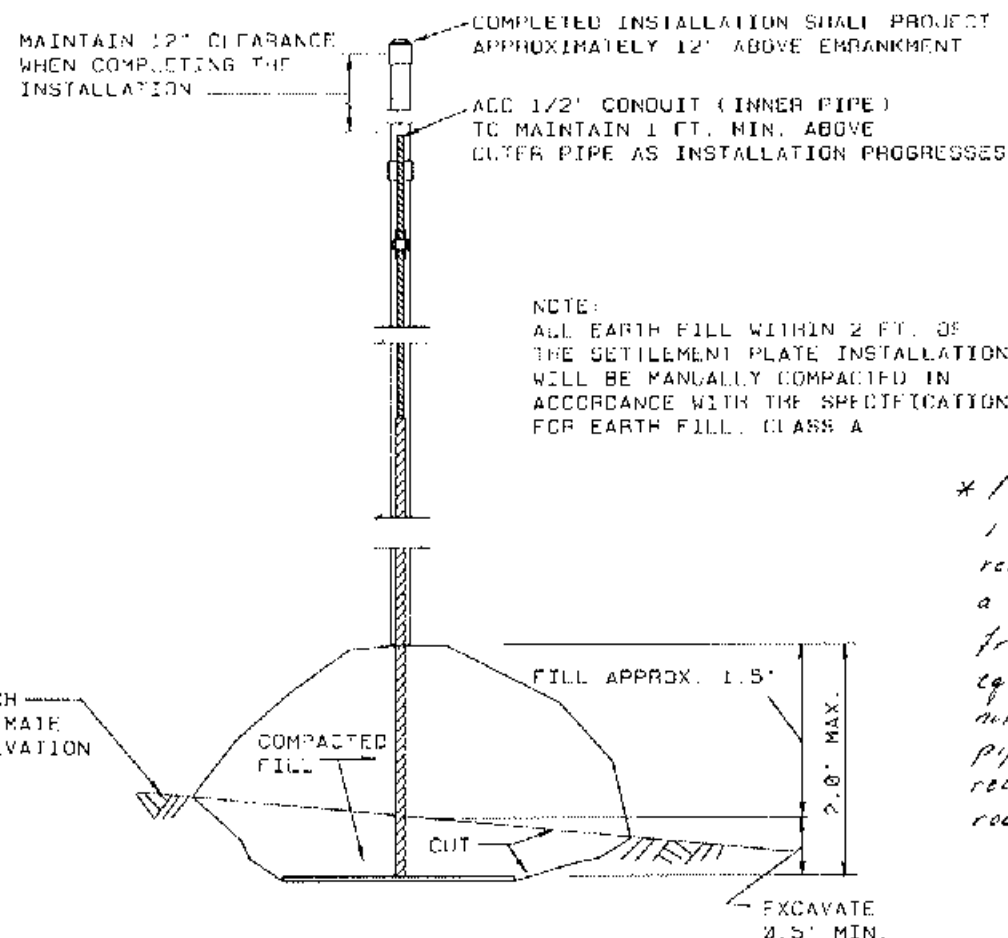
Designed by: W. L. Winkler	Date: 1/87	Approved by: [Signature]
Drawn by: G. F. Hall	Date: 3/87	Checked by: [Signature]
Traced by: [Signature]	Date: 3/87	Project No.: 08-87-029



FLOODWATER RETARDING STRUCTURE	
ENGLISH COULEE WATERSHED	
GRAND FORK COUNTY, NORTH DAKOTA	
U. S. DEPARTMENT OF AGRICULTURE	
SOIL CONSERVATION SERVICE	
Designed by J.E. NORTON 4/87	Approved by W.H. WOODWARD 5/87
Drawn by G.F. WOODWARD 4/87	Checked by W.H. WOODWARD 5/87
Traced by W.H. WOODWARD 5/87	Scale 1" = 20'
Sheet 08-87-029	



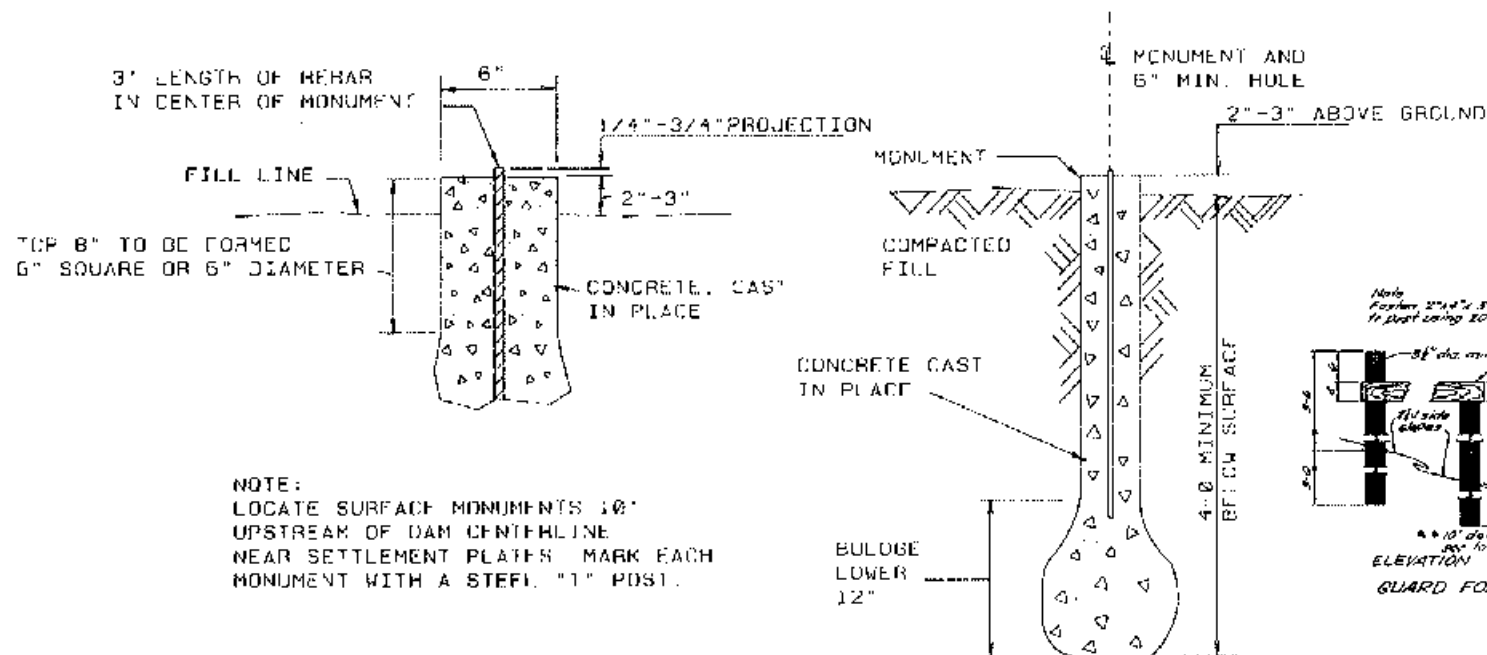
FABRICATION DETAIL- SETTLEMENT PLATES
(2 REQUIRED)



INSTALLATION DETAIL-SETTLEMENT PLATES

* Note:

1 Settlement Plate at Sta. 278+00 remains intact. The pipe does have a slight bend, approx 4.5 feet down from the top, caused by heavy equipment operations. The bend will not hamper the sliding of the inner pipe. An elevation of 916.35 was recorded, on 8-24-90, atop the 5/8" rod.



DETAILS OF MONUMENT INSTALLATION
(2 REQUIRED)

TABLE OF SETTLEMENT PLATE LOCATION AND PIPE LENGTHS

PLATE NO.	LOCATION NORMAL TO CENTERLINE STATION	ELEVATION PLATE (APPROX.)	LENGTH 1\"/>
-----------	---------------------------------------	---------------------------	--------------

* LAST SECTION OF PIPE MAY VARY DUE TO SETTLEMENT.
 3/4\"/>

AS BUILT INSTRUMENTATION DETAILS

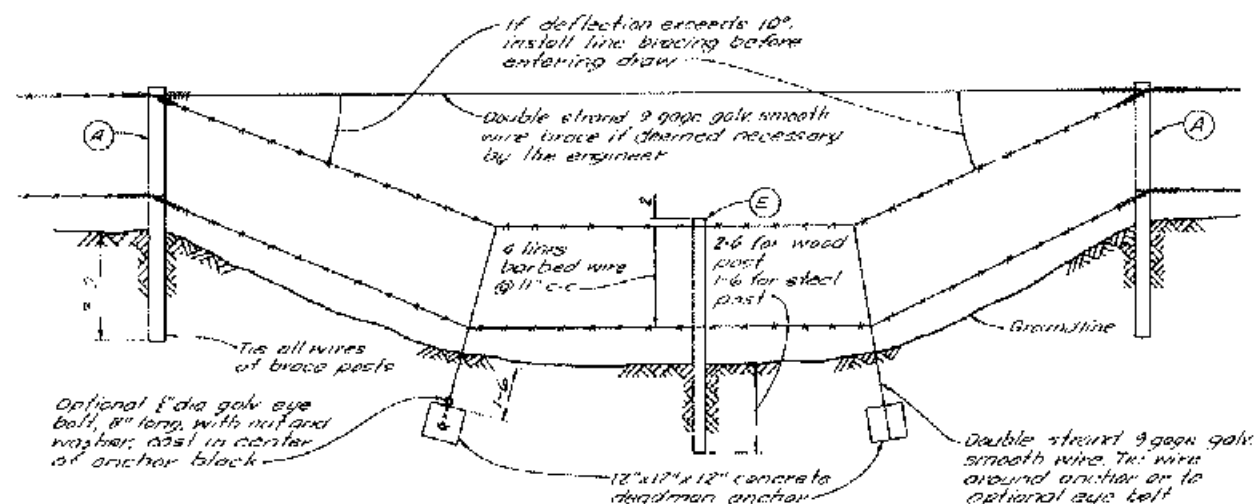
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

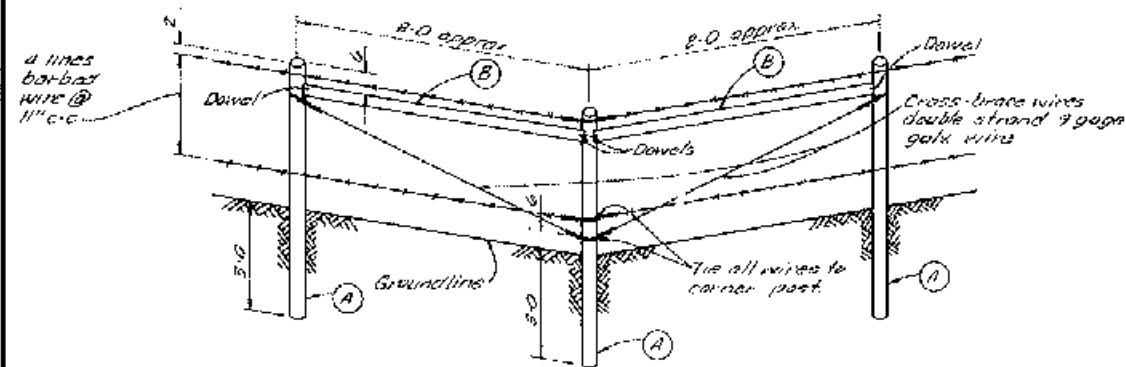
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Drawn by J.E. Neetase 4/87	Approved by
Drawn by D.J. Kvittum 4/87	Checked
Traced	Drawn by
Checked by W.J. Wiedemeyer 5/87	Drawn by

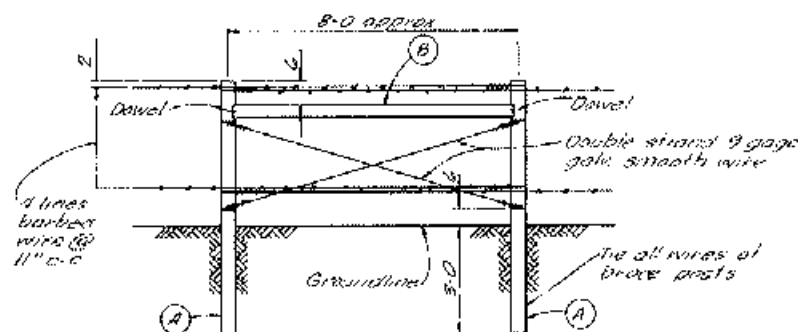
NOT TO SCALE.



LINE FENCE ACROSS NARROW DRAWS

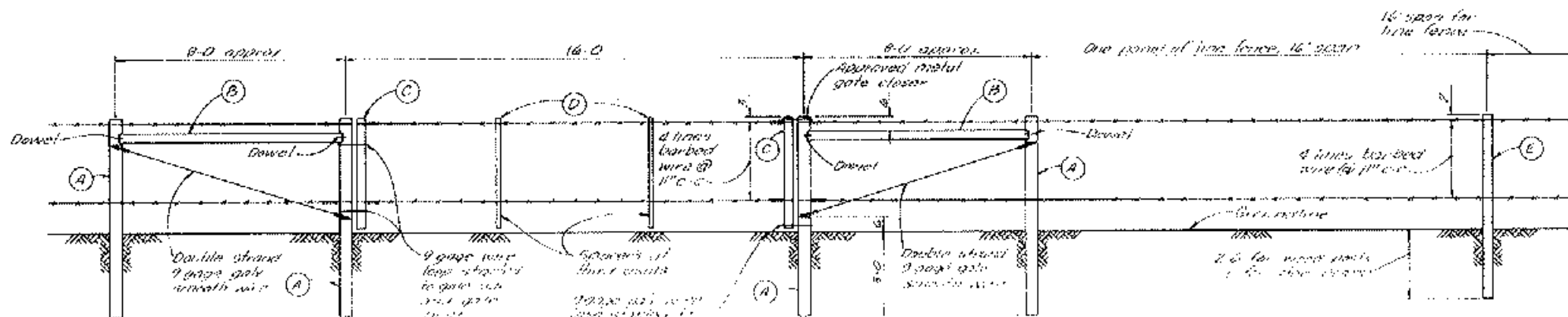


CORNER AND DIRECTION CHANGE BRACING
(Use for interior angles from 70° to 163°)



Note:
Place in fence line so that maximum distance between braced posts does not exceed 40 rods.

LINE BRACING



GATE SECTION

LINE FENCE SECTION

NOTES:

1. BARBED WIRE MUST CONSIST OF DOUBLE STRAND OF 12 1/2 GAGE GALVANIZED WIRE WITH 14 GAGE BARBS SPACED ON ABOUT 4-5 INCH CENTERS.
2. ALL WOOD ITEMS WILL BE AT LEAST THE DIMENSIONS INDICATED AND MUST BE FREE OF DECAY, REASONABLY STRAIGHT WITH LIMBS TRIMMED APPROXIMATELY FLUSH WITH THE BODY. DECAY-SUSCEPTIBLE WOOD, SUCH AS PINE, MUST BE TREATED WITH PRESERVATIVES. ROT-RESISTANT WOOD, SUCH AS RED CEDAR OR ROCKY MT. JUNIPER, MAY BE USED UNTREATED.
3. STEEL POSTS MUST BE 5-12 FEET IN LENGTH AND SHALL HAVE A WEIGHT OF 1.33 POUNDS PER FOOT, EXCLUDING OF ANCHOR PLATE. POST MUST HAVE A FIRMLY ATTACHED ANCHOR PLATE AND SUITABLE STUDS, KNOTS, OR GROOVES FOR HOLDING WIRE IN PLACE. STEEL POSTS WILL BE PAINTED OR GALVANIZED.
4. BRACE WIRE WILL BE 3 GAGE GALVANIZED WIRE.
5. STAPLES WILL BE 3 GAGE GALVANIZED WIRE, 1 1/2 INCHES LONG FOR SOFT WOODS AND 1 INCH FOR CLOSE-GRAINED HARDWOODS.
6. WIRE FASTENERS, CLIPS, OR TIES FOR STEEL POSTS SHALL BE FASHIONED FROM 12 1/2 GAGE GALVANIZED WIRE.
7. ALL POSTS SHALL BE SET VERTICALLY.
8. LINE POST SPACING SHALL NOT EXCEED 16 FEET. AT LEAST EVERY THIRD POST MUST BE WOOD. IF ALL LINE POSTS ARE WOOD, FENCE WIRES SHALL BE GROUNDED WITH A STEEL ROD AT EVERY TENTH POST.
9. ALL POSTS WILL BE SET TO AT LEAST THE DEPTH SHOWN ON THE DRAWINGS.
10. LINE BRACING WILL BE INSTALLED:
 - A. IN STRAIGHT FENCE SECTIONS AT INTERVALS OF NOT MORE THAN 40 RODS.
 - B. AT ANY POINT WHERE THE ALIGNMENT OF WIRES CHANGES VERTICALLY IN EXCESS OF 10 DEGREES.
 - C. AT THE BEGINNING AND END OF ANY CURVE.

11. END PANELS SIMILAR TO LINE BRACING WILL BE BUILT AT BOTH ENDS OF GATES AND AT FENCE ENDS.
12. CORNER BRACE ASSEMBLY WILL BE INSTALLED AT ALL POINTS WHERE FENCE ALIGNMENT CHANGES 15 DEGREES OR MORE.
13. NOTCH GATE, BRACE, AND CORNER POSTS 3/4" FOR HORIZONTAL BRACES. HORIZONTAL BRACES WILL BE SECURED BY 1/2" DIA. PLAIN STEEL BOLTS 6" LONG, DRIVEN IN 7/16" DIA. HOLES DRILLED 2 1/2" INTO EACH POST AND BRACE. SPACING WITH 16 PERRY NAILS MAY BE SUBSTITUTED FOR DOWELING.
14. WIRE WILL BE SERVICED AND SECURELY FASTENED TO ALL POSTS. WIRE WILL BE ANCHORED AT LOW SPOTS. FENCING SHALL BE PLACED ON SIDE OF POST OPPOSITE AREA BEING PROTECTED, EXCEPT THAT IT SHALL BE PLACED ON OUTSIDE OF CURVES. FENCING WILL BE WRAPPED AROUND EACH END, CORNER, BRACE, OR GATE POST AND TIED BACK ON ITSELF WITH AT LEAST THREE TIGHTLY WOUND WRAPS.
15. AT CORNER AND GATE POSTS, STAPLE EACH WIRE AT QUARTER POINTS OF POST.
16. AT BRACE POSTS AND GATE BARS, DOUBLE STAPLE EACH WIRE.
17. AT LINE POSTS, SECURE EACH WIRE WITH STANDARD CLAMP OR SINGLE STAPLE.
18. AT GATE SPACERS, SINGLE STAPLE EACH WIRE.
19. STAPLE 9 GAGE CROSS-BRACE WIRES TO GATE, BRACE, AND CORNER POSTS AT QUARTER POINTS OF POST.
20. FOR LOCATION OF FENCE AND GATES, SEE SHEET 3.

MATERIALS

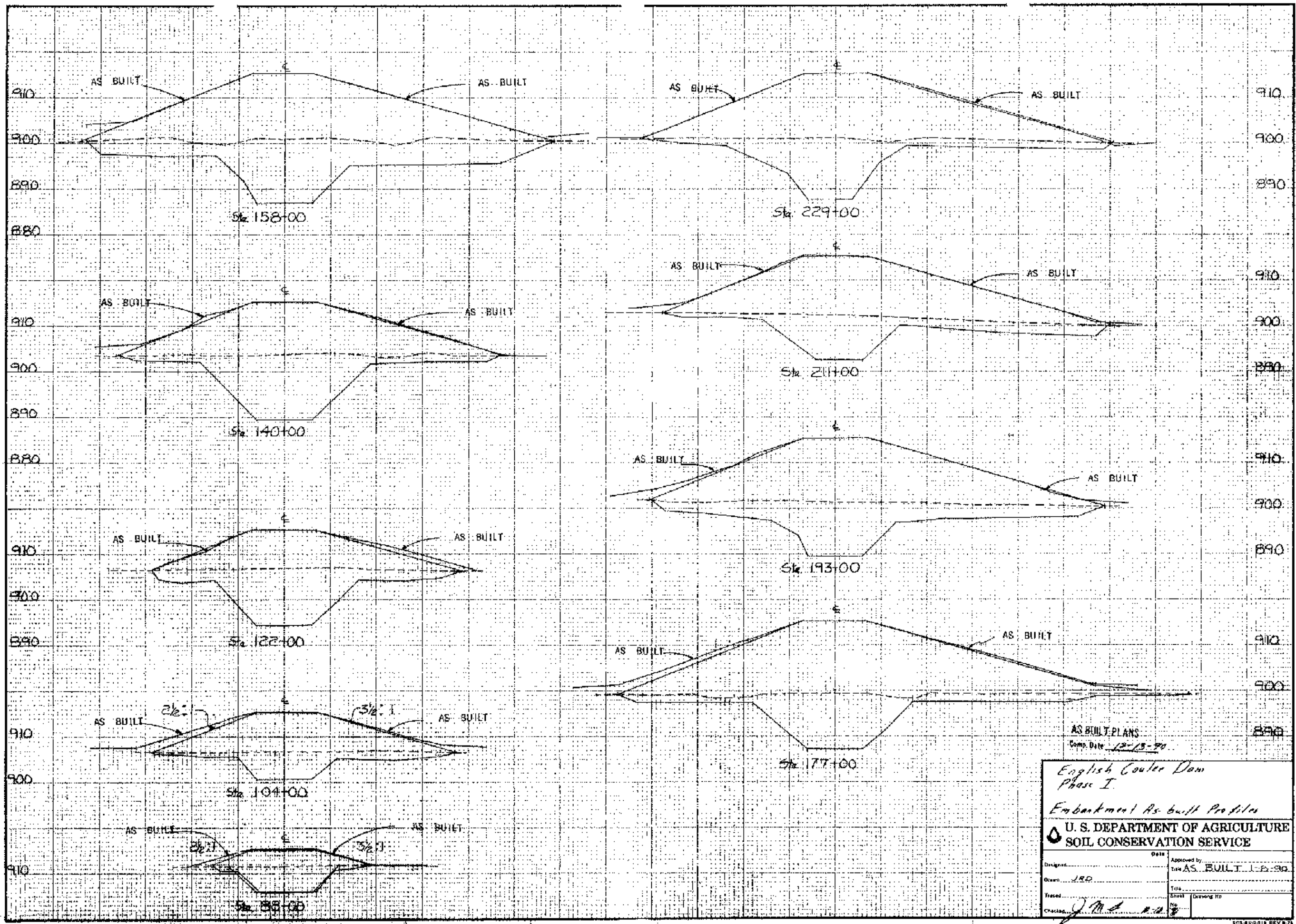
MARK	LOCATION	DESCRIPTION
A	BRACE POST, CORNER POST, GATE POST	WOOD - 6" DIA. X 7' LONG
B	HORIZONTAL BRACE	WOOD - 4" X 4" X 8' LONG OR 4" DIA. X 8' LONG
C	GATE BAR	WOOD - 2" X 4" X 4' LONG
D	GATE SPACER	WOOD - 2" X 2" X 4' LONG OR WIRE STAY - 9 GA. TWISTED GALV. WIRE, FOR SCREW-ON INSTALLATION, 36" LONG
E	LINE POST	WOOD - 4" DIA. X 6 1/2' LONG OR STEEL - 5 1/2' LONG

AS BUILT

DETAILS OF PERMANENT FENCE
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed E. R. Weimer 4/77
Drawn G. E. Waliser 4/77
Traced ...
Checked Ronald Sando 4/77
Date 4/77
Title ...
Scale ...
Drawing No. 08-87-029



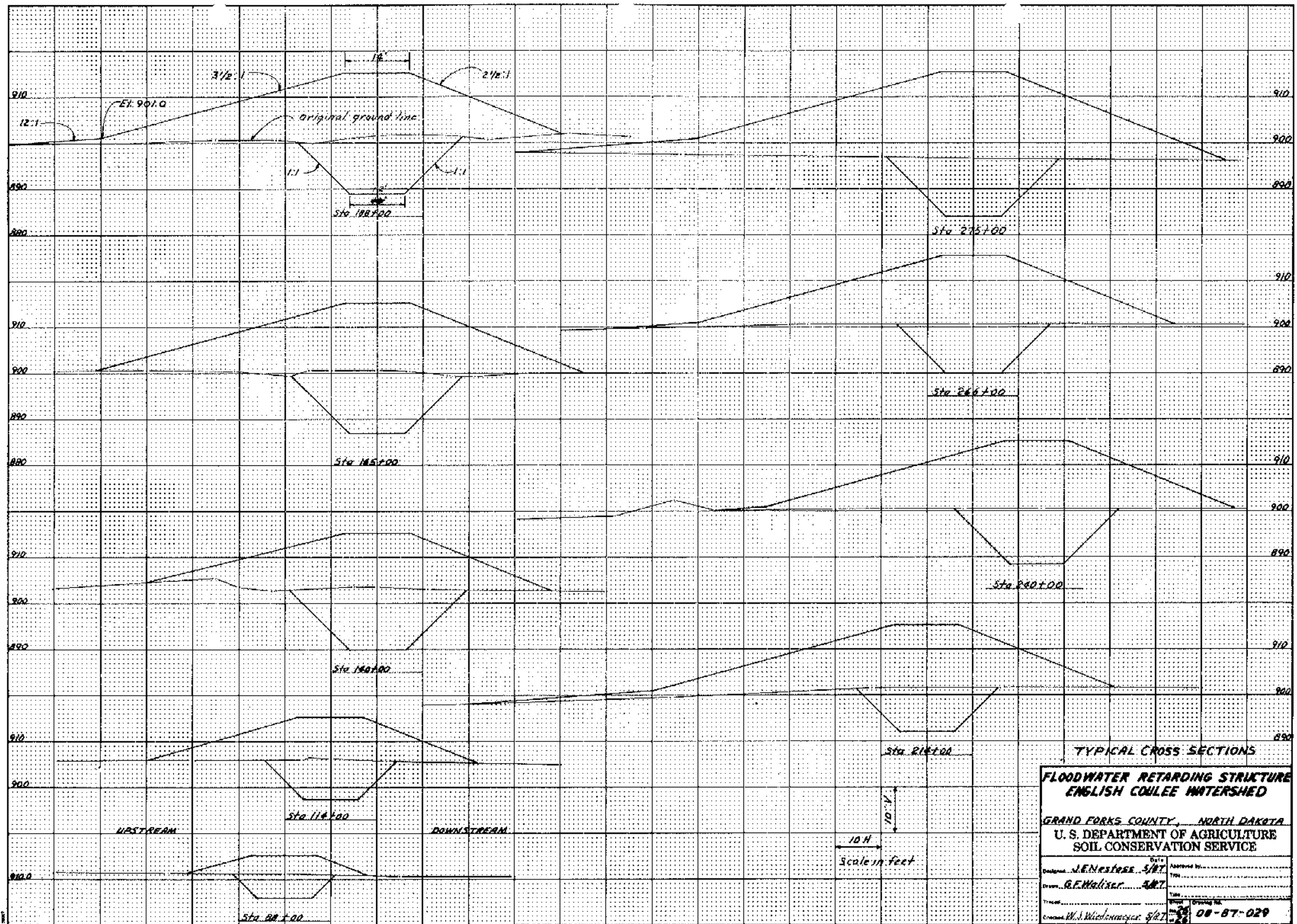
AS BUILT PLANS
Comp. Date 12-13-90

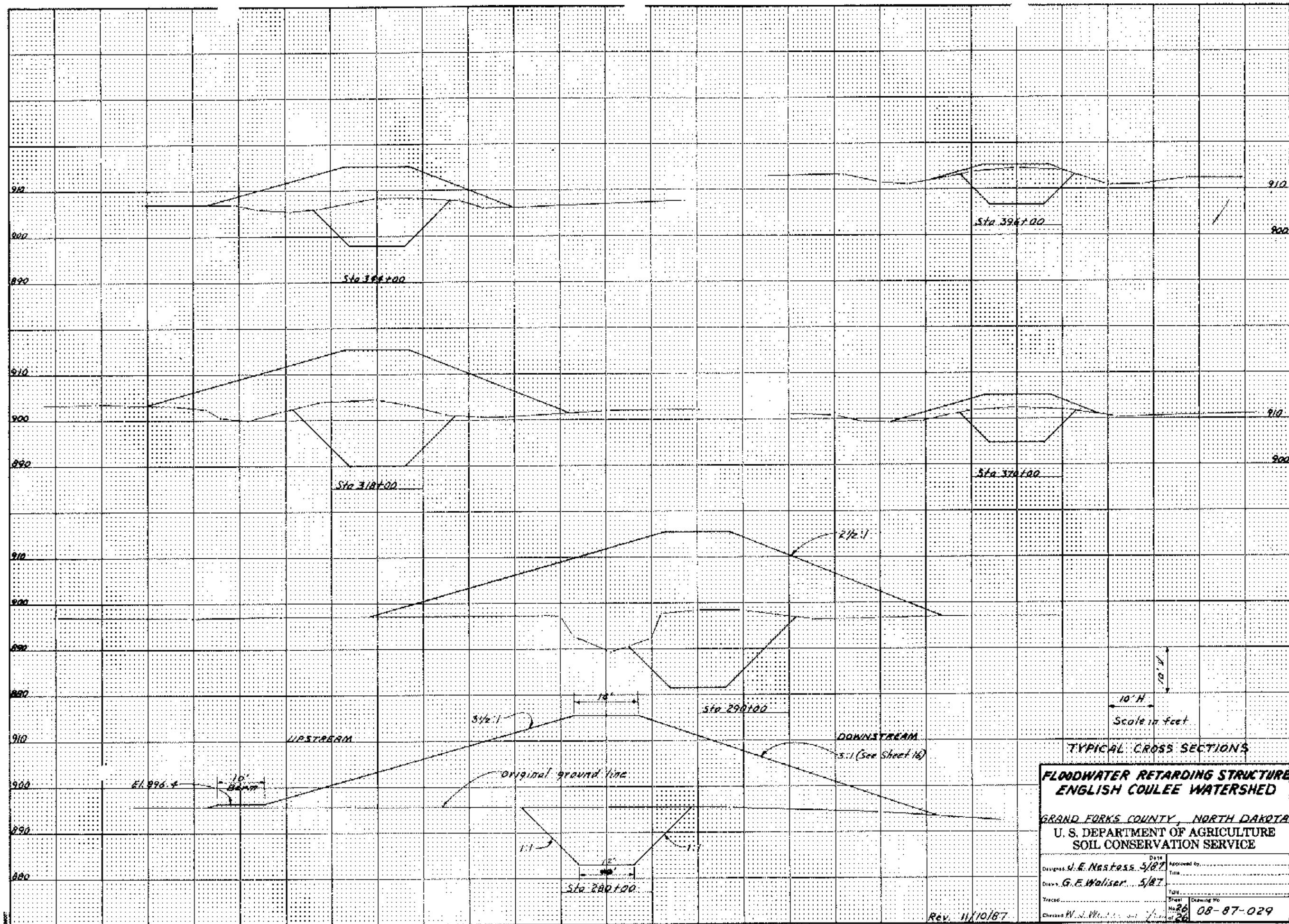
English Couler Dam
Phase I
Embankment As-built Profiles

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn JRD		Title AS BUILT 12-90
Traced	Sheet	Drawing No.
Checked J.M. 12-90	No.	

SCS-ENG-318 REV 9-79





AS-BUILT PLANS

ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY

NORTH DAKOTA

FLOODWATER RETARDING STRUCTURE

CONTRACTOR: SWINGEN CONSTRUCTION COMPANY
BOX 126, GRAND FORKS, ND 58206

CONTRACT NO. 50-6633-9-24

CONSTRUCTION STARTED: 10-12-89

CONSTRUCTION COMPLETED: 11-15-90

ENGINEERS: ROGER THOMPSON, P.E.
KATE MEHL, A.E.
JODY KRAENZEL, A.E.

INSPECTOR: JOHN SUCHOR JR.

PHASE 2

SPONSORING AGENCIES

EASTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT

WESTERN GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT

GRAND FORKS COUNTY WATER RESOURCE DISTRICT

CITY OF GRAND FORKS

NORTH DAKOTA STATE WATER COMMISSION

WITH ASSISTANCE BY

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Roger Thompson, P.E.
5-13-91

John Suchor, CET
5-13-91



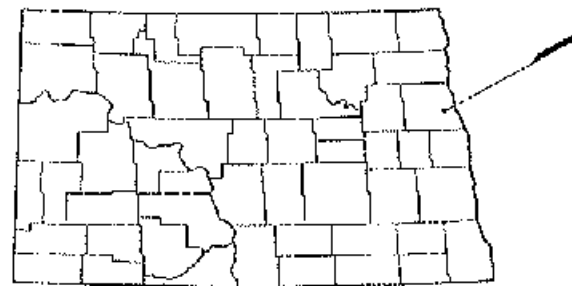
INDEX TO DRAWINGS		INDEX TO DRAWINGS	
SHEET NO.	CONTENTS	SHEET NO.	CONTENTS
1.	Cover Sheet	37 thru 39	Chute Spillway - Steel Reinforcement Schedules - Side Wall Joint Details
2.	Location Map Table of Quantities Typical Cross Section Intermediate Storage Basin	40.	Chute Spillway - Floor Joint Details
3.	Topographic Map of Dam Site	41.	Chute Spillway - Typical Pavement Slab Sections
4.	Profile Along Centerline of Dam Test Area Data Collection Area	42 thru 50	Chute Spillway - Detail to J43 Excavation & Backfill Details
5.	Details of Rock Weir Dikes	51 thru 57	Chute Spillway - J41 to J42
6.	Topographic Map of Structure Inlets	58 thru 64	Chute Spillway - J42 to J43
7.	Profile Along Centerline of Principal Spillway	65 thru 71	Chute Spillway - J43 to J44
8.	Principal Spillway - Seepage Drainage	72 thru 79	Chute Spillway - J44 to J45
9.	Principal Spillway - Inlet and Outlet Details	80 thru 88	Chute Spillway - J45 to Inlet
		Attachments	Soil Legend, Drawg. No. 5, R-10, 600, 27

NOTED: THAT THE PLANS AND DETAIL SPECIFICATIONS
ON THIS DRAWING HAVE BEEN REVIEWED BY THE SOIL CONSERVATION
SERVICE AND APPROVED.

Michael C. Schmedel
9-5-89

DRWG. NO. 08-89-031

SHEET NO. 1 OF 88



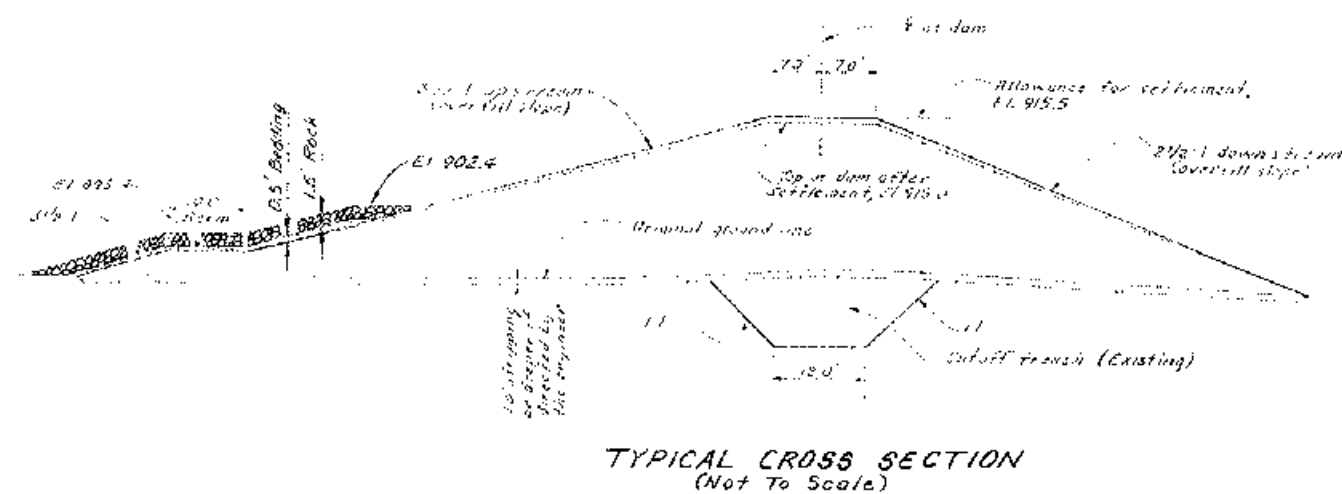
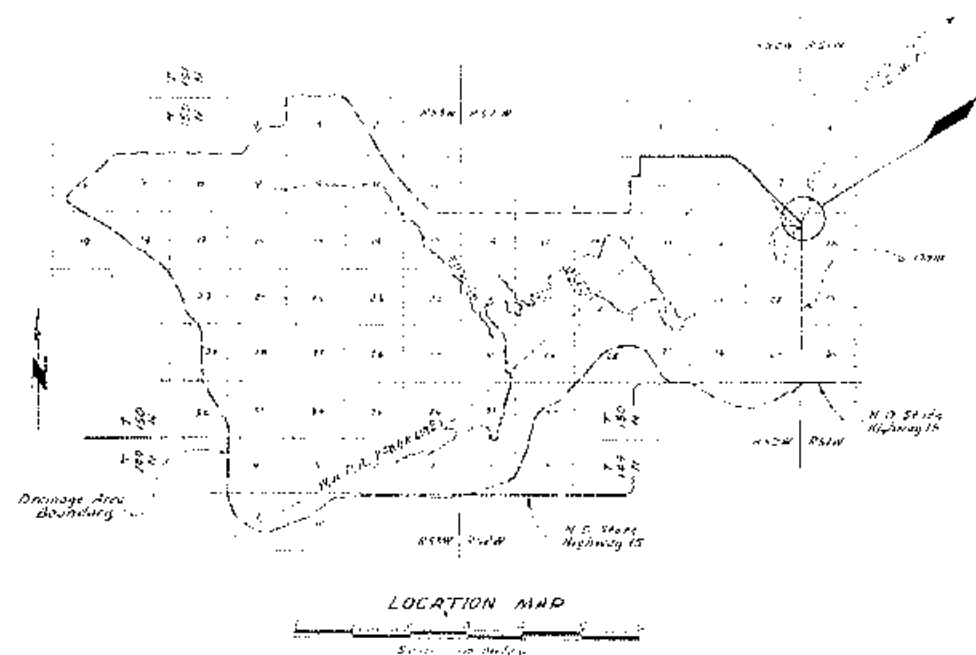
LOCATION IN GRAND FORKS COUNTY, NORTH DAKOTA

STATION	AREA (SQ. YD.)	CUMULATIVE SPILLWAY (AC. FT.)
895.0	1.0	1.0
896.0	2.0	3.0
897.0	3.0	6.0
898.0	4.0	10.0
899.0	5.0	15.0
900.0	6.0	21.0
901.0	7.0	28.0
902.0	8.0	36.0
903.0	9.0	45.0
904.0	10.0	55.0
905.0	11.0	66.0
906.0	12.0	78.0
907.0	13.0	91.0
908.0	14.0	105.0
909.0	15.0	120.0
910.0	16.0	136.0
911.0	17.0	153.0
912.0	18.0	171.0
913.0	19.0	190.0
914.0	20.0	210.0
915.0	21.0	231.0

Original Ground

Grass - 10' Spillway

Top of dam after settlement



TYPICAL CROSS SECTION (Not To Scale)

TABLE OF QUANTITIES

AS BUILT

ITEM	UNIT	QUANTITY	QUANTITY
Seeding (includes fertilizing and mulching)	Ac.	17.0	20.2
Excavation: Foundation Stripping	Cu. Yd.	1,440	1290.24
Principal Spillway and Outlet	Cu. Yd.	9,548	3918.4
Chute Spillway and Outlet	Cu. Yd.	4,255	4016.45
Earth Fill, Class A	Cu. Yd.	78,154	78,251.2
Fine Gravel Fill	Cu. Yd.	889	869
Coarse Drain Fill	Cu. Yd.	1,101	1,181
Salvaging and Spreading Topsoil	Sq. Yd.	10,500	28,364
Concrete Working Slab, Class 2500, Air-Entrained (12" Thick)	Cu. Yd.	198.9	186.9
Reinforced Concrete, Class 4000, Air-Entrained	Cu. Yd.	2,324.3	2,524.3
Steel Reinforcement	Lb.	290,446	290,446
24" Dia. Reinforced Concrete Pipe	Lin. Ft.	16	16
88" Dia. Reinforced Concrete Pipe	Lin. Ft.	128	128
24" x 24" Slide Gate	Ea.	1	1
15" Dia. Flap Gate	Ea.	2	2
Trash Racks	Lump Sum	---	---
Gate Well Gratings	Lump Sum	---	---
Expansion Joint Plates	Lump Sum	---	---
Chain Link Fence	Lin. Ft.	140	208.5
6" Dia. Perforated PVC Pipe	Lin. Ft.	1295	1295
6" Dia. Non-Perforated PVC Pipe	Lin. Ft.	637	637
Rock Riprap with Bedding	Cu. Yd.	8762	8,335
88" Dia. Beveled Pipe Fitting	Lump Sum	---	---
Manholes	Ea.	12	12

*ALL QUANTITIES ARE ESTIMATED

MODIFIED ITEM #28, ROCK RIPRAP @ CMP STA 326+83

107 CY.

MODIFIED ITEM #31, ROCK RIPRAP @ PRIN. SPILLWAY OUTLET

54 CY.

EXCAVATION, CHUTE SPILLWAY BACKFILL-STRIPPING

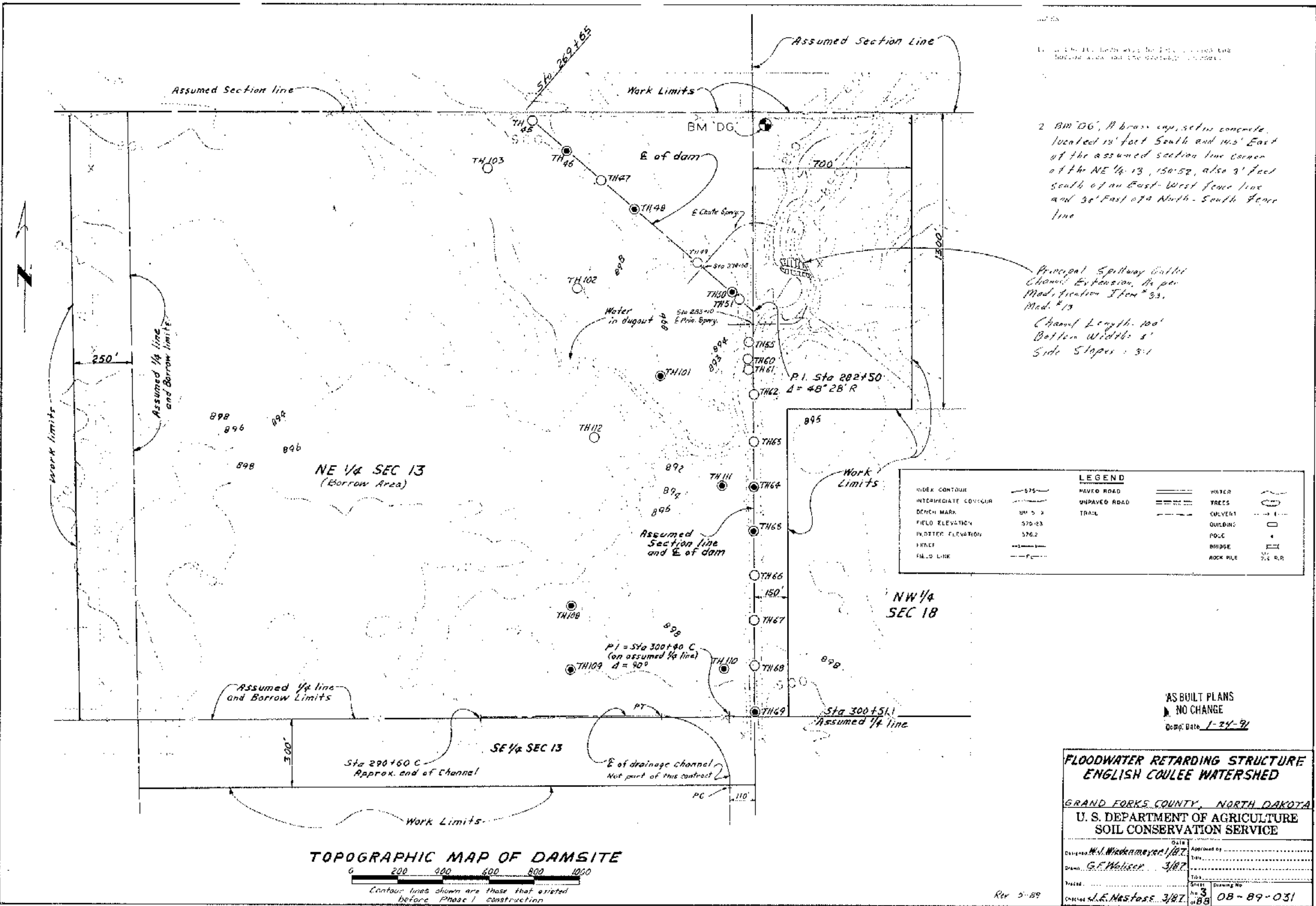
253 CY.

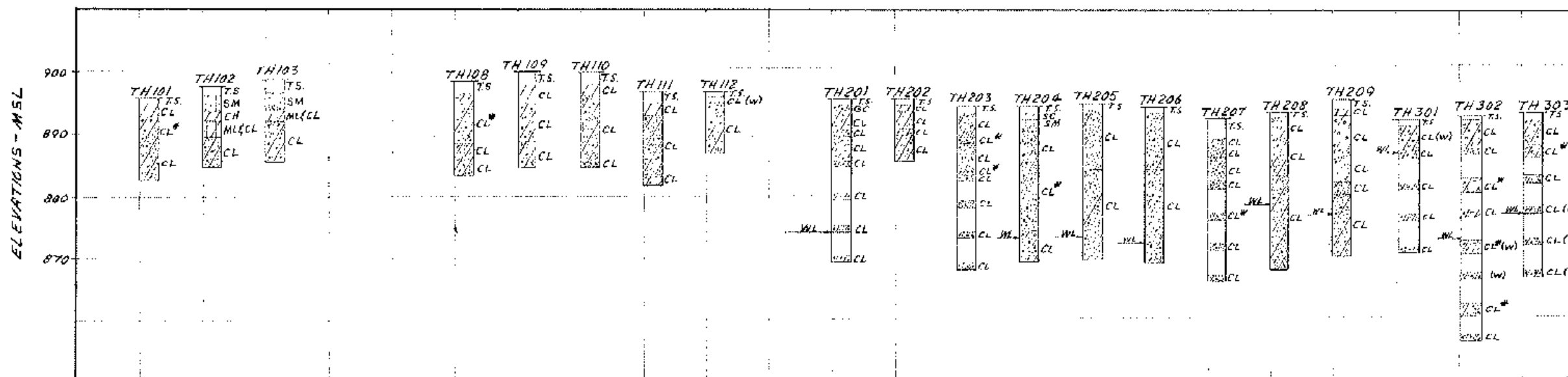
AS BUILT 1-24-91

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Drawn	Jon Nestoss 5/89	Checked	George Waliser 5/89
Revised	Dennis Reep 6/89	Drawn	---
Scale	1" = 20'	Sheet	2
Project	08-89-031	Drawn	---

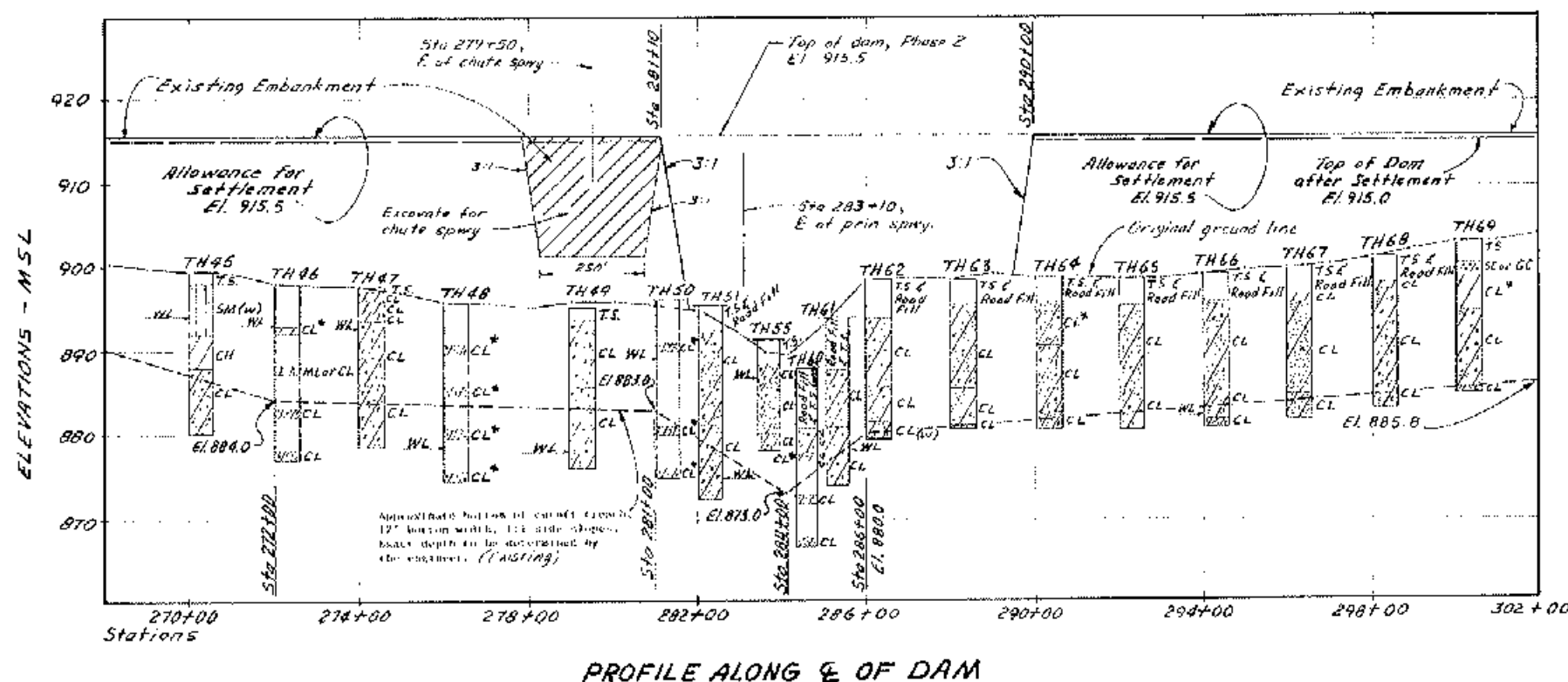




TEST HOLE DATA - BORROW AREA

NOTES-

1. For soils legend, see Standard Drawing S.E. 10,000, C7.
2. Soil Exploration Date: August 1979.
3. Groundwater and site conditions:
 - a. WL indicates groundwater on the date of the soil exploration. Variation should be expected.
 - b. (w) indicates either wet and soft or saturated and soft materials on soils logs on date of the soil exploration. Variation should be expected.
 - c. In general, the surface 1 ft to 5 ft can be expected to be wet and soft with moist, firm materials below.
 - d. Scattered concentrations of cobbles and boulders are present on the dam site foundation and borrow areas. These materials will be stockpiled in the borrow areas or other areas approved by the engineer.
4. The Unified Soil Classification symbols followed by an asterisk are based on laboratory classification. Those without an asterisk are based on field classification and are subject to revision based on laboratory tests.
5. Records of the geologic investigation and laboratory test data can be reviewed at the SCS office in Grand Forks.
6. TS indicates topsoil on soils logs.
7. A 100 ft berm will be left between the upstream toe of the dam and all borrow areas.



PROFILE ALONG E OF DAM

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by W. J. Wickham, Jr. 1/87	Date 1/87
Drawn by G. E. Wolcott 2/87	Checked by J. E. Nestors 3/87
Scale 1" = 20'	Drawing No. 08-89-031

Rev. 5-89

NOTES:

1. Rock riprap dikes are located on the upstream face of the embankment constructed under Phase 1 of this project.
2. The dikes are located at the stations indicated on the plan view and are perpendicular to the centerline of the dam.

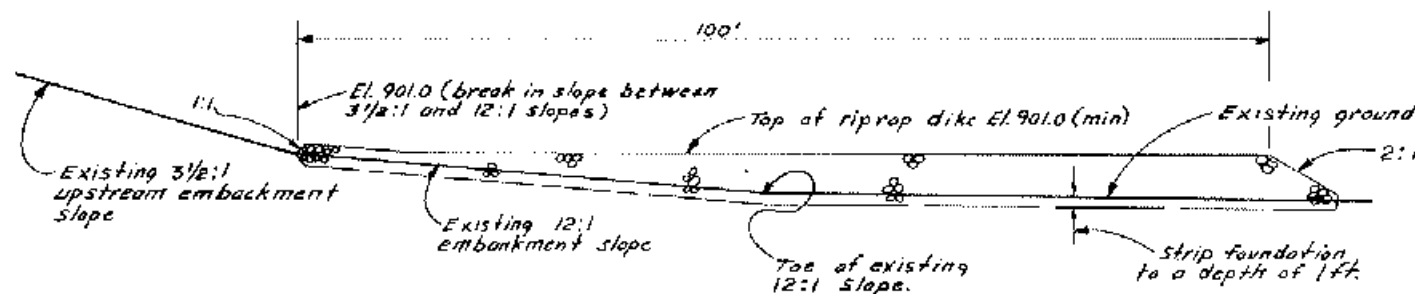
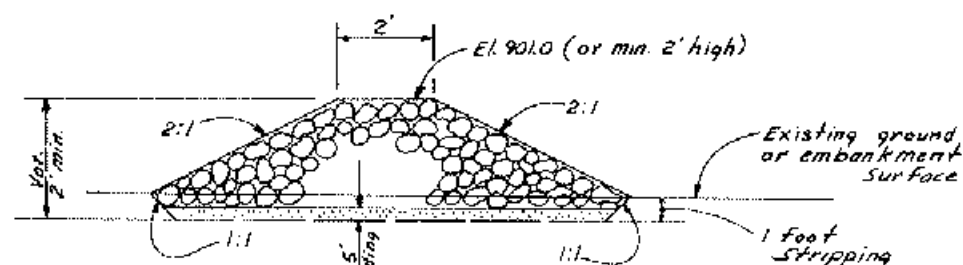
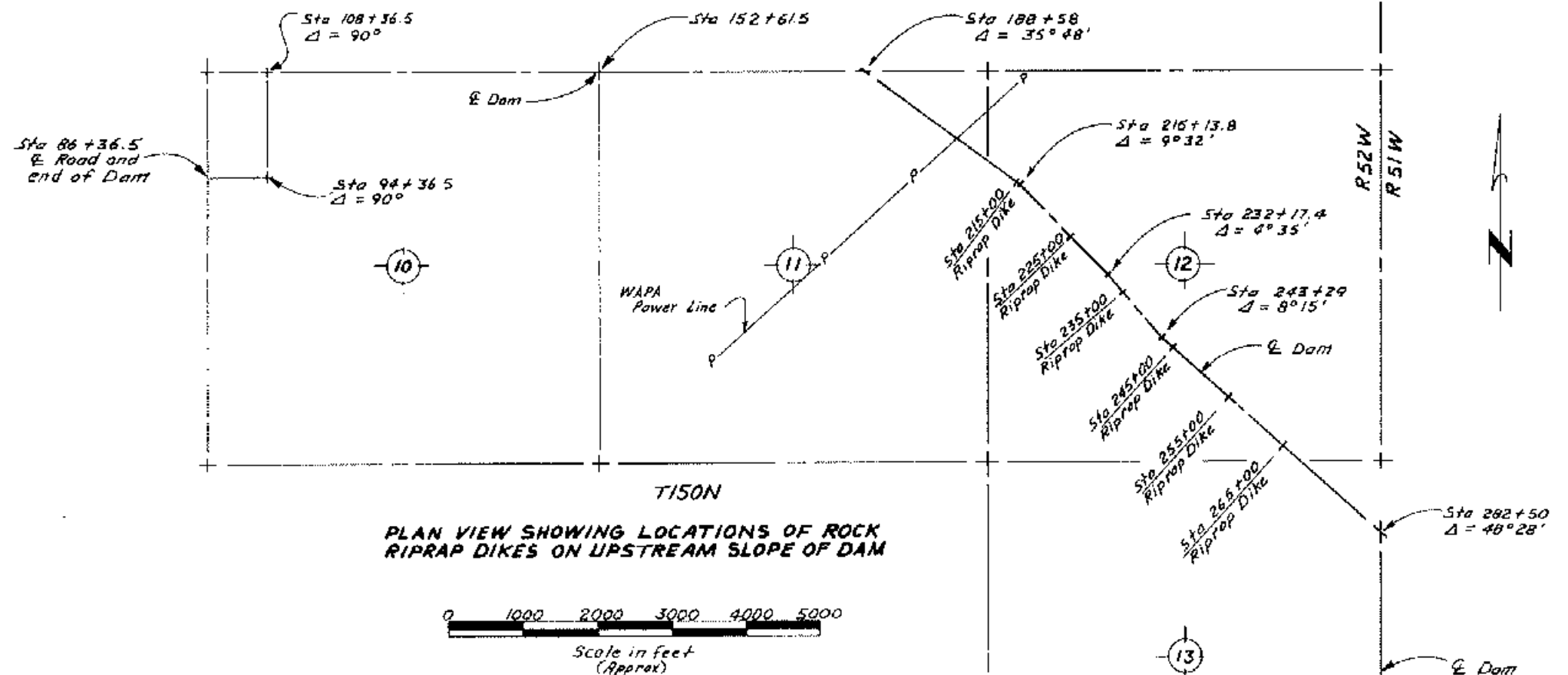


TABLE OF QUANTITIES
ROCK RIPRAP DIKES

Station	Unit	Quantity	Quantity
215 + 00	C.Y.	155	157
225 + 00	C.Y.	175	168.3
235 + 00	C.Y.	86	149.6
245 + 00	C.Y.	115	99.8
255 + 00	C.Y.	115	127
265 + 00	C.Y.	61	47

AS BUILT 1-24-91

DETAIL OF ROCK RIPRAP DIKES

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed *Jan Nestoss* 5/89
Drawn *George Holiser* 5/89
Checked *Dennis Reep* 6/89
No. 5
08-89-031

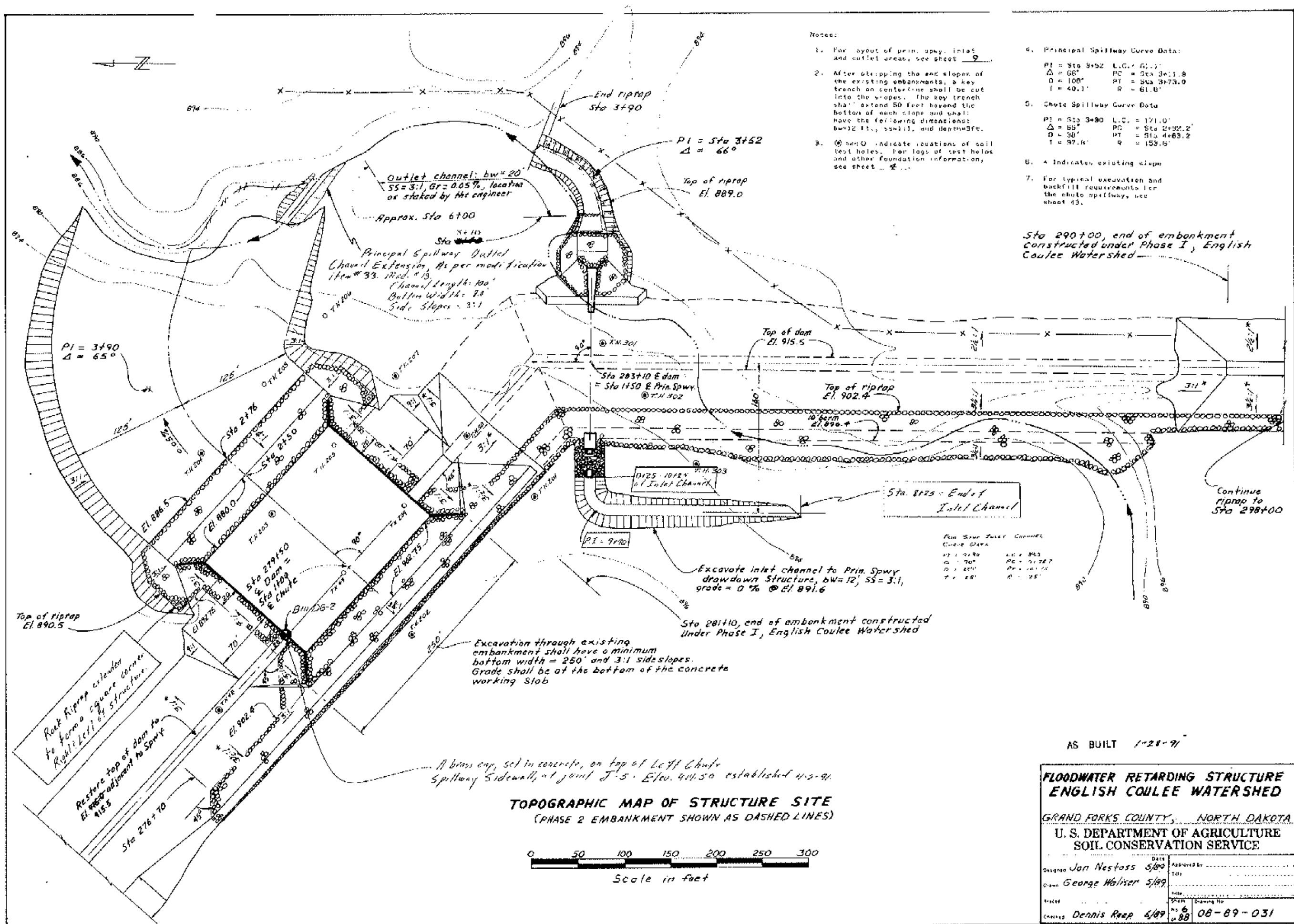


TABLE OF JOINT ELEVATIONS

LOCATION	LENGTH (ft.)	ELEVATION (m.s.l.)
OUTLET	16.82	881.75
J#1	9.67	881.08
J#2	15.67	884.88
J#3	3.0	887.08
J#4	3.0	888.0
J#5	16.6	889.04
J#6	16.0	888.55
J#7	16.0	890.11
J#8	16.0	890.38
J#9	16.0	890.67
J#10	16.0	891.13
J#11	16.0	891.50
J#12	4.0	891.45
INLET		881.25

NOTES:

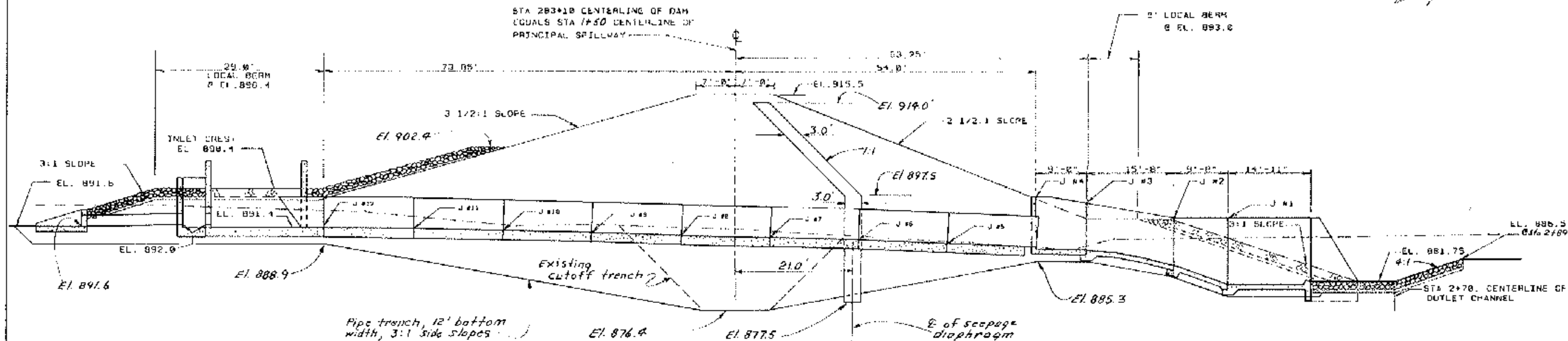
1. Elevations for J#4 through J#12 are invert elevations for the 66 inch dia. reinforced concrete pipe. Lengths are nominal pipe lengths and actual laying lengths will vary.
2. The length from J#12 to the inlet structure is measured along the invert of the pipe of section of 66" dia. reinforced concrete pipe.
3. Bank wrap is 1.5 ft. thick plus 0.5 thick bedding (measured vertically).

Use these elevation
this sheet.

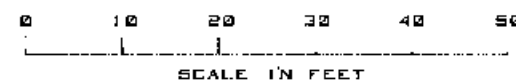
* Please Note:

During the course of construction, it was discovered by the Construction Project Crew Staff, on 6-18-90, that the Table of Joint Elevations did not reflect necessary camber designed from the Principal Spillway. The Contractor had already laid three pipe sections, J-4 thru J-7. Pipe concrete cradle had been poured J-4 thru J-6. The Contracting Officer, at the advice of the engineering section directed the pipe be laid at a basically straight line grade from joint 8 to joint 12. This results in minor changes to these joint elevations. The changes did not affect or alter any of the excavation quantities, placement of support pads or procedures planned by Contractor. See revised page 7 (dated 6/90) for the built pipe grades.

John Duster,
Inspector 1-28-91



PROFILE ALONG CENTERLINE OF PRINCIPAL SPILLWAY

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

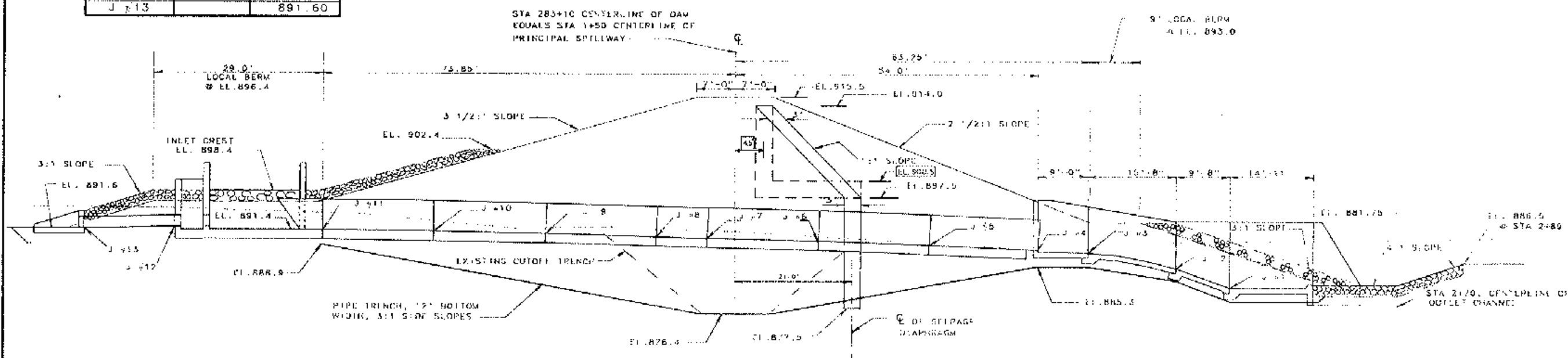
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

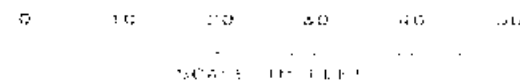
Designed	JON NESTORS	DATE	2/89	Approved By	
Drawn	GEORGE WALZEB	DATE	2/89	Checked	
Traced		DATE		Drawn No.	
Checked	DENNIS REEP	DATE	6/89	Drawn No.	08-89-031

LOCATION	LENGTH (ft)	ELEVATION (msl)
OUTLET		881.75
J #1	14.92	881.08
J #2	9.67	884.33
J #3	15.67	887.08
	9.0	
J #4		888.0
	19.83	
J #5		888.52
	19.83	
J #6		889.04
	19.83	
J #7		889.57
	8.87	
J #8		889.80
	19.83	
J #9		890.30
	19.83	
J #10		890.80
	19.83	
J #11		891.30
	4.0	
INLET		891.40
J #12		892.00
	16.0	
J #13		891.60

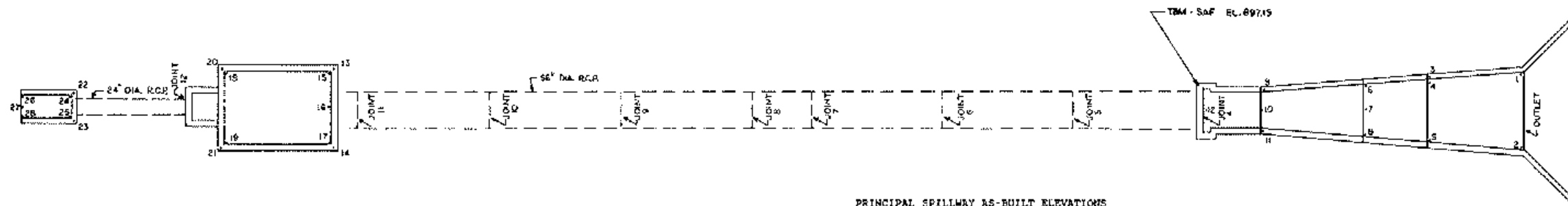
1. ELEVATIONS FOR J#4 THROUGH J#11 ARE INVERT ELEVATIONS FOR THE 66 INCH DIA. REINFORCED CONCRETE PIPE. ELEVATIONS FOR J#12 AND J#13 ARE INVERT ELEVATIONS FOR THE 24 INCH DIAMETER REINFORCED CONCRETE PIPE. LENGTHS ARE AVERAGE LAID LENGTHS AND ACTUAL LAYING LENGTHS WILL VARY.
2. THE LENGTH FROM J#13 TO THE INLET STRUCTURE IS MEASURED ALONG THE INVERT OF THE BEVELLED SECTION OF THE 66" DIA. REINFORCED CONCRETE PIPE.
3. ROCK RIPRAP IS 1.5 FT. THICK PLUS 0.5 THICK BEDDING (measured vertically).



PROFILE ALONG CENTERLINE OF PRINCIPAL SPILLWAY



FLOODWATER RETARDING STRUCTURE		ENGLISH COULEE WATERSHED	
GRAND FORKS COUNTY		NORTH DAKOTA	
 U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed BY	JOHN KESTRESS	1871	Approved By
	3/2/59		1-1-59
Checked BY	GEORGE WALSH	3/2/59	
Drawn BY			
Engineer	LENNIS REIF	4/2/59	08 - 89 - 03



PRINCIPAL SPILLWAY PIPE INVERT ELEVATIONS

LOCATION	ELEVATION (FT)	DATE TAKEN
JOINT #4	887.99	6/12/90
	887.93	11/9/90
JOINT #5	888.52	6/12/90
	888.28	11/9/90
JOINT #6	889.06	6/19/90
	888.77	11/9/90
JOINT #7	889.58	6/18/90
	889.17	11/9/90
JOINT #8	889.80	6/19/90
	889.53	11/9/90
JOINT #9	890.30	6/20/90
	890.17	11/9/90
JOINT #10	890.83	6/22/90
	890.77	11/9/90
JOINT #11	891.31	6/23/90
	891.32	11/9/90
JOINT #12	891.40	6/27/90
	891.40	11/9/90

PRINCIPAL SPILLWAY PIPE JOINT GAPS

	LEFT	RIGHT	TOP	BOTTOM	DATE TAKEN
JOINT 5	1/2"	1/2"	3/4"	1/8"	6/16/90
	1/2"	7/8"	3/4"	0"	11/26/90
JOINT 6	3/4"	1/2"	1/4"	1"	6/18/90
	1 1/4"	1"	5/8"	1 1/4"	11/26/90
JOINT 7	1/2"	3/8"	1/4"	7/8"	6/18/90
	1 7/8"	1 3/4"	1 1/8"	2 3/4"	11/26/90
JOINT 8	1/2"	3/8"	3/8"	3/4"	6/21/90
	2 1/8"	2 1/8"	2 1/2"	1 3/4"	11/26/90
JOINT 9	3/4"	5/8"	3/4"	1/2"	6/22/90
	1 1/8"	7/8"	1"	3/4"	11/26/90
JOINT 10	7/8"	1/2"	1/2"	3/4"	6/23/90
	2"	3/4"	3/4"	5/8"	11/26/90
JOINT 11	1 2/8"	1 1/2"	1 1/8"	1 1/4"	11/26/90

PRINCIPAL SPILLWAY AS-BUILT ELEVATIONS

MARK (.)	ELEVATION (FT)	DATE TAKEN
1	881.70	5/16/90
2	881.71	5/16/90
3	893.33	5/25/90
4	881.01	5/16/90
5	881.07	5/16/90
6	884.33	5/26/90
7	884.33	5/26/90
8	884.33	5/26/90
9	895.99	6/5/90
10	887.07	5/31/90
11	896.00	6/5/90
12	887.99	6/12/90
13	898.40	7/11/90
14	898.40	7/11/90
15	891.40	6/29/90
16	891.40	6/27/90
17	891.42	6/29/90
18	891.44	6/29/90
19	891.43	6/29/90
20	898.41	7/11/90
21	898.40	7/11/90
22	894.89	7/19/90
23	894.92	7/19/90
24	891.65	7/19/90
25	891.63	7/19/90
26	891.64	7/19/90
27	891.67	7/18/90
28	891.63	7/19/90

0 10 20
SCALE IN FEET

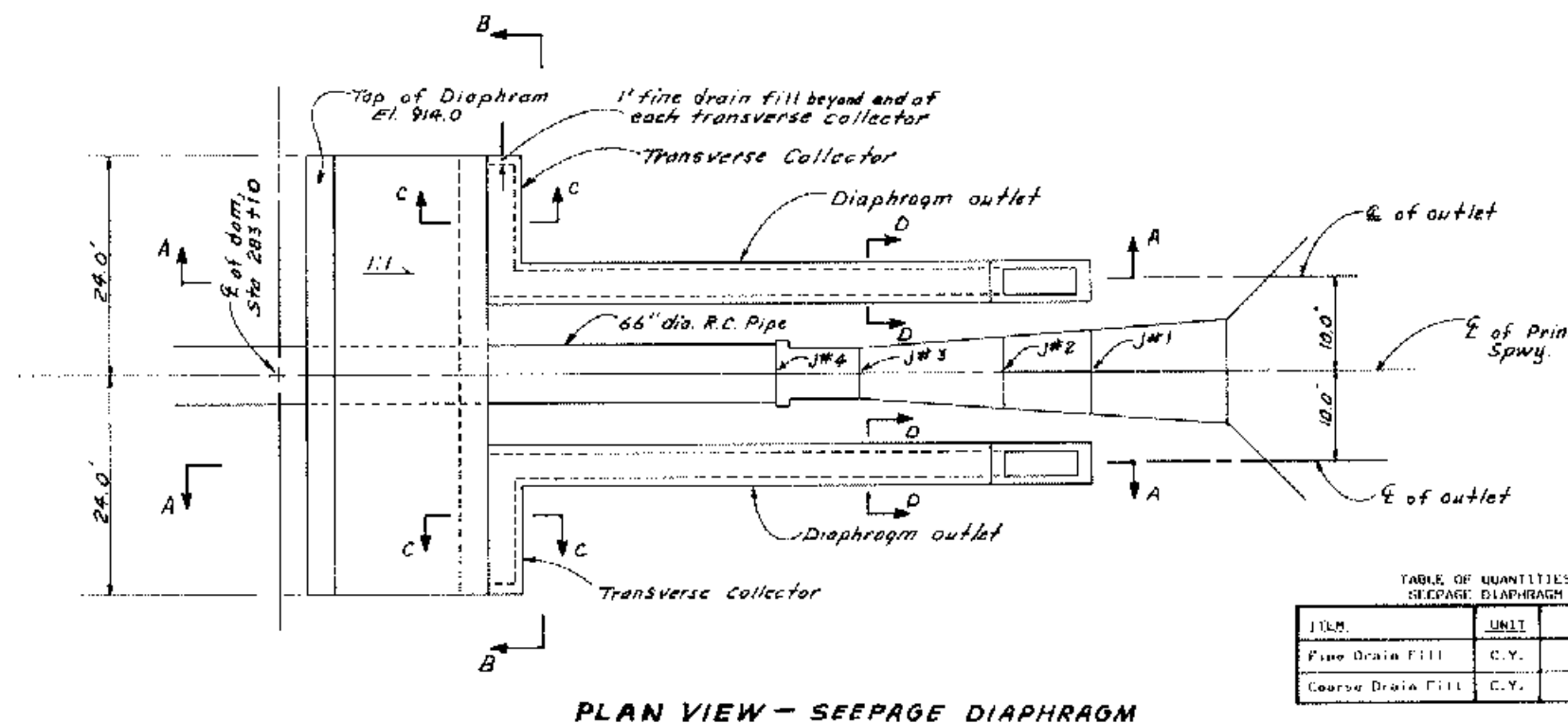
PRINCIPAL SPILLWAY AS-BUILT'S

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH CAROLINA

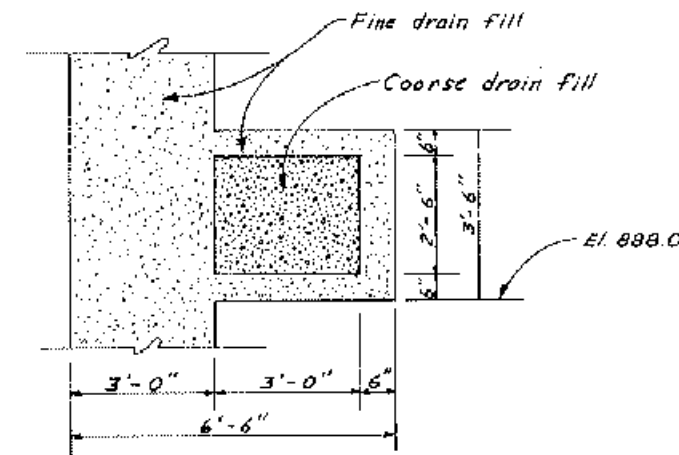
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by	Date	Approved by
Drawn by	1/91	Title
Trapped		Sheet
Checked		Drawing No.
		No. 7.1
		of 22



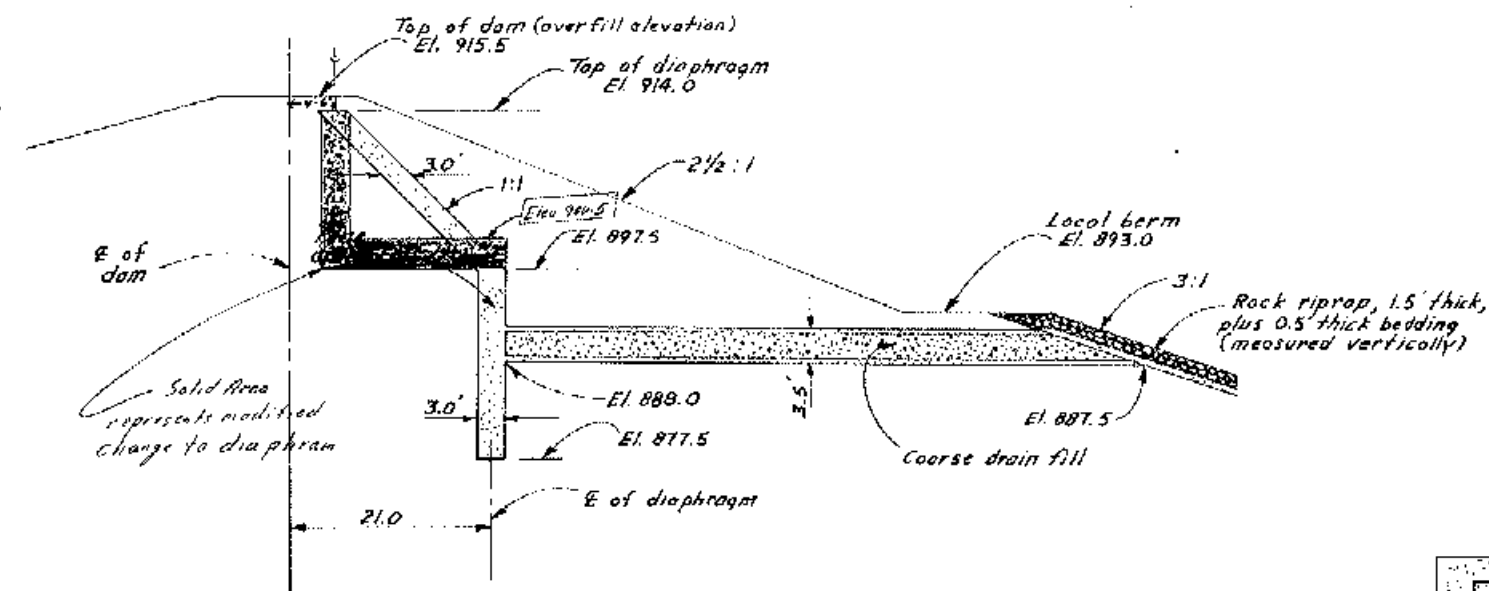
PLAN VIEW - SEEPAGE DIAPHRAGM

ITEM	UNIT	QUANTITY
Fine Drain Fill	C.Y.	236
Coarse Drain Fill	C.Y.	40

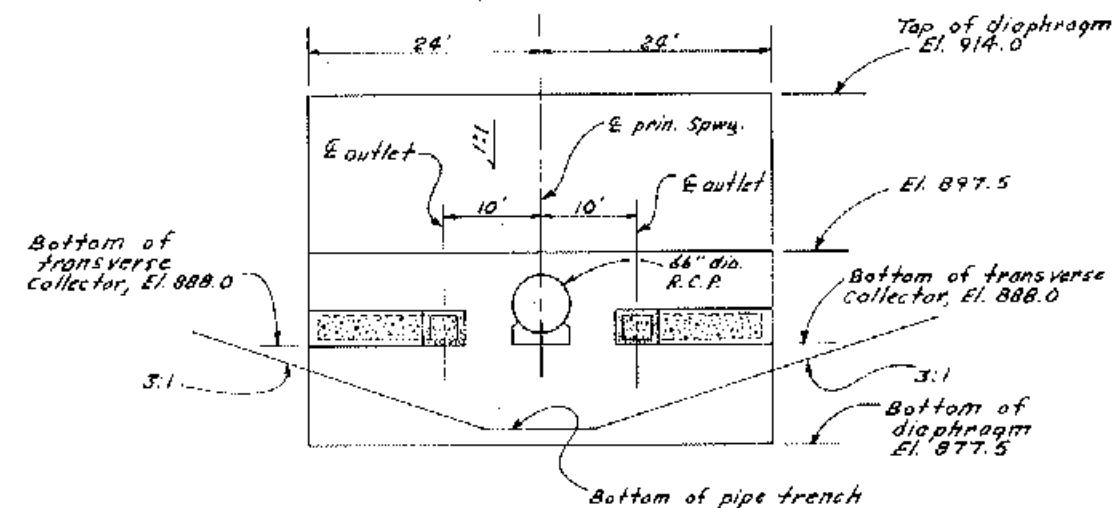


TRANSVERSE COLLECTOR
SECTION C - C

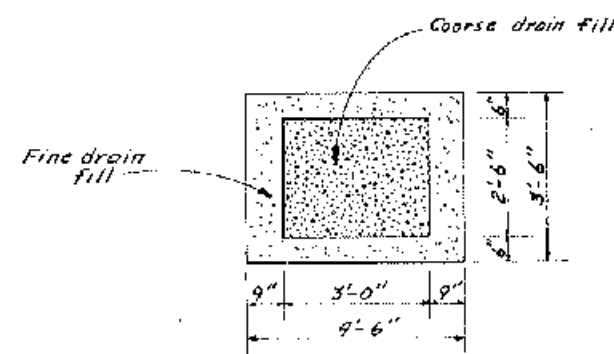
This quantity reflects the contract paid item only.
Actual quantity was considerably more due to
modified change of seepage diaphragm at Contractor's
expense, due to ease of construction.



PROFILE ALONG E OF DIAPHRAGM OUTLET
SECTION A - A



DOWNSTREAM ELEVATION
OF SEEPAGE DIAPHRAGM
SECTION B - B



DIAPHRAGM OUTLET
SECTION D - D

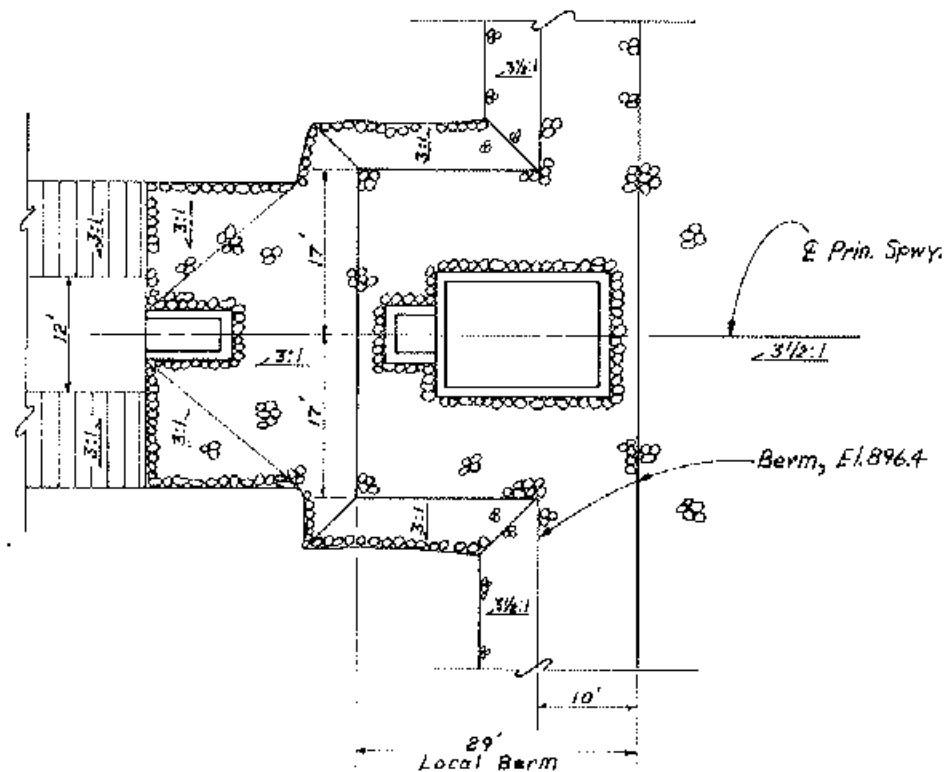


AS BUILT 1-21-91

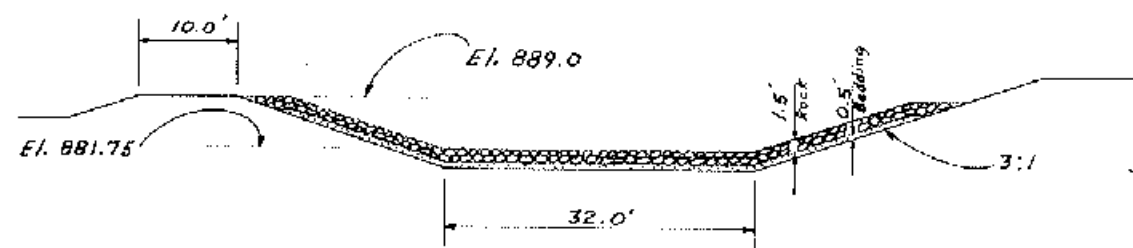
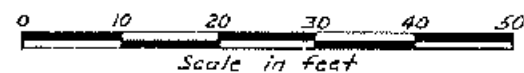
DETAILS OF PRIN. SPWY DIAPHRAGM
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORK'S COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

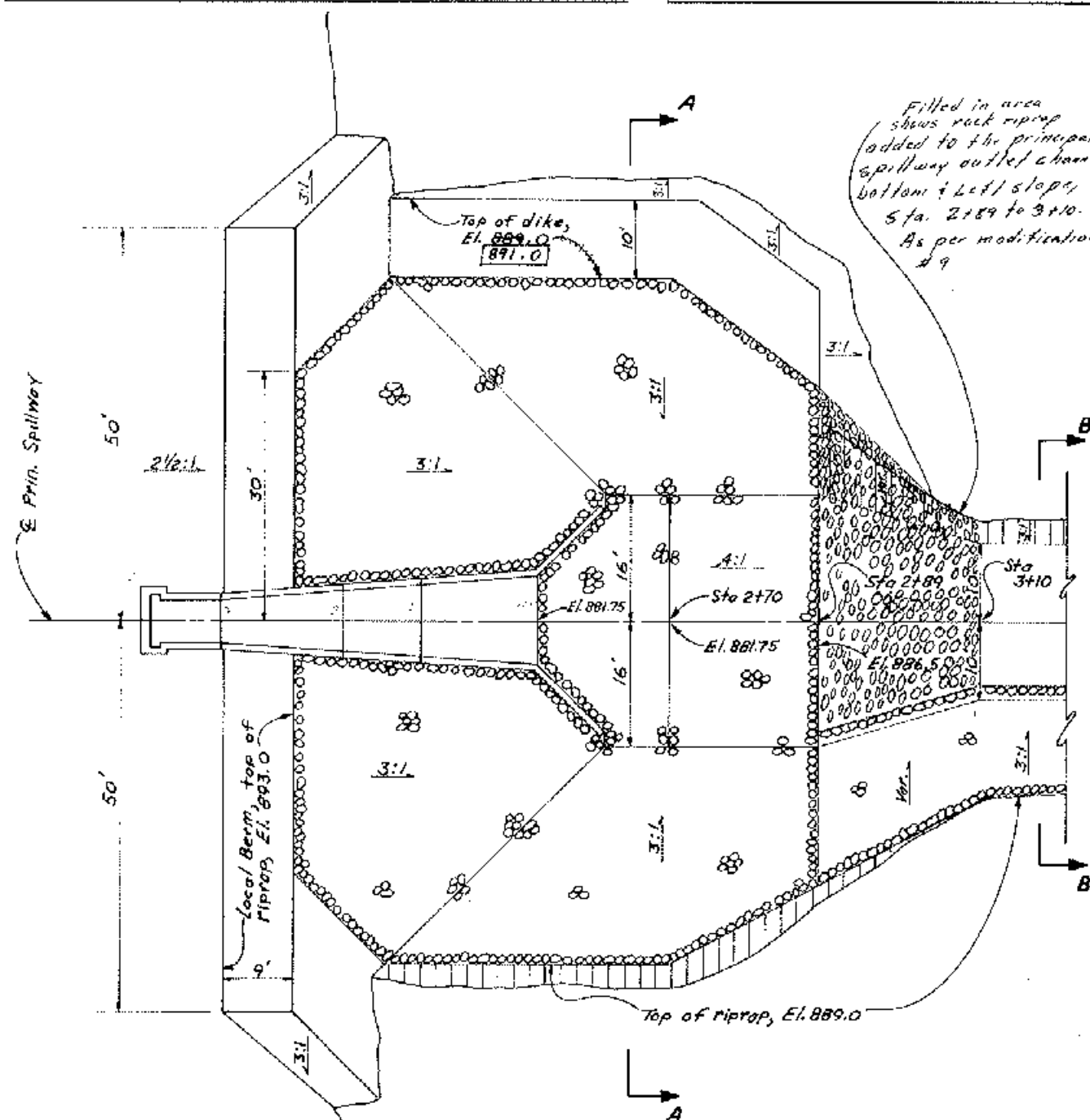
DESIGNED	Jon Nestess 5/89	Date	Approved by	
DRAWN	George Maliser 5/89	Title		
Traced		Sheet		
Checked	Dennis Reap 6/89	Drawing No		



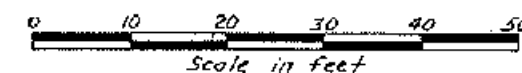
PLAN VIEW - PRINCIPAL SPILLWAY INLET



SECTION A-A
(NOT TO SCALE)



PLAN VIEW - PRINCIPAL SPILLWAY OUTLET



AS BUILT 1-24-97

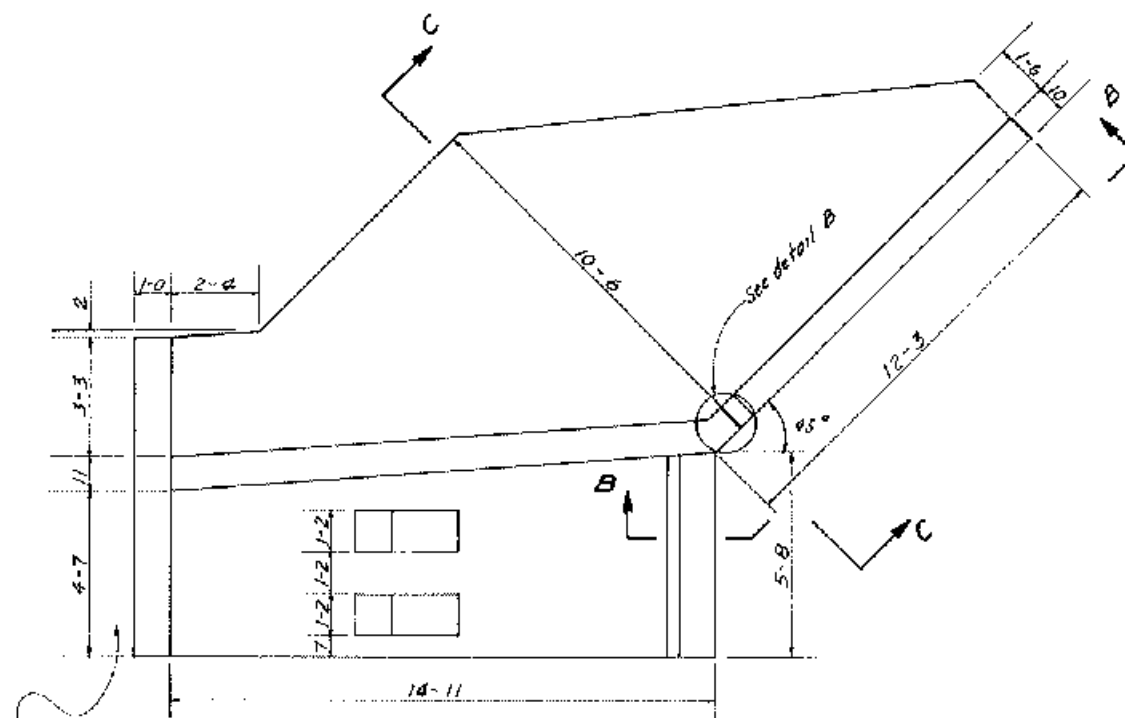


SECTION B-B
DETAIL OF RIPRAP ON OUTLET
CHANNEL CURVE
(NOT TO SCALE)

FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED

GRAND FORK COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

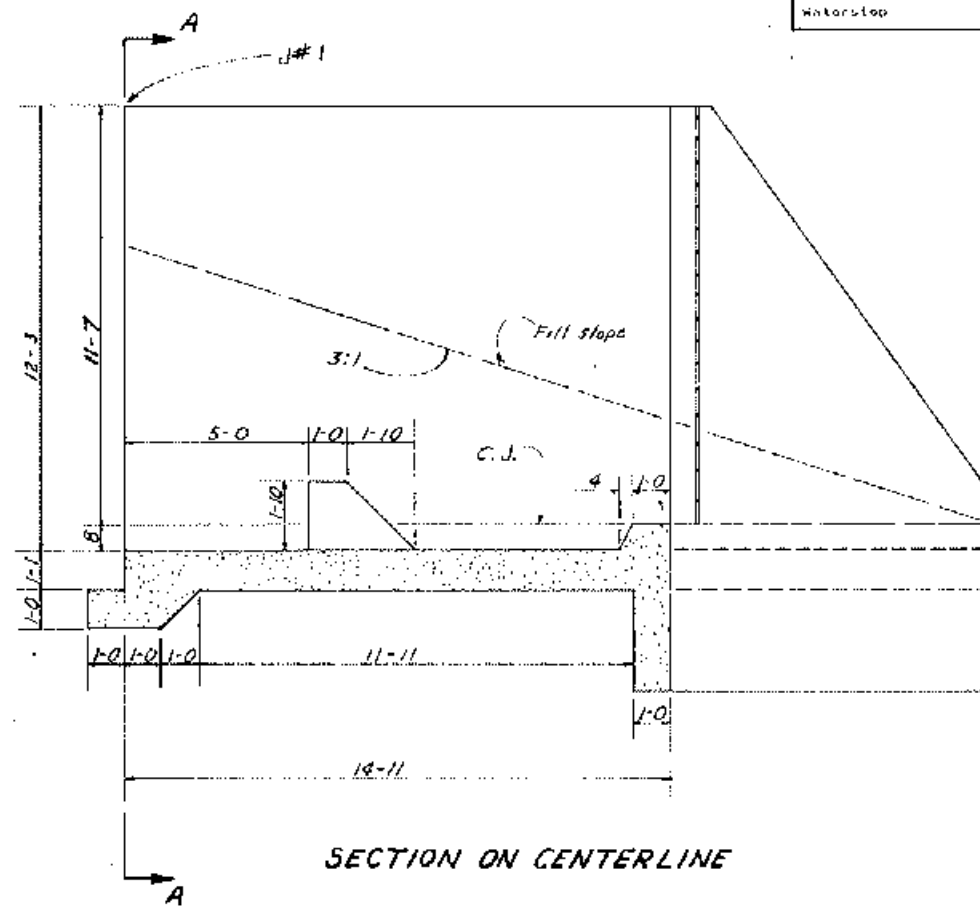
Designed: Jon Nestess 5/89
Drawn: George Nolliser 5/89
Traced: [blank]
Checked: Dennis Reap 6/89
Date: 5/89
Approved by: [blank]
Title: [blank]
Drawing No: 08-89-031



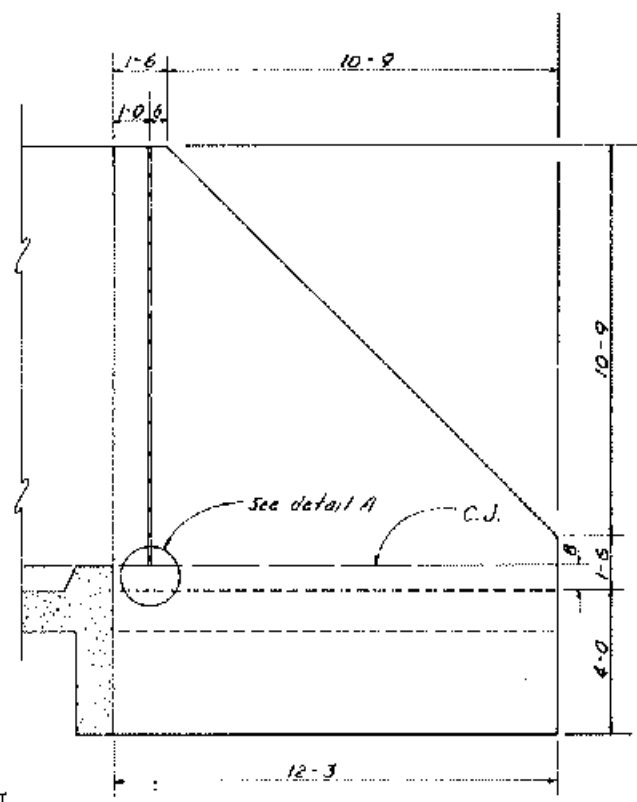
HALF PLAN

TABLE OF QUANTITIES AS BUILT

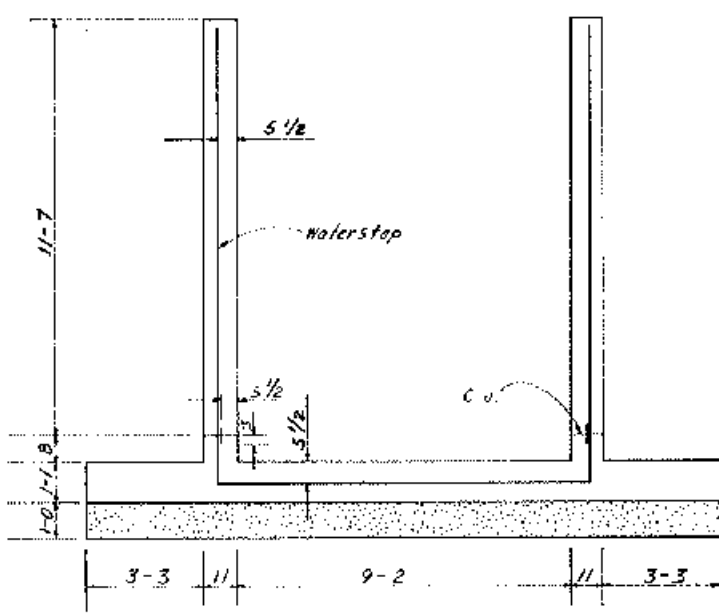
ITEM	UNITS	QUANTITY
Concrete (Class 4000)	Cu. Yd.	45.4
Steel Reinforcement	Lb.	6053
Steel Bar, 1/2" x 1/4" (C.J.)	Lins. Ft.	54
Waterstop	Lins. Ft.	58



SECTION ON CENTERLINE

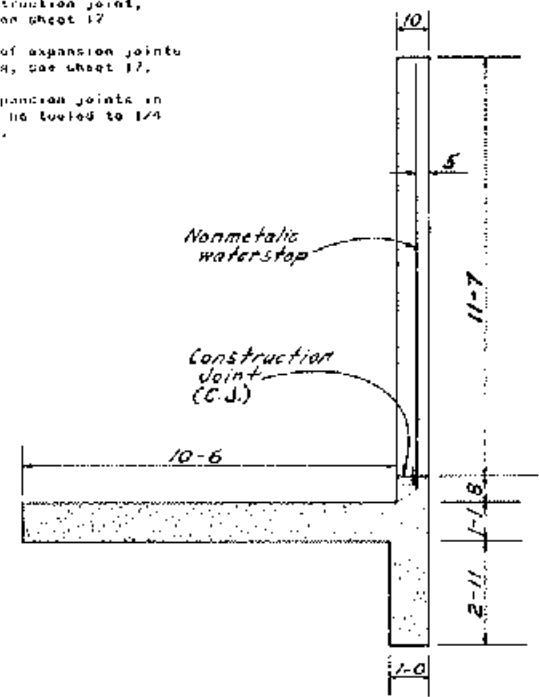


SECTION B-B

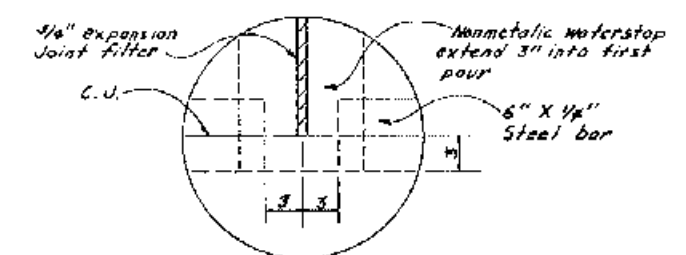


SECTION A-A

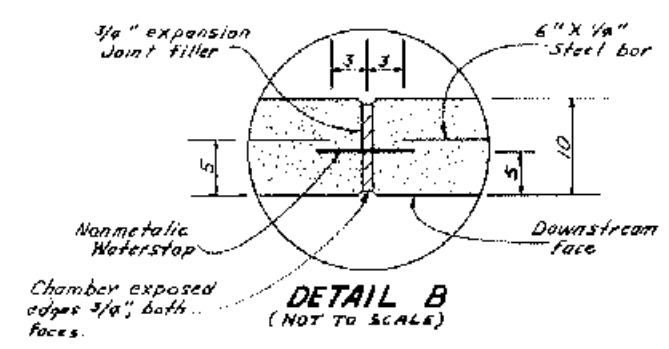
- Notes:
1. J - Expansion joint
 2. C.J. - Construction joint, see detail on sheet 17
 3. For detail of expansion joints in sidewalk, see sheet 17.
 4. Edges of expansion joints in floor will be tued to 1/4 inch radius.



SECTION C-C



DETAIL A
(NOT TO SCALE)



DETAIL B
(NOT TO SCALE)

SAF - OUTLET TO J#1

AS BUILT PLANS
NO CHANGE
Comp. Date 1-21-97

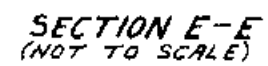
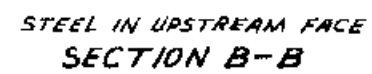
**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by Wes. Niekomeyer 6/86 Date 6/86
 Drawn by George M. Miller 6/86
 Checked by Don Nestoss 12/86
 Approved by _____ 12/86
 Title _____
 Sheet 10 of 88
 Drawing No. 08-89-031





AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-91

SAF - OUTLET TO J#1

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

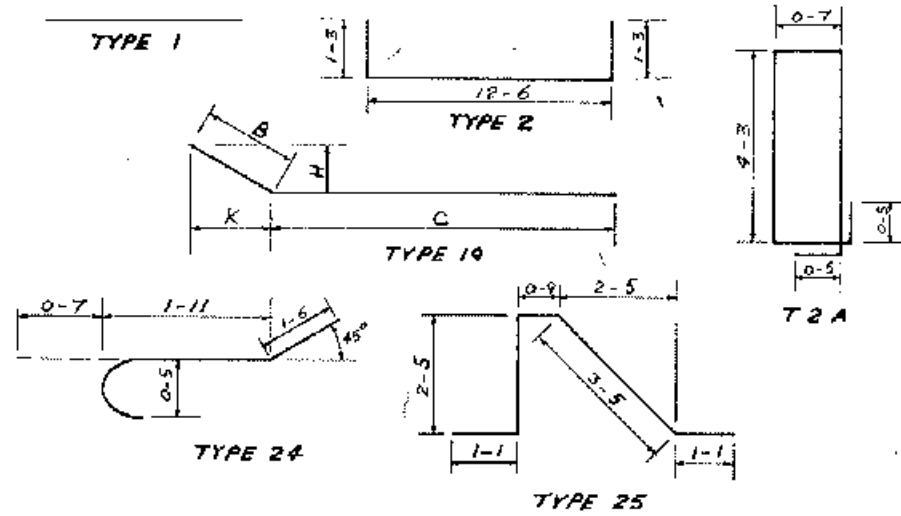
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		Approved by:	
Designed <i>WJW</i>	<i>11/86</i>	Title	
Drawn <i>GFW</i>	<i>1/87</i>	Title	
Traced		Sheet	Drawing No
Checked <i>J.E.N.</i>	<i>12/86</i>	No. <i>11</i>	<i>08-89-031</i>
		of <i>18</i>	



BAR BENDS



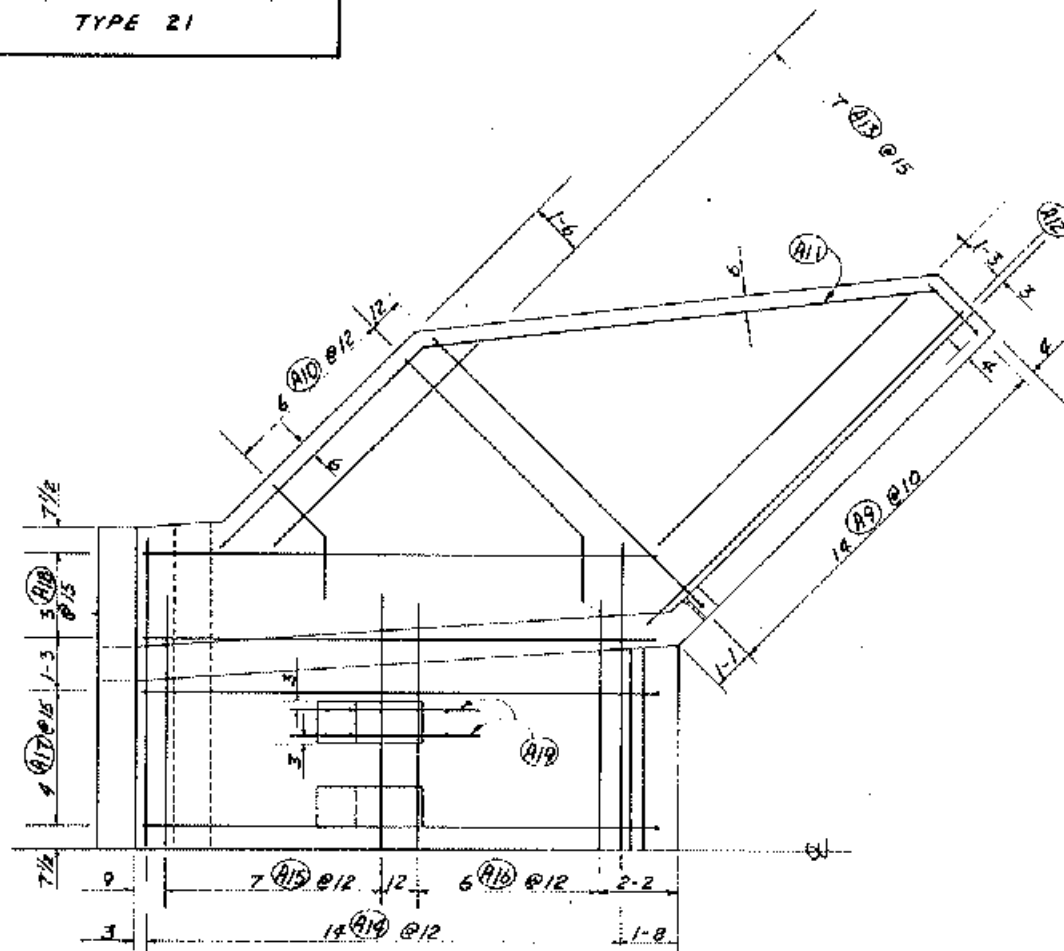
STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	C	H	K
A1	5	4	2-0	20-0	1				
A2	5	42	6-0	252-0	1				
A3	5	8	14-6	116-0	19	1-9	12-9	1-5	1-5
A4	5	6	14-0	84-0	19	2-0	11-6	1-9	1-9
A5	4	17	10-0	170-0	17A	See Detail			
A6	5	6	11-3	67-8					
A7	5	3	15-0	45-0	2	See Detail			
A8	5	4	10-5	42-0	1				
A9	5	6 sets of 10 bars	2-5 to 11-5 @ 8" incr.	390-0	21	1-0	1-9 to 10-5 @ 8" incr.		
A10	5	6 sets of 6 bars	3-0 to 8-9 @ 12" incr.	150-0	1	1-9	2-0 to 7-0 @ 12" incr.		
A11	5	4	22-0	88-0	19	6-0	14-0	5-1	8-2
A12	5	4	17-5	69-0	1				
A13	5	4 sets of 7 bars	2-5 to 9-9 @ 4" incr.	245-0	1				
A14	4	16	17-0	272-0	1				
A15	7	2	14-0	98-0	1				
A16	5	6	13-0	78-0	1				
A17	4	6	10-5	63-0	1				
A18	4	6	14-1	84-6	1				
A19	5	6	8-5	51-0	25	See Detail			
A20	5	3	17-0	51-0	1				
A21	5	17	4-0	68-0	24	See Detail			
A22	5	11	15-6	171-6	21	1-3	14-3		
A23	5	6	14-3	85-8	1				
A24	5	14	17-0	238-0	1				
A25	7	60	6-3	378-0	21	1-6	4-9		
A26	5	2	10-9	21-8	1				
A27	5	30	4-9	147-0	21	2-2	2-9		
A28	5	2	15-5	31-0	19	0-8	14-9	0-5	2-6
A29	3	0	7-0	56-0	21	1-0	6-0		
B1	5	4 sets of 8 bars	2-0 to 11-5 @ 15" incr.	290-0	1				
B2	5	4 sets of 8 bars	2-0 to 10-9 @ 15" incr.	204-0	1				
B3	5	4	15-0	60-0	1				
C1	5	64	11-6	725-4	1				
C2	5	24	14-9	354-0	1				
C3	5	24	15-5	372-0	14	6-8	14-9	0-5	0-6

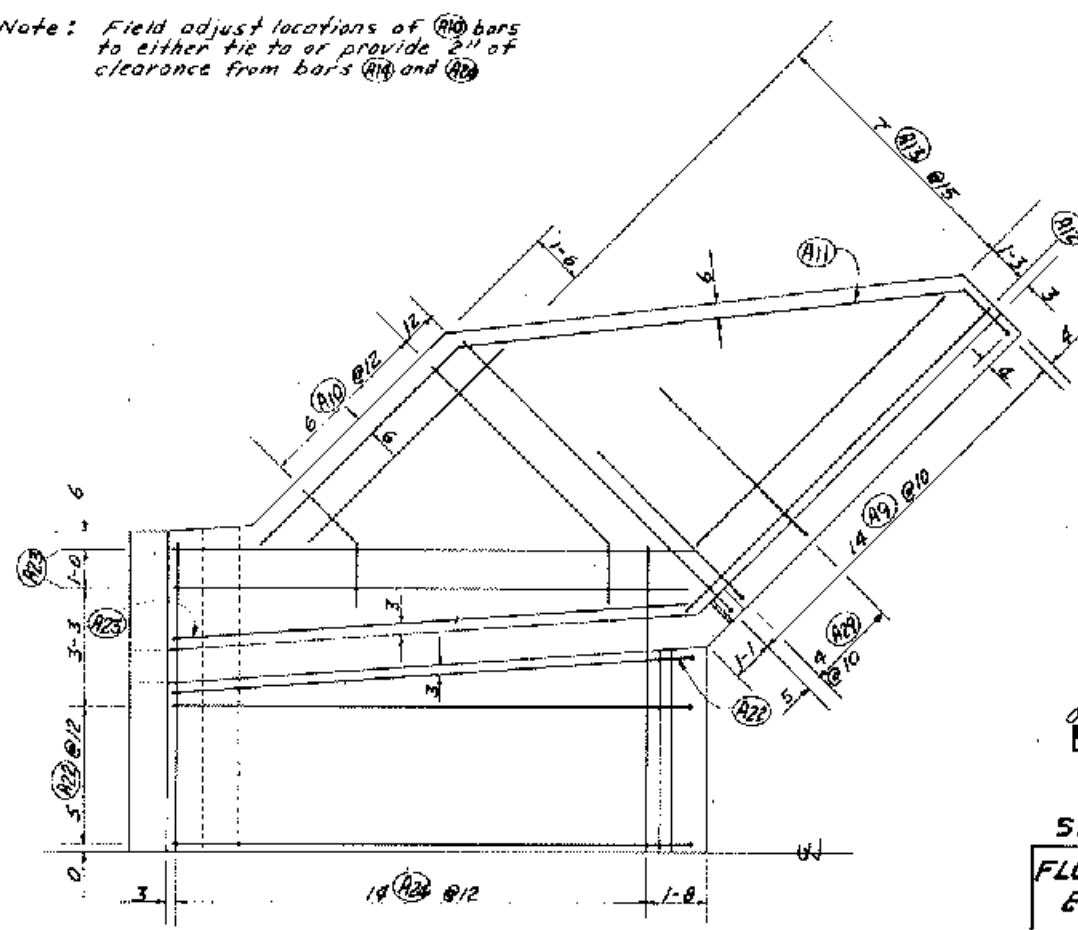
Note: Field adjust locations of (A10) bars to either tie to or provide 2" of clearance from bars (A11) and (A12)

Notes:

- Bar dimensions are out to out of bar.
- Radius of bends shall be 3 times the diameter of the bar for size #7 and smaller and 4 times the diameter of the bar for size #8.



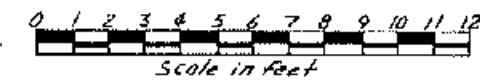
STEEL IN BOTTOM FACE
HALF PLAN



STEEL IN TOP FACE
HALF PLAN

AS BUILT PLANS
NO CHANGE

Drawn Date 1-24-91

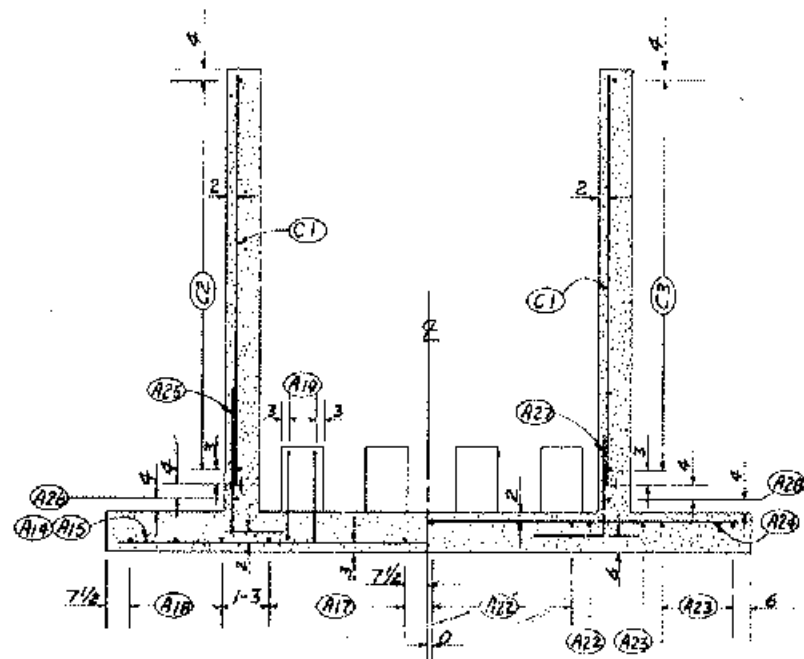


SAF OUTLET TO J#1

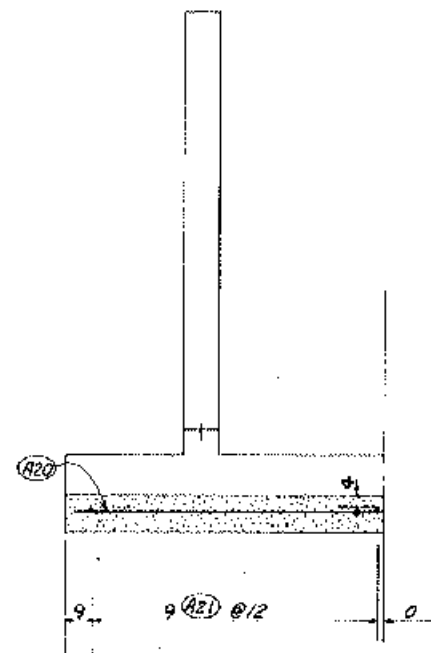
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by	M.J.W.	Date	11/86
Drawn by	G.F.W.	Date	1-87
Checked by	J.E.N.	Date	12/86
Project No.	08-89-031	Sheet No.	12 of 88



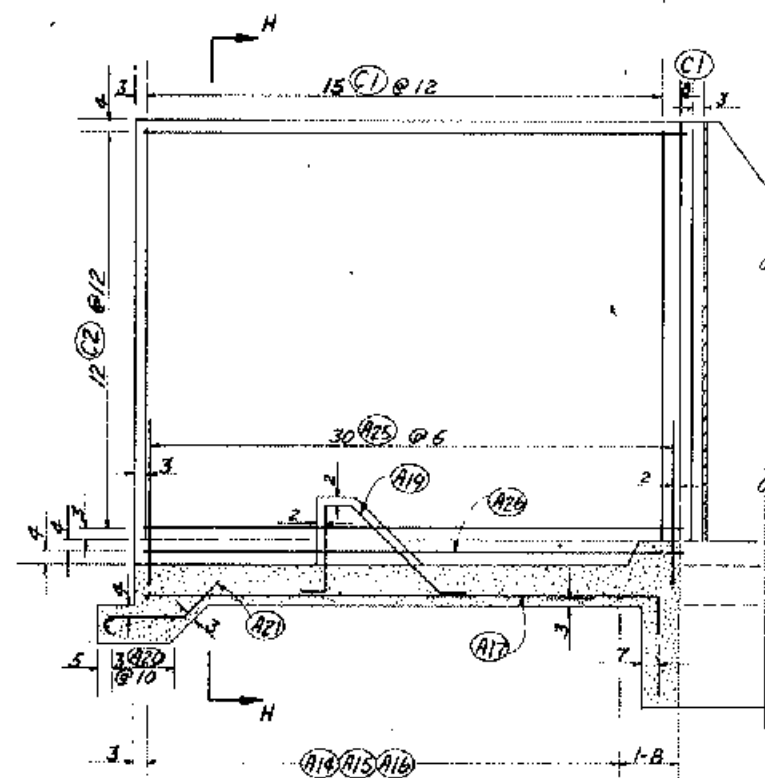
SECTION H-H



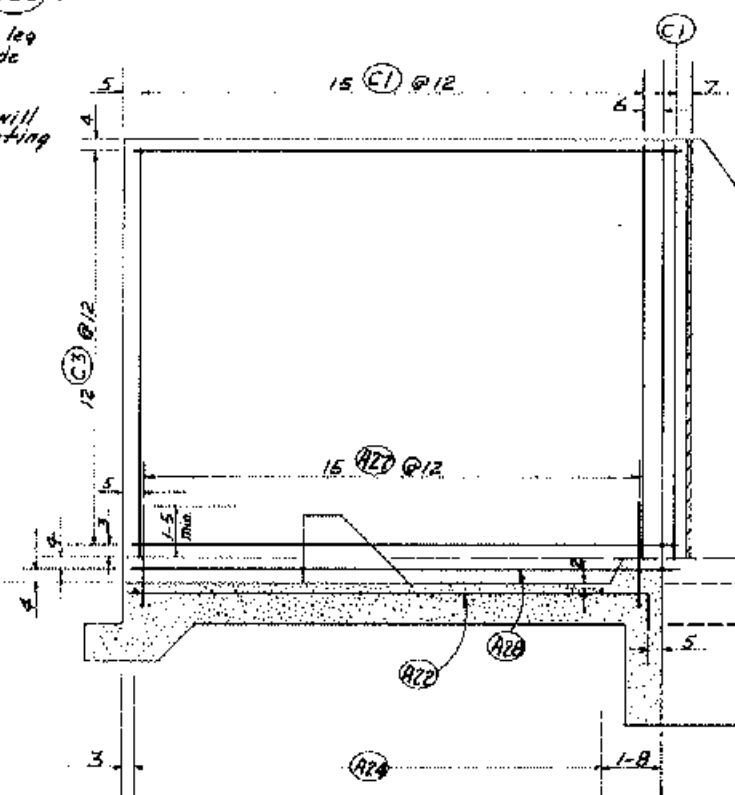
HALF OF SECTION A-A
(FOR LOCATION, SEE SHEET 10)

Note: The following applies to the horizontal leg of bar mark (A25):

- at the far downstream bar, the leg will be canted upstream to provide of least 2" clear cover at the toe wall.
- at the upstream bar, the leg will be turned into the side wall footing to clear the waterstop.



STEEL IN OUTSIDE FACE
SECTION ON CENTERLINE



STEEL IN INSIDE FACE
SECTION ON CENTERLINE

AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-91

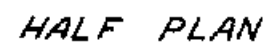


SAF - OUTLET TO J#1

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	W.J.W.	Date	11/86	Approved by	
Drawn	G.F.W.	Date	1/87	Checked	
Traced		Date		Drawn by	
Checked	J.E.N.	Date	12/86	Sheet	18
				Drawing No.	08-89-031



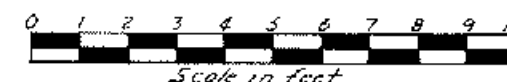
- Notes:

1. J. B. Expansion joint
2. C. J. - Construction joint,
see detail to sheet 12
3. For detail of expansion joints
on subwall 11, see sheet 12.
4. Edges of expansion joints in
floors will be beveled to 1/4
inch radius.



TABLE OF QUANTITIES AS BUILT

ITEM	UNIT	QUANTITY
Concrete (Class 4000)	Cu. Yd.	15.4
Steel Reinforcement	lb.	2678
Steel Bar, 6" x 1/4" (C.J.)	Lin. Ft.	20
Waterstop	Lin. Ft.	27



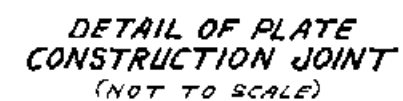
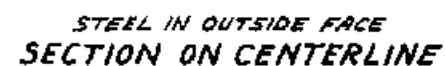
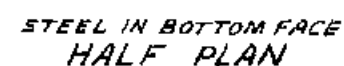
DETAILS OF CHUTE- J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

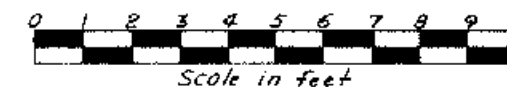
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date <u>1/14/46</u>		Addressed by <u>Wes. Hinkemeyer</u>
Designated <u>Wes. Hinkemeyer</u>		Title <u></u>
Dear <u>George Malliar</u>		<u>206</u>
Topic <u></u>		<u></u>
Typed <u></u>	Serial <u>14</u>	Checked by <u>08-89-031</u>
Written <u>Jan Nestoss</u>	File # <u>14</u>	



AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-97



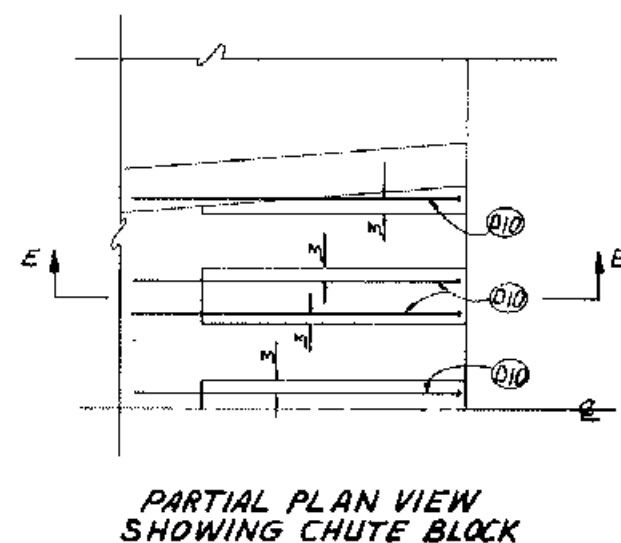
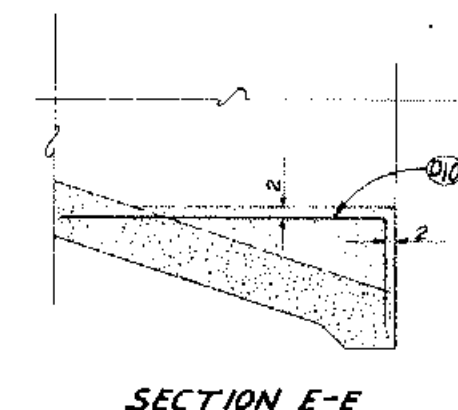
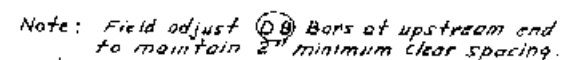
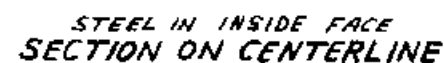
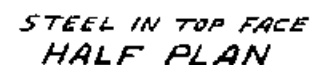
DETAILS OF CHUTE J#1 TO J#2

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		Approved by	
Designed	W.L.W. 11/86	Title	
Drawn	G.F.W. 11/87	Vite	
Issued		Sheet	Drawing No
Checked	J.E.N. 12/86	No 15 of 28	08 - 89 - 031



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	C
D1	5	2 sets of 13 bars	15-5 to 17-1 # 2" incr.	357-6	1		
D2	6	10	11-6	115-6	1		
D3	5	3	11-9	33-3	1		
D4	5	12	3-3	39-5	24	\$500 Dots 1	
D5	4	18	9-0	162-6	1		
D6	7	42	6-3	262-6	21	1-6	4-9
D7	5	22	5-3	115-6	21	1-3	4-0
D8	5	10	8-0	175-0	1		
D9	5	12	9-9	117-0	1		
D10	5	8	9-0	72-0	21	2-3	6-9
E1	7	2 sets of 10 bars	2-9 to 3-0 # 6" incr.	35-0	1		
E2	5	4 sets of 11 bars	6-9 to 10-1 # 4" incr.	270-4	1		
E3	5	4 sets of 3 bars	2-8 to 8-8 # 3'-0" incr.	68-0	1		
E4	5	28	9-3	258-6	1		

Noting 6.2

1. Bar dimensions are out to out of bar.
2. Radius of bonds shall be 3 times the diameter of the bar for size #7 and smaller and 4 times the diameter of the bar for size #8.

AS BUILT PLANS
NO CHANGE

Comp. Date 1-24-91

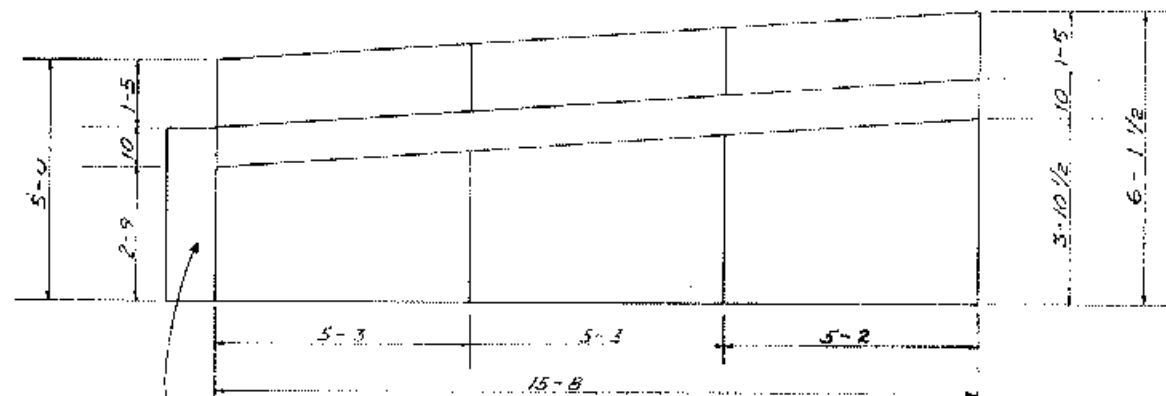
DETAILS OF CHUTE - J#1 TO J#2

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

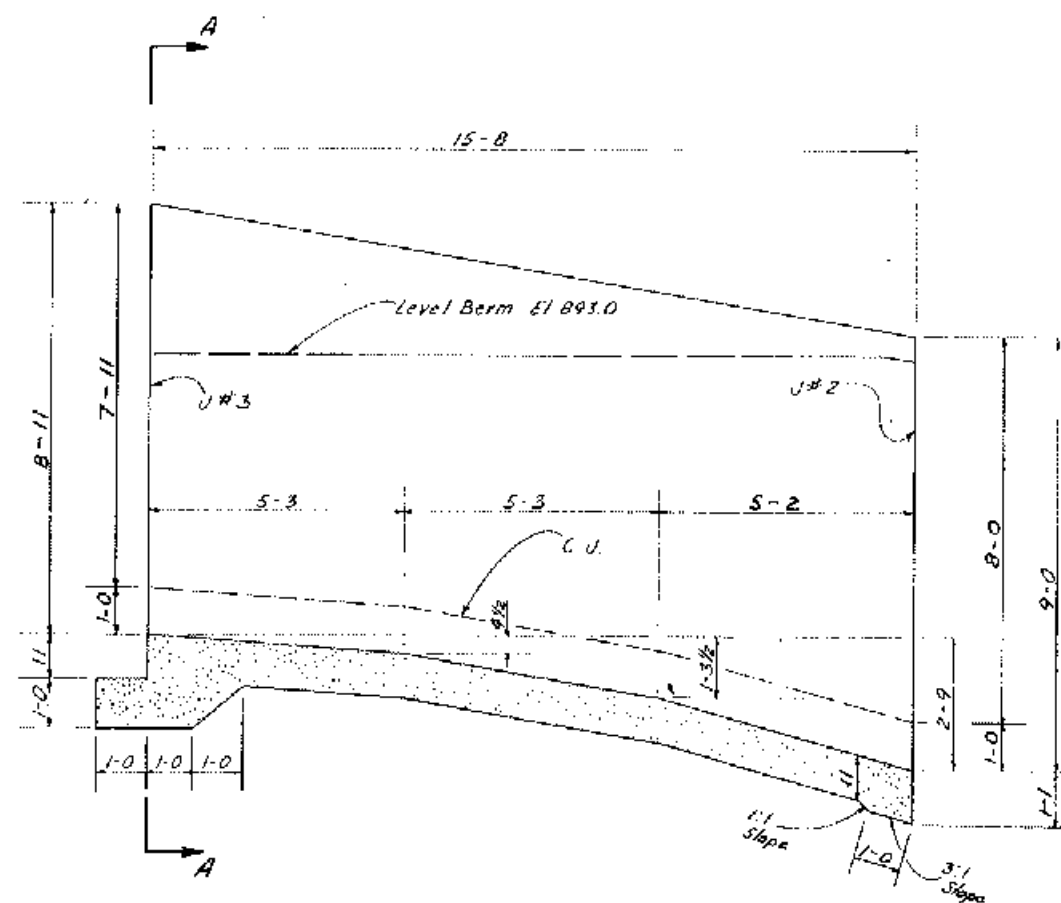
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed <i>W.J.W.</i>	Date <i>1/18/82</i>	Approved by _____
Drawing <i>G.F.W.</i>	<i>1/8/82</i>	Title _____
Tracing _____		Time _____
Checked <i>J.E.N.</i>	<i>12/1/81</i>	Sheet <i>16</i> of <i>88</i>
		Drawing No. <i>08-89-031</i>

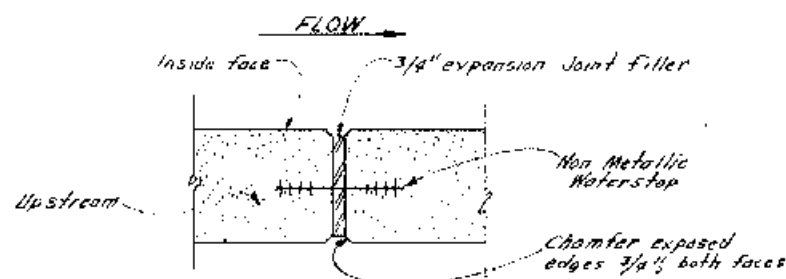


HALF PLAN

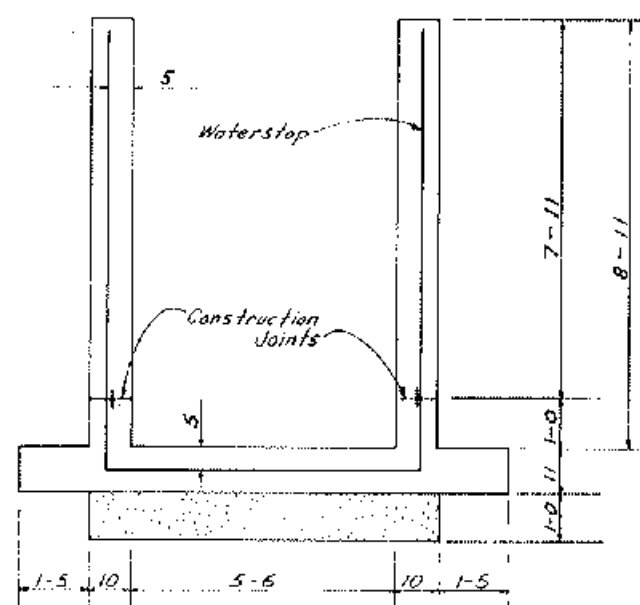


SECTION ON CENTERLINE

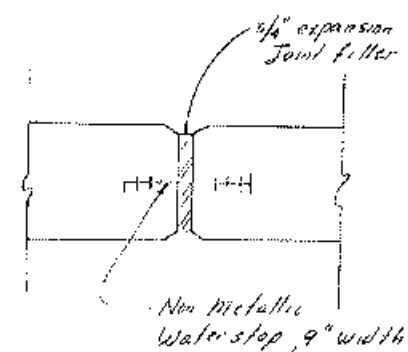
- Notes:
1. J. Expansion joint.
 2. C.J. - Construction joint, see detail on sheet 17.
 3. For detail of expansion joint in sidewalk, see sheet 17.
 4. Edges of expansion joints in floor will be beveled to 1/4 inch radius.



DETAIL OF JOINTS
(Not to Scale)



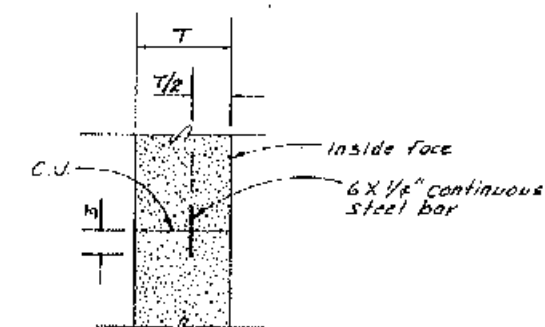
SECTION A-A



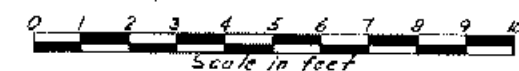
DETAIL OF JOINTS

Note: All rebar, affected by the 9" waterstop width, had to be field adjusted to clear waterstop during placement. Bars normally were to be spaced @ 3" from a joint. Bars were spaced between 5 and 6 inches. This note pertains to Chute Spillway & Principal Spillway.

TABLE OF QUANTITIES AS BUILT		
ITEM	UNIT	QUANTITY
Concrete (Class 4000)	Cu. Yd.	14.9
Steel Reinforcement	Lb.	7164
Steel Bar, 6" x 1/4" (C.J.)	Lin. Ft.	32
Waterstop	Lin. Ft.	25



DETAIL OF PLATE
CONSTRUCTION JOINT
(Not To Scale)



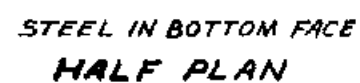
DETAILS OF CHUTE - J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

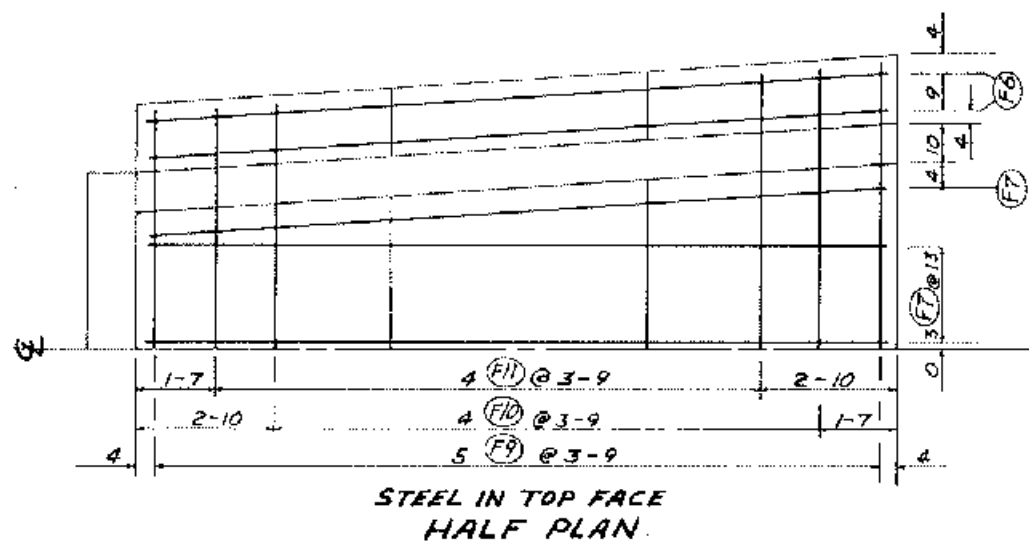
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by <u>W. S. Winkler</u>	Date <u>6/26</u>	Approved by <u></u>
Drawn <u>George M. Miller</u>	Title <u></u>	
Traced <u></u>	Sheet <u>17</u>	Drawing No. <u>08-89-031</u>
Checked <u>Dennis Reep</u>	Scale <u>1/8"</u>	

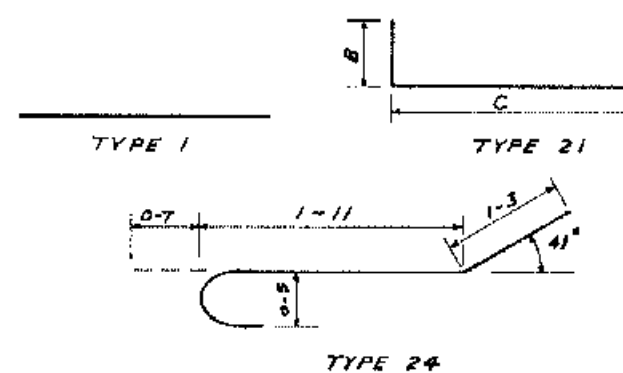


A scale bar labeled "Scale in feet" with markings from 0 to 10. The bar is divided into alternating black and white segments, with each segment representing 1 foot.

Date		Approved By	
Designed <i>Jan. Nestass</i> <i>1/89</i>		By <i>He</i>	
Drawn <i>George Woliser</i> <i>1/89</i>		Title	
Title		Drawing No	
Checked <i>Dennis Reep</i> <i>6/89</i>		No <i>18</i> <i>08-89-031</i>	



BAR BENDS

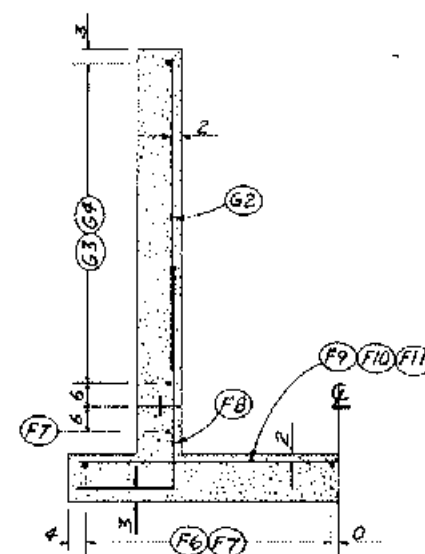
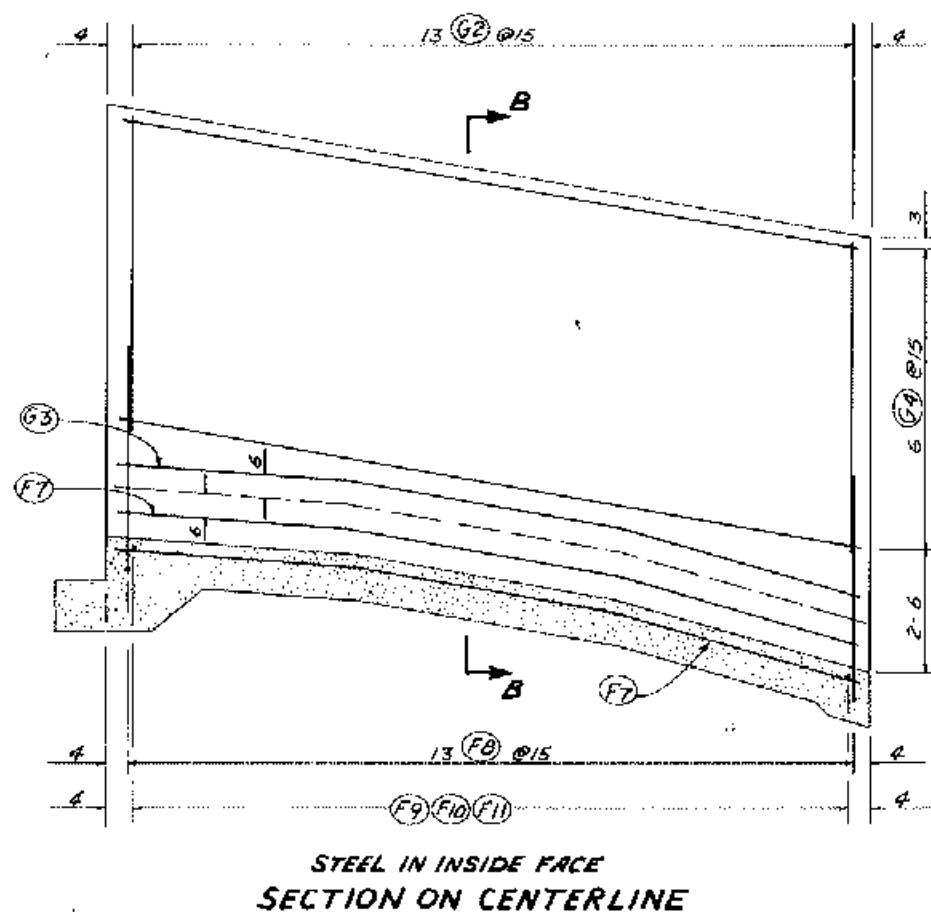


STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	C
F1	7	16	11-0	176-0	21	5-6	5-6
F2	7	16	9-0	144-0	21	3-6	3-6
F3	6	10	9-0	90-0	21	4-6	4-6
F4	5	6	3-9	23-4	24	See Detail	
F5	6	2	5-9	11-8	3		
F6	4	16	15-6	249-6	3	Field Bend	
F7	5	11	15-6	171-6	3	Field Bend	
F8	5	26	6-6	165-6	21	4-10	4-6
F9	5	1 set of 2 bars	4-6 to 11-6 # 6" max.	57-0	1		
F10	5	1 set of 4 bars	10-0 to 11-6 # 6" max.	43-0	1		
F11	5	1 set of 8 bars	9-9 to 11-3 # 6" max.	42-0	1		
G1	5	16	5-6	89-6	1		
G2	5	36	6-6	234-0	1		
G3	5	4	15-6	62-0	1	Field Bend	
G4	5	24	15-6	372-0	1		

Notes:

1. Bar dimensions are out to out of bar.
2. Radius of bends shall be 3 times the diameter of the bar for size #7 and smaller and 4 times the diameter of the bar for size #8.



AS BUILT PLANS

NO CHANGE

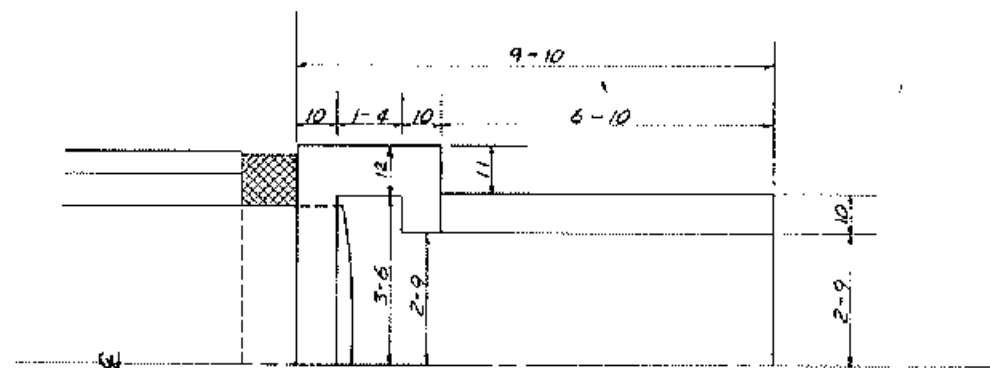
Comp. Date 1-24-99



DETAIL OF CHUTE -- J#2 TO J#3
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

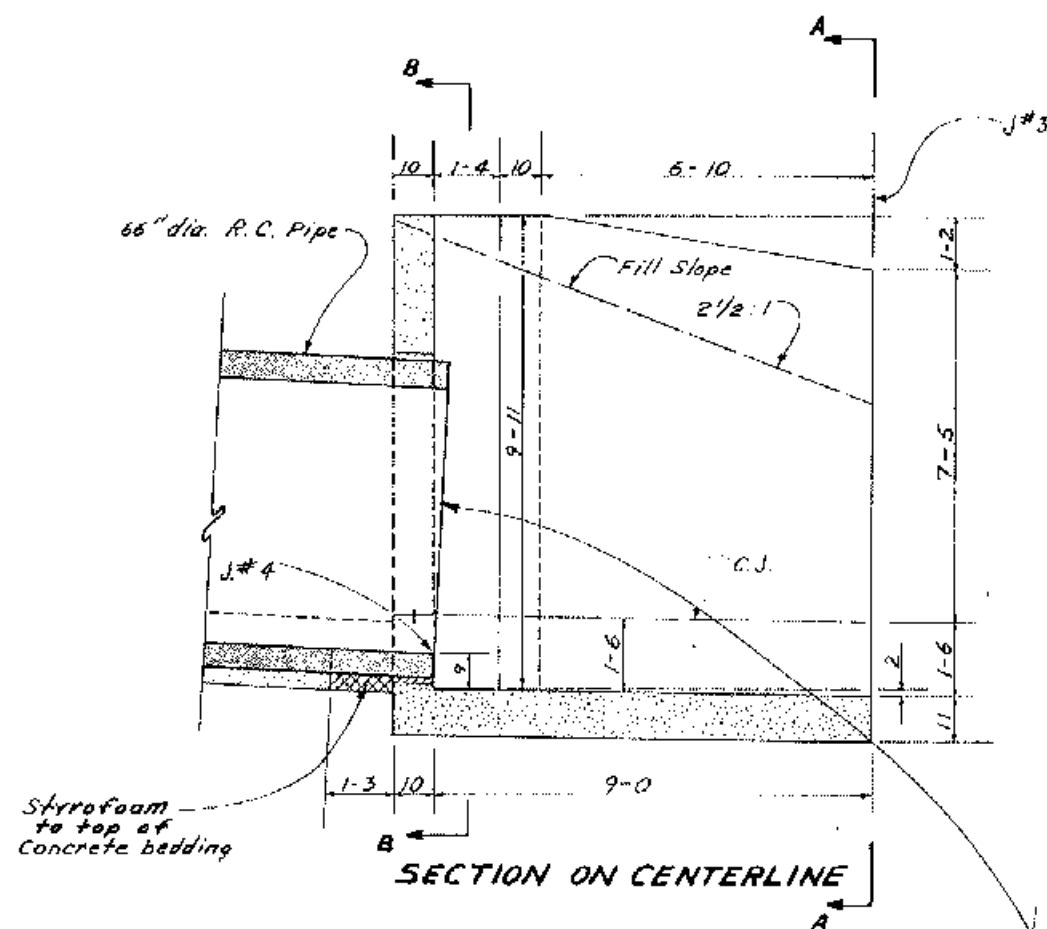
Designed **Jon Nestor** 1/89
Drawn **George Walster** 1/89
Titled
Checked **Dennis Reep** 6/89
Date
Approved by
Title
Sheet
Drawing No.
08-89-031



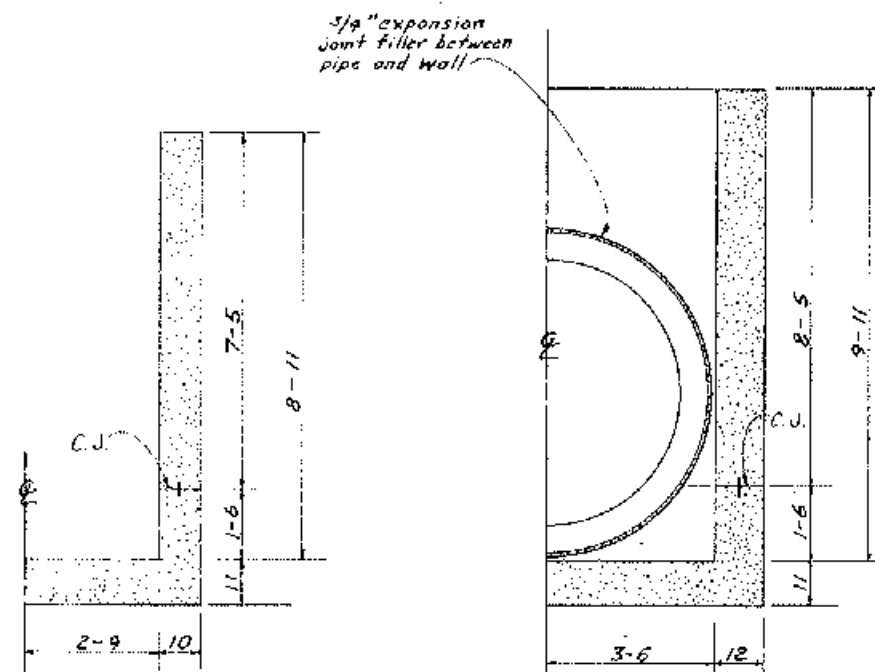
HALF PLAN

Notes:

1. J = Expansion joint.
2. C.J. = Construction joint, see detail on sheet 17.
3. For detail of expansion joints in sidewalk, see sheet 17.
4. Edges of expansion joints in floors will be tool to 1/4 inch radius.



SECTION ON CENTERLINE



SECTION A-A

SECTION B-B

The 66" dia. R.C. Pipe came from the supplier, Creston, with a spigot end for J-4. Plans and specifications did not show pipe not to be fabricated as such. Therefore the spigot end was wrapped to outside dia. of pipe, with 5/8" expansion joint filler as per material spec. approval, banded to prevent slippage, and then poured as per detail.

TABLE OF QUANTITIES AS BUILT		
ITEM	UNIT	QUANTITY
Concrete (Class 4000)	Cu. Yd.	10.0
Steel Reinforcement	Lb.	1021
Steel Bar, 6" x 1/4" (C.J.)	Lin. Ft.	20
Waterstop	Lin. Ft.	—



AS BUILT 1-28-90

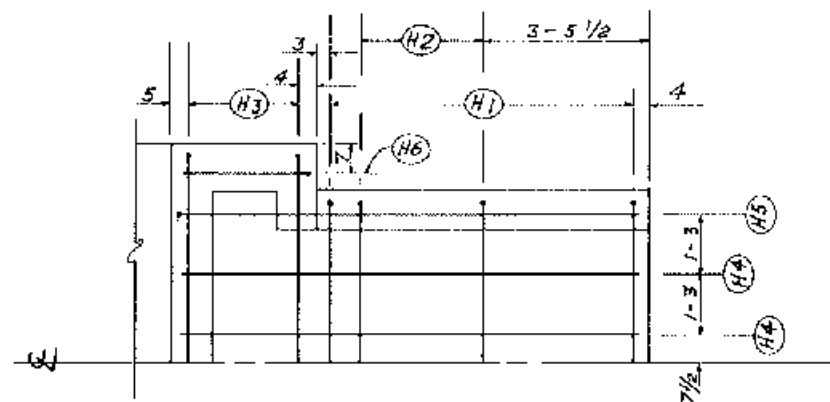
DETAILS OF PARALLEL TRANSITION J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

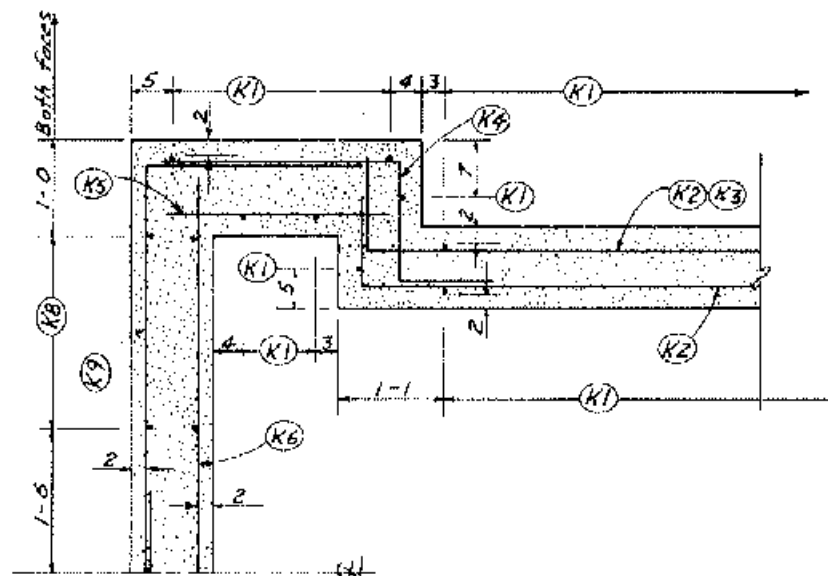
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

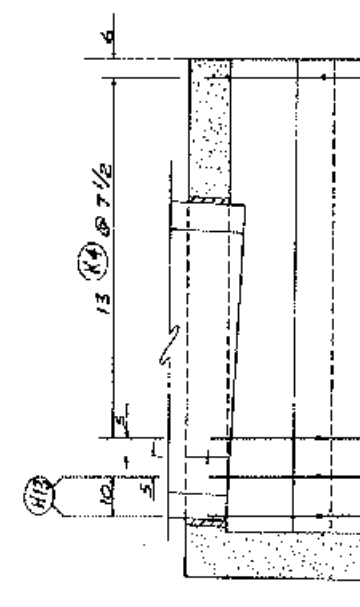
Designed by Wes. Wiedenmeyer 11/86
Drawn by George Walser 11/86
Checked by Dennis Reed 6/89
Date 11/86
Title AS BUILT
Sheet 20
Drawing No. 08-89-031



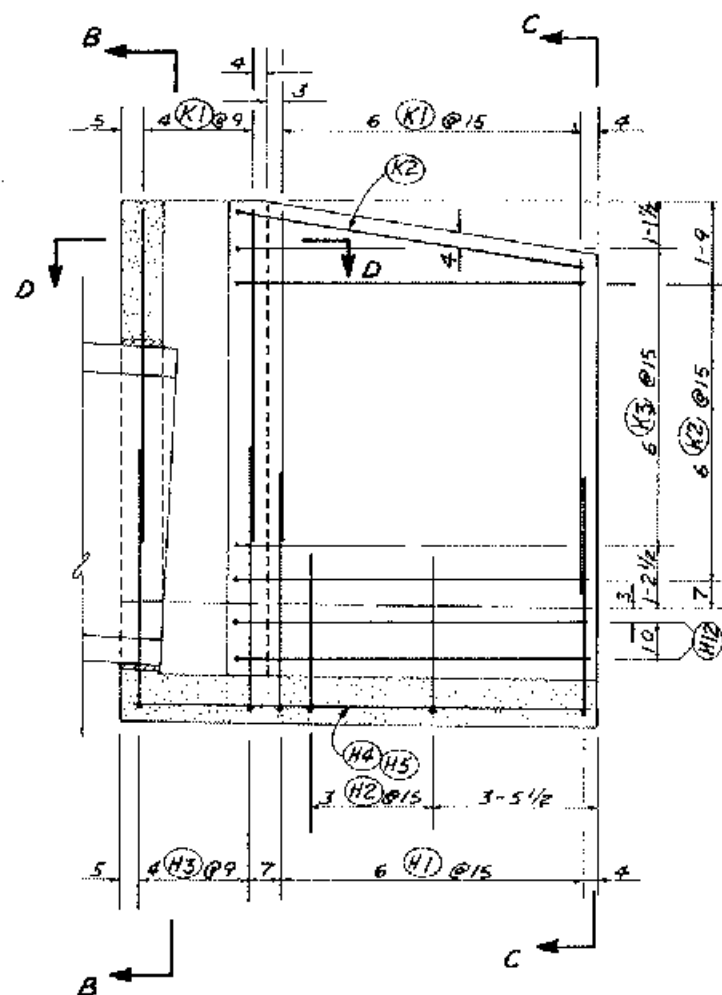
STEEL IN BOTTOM FACE
HALF PLAN



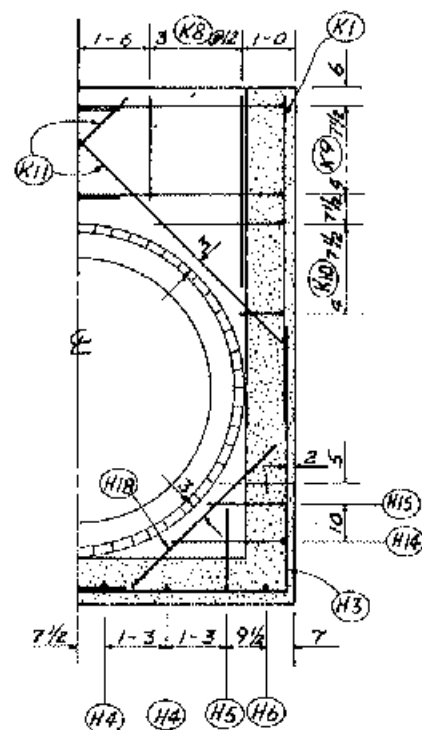
SECTION D-D
DETAILS OF STEEL IN EXPANSION SECTION



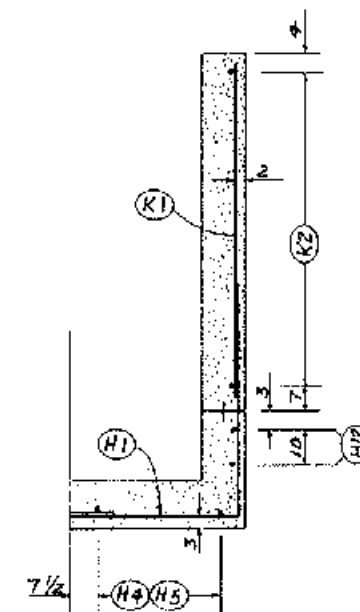
PARTIAL E SECTION SHOWING
STEEL IN EXPANSION SECTION



STEEL IN OUTSIDE FACE
CENTERLINE PROFILE

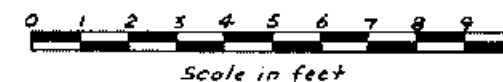


STEEL IN UPSTREAM FACE
SECTION B-B



STEEL IN OUTSIDE FACE
SECTION C-C

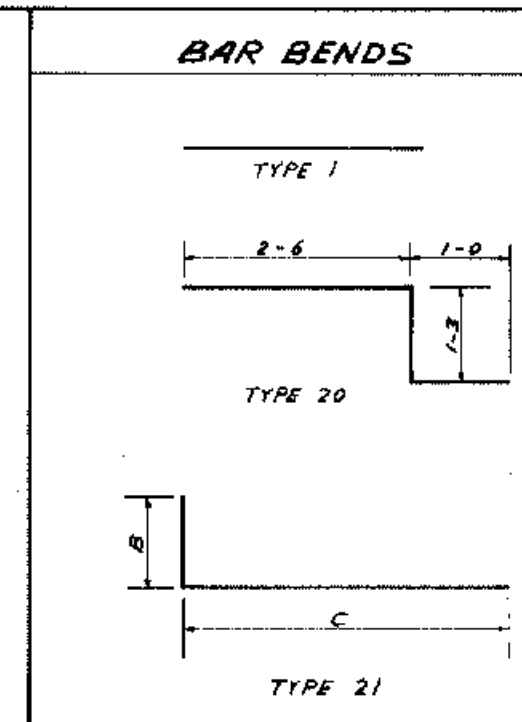
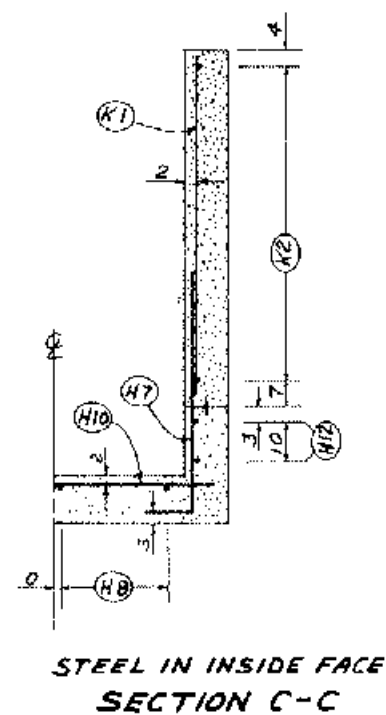
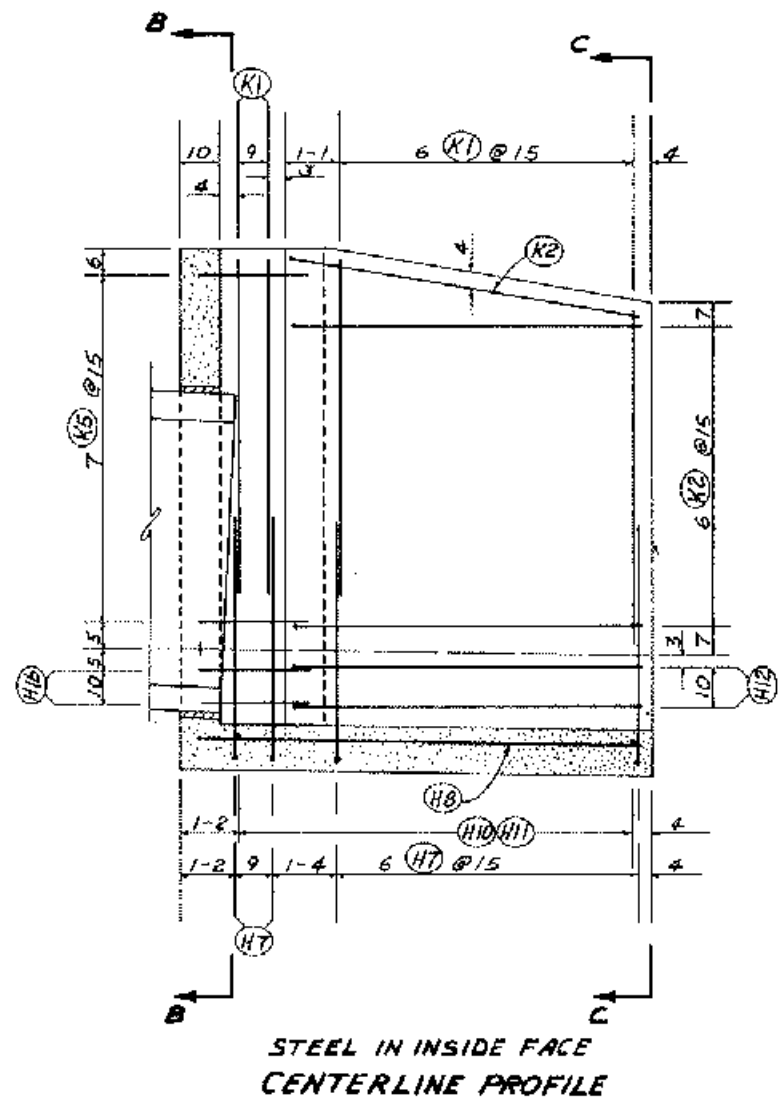
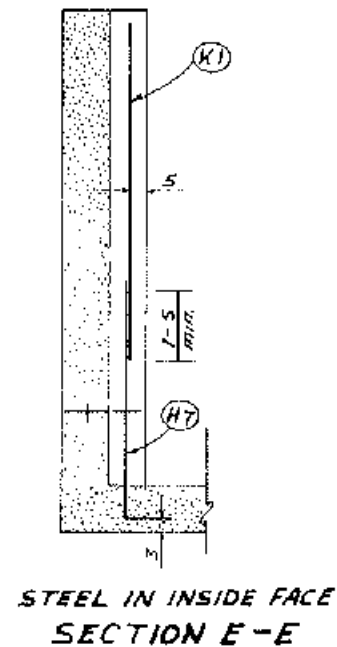
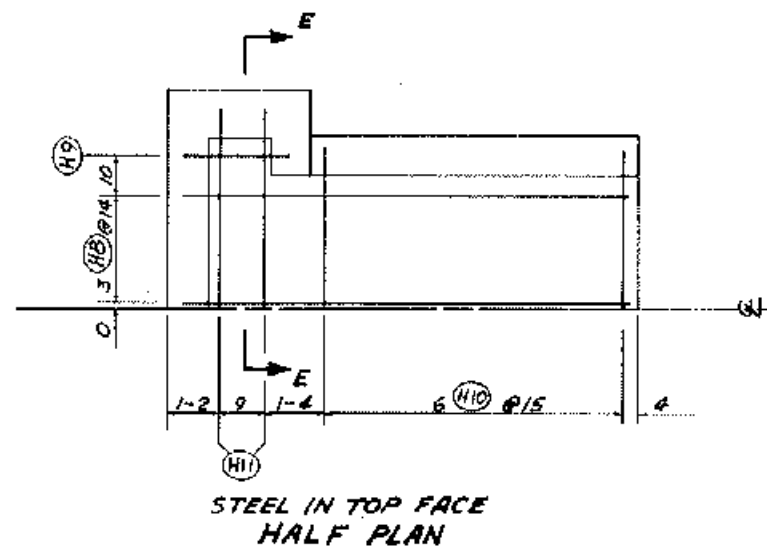
AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-77



FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

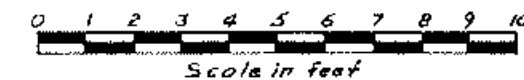
Designed by Jon Nestess 1/89	Reviewed by George Waliser 2/89
Checked by Dennis Reep 6/89	Drawn by 08-89-031



STEEL SCHEDULE									
BAR	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	D	C		
H1	7	12	10-0	120-0	21	5-0	5-0		
H2	7	6	8-0	48-0	21	3-3	4-9		
H3	7	8	11-0	88-0	21	5-0	5-0		
H4	5	4	9-3	37-0	1				
H5	5	2	11-0	22-0	21	1-9	9-3		
H6	5	2	7-6	15-0	21	2-0	3-0		
H7	5	16	6-0	108-0	21	1-0	5-0		
H8	5	4	9-3	37-0	1				
H9	5	2	2-3	4-6	1				
H10	5	6	6-3	37-0	1				
H11	5	2	8-0	16-0	1				
H12	5	8	8-3	66-0	21	1-0	7-3		
H13	5	4	4-9	19-0	20	See Detail			
H14	5	2	4-9	9-0	21	2-3	2-6		
H15	5	2	4-8	8-0	21	1-6	2-6		
H16	5	4	2-3	8-0	1				
H17	5	2 sets of 2 bars	1-6 to 2-1 # 6" incr.	7-6	1				
H18	5	4	6-0	18-0	1				
K1	5	20	7-0	280-0	1				
K2	5	20	8-1	231-0	21	1-0	7-3		
K3	5	12	4-6	54-0	21	1-0	3-6		
K4	5	26	4-9	123-6	20	See Detail			
K5	5	14	2-3	31-6	1				
K6	5	3	6-0	18-0	1				
K7	5	2	1-9	3-6	1				
K8	5	4 sets of 3 bars	2-0 to 4-0 # 3" incr.	30-0	1				
K9	5	6	9-0	62-0	21	2-6	3-3		
K10	5	2 sets of 4 bars	3-0 to 5-0 # 6" incr.	30-0	21	1-0 to 2-6 # 6" incr.	2-6		
K11	5	4	7-0	28-0	1				

- Notes:
1. Bar dimensions are cut to out of bar.
 2. Radius of bends shall be 3 times the diameter of the bar for size #7 and smaller and 4 times the diameter of the bar for size #8.

AS BUILT PLANS
NO CHANGE
Date: 1-24-91



**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Drawn: Jon. Heston Date: 1/89
Checked: George Wolser Date: 2/89
Title: Steel Reinforcement
Drawing No: 08-89-031

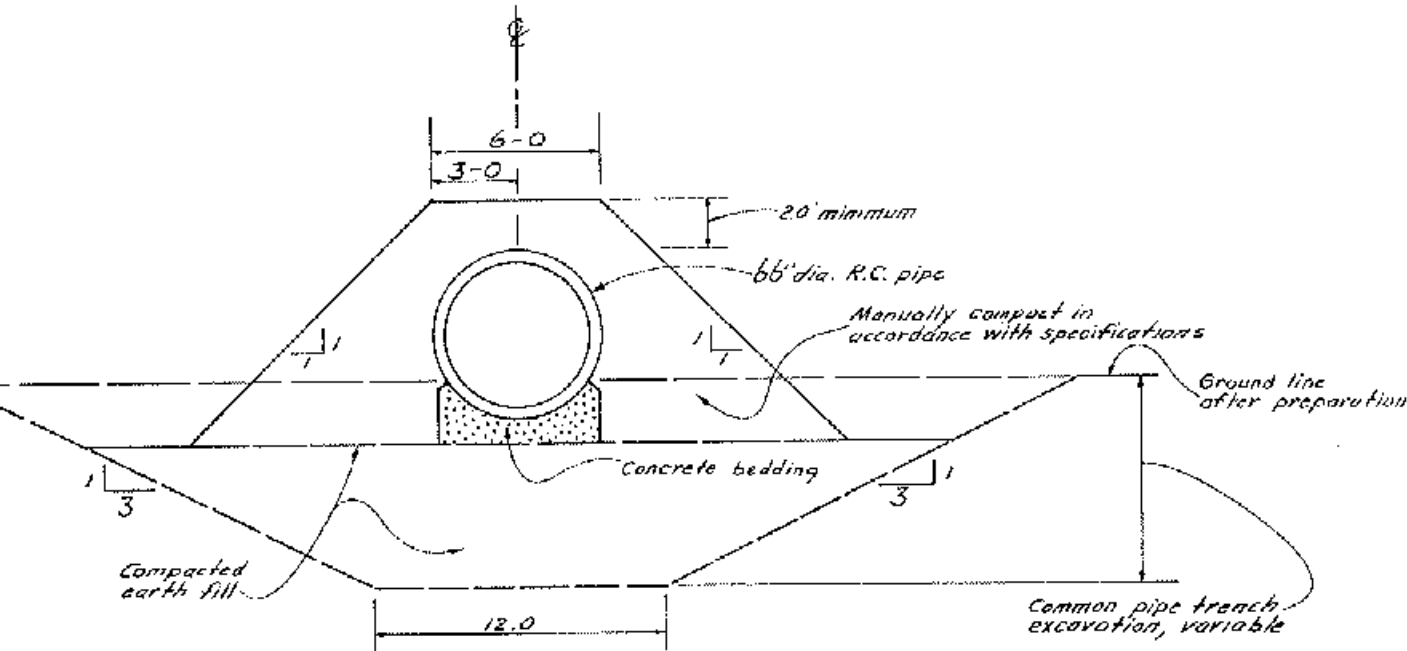
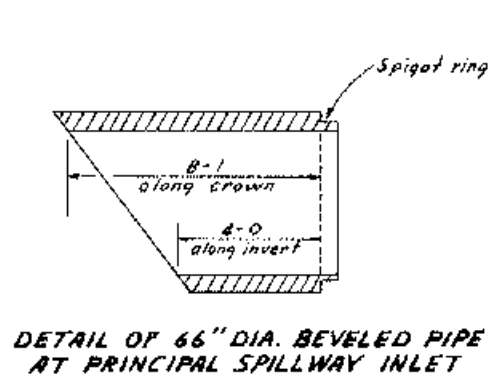
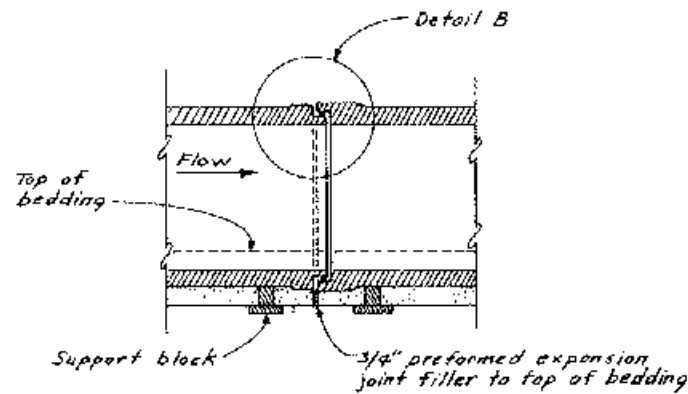


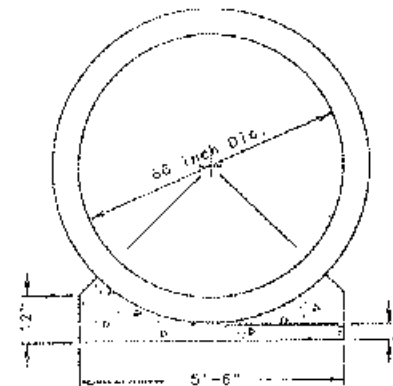
DIAGRAM OF BACKFILL FOR 66" DIA. PIPE
(Not to Scale)



DETAIL OF 66" DIA. BEVELED PIPE
AT PRINCIPAL SPILLWAY INLET



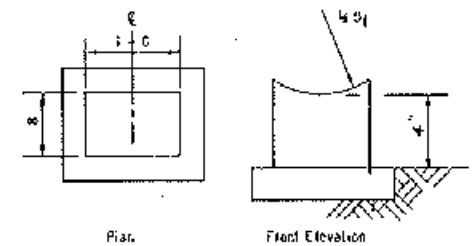
DETAIL OF PIPE JOINT



DETAIL OF BEDDING

QUANTITIES	
Concrete	Cu. Yds.
Cradle	
Per Linear Foot of Cradle	0.147
Total	18.6

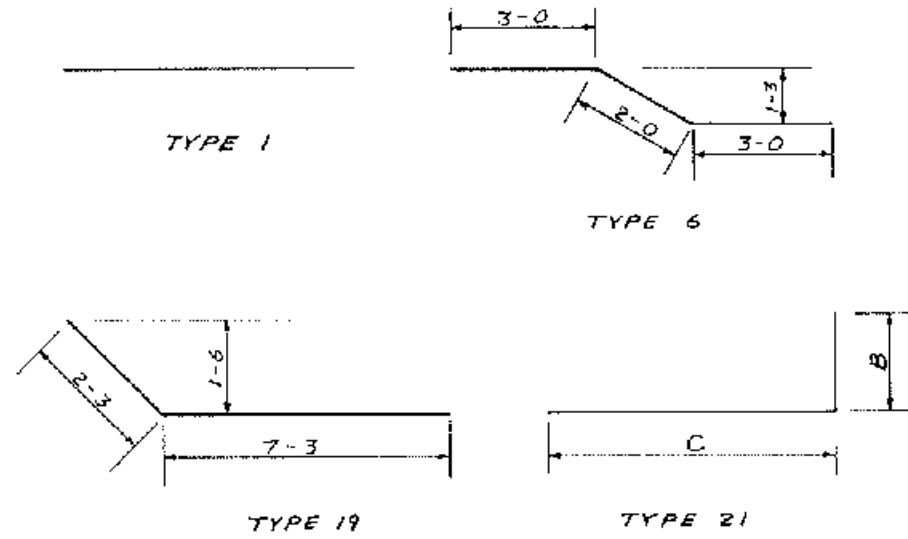
Concrete quantities are based on an outside diameter of pipe of 79 inches.



SUGGESTED SUPPORT BLOCKS

Sufficient blocks shall be provided to support the pipe to the required line and grade. The Contractor shall determine the number and size of blocks and whether they may be used as to

BAR BENDS

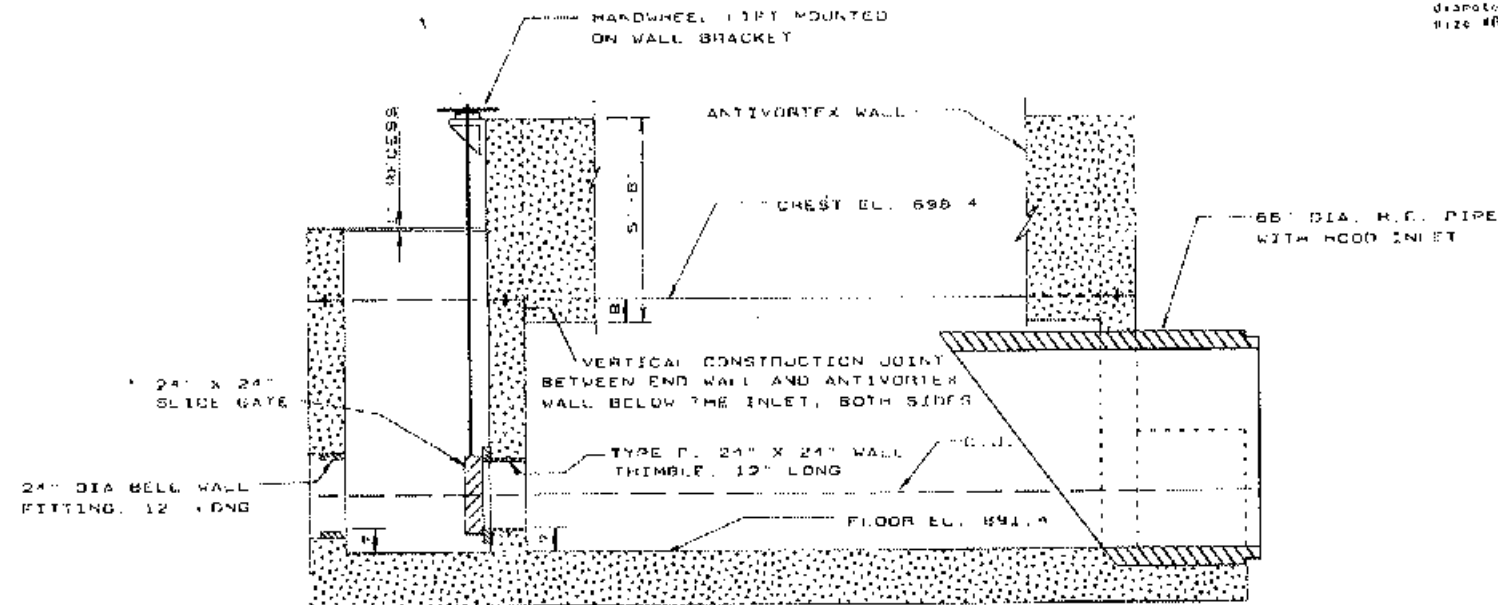


STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	H	C
N1	5	66	5'-5	357'-0	1		
N2	5	24	7'-5	174'-0	1		
N3	5	4	6'-0	24'-0	1		
N4	5	4	8'-9	35'-0	1		
N5	5	35	10'-3	360'-6	1		
N6	5	2	4'-9	9'-0	1		
N7	6	4	6'-5	26'-0	1		
N8	6	4	5'-6	22'-0	1		
N9	6	2	4'-6	9'-0	21	1'-0	3'-6
N10	6	5	2'-6	13'-0	1		
N11	6	4	6'-0	24'-0	6	See Detail	
N12	6	2	3'-6	7'-0	1		
N13	6	1	12'-0	12'-0	1		
N14	6	10	17'-0	170'-0	1		
N15	6	10	5'-5	55'-0	21	3'-11	5'-4
N16	6	7	5'-5	38'-5	1		
N17	6	4	5'-0	20'-0	1		
N18	6	6	12'-9	77'-6	21	7'-9	10'-9
N19	6	6	13'-6	81'-0	21	3'-6	10'-0
N20	6	4	0'-6	24'-0	21	3'-6	5'-6
N21	6	7	14'-9	103'-3	21	4'-9	10'-0
N22	6	1	17'-6	170'-6	21	7'-6	10'-0
N23	6	4	5'-5	22'-0	21	1'-6	3'-9
N24	6	16	7'-6	120'-0	21	1'-5	5'-9
P1	6	2	15'-6	31'-0			
P2	9	20	15'-6	310'-0	21	3'-6	10'-0
P3	5	12	5'-5	66'-0	1		
P4	5	4 sets of 5 bars	4'-0 to 10'-0 & 5'-0" max.	140'-0	1		
P5	5	1 set of 5 bars	14'-6 to 25'-0 & 5'-0" max.	97'-6	1		
P6	2	8 sets of 5 bars	1'-6 to 4'-6 & 9'-0" max.	120'-0	1		
P7	5	8	9'-6	76'-0	19	See Detail	
P8	5	2	10'-3	20'-6	21	5'-0	5'-3
P9	5	9	1'-6	23'-0	21	5'-3	6'-5
P10	5	9	5'-6	50'-0	1		
P11	5	8	7'-6	60'-0	21	3'-9	3'-6
P12	5	1 set of 5 bars	19'-6 to 25'-0 & 2'-0" max.	16'-9			

Notes:

- Bar dimensions are out to out of bar.
- Radius of bends shall be 5 times the diameter of the bar for size 42 and smaller and 4 times the diameter of the bar for size 48.



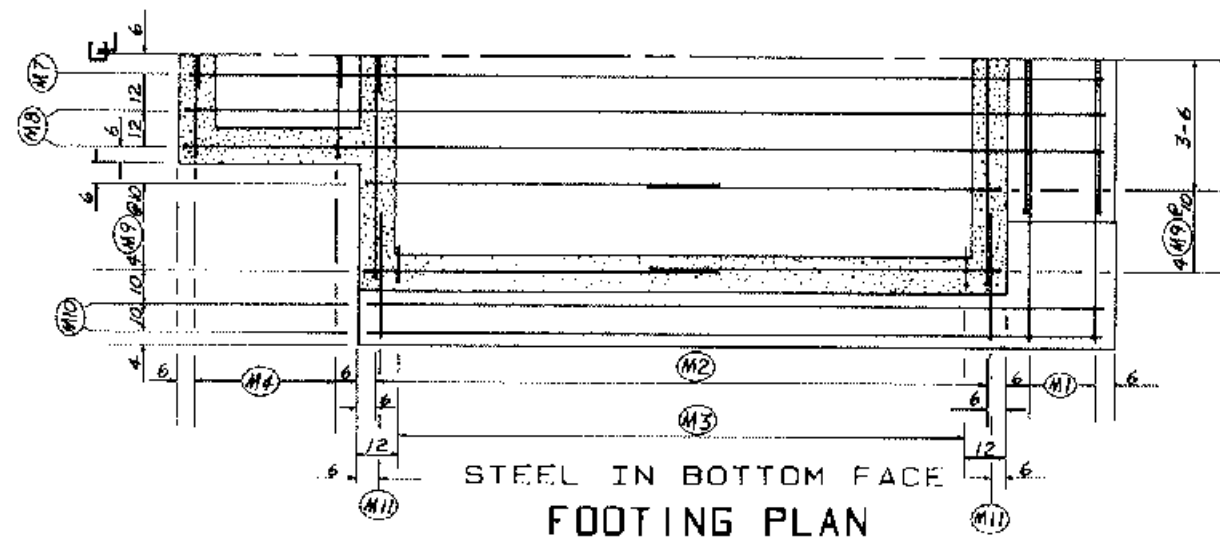
SECTION ON CENTERLINE



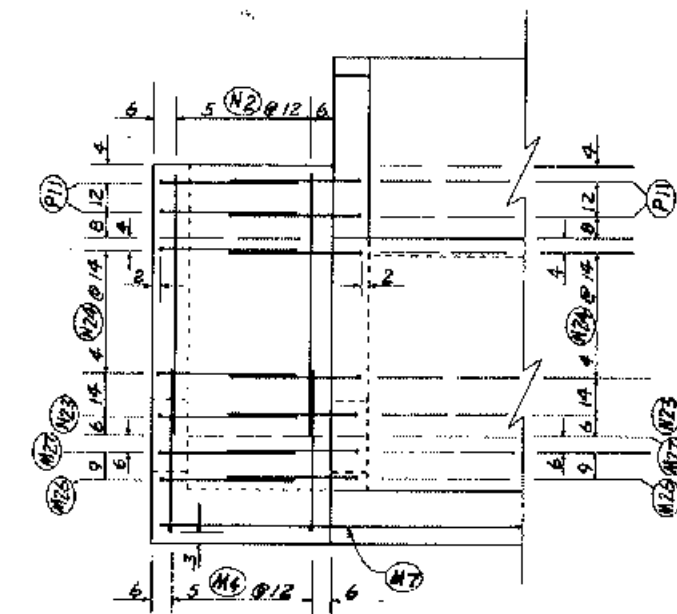
AS BUILT PLANS
NO CHANGE
Drawn Date 1-24-91

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

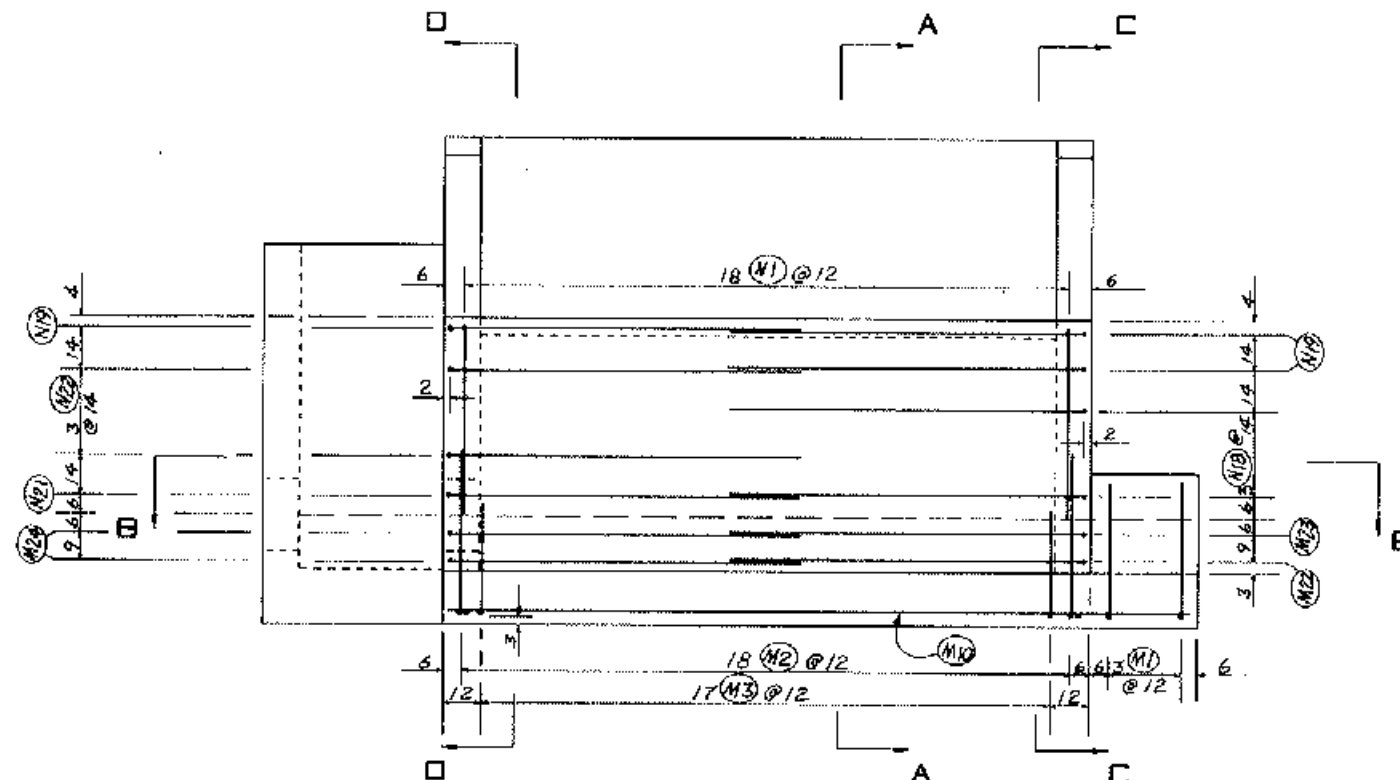
DESIGNED BY	JON NEIBERGER	DATE	3/89
DRAWN BY	GEORGE MALISER	DATE	3/89
CHECKED BY	DENNIS REED	DATE	6/89
APPROVED BY		DATE	
PROJECT NO.	08-89-031	SHEET NO.	25



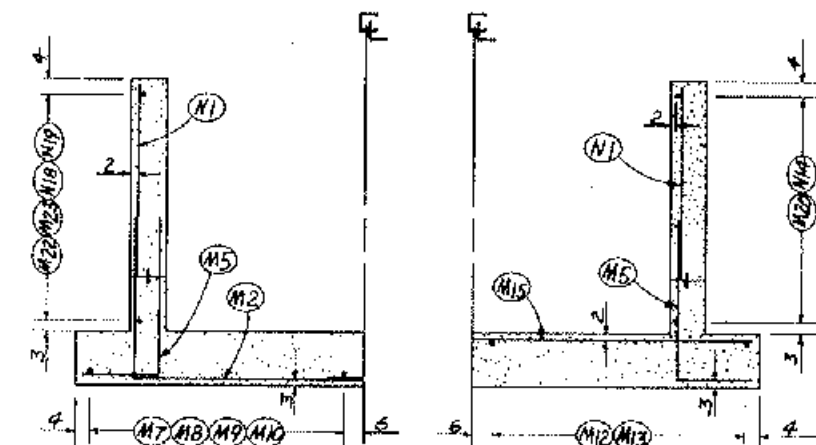
[66" DIA. R.C. PIPE NOT SHOWN]



STEEL IN OUTSIDE FACE OF GATE WELL
PARTIAL SIDEWALL ELEVATION



STEEL IN OUTSIDE FACE
SIDEWALL ELEVATION
[66" DIA. R.C. PIPE NOT SHOWN]



STEEL IN OUTSIDE FACE STEEL IN INSIDE FACE
SECTION A - A
[ANTIVORTEX WALL NOT SHOWN]

DETAILS OF PRINCIPAL SPILLWAY RISER

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

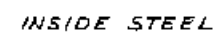
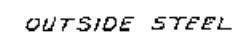
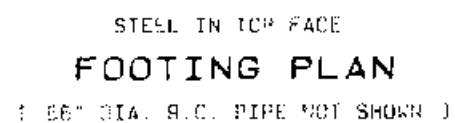
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed JON NESTOR 2/89
Drawn G. F. WALISER 2/89
Traced
Checked DENNIS REEP 6/89
Date 2/89
Drawing No. 08-89-031

AS BUILT PLANS
NO CHANGE
Revised Date 1-24-91

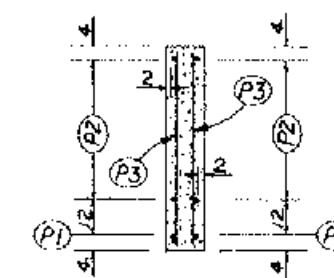
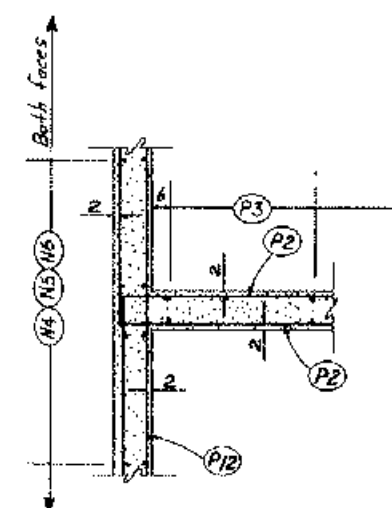
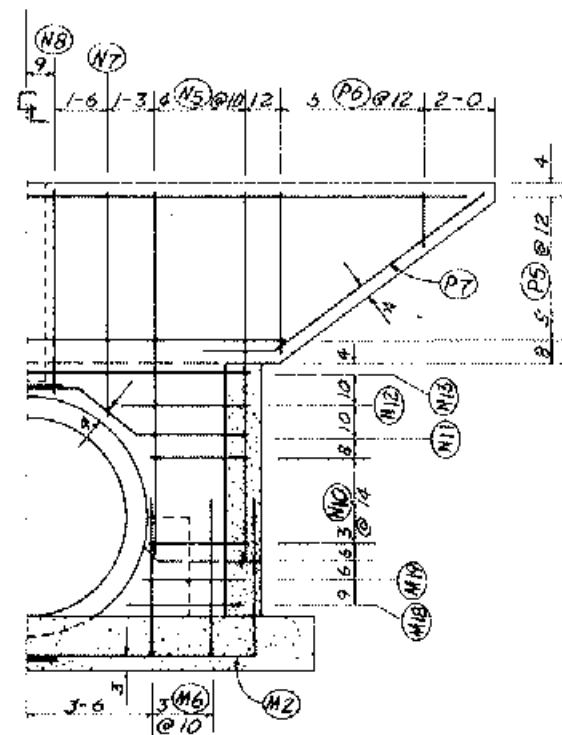
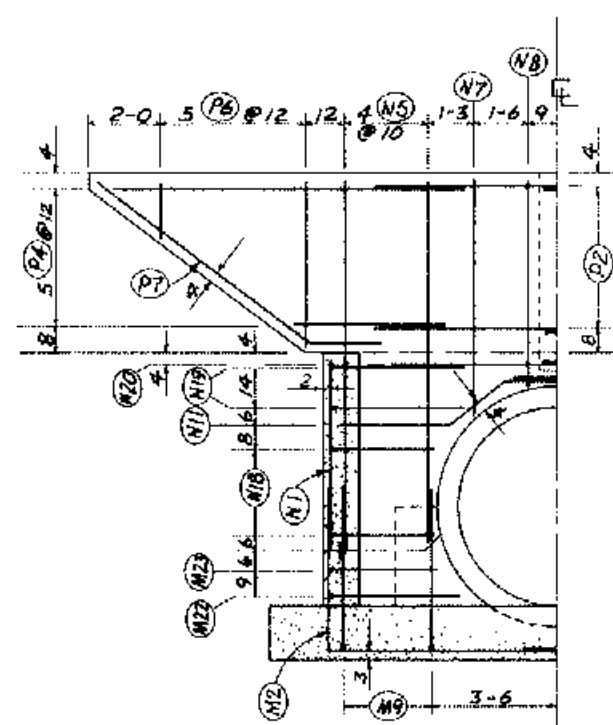
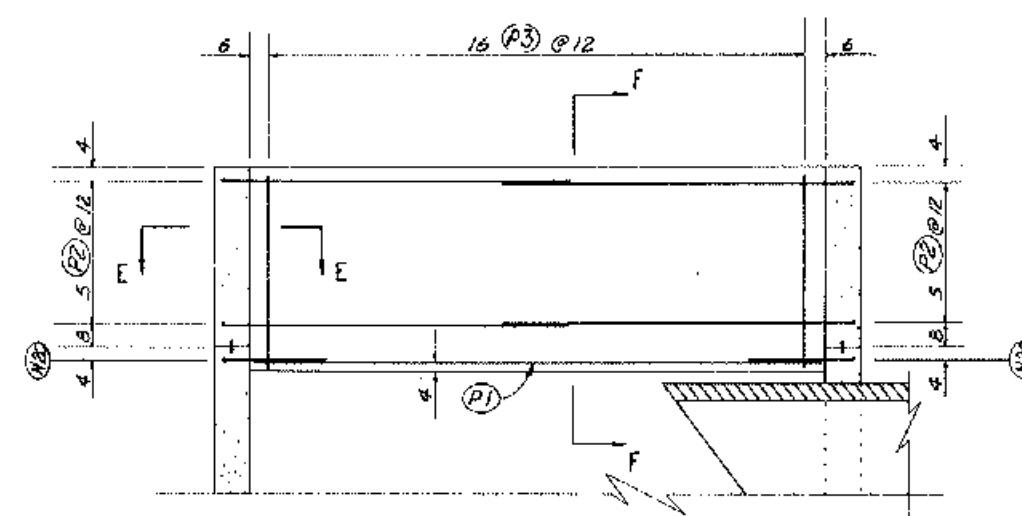
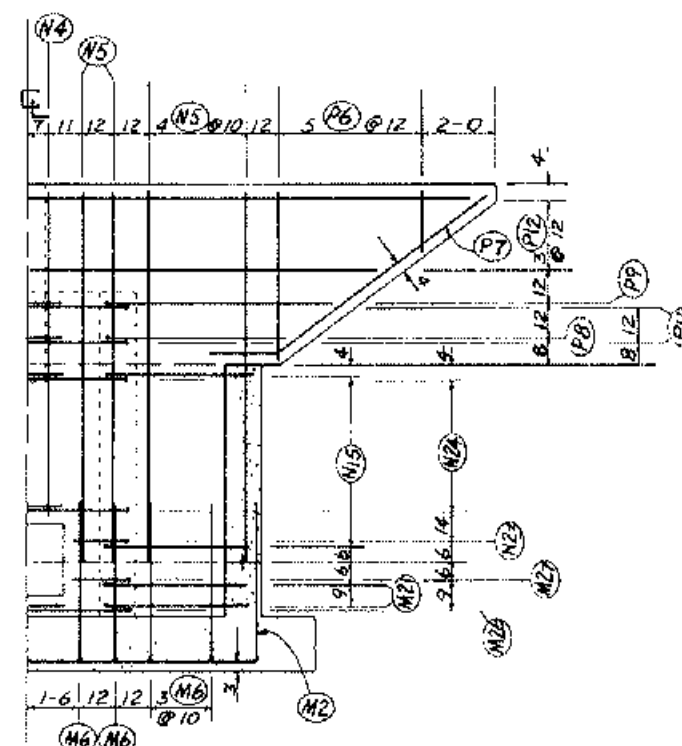
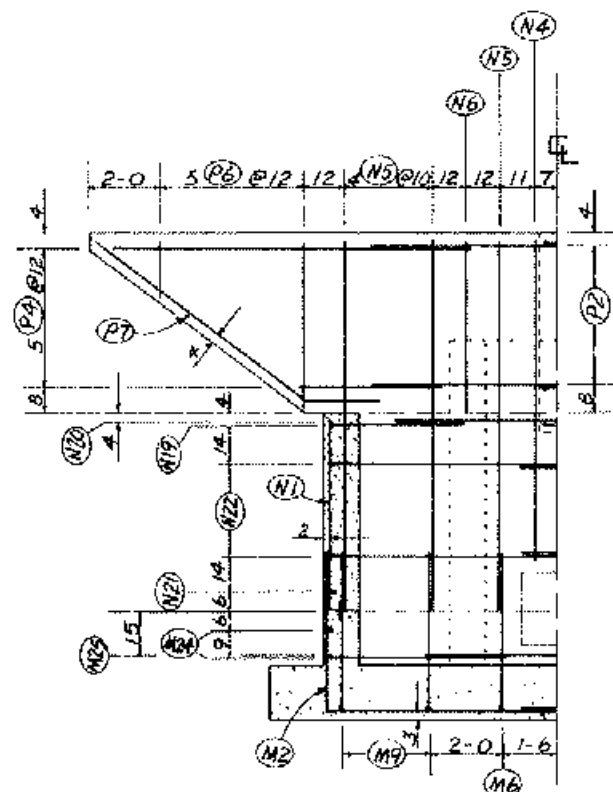




SECTION B - B



AS BUILT PLANS
NO CHANGE



SECTION E - E
JUNCTION OF ANTIVORTEX
WALL AND ENDWALL

SECTION F - F

ANTIVORTEX WALL

DETAILS OF PRINCIPAL SPILLWAY RISER

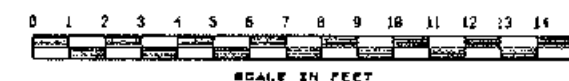
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

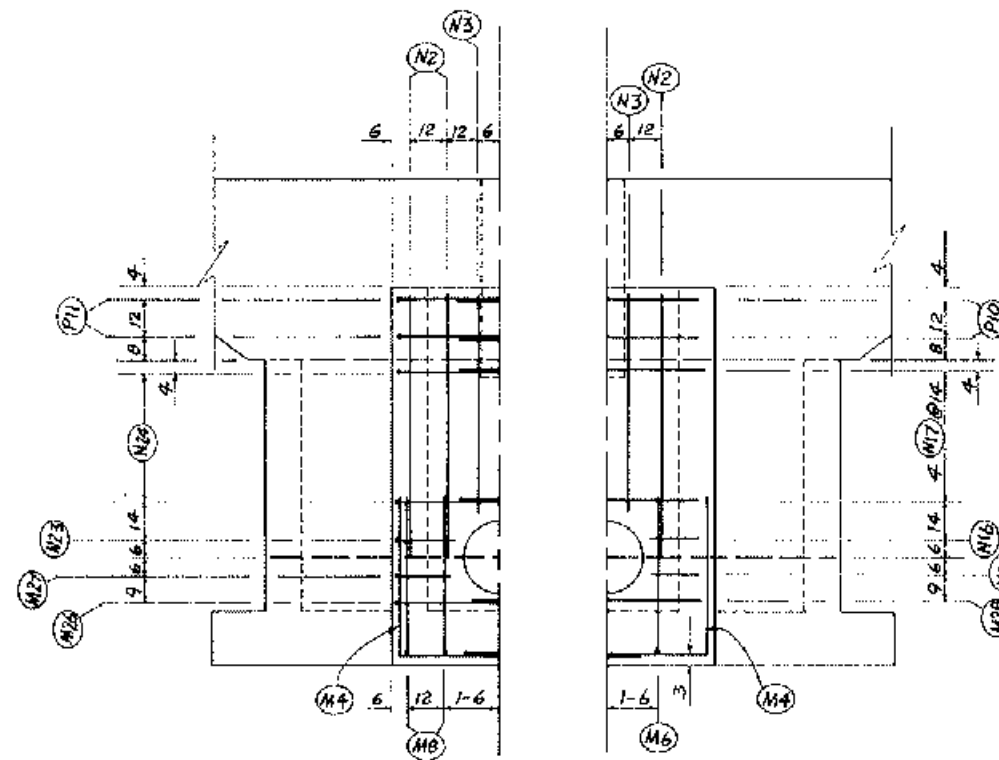
GRAND FORKS COUNTY	NORTH DAKOTA
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

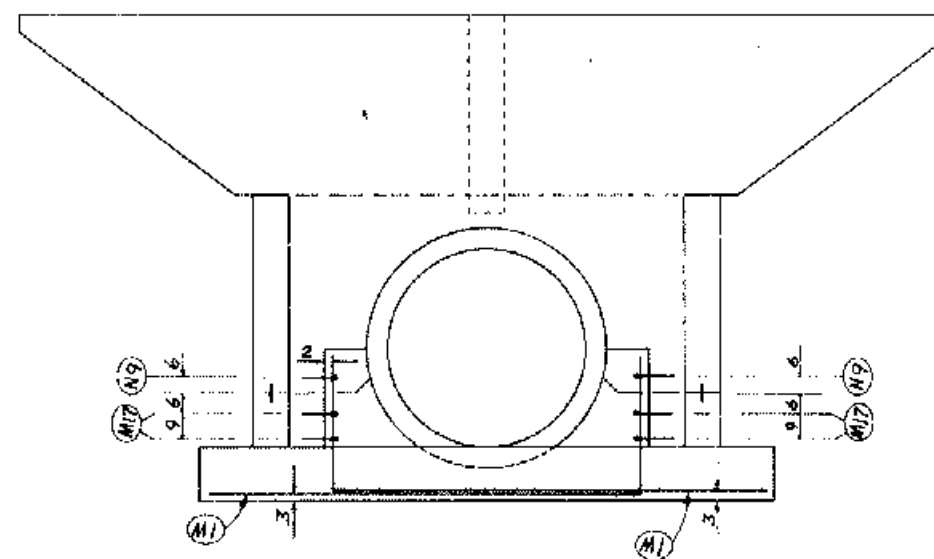
Date	
Assigned	JUN NESTOSS 2789
Drawn	G.F. WALISER 2789
Prepared	
Checked	BENNIS REEF 4/28/68
Approved By	[Signature] 08-89-031

AS BUILT PLANS
NO CHANGE
Comp Date 1-24-1

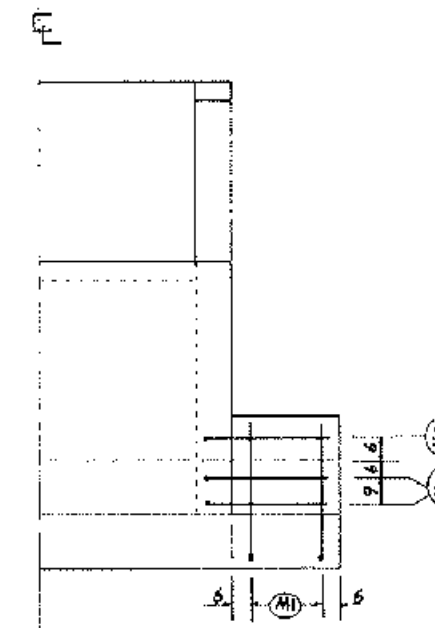




STEEL IN OUTSIDE FACE STEEL IN INSIDE FACE
UPSTREAM ENDWALL ELEVATION



STEEL IN PIPE CRADLE
DOWNSTREAM ENDWALL ELEVATION

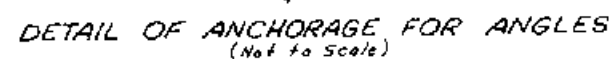


STEEL IN PIPE CRADLE
PARTIAL SIDEWALL ELEVATION

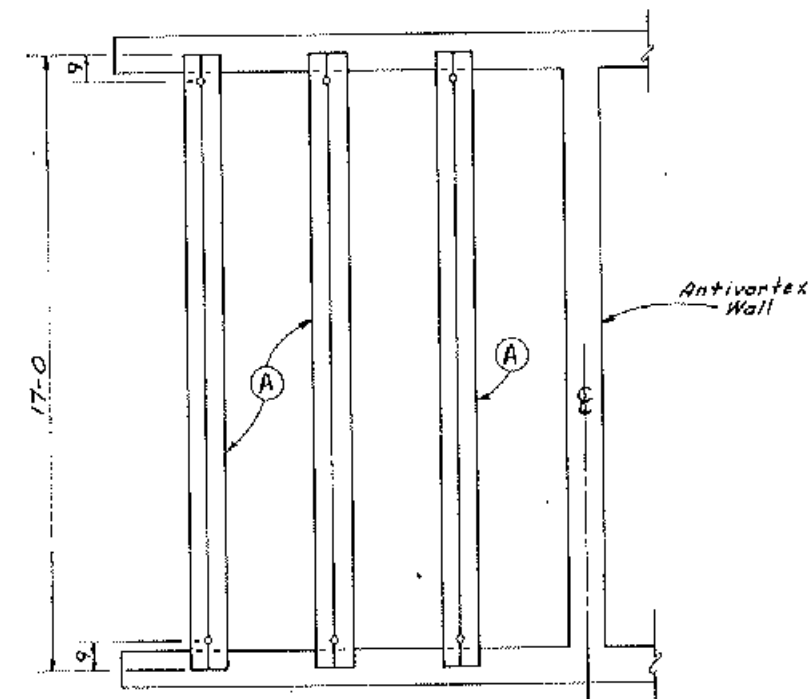
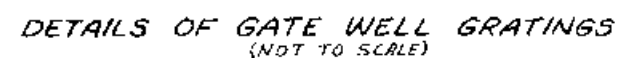
AS BUILT PLANS
NO CHANGE
Comp. Date: 1-24-91



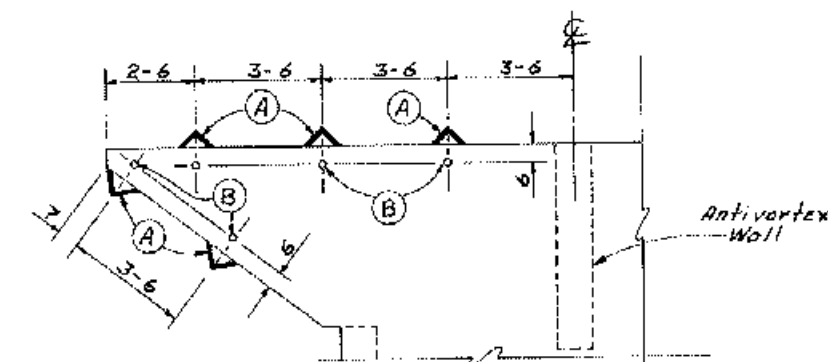
FLOODWATER RETARDING STRUCTURE	
ENGLISH COULEE WATERSHED	
GRAND FORKS COUNTY, NORTH DAKOTA	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed: JON NESTOR 2/88	Approved By: _____
Drawn: George Holiser 5/89	Title: _____
Traced: _____	Sheet: _____
Checked: GEMMA REED 6/89	Drawing No. 08-89-031



NOTE: The opening for the slide gate stem will be field cut in the graving. The bearing bars will be cut with a BBR.



HALF TOP PLAN
DETAILS OF TRASH RACK



HALF END WALL ELEVATION
DETAILS OF TRASH RACK



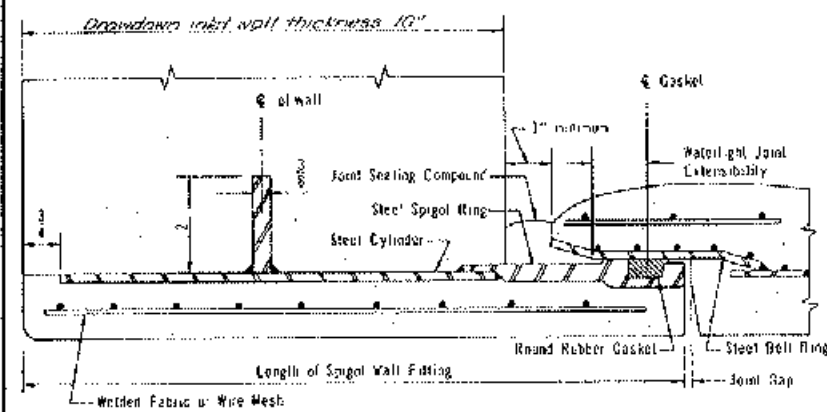
AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-91

DETAILS OF TRASH RACK AND GATEWELL GRATINGS

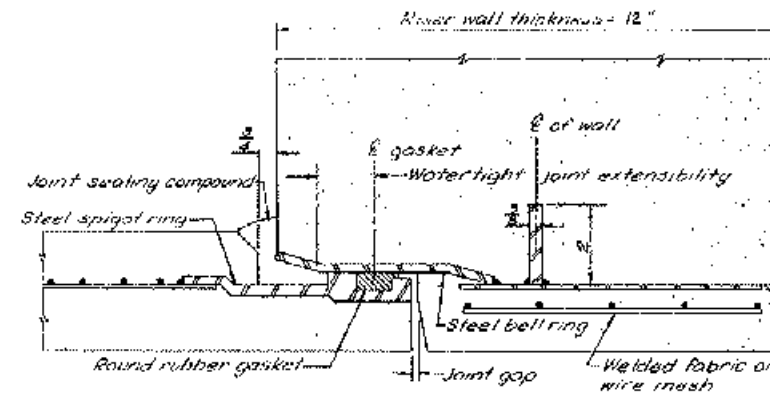
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORK'S COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date		Approved by	
Assigned <i>Jon Neefoss 5/89</i>		Time	
Drawn <i>George Wolser 5/89</i>		Title	
PROJECT		SHEET	
Checked <i>Dennis Reep 6/89</i>		Drawing No	
		No 30 of 88	
		<i>08-89-031</i>	



DETAIL A



DETAIL C

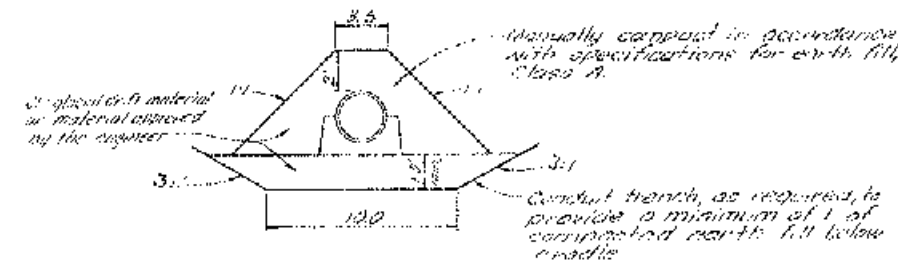
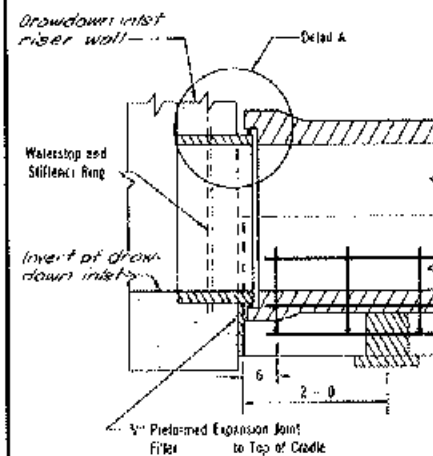
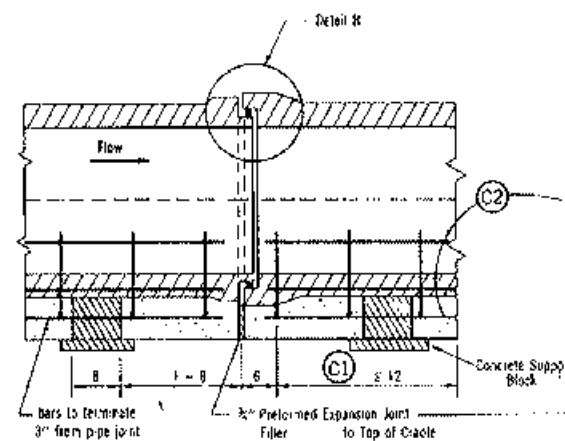


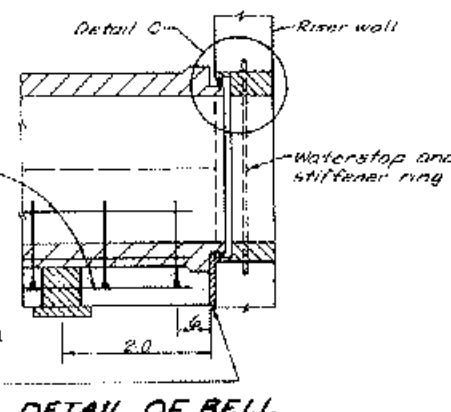
DIAGRAM OF BACKFILL
FOR 24\"/>



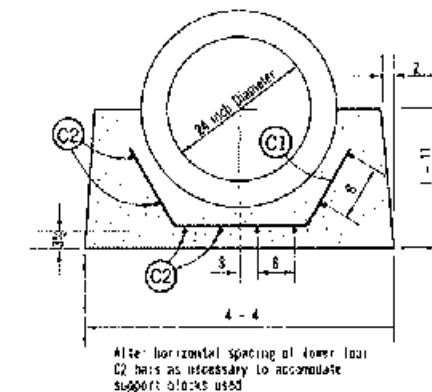
DETAIL OF SPIGOT
WALL FITTING



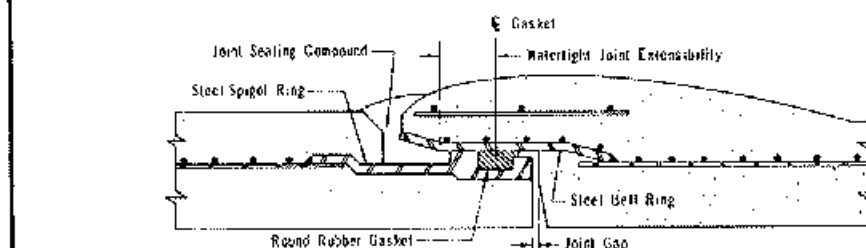
DETAIL OF PIPE JOINT
(No intermediate joints)



DETAIL OF BELL
WALL FITTING



DETAIL OF CRADLE



DETAIL B

JOINT REQUIREMENTS			
Length of Pipe Section	Minimum Joint Length	Minimum Joint Lifting Angle	
feet	inches	radians	degrees
15	2' 1 7/8		19.83

For pipe length other than shown, joint requirements will be determined by the Engineer.

Where pipes of different length are connected, adjoining pipes shall meet the requirements of the longer pipe.

Prior to delivery of pipe, the pipe joint detail proposed for use shall be submitted to the Engineer for approval.

STRENGTH REQUIREMENTS			
Inside Diameter of Pipe	Internal Load	External Load	
		Minimum 3-Edge Bearing Strength in Pounds per Linear Foot of Pipe	Applicable Standard Specification
		AWWA C-301	AWWA C-300
inches	Head of Water	Load to produce 0.001 inch crack one foot long	Load to produce 0.01 inch crack one foot long
24	25	2900	3800

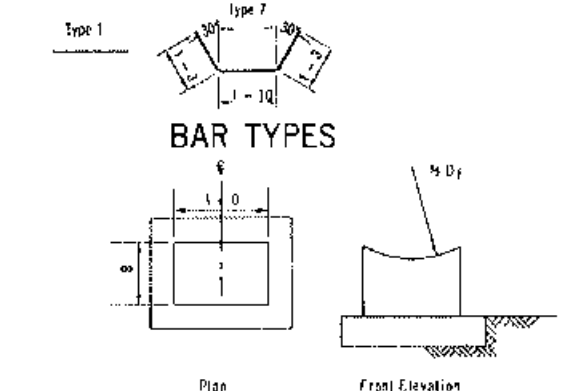
The outside diameter of pipe assumed in design is 30 1/8 inches. Where the pipe furnished has an outside diameter greater than assumed in design, the three-edge bearing strength of the pipe furnished must not be less than the specified three-edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter assumed in design.

STEEL SCHEDULE						
Mark	Size	Total Quantity	Length	Type		Total Length
C1	4	16	4 - 4	2		69-4
C2	6	8	15 - 6	1		124-0

QUANTITIES	
Concrete	cu. yds.
Cradle	
** Per Linear Foot of Cradle	0.233
Total	3.4
Steel	Pounds
Cradle	233

Concrete quantities are based on an outside diameter of pipe of 29 5/8 inches. Steel quantities do not change with outside diameter of pipe.

** This quantity is given by:
 $0.1923 + 0.000170 (D_1 + 32) (D_1 - 32)$ cu. yds.
 D_1 = outside diameter of pipe furnished, inches.



SUGGESTED SUPPORT BLOCKS

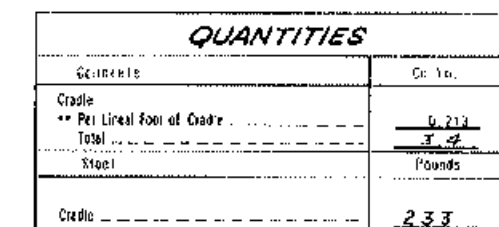
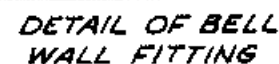
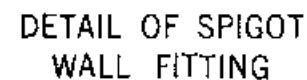
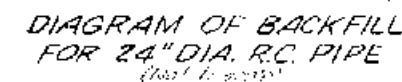
AS BUILT PLANS
 NO CHANGE
 Comp. Date: 1-21-77

Sufficient blocks shall be provided to support the pipe to the required line and grade. The Contractor shall determine the number and size of blocks required. Wedges may be used as an alternative.

FLOODWATER RETARDING STRUCTURE			
ENGLISH COULEE WATERSHED			
Grand Forks County		North Dakota	
U. S. DEPARTMENT OF AGRICULTURE			
SOIL CONSERVATION SERVICE			
Designed by	Date	Approved by	
Drawn	8-79	Title	
Traced	George Welker 5/89	Title	
Checked	Dennis Reap 6/89	Sheet No. 31 of 88	Drawing No. 08-89-031

REVISED 8-76 BY MFS	
STANDARD CONDUIT DETAILS	
FOR REINFORCED CONCRETE PRESSURE PIPE	
PRINCIPAL SPILLWAY	
STANDARD DWG. NO.	ES-5024-CE
DATE	2-70
BY	J. 12
SHEET	1 OF 1

Joint length equals watertight joint extensibility plus joint gap. The pipe shall be placed together so that the watertight joint gap does not exceed 3/8 inch for pipe laid on a straight line. For centerline pipe or pipe laid on a curved line, the joint gap at the "inside point" shall not exceed 3/8 inch.

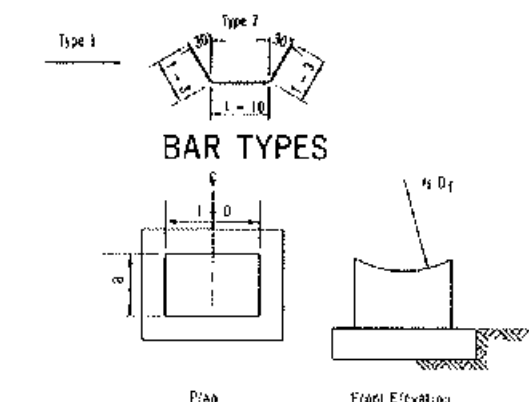


Concrete quantities are based on an outside diameter of pipe of 20 5/8 inches.
Steel quantities do not change with outside diameter of pipe.

^{**} This quantity is given by

$$0.1923 = 0.0001310 (D_f + 32) (D_f - 32) \text{ cu yds}$$

$$D_f = \text{outside diameter of pipe furnished, inches}$$



SUGGESTED SUPPORT BLOCKS

AS BUILT PLANS
NO CHANGE
Comp. Date 1-28-91

Sufficient blocks shall be provided to support the pipe to the required line and grade. The Contractor shall determine the number and size of blocks required. #2s may be used as an alternate.



For pipe length other than shown, joint requirements will be determined by the Engineer.

Where pipes of different length are connected, adjoining joints shall meet the requirements of the longer pipe.

Prior to delivery of pipe, the pipe joint detail proposed for use shall be submitted to the Engineer for approval.

The outside diameter of pipe assumed in design is 30.125 inches. Where the pipe furnished has an outside diameter greater than assumed in design, the three-edge bearing strength of the pipe furnished must not be less than the specified three-edge bearing strength multiplied by the ratio of the outside diameter of the pipe furnished to the outside diameter assumed in design.

REVISED A-76 BY MTSC
STANDARD CONDUIT DETAILS

FOR
REINFORCED CONCRETE PRESSURE PIPE
PRINCIPAL SPILLWAY

STANDARD DWG. NO. ES-5024-CE

DATE	2-70	REV. 3 77	SHEET	1	OF	1
------	------	-----------	-------	---	----	---

The pipe shall be drawn together so that the maximum joint gap does not exceed 3/8 inch for pipe laid on a straight line. For curved pipe or pipe laid on a curved line, the joint gap at the "closed" point shall not exceed 3/8 inch.

Grand Forks County North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
----------	------	-------------

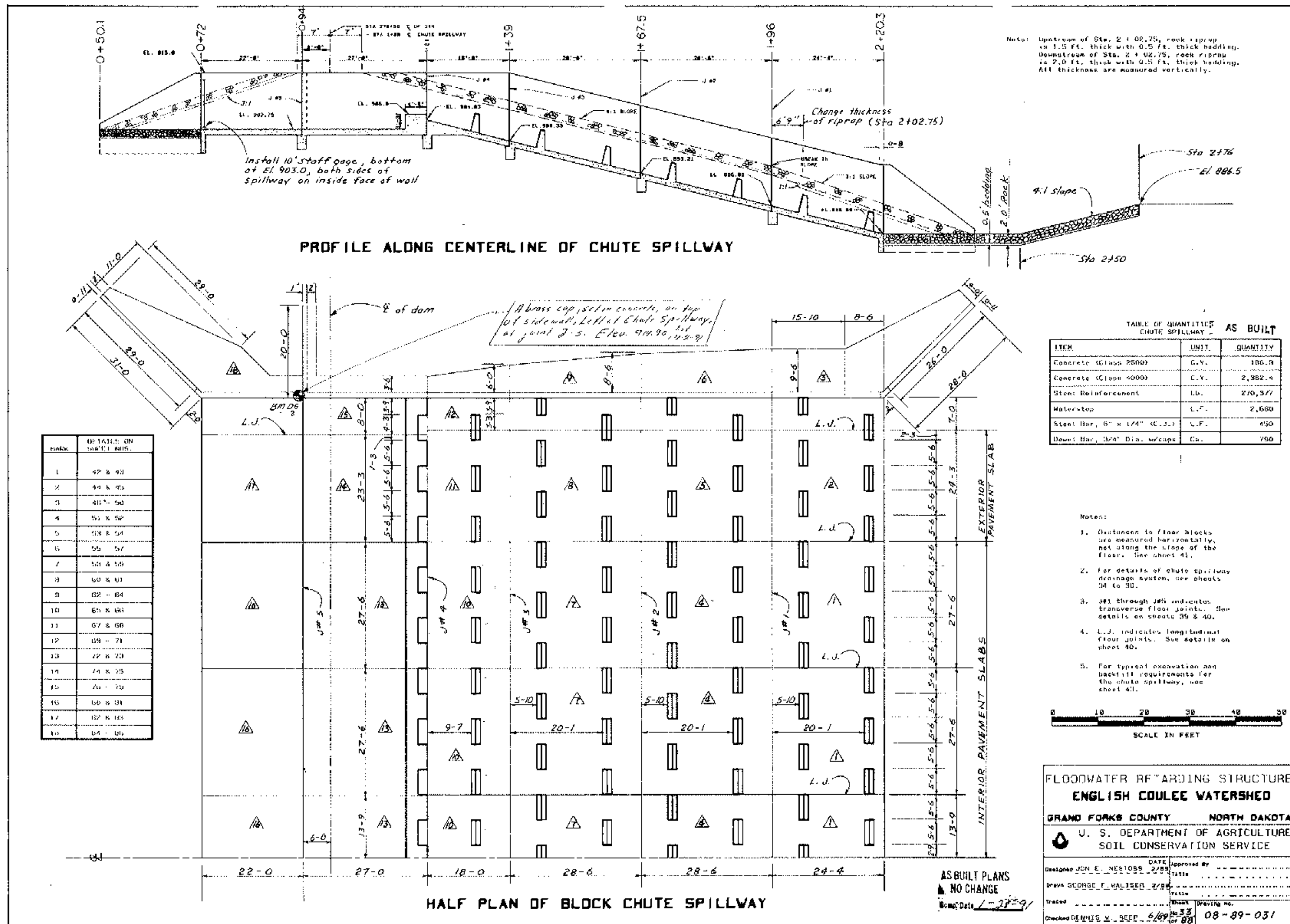
NAME J. E. N. B-7C Title _____

George Walker 5/69

Preced

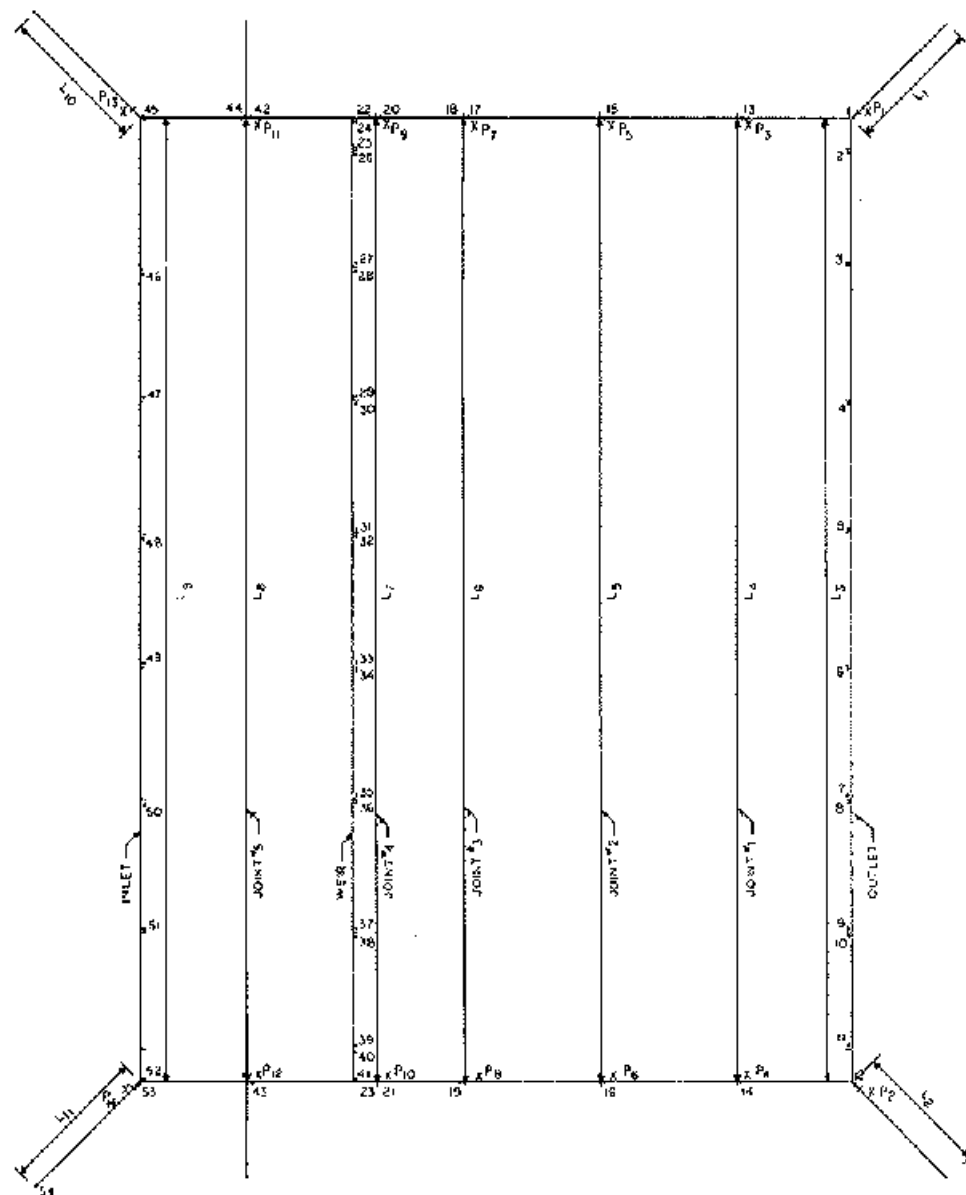
Sheet Drawing No.

Dennis Reep 6/89 No 31 08-89-031
of 88



CHUTE SPILLWAY AS-BUILT ELEVATIONS

MARK	ELEVATION FT.	DATE TAKEN
1	879.99	7/12/90
2	880.00	7/12/90
3	879.99	7/12/90
4	880.00	7/12/90
5	879.99	7/12/90
6	879.98	7/12/90
7	879.99	7/12/90
8	879.98	8/20/90
9	879.97	8/20/90
10	879.98	8/18/90
11	879.99	8/18/90
12	894.85	8/2/90
13	900.80	8/10/90
14	900.75	8/7/90
15	907.90	8/22/90
16	907.88	8/13/90
17	915.01	8/24/90
18	915.03	9/13/90
19	914.99	9/12/90
20	915.01	9/13/90
21	915.00	9/10/90
22	915.02	9/21/90
23	915.00	9/20/90
24	906.00	9/21/90
25	906.01	9/21/90
26	906.01	9/27/90
27	906.00	9/27/90
28	906.00	9/24/90
29	906.00	9/24/90
30	906.00	9/20/90
31	906.00	9/28/90
32	906.00	9/21/90
33	906.00	9/21/90
34	906.00	9/26/90
35	906.00	9/26/90
36	906.00	9/12/90
37	906.00	9/12/90
38	906.00	10/1/90
39	906.00	10/1/90
40	906.02	9/20/90
41	906.00	9/20/90
42	915.00	9/21/90
43	915.00	9/20/90
44	915.00	10/5/90
45	916.89	10/5/90
46	902.74	9/26/90
47	902.75	9/26/90
48	902.76	9/26/90
49	902.75	9/26/90
50	902.76	9/26/90
51	902.77	9/25/90
52	902.74	9/25/90
53	914.98	10/2/90
54	903.99	10/2/90



CHUTE SPILLWAY AS-BUILT PLUMBNESS

PLUMB MARK (X)	PLUMBNESS	DATE TAKEN
P1	2/16" TOP	11/26/90
P2	2/16" TOP	11/26/90
P3	1/16" BOTTOM	11/26/90
P4	1/16" BOTTOM	11/26/90
P5	PLUMB	11/26/90
P6	2/16" TOP	11/26/90
P7	2/16" TOP	11/26/90
P8	PLUMB	11/26/90
P9	1/16" TOP	11/26/90
P10	PLUMB	11/26/90
P11	1/16" TOP	11/26/90
P12	1/16" TOP	11/26/90
P13	PLUMB	11/26/90
P14	PLUMB	11/26/90

NOTE: Plumbness of the sidewalls and the wingwalls was measured with a 30" carpenter level. Measurements were taken 6" from the construction joint and 1.0' below the top of the concrete at the point marked by an X on this plan view.

CHUTE SPILLWAY AS-BUILT LENGTHS

LENGTH (L)	LENGTH (FT)	DATE TAKEN
L1	28.25	11/26/90
L2	28.25	11/26/90
L3	200.01	11/26/90
L4	200.11	11/26/90
L5	200.12	11/26/90
L6	200.13	11/26/90
L7	200.00	11/26/90
L8	200.00	11/26/90
L9	200.01	11/26/90
L10	31.25	11/26/90
L11	31.25	11/26/90

0 10 20
SCALE IN FEET

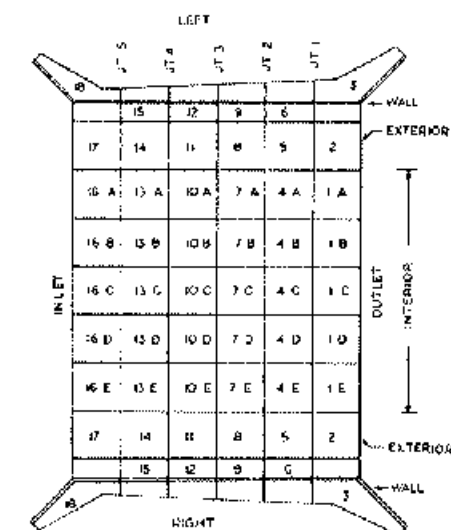


DIAGRAM OF SEGMENTS FOR
CHUTE SPILLWAY
(Not to Scale)

CHUTE SPILLWAY AS-BUILT'S

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY

NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

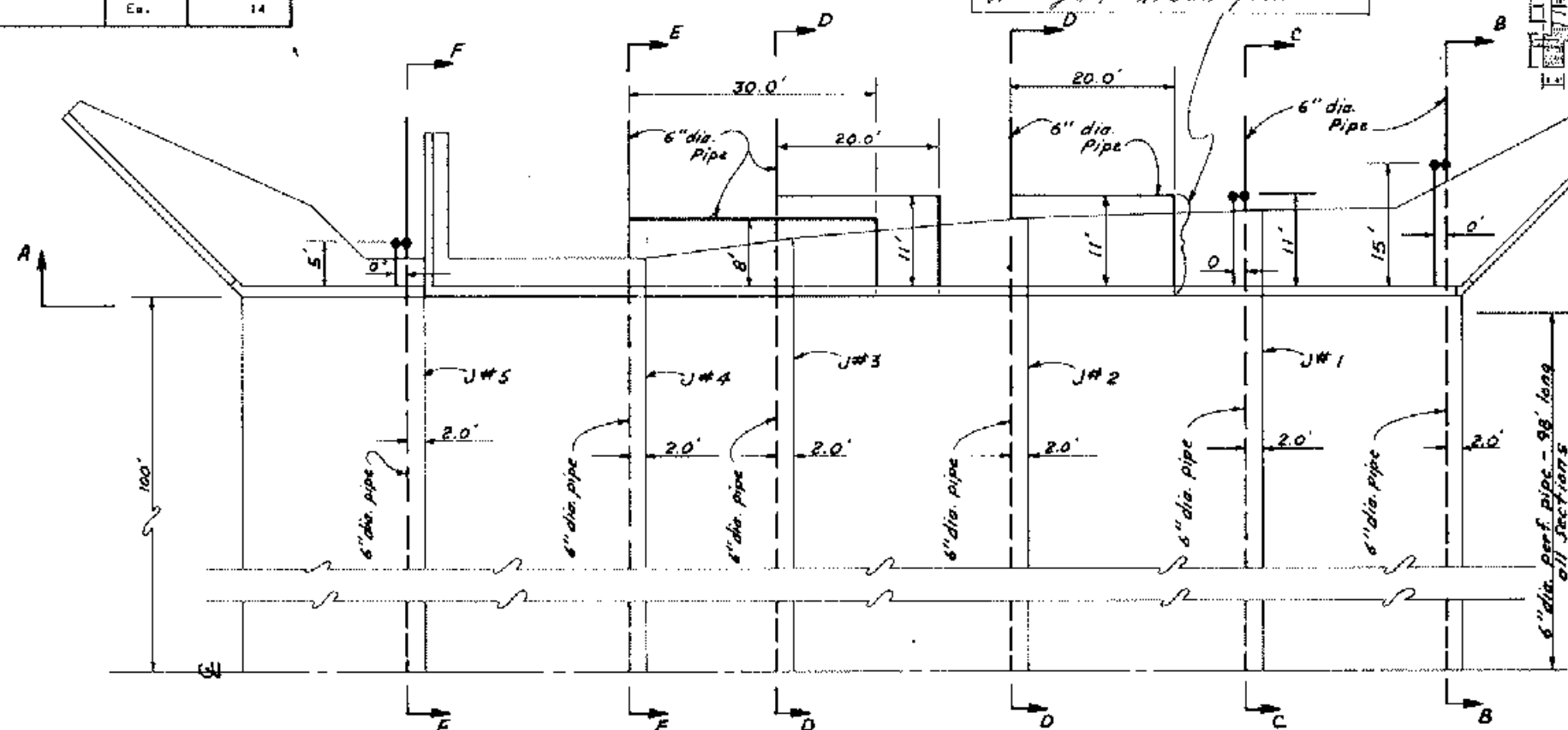
Designed	Date	Approved by
Drawn	DATE	DATE
Traced	DATE	DATE
Checked	DATE	DATE

TABLE OF QUANTITIES CHUTE SPILLWAY FLOOR AND SIDEWALL DRAINS		
ITEM	UNIT	QUANTITY
Fine Drain Fill	C.Y.	833
Coarse Drain Fill	C.Y.	1,141
6" Dia. Perf. PVC Pipe	L.F.	1,295
6" Dia. Non-Perf. PVC Pipe	L.F.	637
6" Dia. PVC Pipe End Caps	EA.	18
6" Dia. Flap Gates	EA.	2
Animal Guards	EA.	14

AS BUILT

FLOOR DRAIN AND COLLECTOR PIPES

SECTION A - A



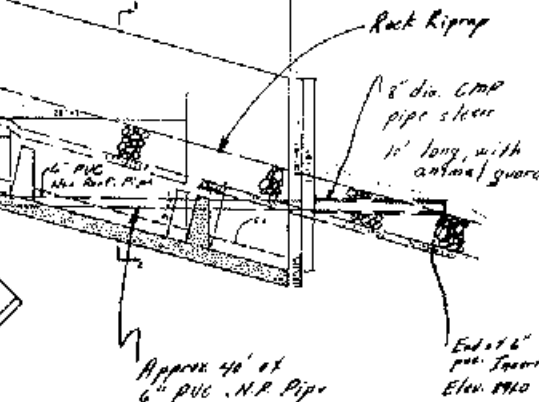
HALF PLAN VIEW - TRANSVERSE COLLECTORS
(FLOOR BLOCKS NOT SHOWN)

These sidewall drains left and right of chute spillway sidewalls were not installed by the Contractor. To rectify the outlet drain problem @ J-2, another 20' length of 6" N.P. pipe was added on to the planned 20' length and installed to outlet into the rock rip rap @ elev. 991.0.

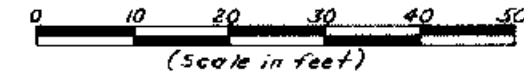
- Notes:
1. See details of drain outlets and animal guards, see sheet 35.
 2. n.p. indicates non-perforated pipe.

Install 6" dia. flap gate on this outlet. All other drain outlets to have animal guards.

This section of pipe was deleted due to construction error of not installing drain outlet in chute sidewalls. Left Right. Note view right for As built plan.



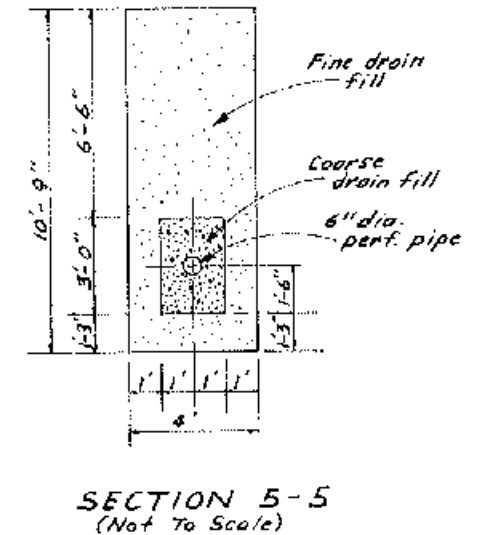
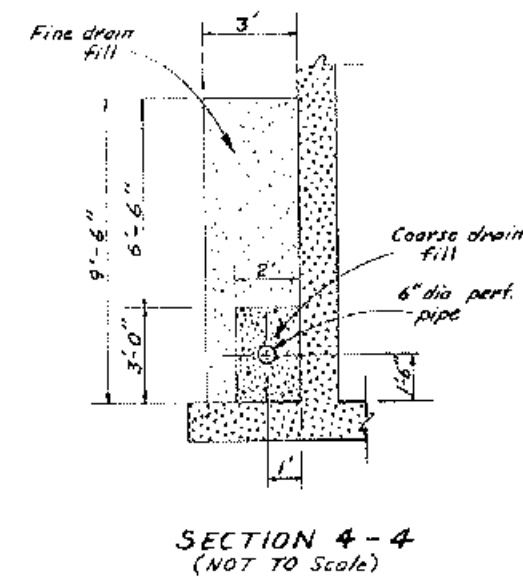
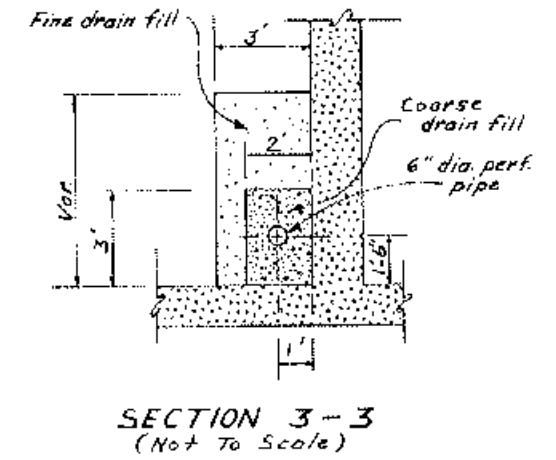
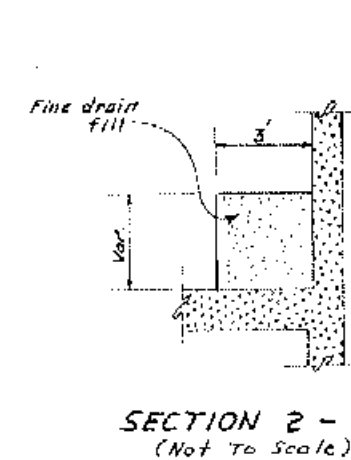
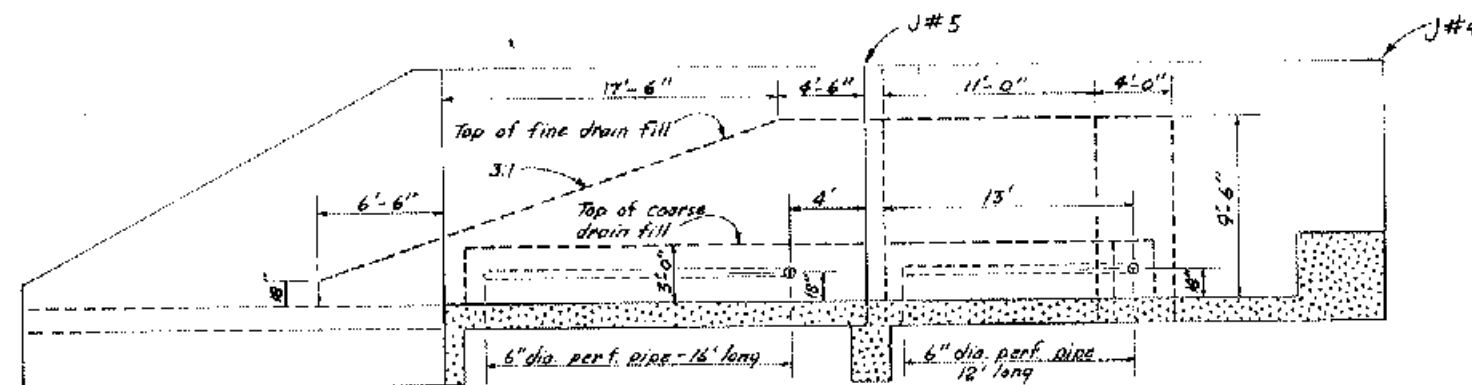
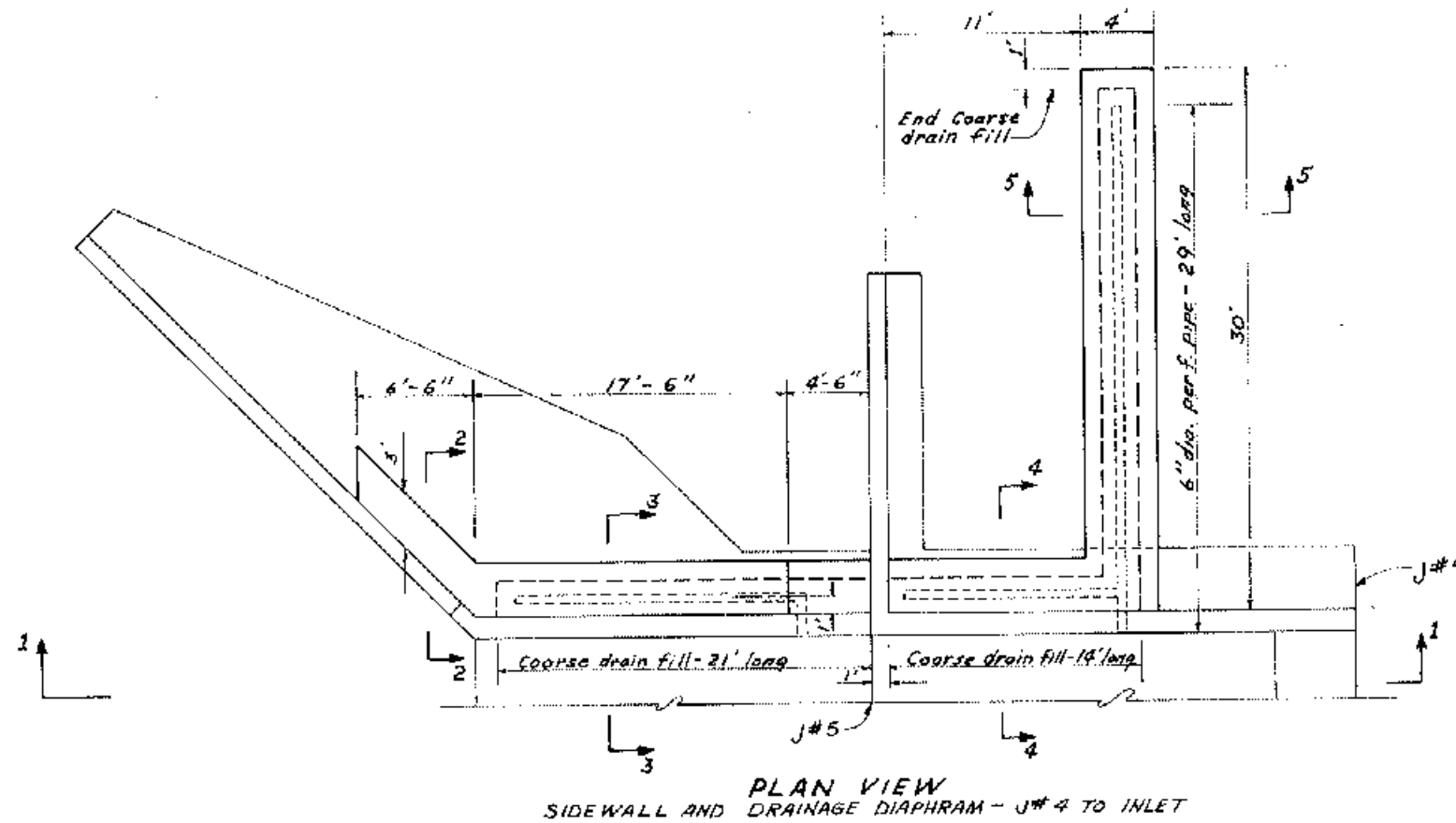
All pipe beyond 98' from E shall be 6" dia., non-perforated pipe.



DETAILS OF FLOOR DRAINAGE
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

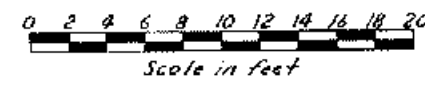
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by Jon Nestor	Date 4/89	Approved by George Muller	Date 5/89
Tracked by Dennis Reap	Date 4/89	Sheet 34	Drawing No. 08-89-031



- Notes:
1. Cap upstream ends of all pipes.
 2. For details of pipe outlet and animal guard, see sheet 36.

AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-91

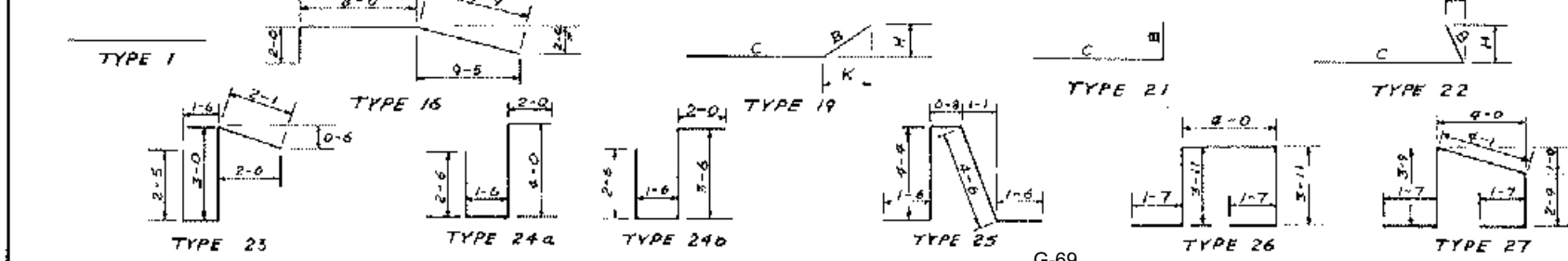


DETAILS OF SIDEWALL DRAIN			
FLOODWATER RETARDING STRUCTURE			
ENGLISH COULEE WATERSHED			
GRAND FORK'S COUNTY, NORTH DAKOTA			
U. S. DEPARTMENT OF AGRICULTURE			
SOIL CONSERVATION SERVICE			
Designed by	Don Nestor	Date	5/89
Drawn by	George Waliser	Date	5/89
Traced by		Date	
Checked by	Dennis Reep	Date	6/89
Project No.	36	Sheet No.	88
Project Name	08-89-031		

STEEL SCHEDULE

MARK	SIZE	QUANT.	LENGTH	TOTAL L.	TYPE	B	C	H	K	MARK	SIZE	QUANT.	LENGTH	TOTAL L.	TYPE	B	C	H	K	MARK	SIZE	QUANT.	LENGTH	TOTAL L.	TYPE	B	C	H	K
A1	h	150	5-0	750-0	19	2-1	3-5	2-1	0-6	C19	7	40	12-3	500-0	21	4-5	7-9			E1	5	50	13-6	675-0	1				
A2	4	35	27-0	945-0	1					C20	6	2 sets of 4 bars	25-0 to 31-0 @ 5" incr.	242-0	10	4-3	25-3 to 28-9 @ 5" incr.	3-0	3-0	E2	6	22	25-0	550-0	1				
A3	5	150	9-0	1350-0	23	See	Detail			C21	6	2 sets of 4 bars	14-0 to 25-9 @ 3'-0" incr.	157-0	18	4-3	9-8 to 21-0 @ 3'-0" incr.	3-0	3-0	E3	6	54	13-0	729-0	1				
A4	h	30	27-0	810-0	1					C22	7	2	30-0	60-0	19	2-9	27-3	1-10	2-1	E4	6	22	25-9	566-6	14	1-0	24-3	0-8	0-8
A5	5	75	27-0	2025-0	1					C23	6	2	10-0	20-0	1														
A6	6	125	28-6	3517-6	22	2-0	24-6	1-11	0-6	C24	6	2	9-6	11-0	1														
A7	h	225	12-6	2812-6	25	See	Detail			C25	6	16	10-6	168-0	19	4-6	6-0	3-2	3-2	F1	5	150	9-0	1350-0	23	See	Detail		
A8	6	125	26-0	3500-0	19	3-5	24-6	3-5	0-10	C26	6	10	10-0	324-0	22	2-0	16-0	1-11	0-6	F2	5	30	27-0	810-0	1				
A9	6	105	27-0	2835-0	1					C27	6	14	26-0	364-0	22	2-0	24-0	1-11	0-6	F3	5	95	27-0	2565-0	1				
A10	6	200	5-0	1000-0	1					C28	5	22	12-6	275-0	25	See	Detail			F4	6	125	30-9	3863-9	22	2-0	28-9	1-11	0-6
										C29	6	2 sets of 4 bars	24-9 to 27-9 @ 12" incr.	210-0	1					F5	5	225	12-6	2812-6	25	See	Detail		
										C30	7	2	19-0	38-0	1					F6	6	125	28-9	3593-9	1				
U1	5	48	5-6	264-0	19	2-1	3-5	2-0	0-6	C31	8	2 sets of 4 bars	7-0 to 19-0 @ 4'-0" incr.	104-0	1					F7	7	95	27-0	2565-0	1				
U2	4	14	23-9	332-6	1					C32	7	2 sets of 3 bars	8-9 to 18-9 @ 2'-0" incr.	97-6	1					F8	6	200	5-0	1000-0	1				
U3	5	48	9-0	432-0	23	See	Detail			C33	7	2	13-0	26-0	1														
U4	5	12	23-9	285-0	1					C34	7	2	15-9	31-6	1														
U5	5	30	23-9	712-6	1					C35	7	12	26-3	315-0	1														
U6	6	44	26-6	1168-0	22	2-0	24-6	1-11	0-6	C36	6	12	20-0	336-0	14	3-6	24-6	3-5	0-10	G1	5	48	9-0	432-0	23	See	Detail		
U7	5	70	12-6	875-0	25	See	Detail			C37	6	2 sets of 5 bars	8-0 to 10-6 @ 6" incr.	111-0	21	1-3	8-9 to 9-9 @ 6" incr.			G2	5	12	23-9	285-0	1				
U8	6	44	26-0	1232-0	19	3-5	24-6	3-5	0-10	C38	7	2 sets of 10 bars	11-3 to 15-9 @ 6" incr.	270-0	21	1-6	9-9 to 14-3 @ 6" incr.			G3	5	30	23-9	807-6	1				
U9	6	42	23-9	997-6	1					C39	7	2 sets of 6 bars	13-3 to 15-9 @ 6" incr.	174-0	21	1-6	11-8 to 14-3 @ 6" incr.			G4	6	44	30-9	1353-0	22	2-0	28-9	1-11	0-6
U10	6	64	5-0	320-0	1					C40	7	10	15-0	150-0	1					G5	5	78	12-6	975-0	25	See	Detail		
U11	6	18	1-11	30-8	1					C41	7	2 sets of 9 bars	17-0 to 23-0 @ 6" incr.	342-0	1					G6	6	44	28-9	1265-0	1				
										C42	6	32	17-0	544-0	1					G7	7	36	23-9	902-6	1				
C1	5	4 sets of 3 bars	5-0 to 6-0 @ 6" incr.	66-0	1					C43	6	2	28-3	53-6	19	2-0	24-6	1-5	1-5	G8	6	64	5-0	320-0	1				
C2	5	90	6-3	562-6	1					C44	6	2	25-0	50-0	1					G9	6	16	1-11	30-0	1				
C3	7	14	0-0	112-0	1					C45	6	16	2-9	44-0	1					H1	5	28	9-0	252-0	23	See	Detail		
C4	5	6	30-3	181-8	19	3-1	27-2	2-2	2-2	C46	6	16	3-3	52-0	1					H2	6	28	5-0	140-0	22	2-0	9-0	1-11	0-6
C5	5	8	30-6	244-0	19	3-1	27-5	2-2	2-2											H3	5	12	16-2	194-0	1				
C6	5	4	29-9	111-0	1															H4	7	58	12-3	710-6	21	4-6	7-9		
C7	5	14	5-6	77-0	19	2-1	3-5	2-0	0-6											H5	6	58	15-0	870-0	21	6-8	8-8		
C8	5	6	9-6	57-0	19	2-7	6-11	1-10	1-10											H6	6	58	9-0	504-0	21	3-9	5-3		
C9										D1	5	4 sets of 8 bars	2-1 to 6-7 @ 6" incr.	122-8	1					H7	5	58	5-9	304-6	1				
C10	h	8	7-0	56-0	1					D2	5	4 sets of 7 bars	8-3 to 8-3 @ 6" incr.	217-0	1					H8	6	30	30-9	927-6	22	2-0	28-9	1-11	0-6
C11	5	60	9-0	540-0	23	See	Detail			D3	5	4 sets of 8 bars	9-11 to 13-6 @ 6" incr.	373-6	1					H9	5	26	0-0	200-0	22	2-0	6-0	1-11	0-6
C12	5	12	17-0	204-0	1					D4	5	4 sets of 11 bars	2-0 to 24-6 @ 2'-3" incr.	543-0	1					H10	5	22	12-6	275-0	25	See	Detail		
C13	5	4	5-6	22-0	21	1-0	4-6			D5	5	4	28-3	113-0	1					H11	6	20	28-9	605-0	1				
C14	5	6 sets of 4 bars	2-6 to 5-6 @ 12" incr.	64-0	21	1-0	1-6 to 4-6 @ 12" incr.													H12	6	20	11-0	220-0	1				
C15	5	2 sets of 10 bars	7-9 to 15-3 @ 6" incr.	360-0	21	1-0	6-9 to 14-3 @ 6" incr.													H13	7	30	15-0	450-0	1				
C16	7	2 sets of 8 bars	17-0 to 20-6 @ 6" incr.	500-0	21	6-6	10-6 to 14-0 @ 6" incr.																						
C17	7	6	16-0	100-6	21	6-6	10-9																						
C18	7	28	15-0	420-0	21	4-9	10-3																						

BAR BENDS:



Notes:

1. Bar dimensions are out to out of bar.
2. Radius of bends shall be 3 times the diameter of the bar for size #7 and smaller and 4 times the diameter of the bar for size #8.

AS BUILT PLANS

NO CHANGE

Comp. Date 1-24-91

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Drawn by Jon Nestoss 5/89
Checked by George Waliser 5/89
Date 5/89
Approved by
Title
Scale
Drawing No. 08-89-031

STEEL SCHEDULE

MARK	SIZE	QUANT	LENGTH	TOTAL L	TYPE	B	C	H	K
H14	5	58	8-9	478-0	1				
H15	6	4	28-8	115-0	1				
H16	6	16	2-9	44-0	1				
H17	6	16	3-3	52-0	1				
J1	5	38	9-0	342-0	1				
J2	5	50	13-0	650-0	1				
J3	6	44	20-9	916-0	1				
K1	5	150	9-0	1350-0	23	See	Detail		
K2	5	30	27-0	810-0	1				
K3	5	96	27-0	2592-0	1				
K4	6	125	30-9	3863-0	22	2-0	26-9	1-11	0-6
K5	5	225	12-0	2700-0	25	See	Detail		
K6	6	125	28-9	3525-0	1				
K7	7	35	27-0	945-0	1				
K8	6	200	5-0	1000-0	1				
L1	5	48	9-0	432-0	23	See	Detail		
L2	5	12	23-9	286-0	1				
L3	5	38	23-5	893-0	1				
L4	5	44	30-9	1359-0	22	2-0	26-9	1-11	0-6
L5	5	78	17-6	1362-0	25	See	Detail		
L6	6	44	28-9	1266-0	1				
L7	7	39	23-3	902-0	1				
L8	6	64	5-0	320-0	1				
L9	6	16	1-11	30-0	1				
M1	5	40	9-0	360-0	23	See	Detail		
M2	5	12	13-5	162-0	1				
M3	7	50	12-3	610-0	21	4-6	7-9		
M4	8	58	15-0	870-0	21	6-6	8-0		
M5	8	56	9-0	504-0	21	8-9	5-3		
M6	5	30	4-6	135-0	1				
M7	5	28	3-3	91-0	1				
M8	6	24	30-9	730-0	22	2-0	26-9	1-11	0-6
M9	6	2	16-0	32-0	1				
M10	6	2	28-9	57-0	1				
M11	5	27	12-6	270-0	25	See	Detail		
M12	6	24	20-9	490-0	1				
M13	6	2	16-1	32-0	1				
M14	6	38	11-0	418-0	1				
M15	4	28	4-0	112-0	1				
M16	5	30	7-9	237-0	1				
M17	5	20	6-8	108-0	1				
M18	6	4	28-0	112-0	1				
M19	6	16	2-9	44-0	1				
M20	6	16	3-3	52-0	1				

MARK	SIZE	QUANT	LENGTH	TOTAL L	TYPE	B	C	H	K
N1	6	56	8-0	528-0	1				
N2	5	50	13-6	703-0	1				
N3	5	44	20-0	880-0	1				
P1	5	150	10-0	1500-0	24a	See	Detail		
P2	5	30	27-0	810-0	1				
P3	5	85	27-0	2295-0	1				
P4	6	125	18-8	2480-0	16	See	Detail		
P5	5	108	12-0	1296-0	26	See	Detail		
P6	6	125	22-0	2750-0	22	4-1	17-11	4-0	1-0
P7	7	85	27-0	2295-0	1				
P8	5	15	27-0	405-0	1				
P9	6	96	5-0	480-0	1				
Q1	5	40	10-0	400-0	24a	See	Detail		
Q2	5	12	23-9	286-0	1				
Q3	5	34	23-9	807-0	1				
Q4	6	44	19-0	836-0	16	See	Detail		
Q5	5	42	12-0	504-0	25	See	Detail		
Q6	6	44	22-0	968-0	27	4-1	17-11	4-0	1-0
Q7	7	34	23-9	807-0	1				
Q8	5	6	23-8	142-0	1				
Q9	6	32	5-0	160-0	1				
Q10	6	16	1-11	30-0	1				
R1	5	38	10-0	380-0	24a	See	Detail		
R2	5	18	11-3	203-0	1				
R3	7	20	12-3	240-0	21	4-6	7-9		
R4	7	2 sets of 8 bars	12-6 to 14-3 02" incr.	214-0	21	4-9 to 6-6 02" incr.	7-9		
R5	8	2 sets of 10 bars	13-9 to 15-3 02" incr.	290-0	21	5-3 to 6-9 02" incr.	8-0		
R6	8	20	7-9	158-0	21	2-6	5-3		
R7	8	2 sets of 6 bars	9-11 to 11-1 02" incr.	180-0	21	4-2 to 5-4 02" incr.	5-9		
R8	6	20	18-9	395-0	16	See	Detail		
R9	6	2	10-0	20-0	1				
R10	6	2	10-0	20-0	1	Field	Band		
R11	5	10	12-6	126-0	25	See	Detail		
R12	6	18	22-0	396-0	22	4-1	17-11	4-0	1-0
R13	6	2	10-0	20-0	1				
R14	6	2	10-0	20-0	1				
R15	6	36	9-1	324-0	1				
R16	5	36	5-9	207-0	1				
R17	6	4	10-0	72-0	1				
R18	6	16	7-9	54-0	1				

MARK	SIZE	QUANT	LENGTH	TOTAL L	TYPE	B	C
S1	5	2 sets of 10 bars	9-0 to 13-3 03" incr.	400-0	1		
S2	6	2 sets of 10 bars	6-6 to 8-9 03" incr.	152-0	1		
S3	8	2 sets of 8 bars	8-0 to 10-3 03" incr.	150-0	1		
S4	6	20	18-0	360-0	1		
S5	6	4 sets of 8 bars	4-0 to 14-0 05'-0" incr.	108-0	1		
S6	6	4	17-6	70-0	1		
T1	5	150	9-6	1425-0	24b	See	Detail
T2	5	30	27-0	810-0	1		
T3	6	50	27-9	1395-0	1		
T4	5	70	27-0	1890-0	1		
T5	5	75	15-0	1125-0	26	See	Detail
T6	5	50	13-9	697-0	27	See	Detail
T7	5	125	20-6	2575-0	21	2-0	26-8
T8	6	125	25-0	3125-0	1		
T9	7	65	27-8	1795-0	1		
T10	6	105	27-0	2835-0	1		
T11	6	39	5-0	195-0	1		
T12	5	48	9-6	432-0	24b	See	Detail
T13	5	12	22-8	273-0	1		
T14	6	20	22-8	455-0	1		
T15	5	26	22-9	593-0	1		
T16	5	22	13-9	302-0	27	See	Detail
T17	5	20	18-0	360-0	26	See	Detail
T18	5	42	28-0	1176-0	21	2-0	26-6
T19	6	42	25-0	1050-0	1		
T20	7	26	22-0	572-0	1		
T21	6	42	22-9	955-0	1		
T22	6	12	5-0	60-0	1		

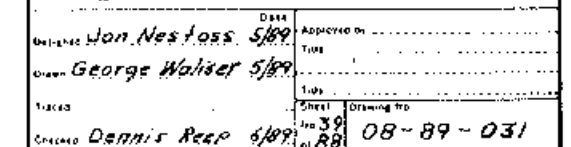
AS BUILT PLANS
NO CHANGE
Comp. Date 1-24-97

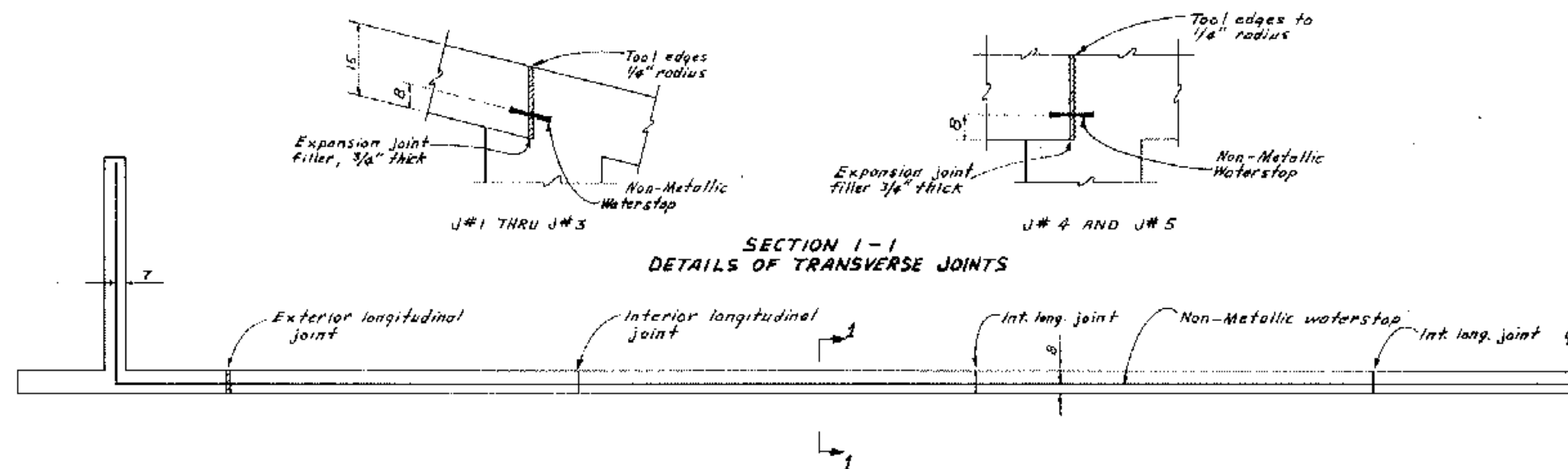
FLOODWATER RETARDING STRUCTURE ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

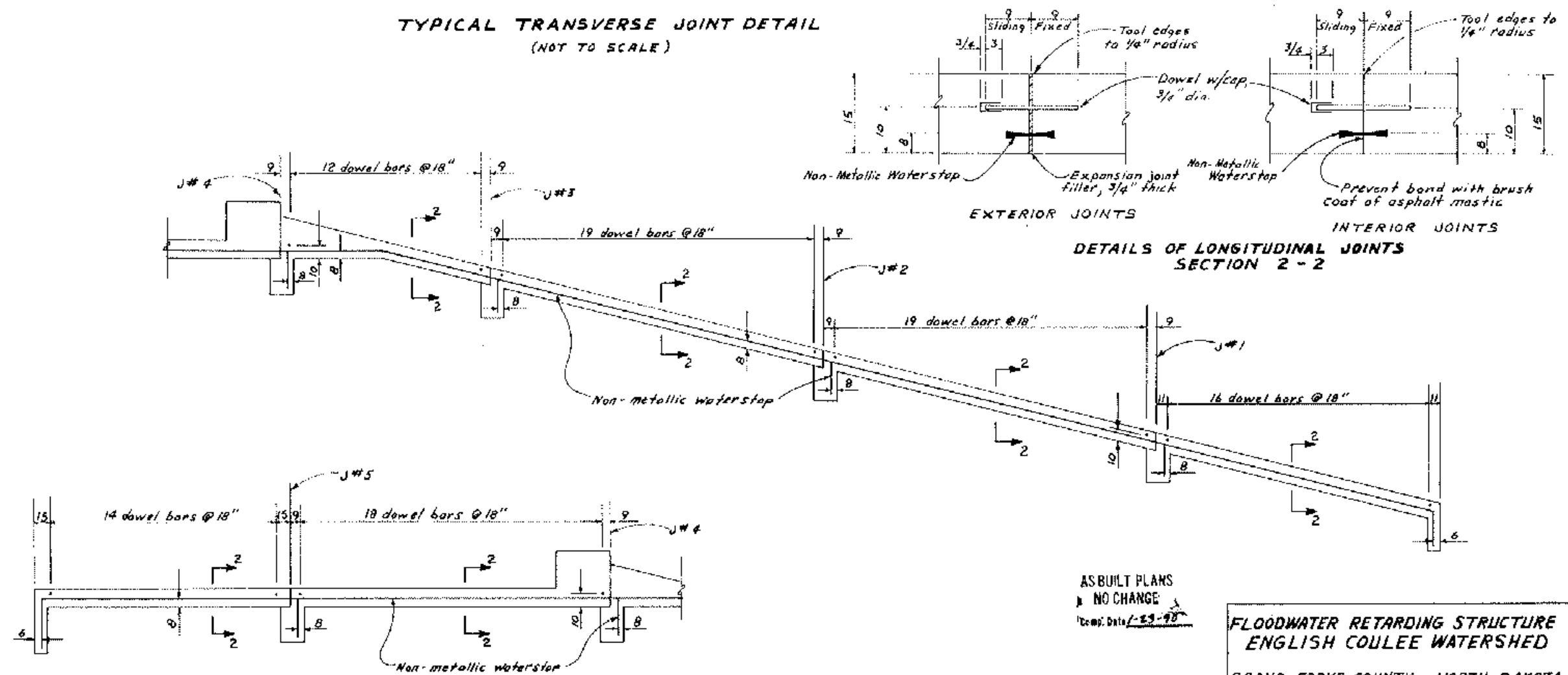
Designed by Don Nestor 5/89
Checked by George Wolser 5/89
Drawn by Dennis Reep 6/89
Scale 1"=30'
Drawing No. 08-89-031

STEEL SCHEDULE																	
MARK	SIZE	QUANT	LENGTH	TOTAL L	TYPE	B	C	MARK	SIZE	QUANT	LENGTH	TOTAL L	TYPE	B	C	H	K
U1	5	30	9-6	285-0	24b	5-6	Detail	X1	7	1b	6-0	96-0	21	1-6	4-6		
U2	4	80	6-6	572-0	1			X2	5	0	10-6	54-0	19	2-7	7-11	1-10	1-10
U3	5	6	27-3	165-0	1			X3	6	109	6-0	654-0	1				
U4	5	6	12-0	72-0	1			X4	4	102	6-0	612-0	1				
U5	5	0	17-9	136-0	1			X5	6	4 sets of 6 bars	6-9 to 7-6 @ 3" incr.	165-0	1				
U6	5	4	20-8	82-0	21	1-0	19-6	X6	5	0	38-3	265-0	19	3-1	30-2	2-2	2-2
U7	0	54	15-3	823-6	21	6-6	37-9	X7	5	11	33-6	395-0	19	3-1	30-5	2-2	2-2
U8	0	52	9-6	494-0	21	4-9	4-9	X8	5	10	18-0	90-0	1				
U9	0	54	0-6	458-0	21	4-3	4-3	X9	3	44	15-3	571-0	21	4-8	3-9		
U10	5	14	13-9	192-6	27	See	Detail	X10	3	42	8-5	359-0	21	4-9	4-9		
U11	5	12	15-0	180-0	26	See	Detail	X11	5	14	7-9	105-6	21	3-6	4-3		
U12	5	8	17-6	140-0	1			X12	5	2 sets of 7 bars	8-0 to 14-0 @ 12" incr.	154-0	21	3-6	4-6 to 10-6 @ 12" incr.		
U13	5	22	20-6	527-0	21	2-0	26-6	X13	5	2 sets of 8 bars	5-9 to 12-9 @ 12" incr.	140-0	21	3-6	2-3 to 11-3 @ 12" incr.		
U14	4	22	3-6	252-0	21	1-0	2-6	X14	5	2	14-3	28-6	21	1-0	13-3		
U15	6	20	21-6	500-0	1			X15	6	2 sets of 20 bars	3-5 to 14-8 @ 7" incr.	358-4	21	1-0	2-5 to 13-6 @ 7" incr.		
U16	5	42	12-0	504-0	1			X16	4	15	22-5	360-0	21	1-0	21-6		
U17	7	8	0-9	70-0	21	1-6	8-1	X17	5	14	8-5	118-0	21	2-0	15-0		
U18	5	6	5-6	44-0	1			X18	5	15	26-3	420-0	21	4-9	21-6		
U19	6	4	26-6	106-0	1			X19	6	10	21-5	215-0	1				
								X20	6	4	6-9	27-0	1				
								X21	5	4	19-0	50-0	19	3-0	11-0	1-1	2-10
V1	7	22	9-3	214-6	21	1-6	48-3	X22	5	4	30-0	120-0	1				
V2	7	6	5-6	33-0	21	1-6	4-0	X23	5	4 sets of 8 bars	11-3 to 25-3 @ 24" incr.	564-0	1				
V3	6	54	8-6	460-0	1			X24	6	4	32-0	128-0	19	2-6	29-6	1-9	1-9
V4	6	38	26-6	994-0	1			X25	6	4	32-6	130-0	19	2-6	30-0	1-9	1-9
V5	6	54	11-0	594-0	1			X26	6	14	12-0	168-0	1				





TYPICAL TRANSVERSE JOINT DETAIL
(NOT TO SCALE)



TYPICAL LONGITUDINAL JOINT DETAIL
(NOT TO SCALE)

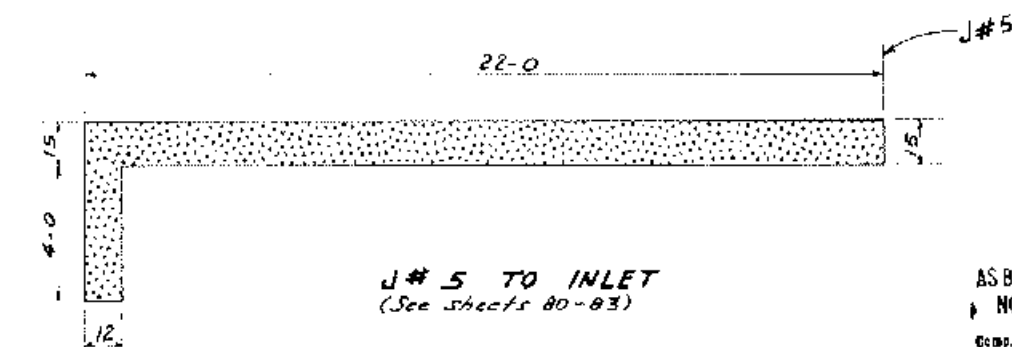
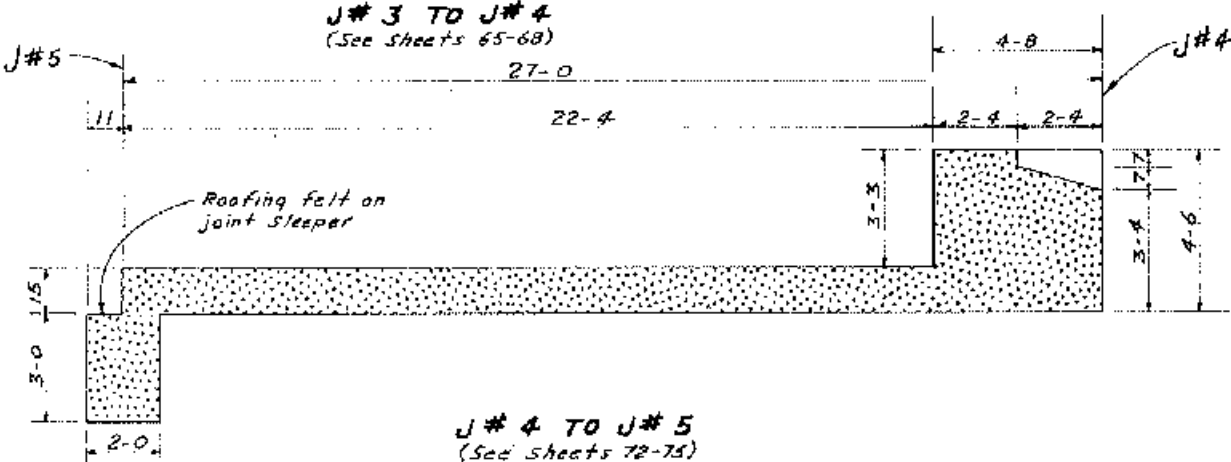
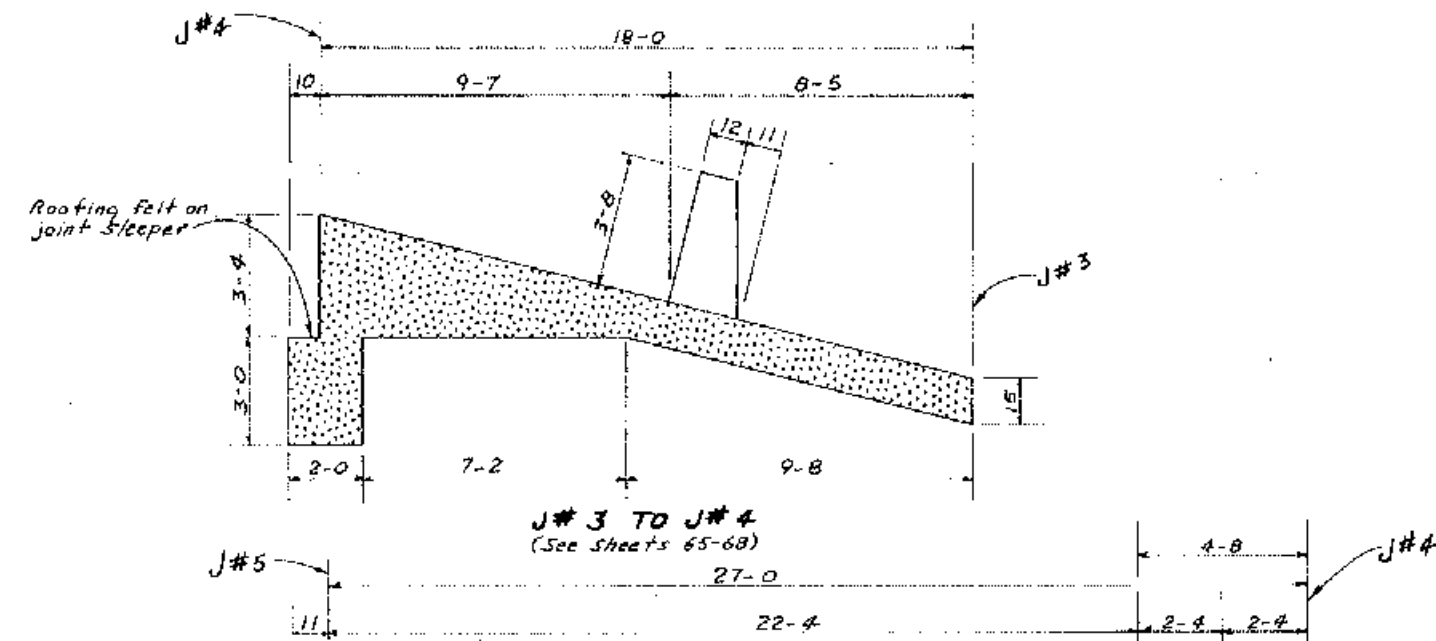
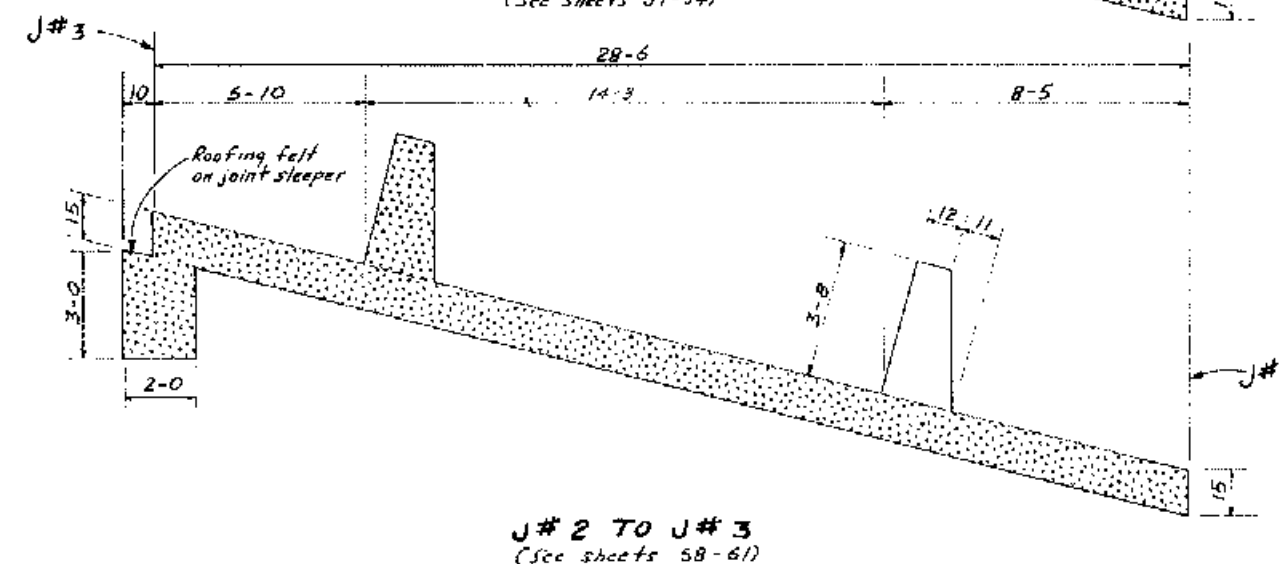
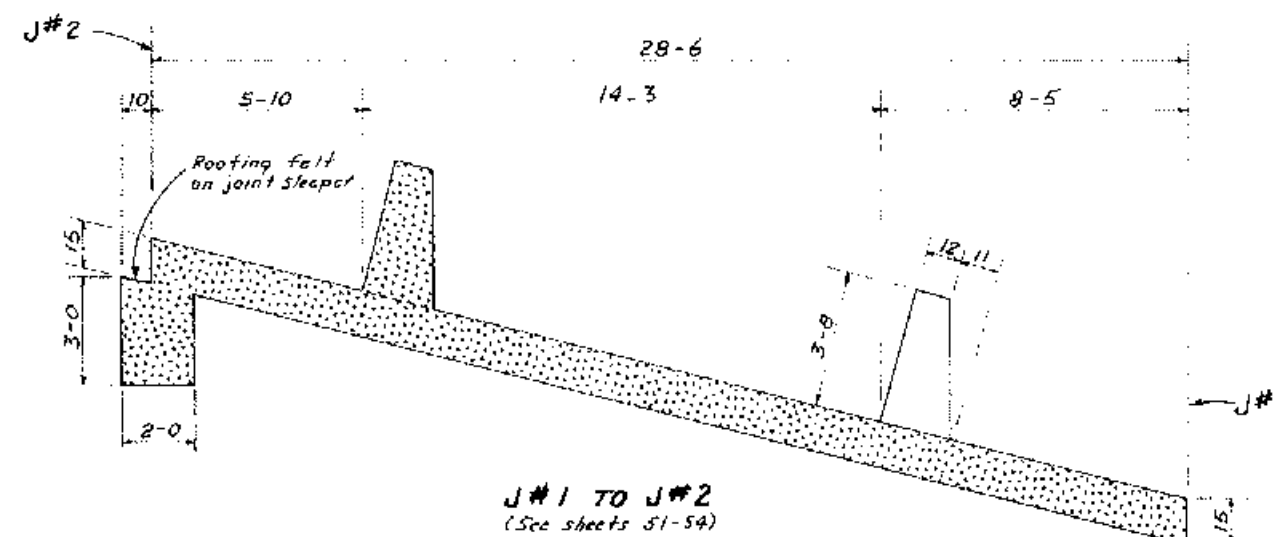
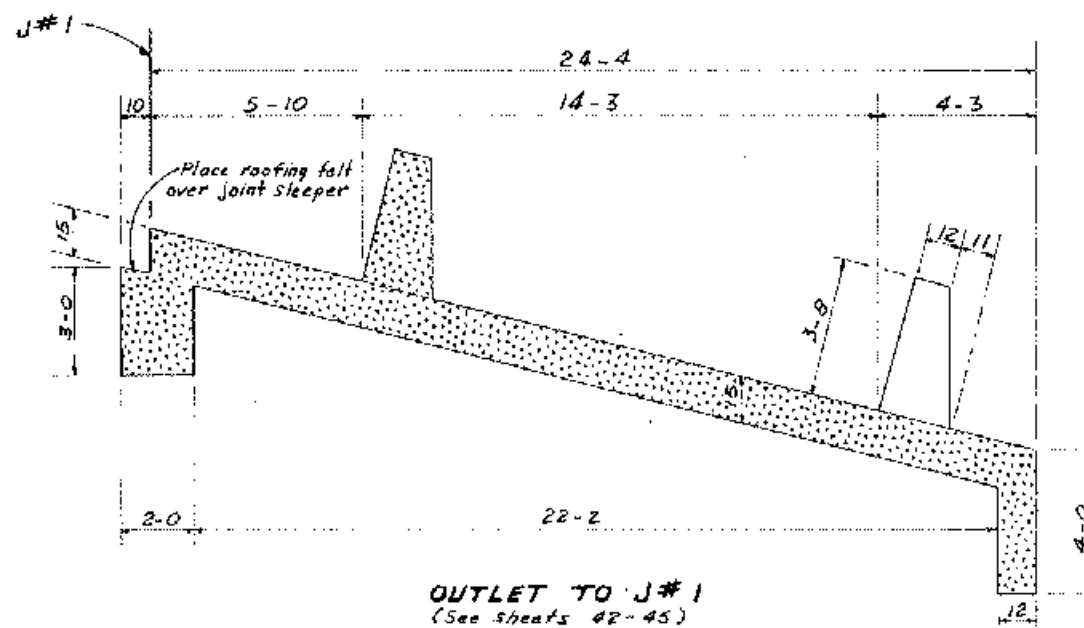
ASBUILT PLANS
NO CHANGE
Comp. Date 6-23-98

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Drawn by Jon Nestor 5/89	Checked by George Wolter 5/89	Date 5/89	Project No. 08-89-031
Scale 1" = 10'	Sheet 1 of 1	Drawn by Dennis Reep 6/89	Project No. 08-89-031



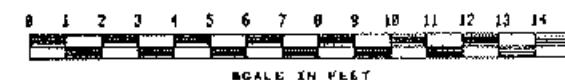
AS BUILT PLANS
NO CHANGE
Comp. Date 1-25-91

CHUTE SPILLWAY
INTERNAL AND EXTERNAL PAVEMENT SLABS

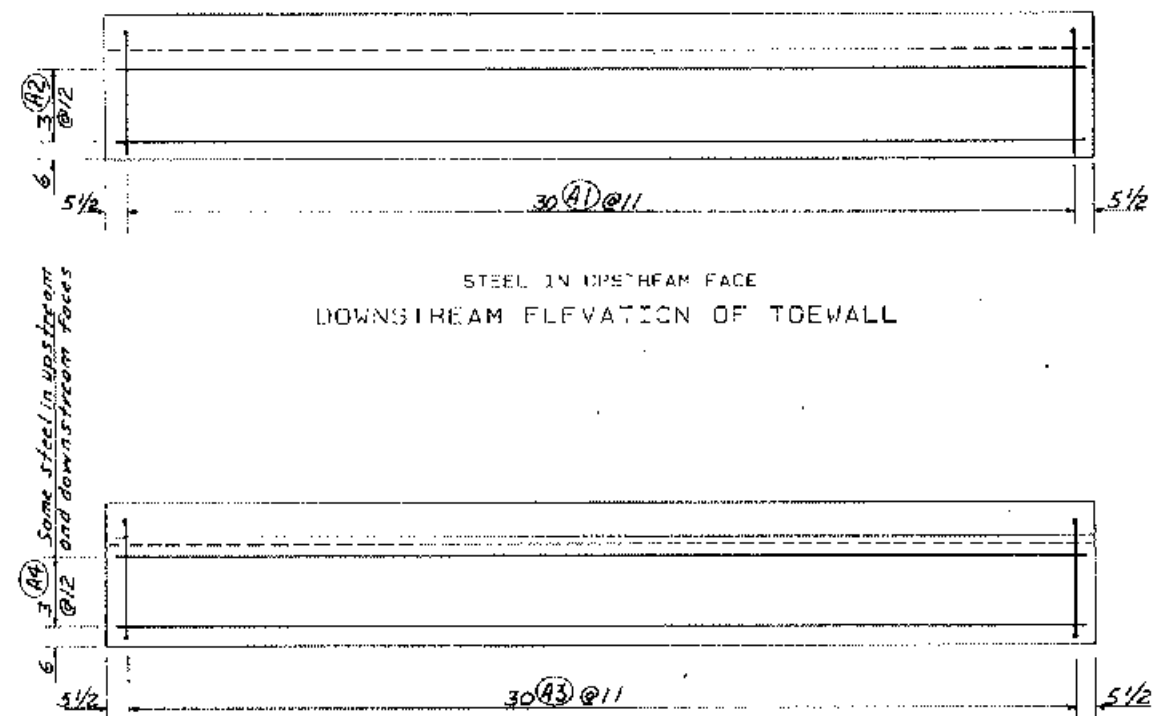
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

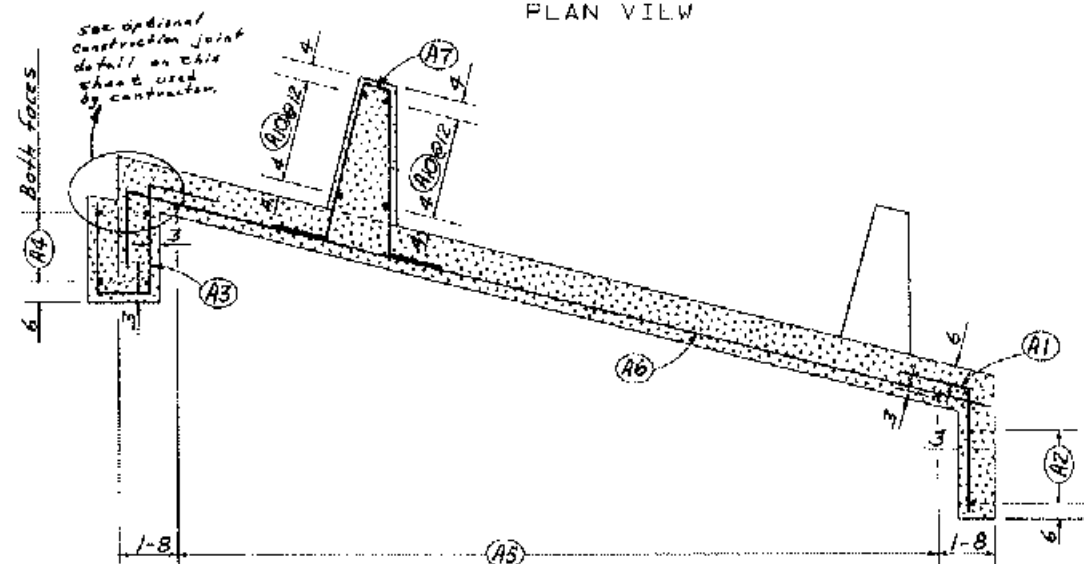
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



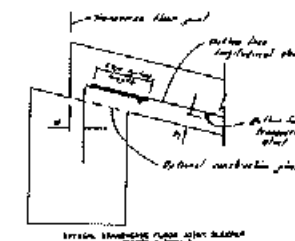
Designed	Jan Nestoss	5/89	Approved by	
Drawn	George Waliser	5/89	Checked	
Traced			Sheet	08-89-031
Checked	Dennis Reep	6/89	Drawn No.	



STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN BOTTOM FACE
SECTION 1 - 1



OPTIONAL CONSTRUCTION JOINT

- Notes:
1. Fiber block layout shown is for the segment on the structure centerline. For dimensions and layout of this and adjacent interior segments, see sheet 33.
 2. For typical pavement slab section, see sheet 41.
 3. For details of transverse and longitudinal fiber joints, see sheet 40.

AS BUILT PLANS
1. ~~NO CHANGE~~
Comp. Date 1-24-91

PAVEMENT SLAB - INTERIOR SEGMENT
OUTLET TO J#1

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

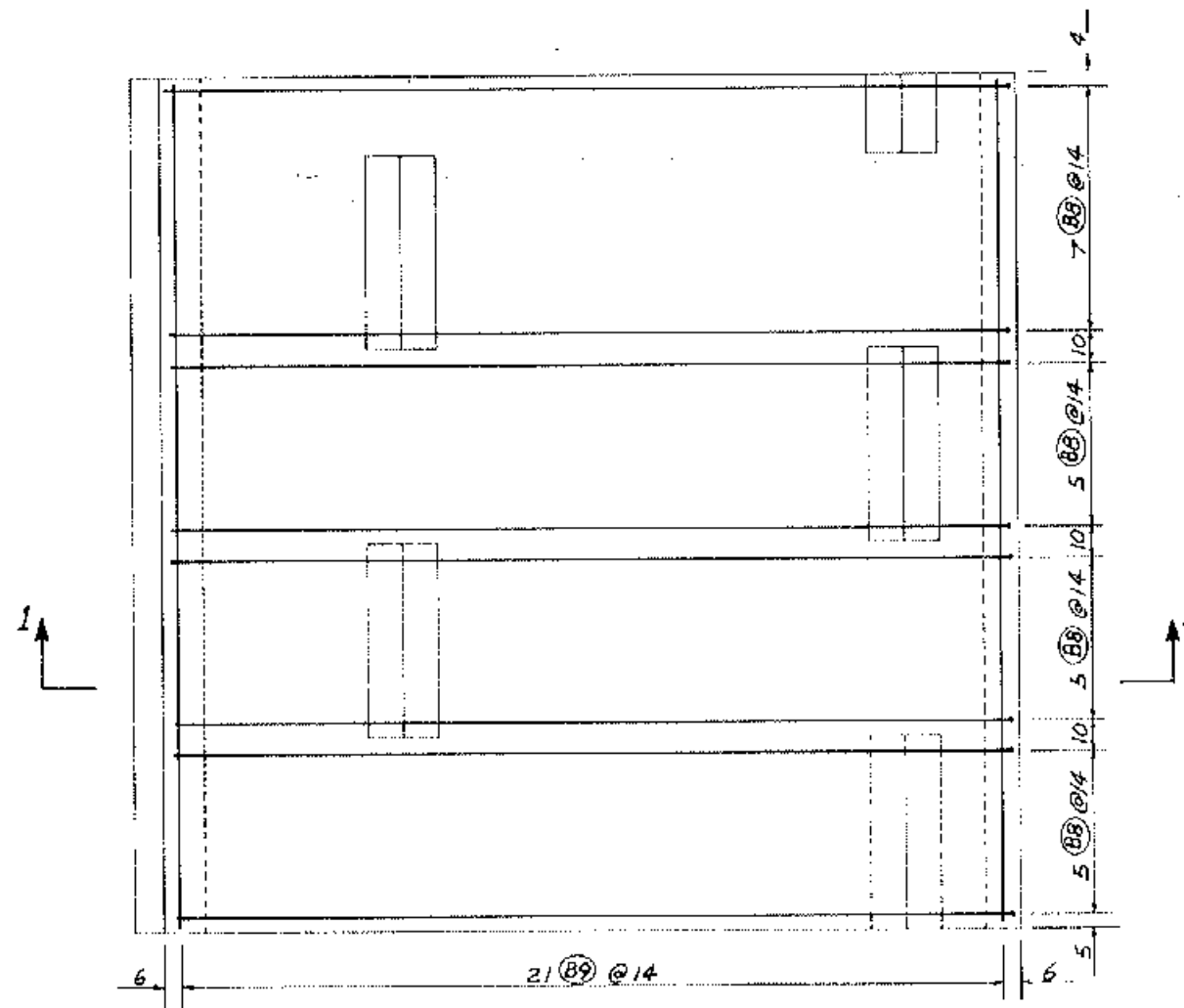
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	GEORGE MAJ 12114	5/00	

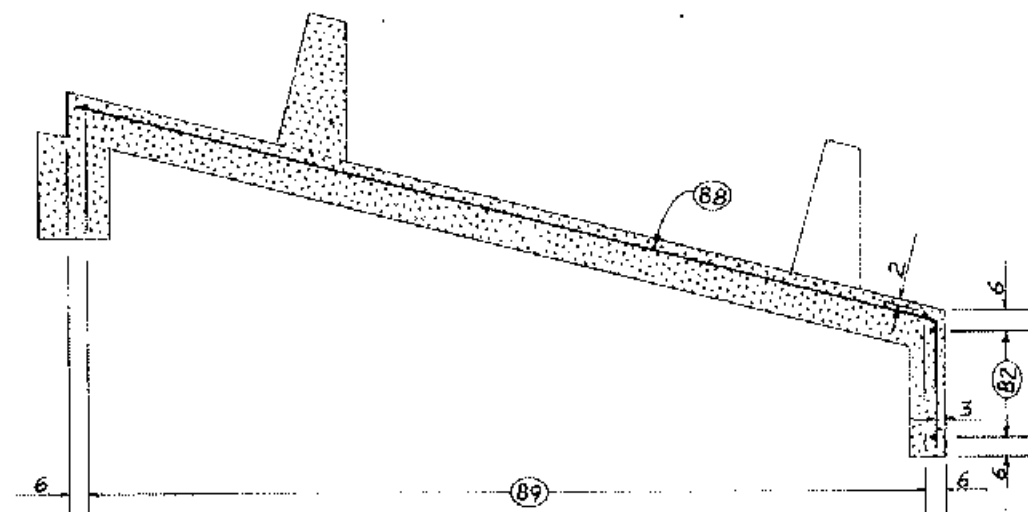
Page 1 GEORGE WAGLE 131.4 3783
1910

Sheet	Drawing No.
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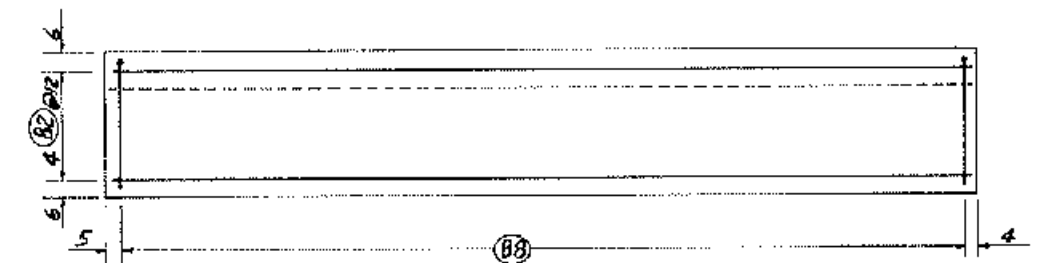
Checked DENNIS REEP - 6/29/89 08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1-1



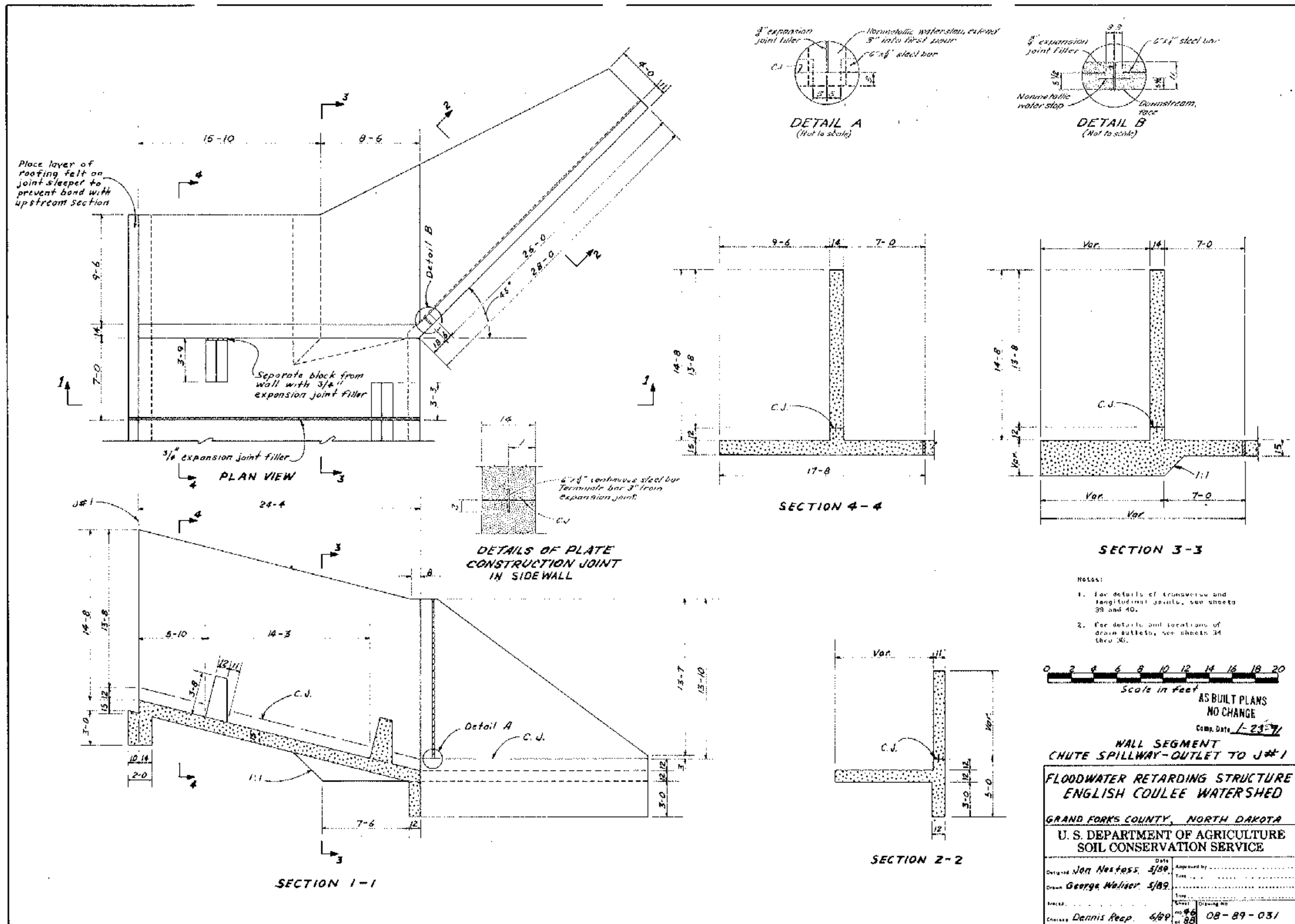
STEEL IN DOWNSTREAM FACE
DOWNSTREAM ELEVATION OF TOEWALL

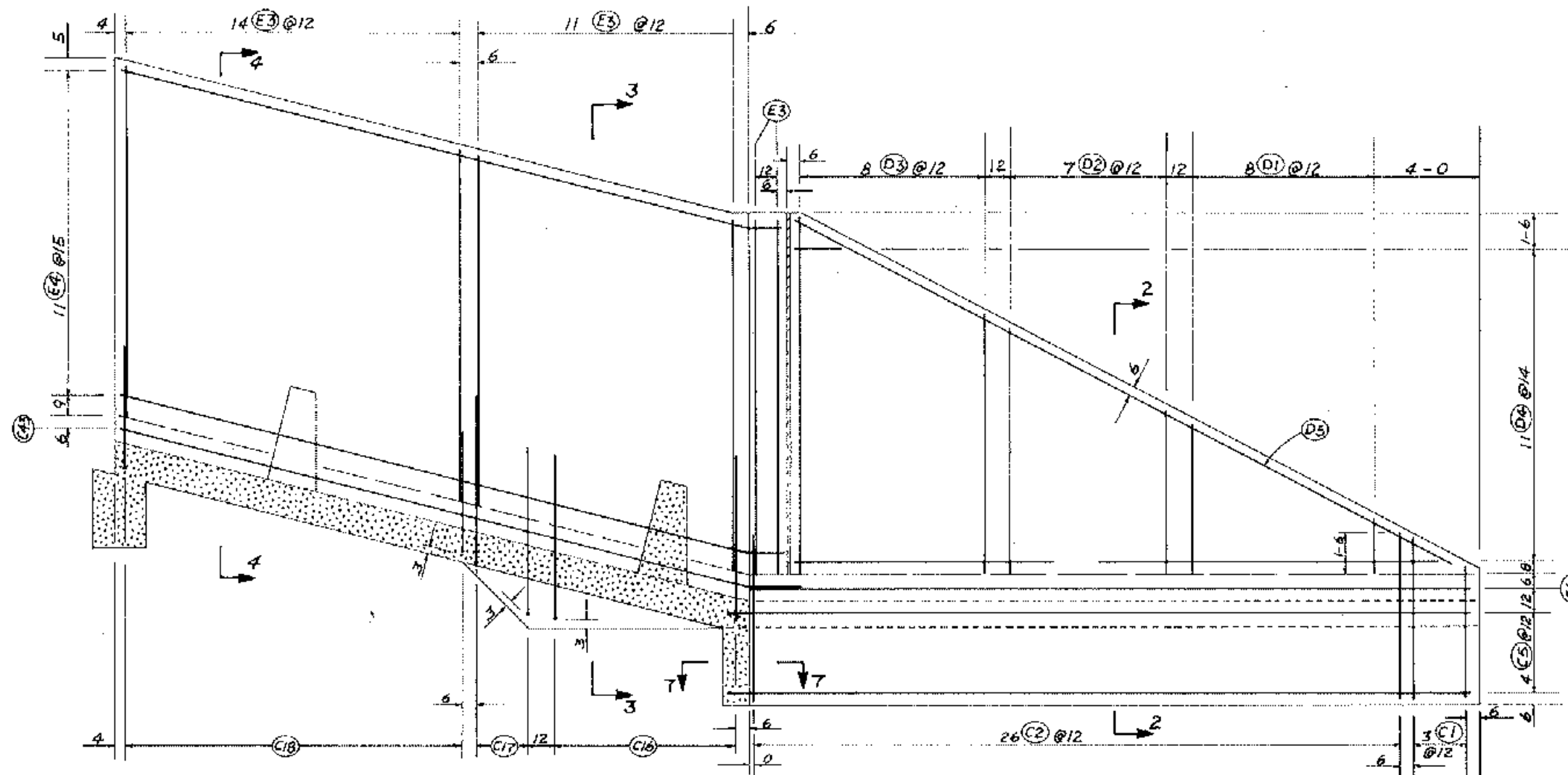


AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

PAVEMENT SLAB - EXTERIOR SEGMENT
OUTLET TO J#1

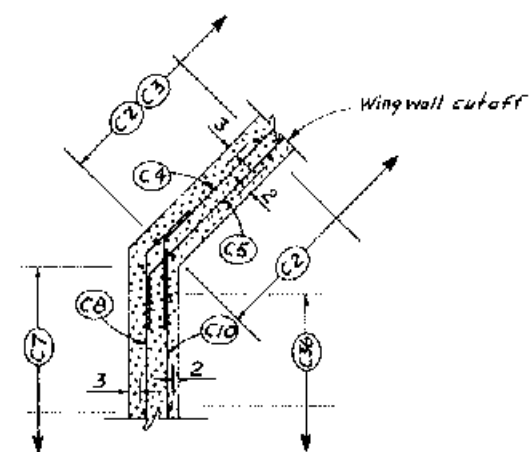
FLOODWATER RETARDING STRUCTURE			
ENGLISH COULEE WATERSHED			
GRAND FORKS COUNTY		NORTH DAKOTA	
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed by	JOHN NESTORS	Date	5/88
Drawn by	GEORGE VALISER	Date	5/88
Traced by		Date	
Checked by	DENNIS REEP	Date	6/89
Sheet No.	45	Drawing No.	08-89-031



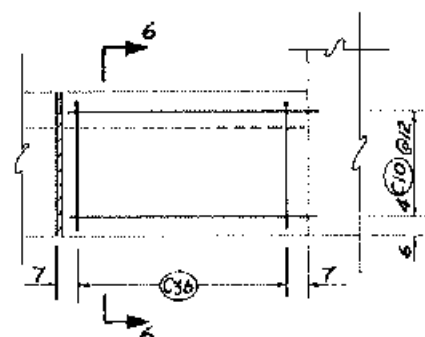


STEEL IN INSIDE FACE OF WALL AND DOWNSTREAM FACE OF WINGWALL

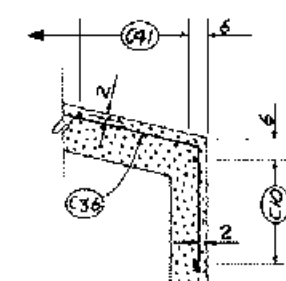
SECTION 1-1
(Location shown on sheet 46)



SECTION 7-7
(NOT TO SCALE)



STEEL IN DOWNSTREAM FACE
DOWNSTREAM ELEVATION OF TOEWALL



SECTION 6-6



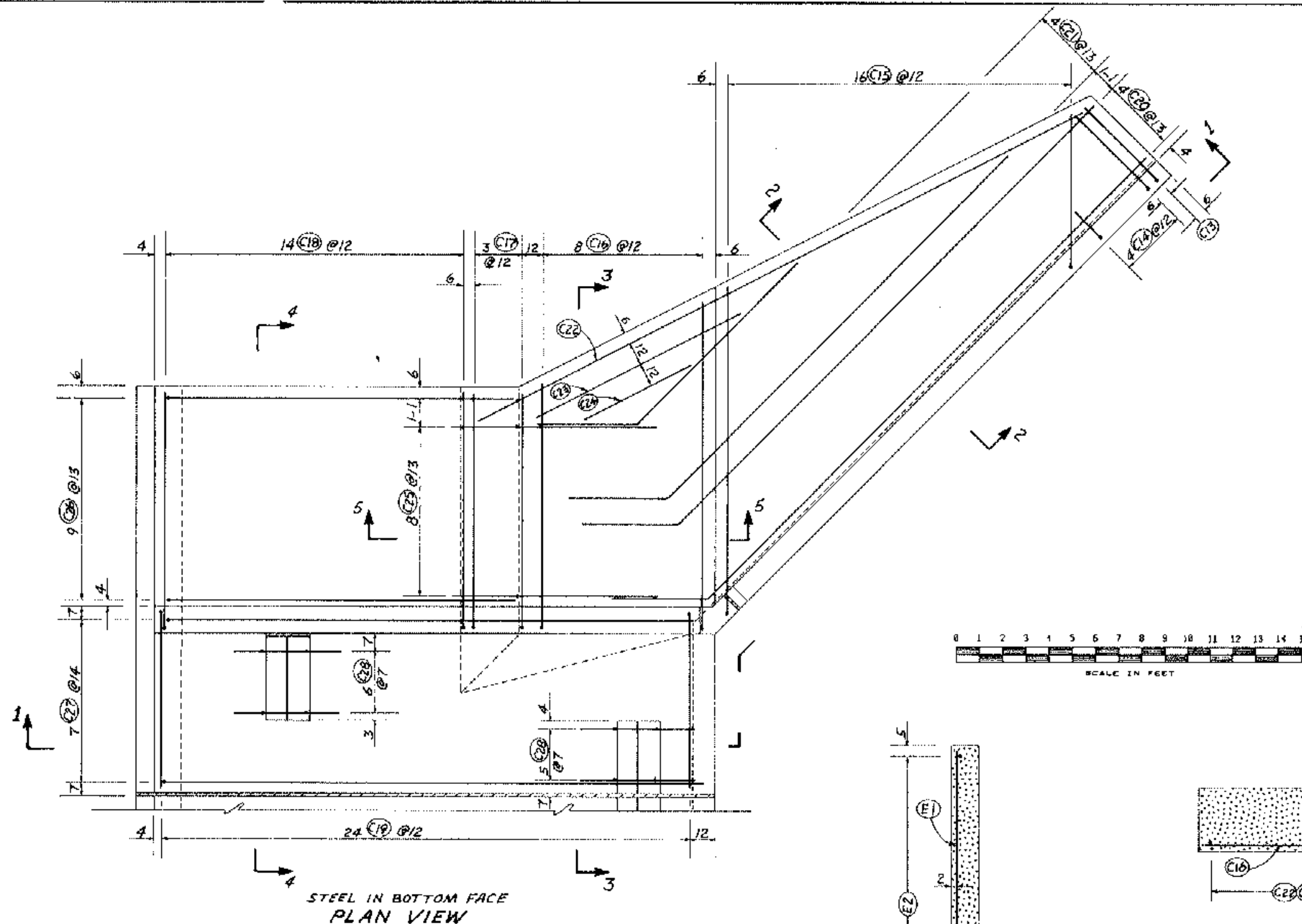
AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY-OUTLET TO J#1
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

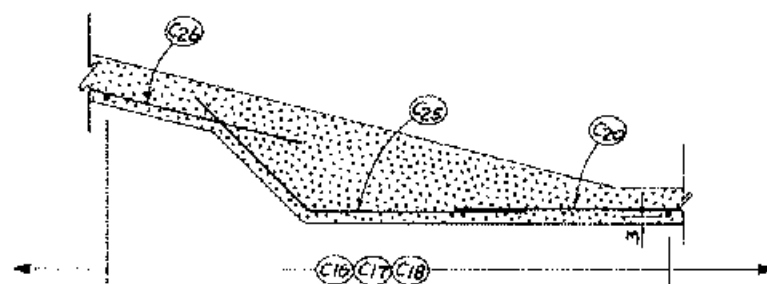
GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

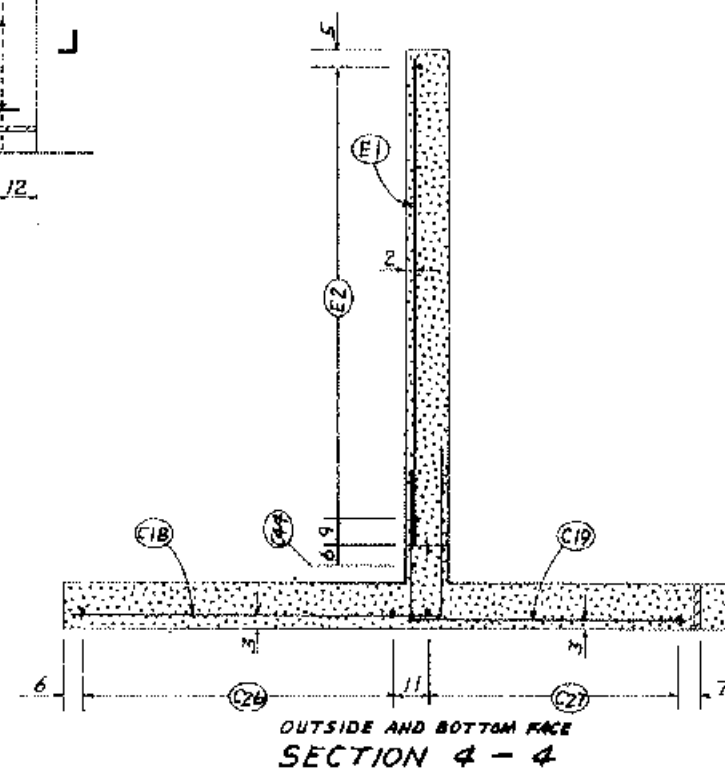
Designed: Van Nestess	Date: 4/89	Approved by:	
Drawn: George Walliser	Sheet: 5/89	Title:	
Checked: Dennis Reep	6/89	Scale:	
		Drawing No:	08-89-031



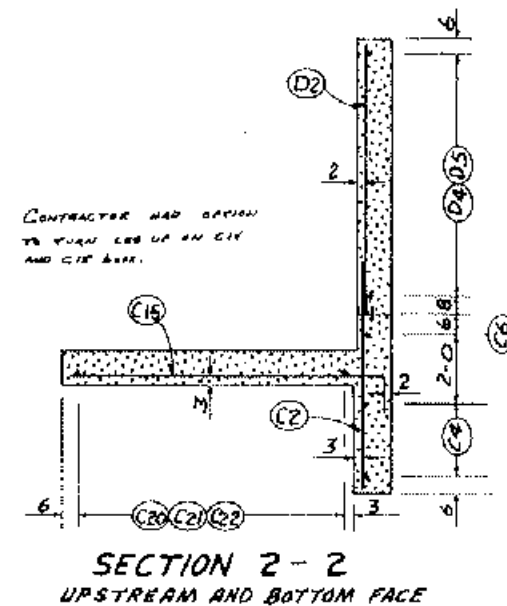
STEEL IN BOTTOM FACE
PLAN VIEW



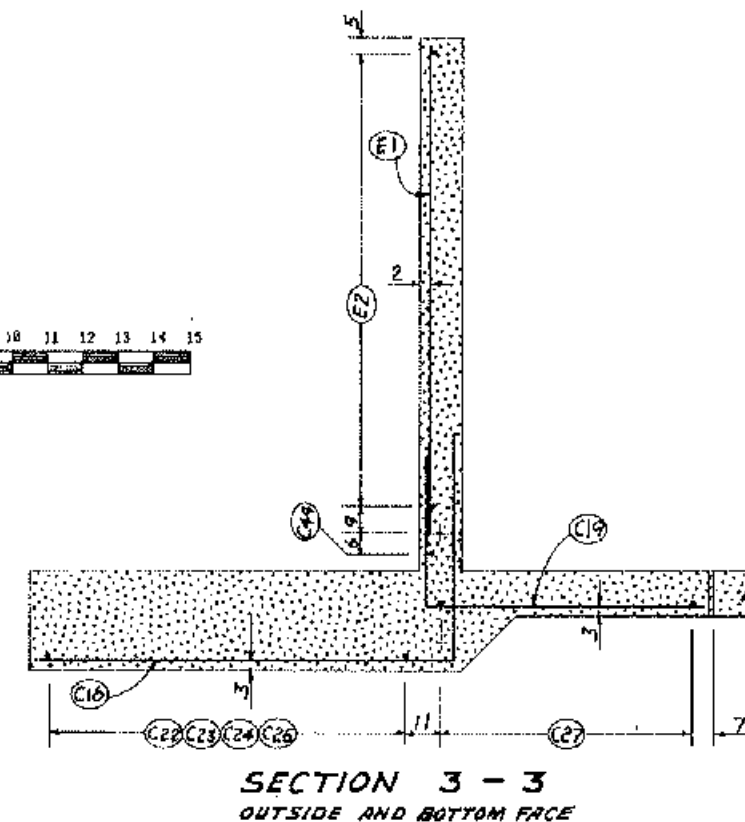
STEEL IN BOTTOM FACE
SECTION 5-5



OUTSIDE AND BOTTOM FACE
SECTION 4-4



SECTION 2-2
UPSTREAM AND BOTTOM FACE



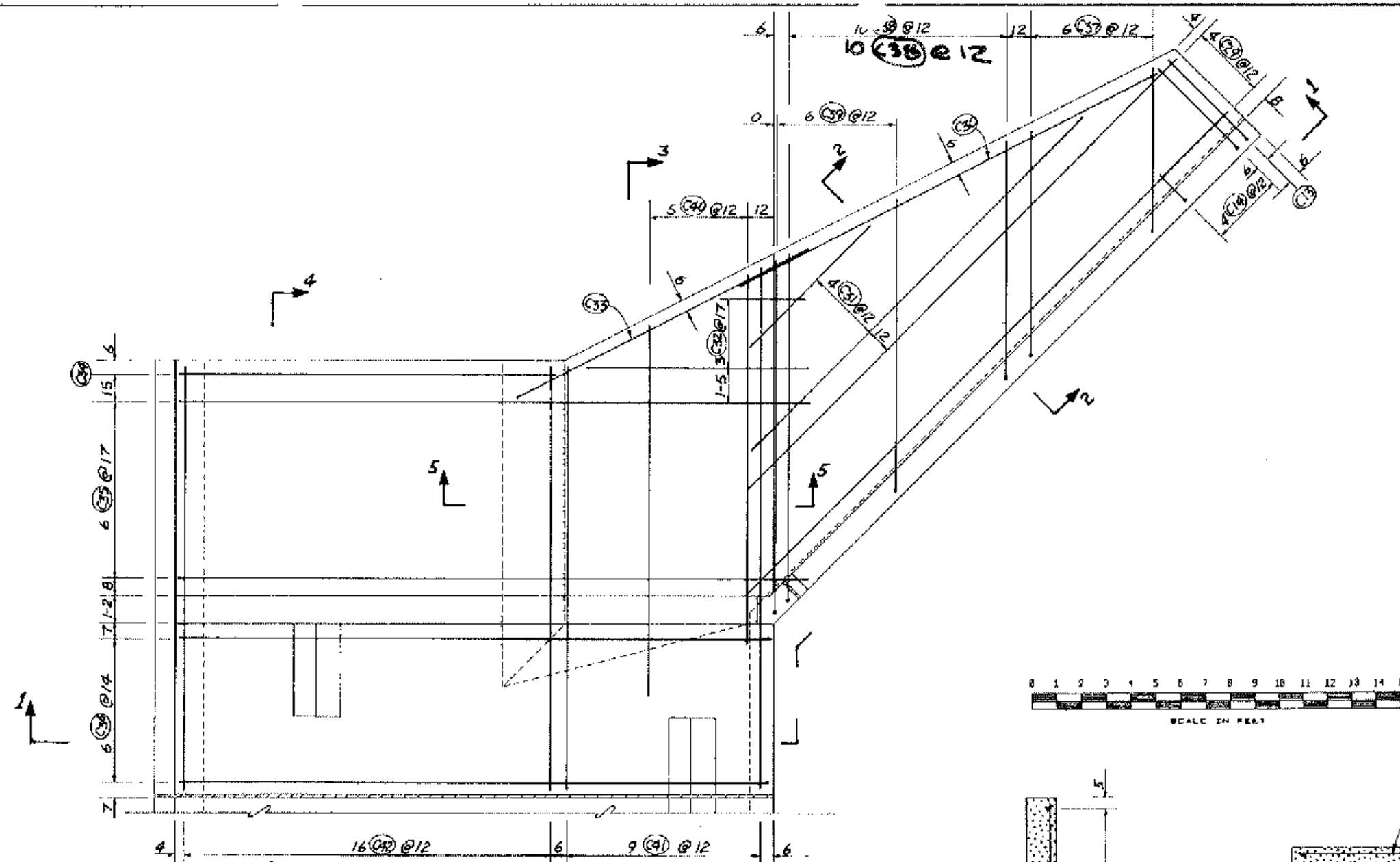
SECTION 3-3
OUTSIDE AND BOTTOM FACE

AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91 WALL SEGMENT
CHUTE SPILLWAY-OUTLET TO J#1

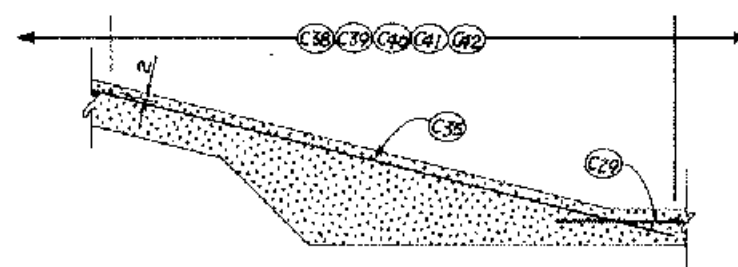
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORK'S COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

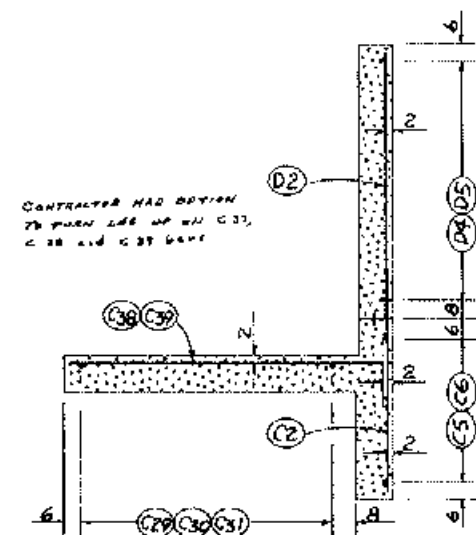
Des. by Jon Nesfoss 4/89	App. by
Drawn George Wolizer 5/89	Time
Traced	Date
Checked Dennis Rapp 6/89	Sheet No. 49
	Drawing No. 88-89-031



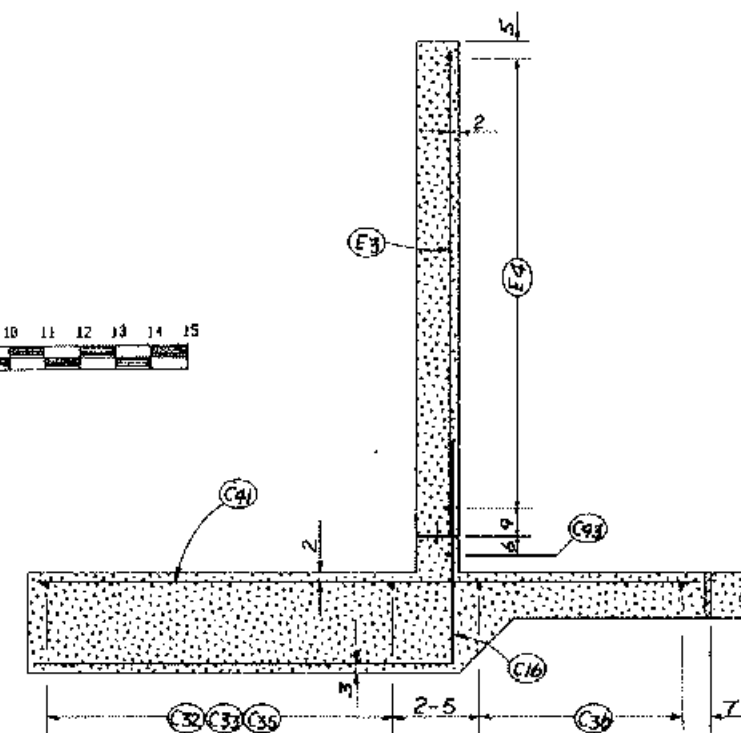
STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 5-5

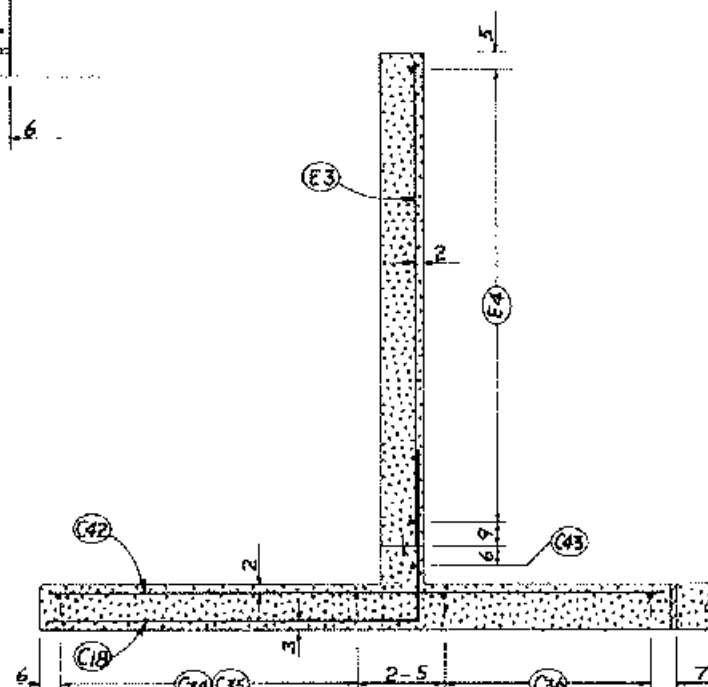


DOWSTREAM AND TOP FACE
SECTION 2-2



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

INSIDE AND TOP FACE
SECTION 3-3

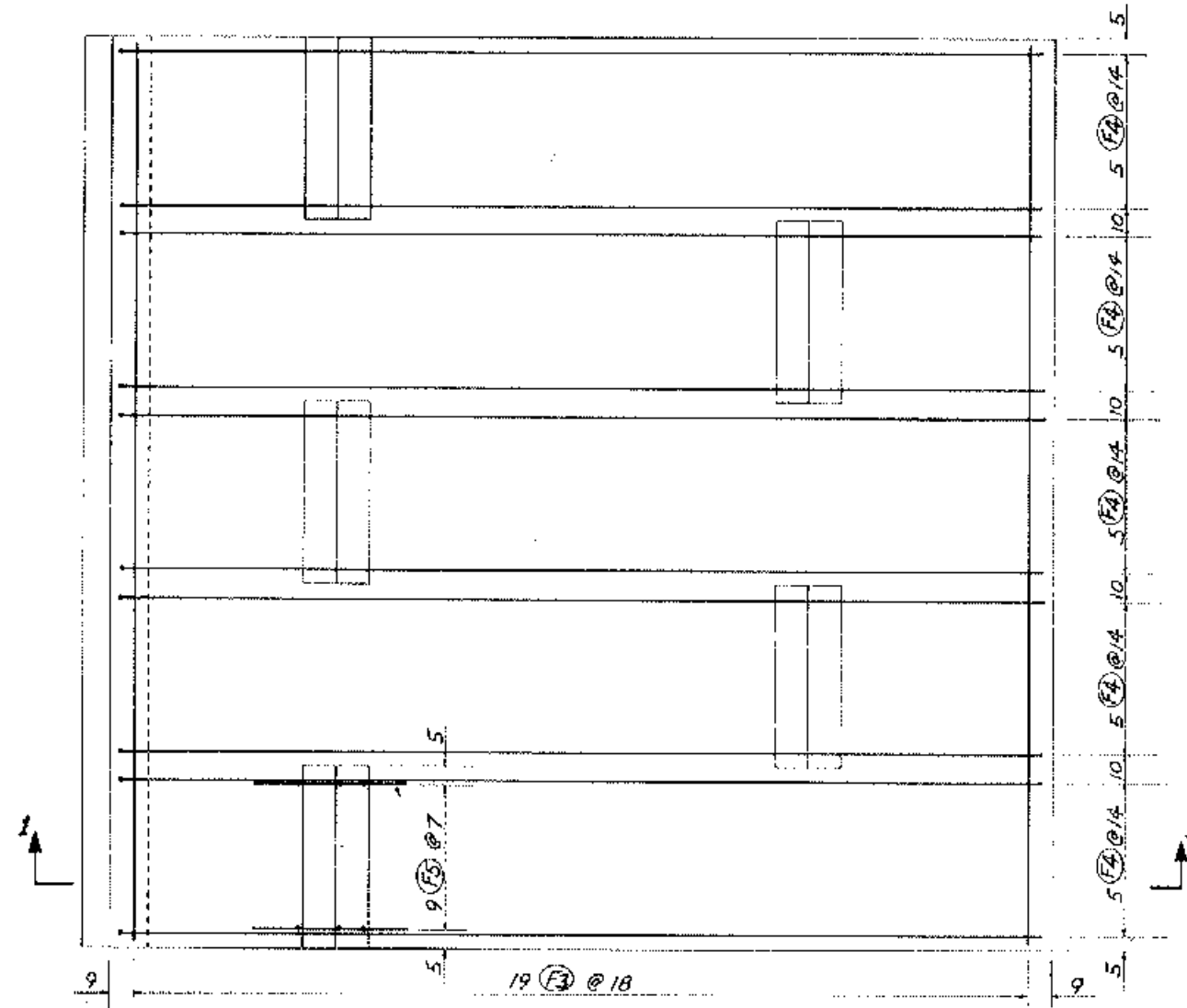


INSIDE AND TOP FACE
SECTION 4-4

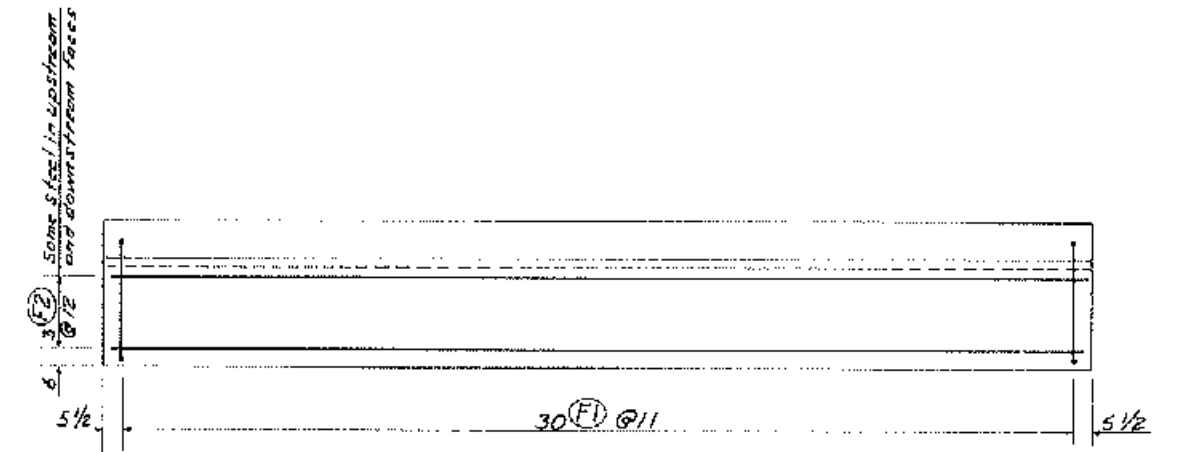
WALL SEGMENT
CHUTE SPILLWAY - OUTLET TO J#1
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

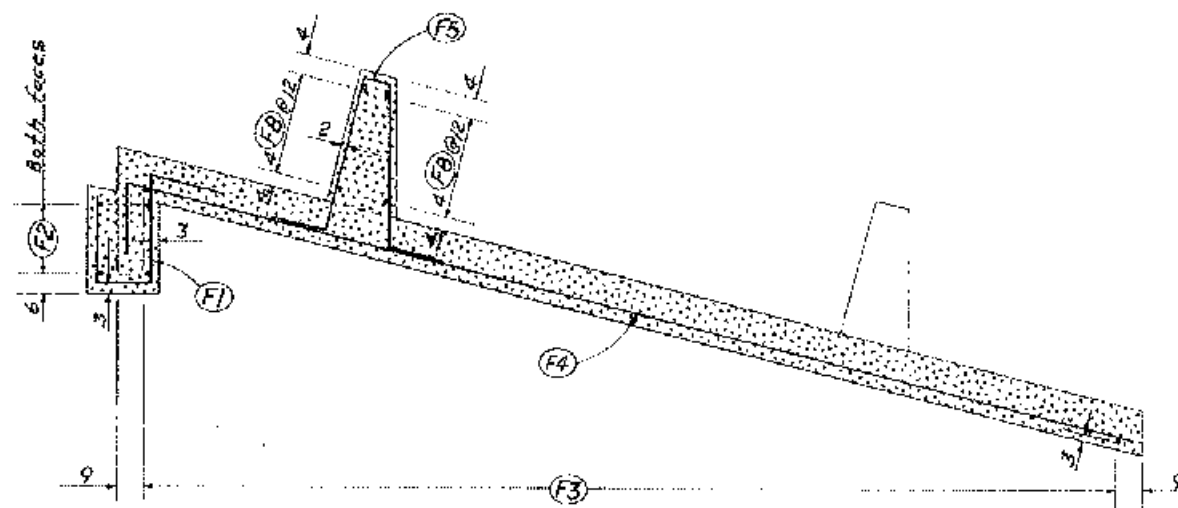
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DRAWN	GEORGE HOLSER	DATE	5/89
CHECKED	DENNIS REEP	DATE	6/89
DRAWING NO.		08-89-031	



STEEL IN BOTTOM FACE
PLAN VIEW



UPSTREAM ELEVATION OF CUTOFF WALL



STEEL IN BOTTOM FACE
SECTION 1 - 1

Notes:

1. Floor slab layout shown is for the segment on the structure centerline. For dimensions and layout of this and adjacent interior segments, see sheet 93.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.



AS BUILT PLANS
NO CHANGE
Date 1-23-91

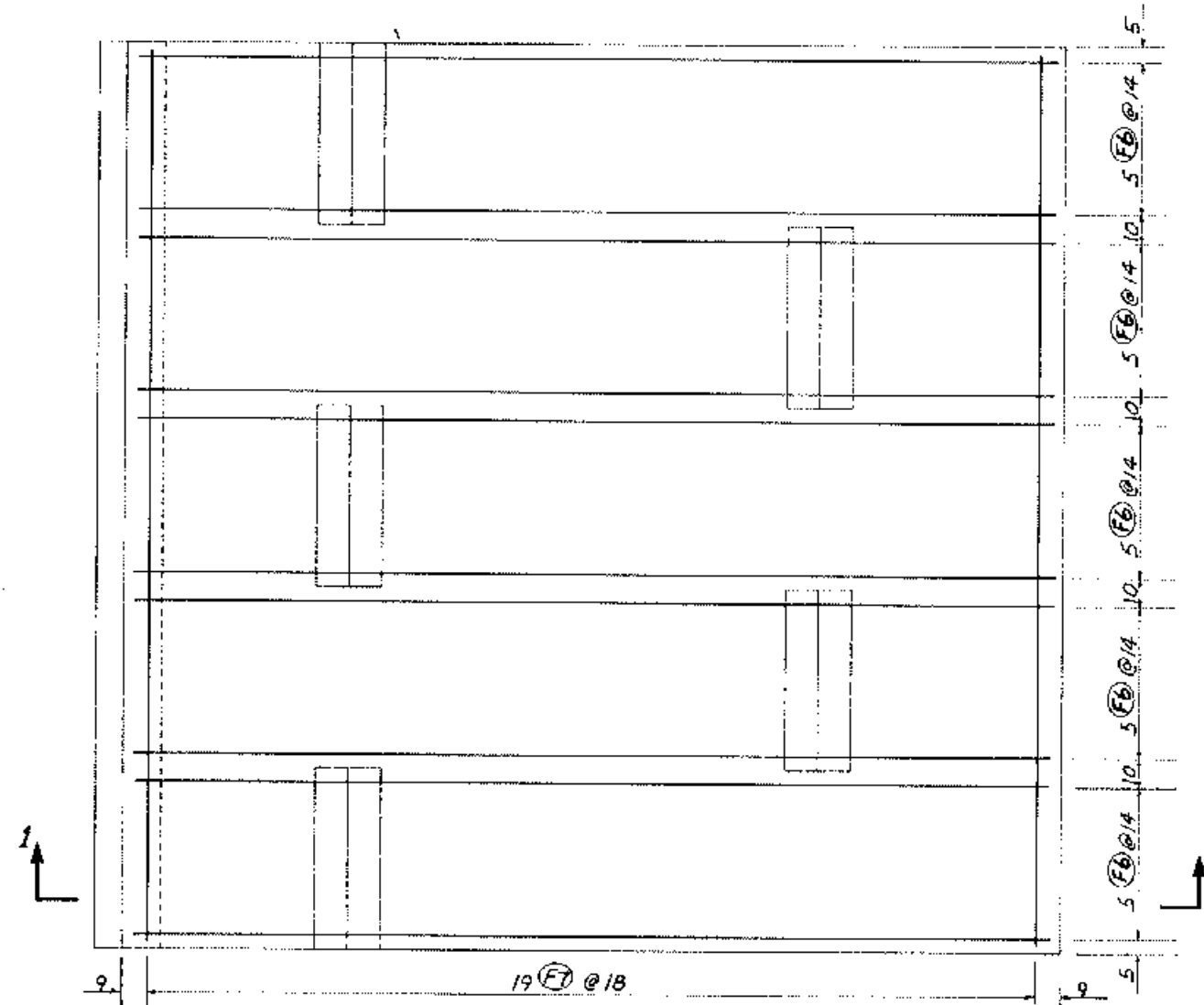
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

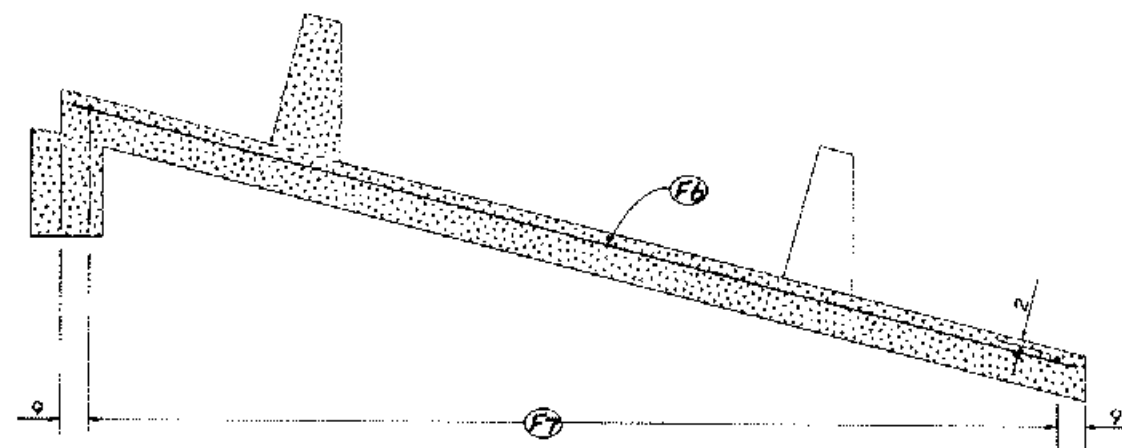
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JON NESTOS	DATE	5/89	Approved by	
Drawn	GLORIE WALSH	DATE	5/89	Title	
Traced		DATE		Sheet	
Checked	CEYVIS REED	DATE	6/89	Drawing No	08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Drawn Date 1-23-91

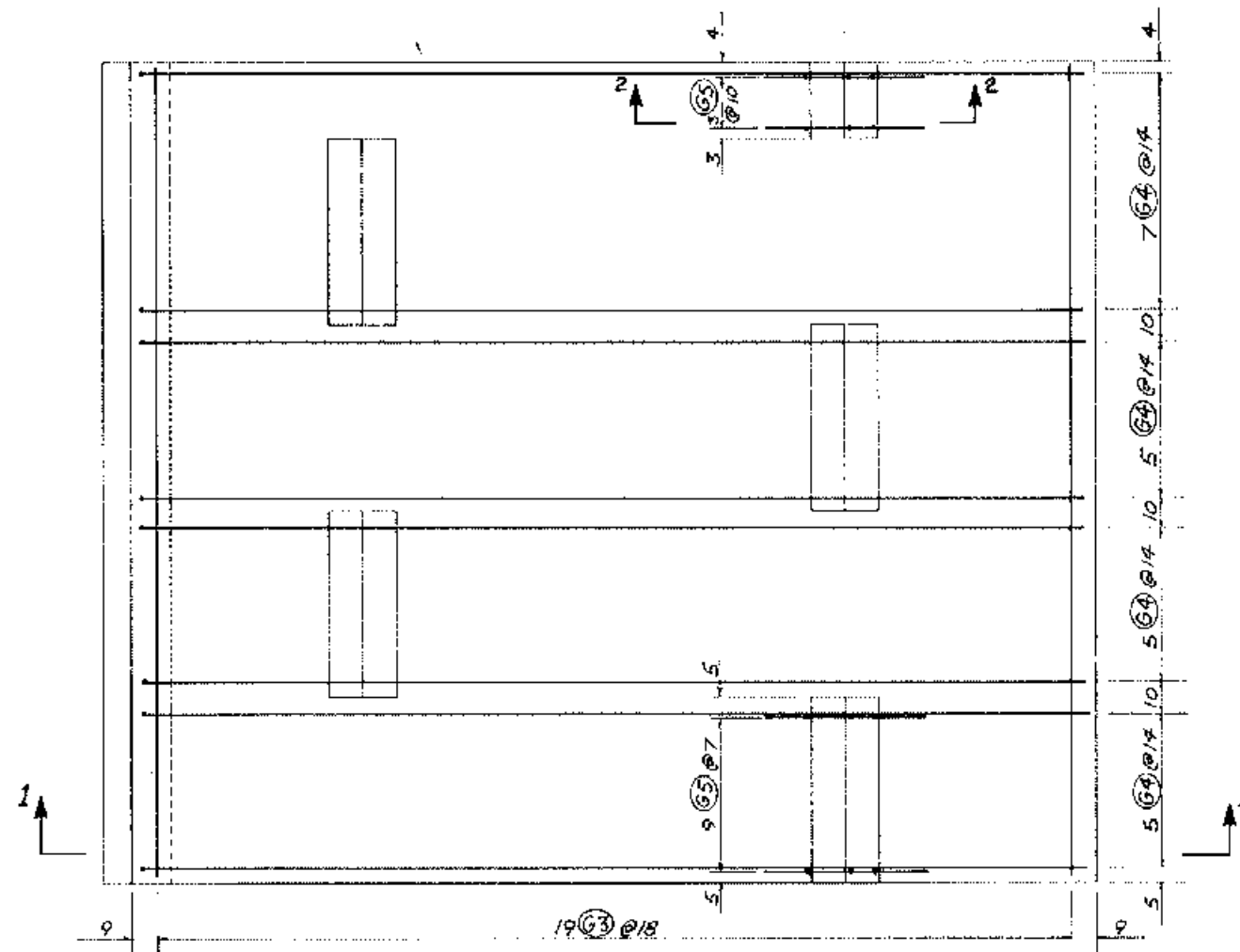
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

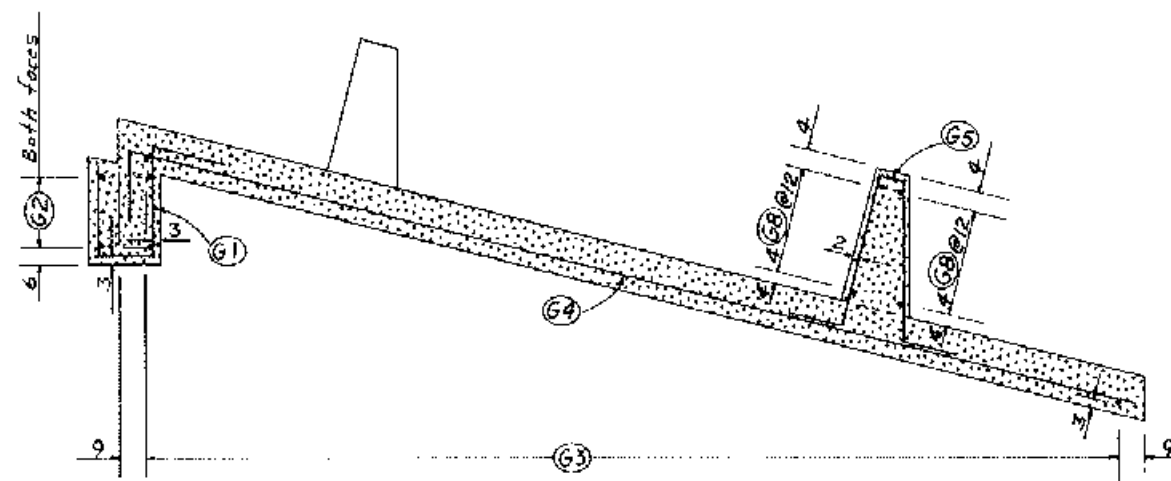
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

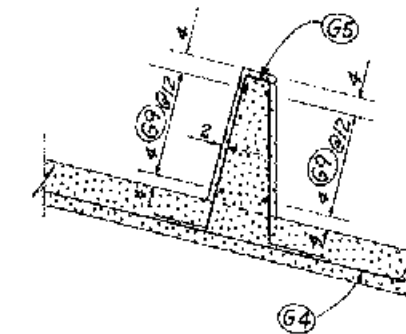
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Drawn	GEORGE WALISER	Date	5/88	Title	
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Checked	DENNIS REEP	Date	5/88	Drawing No.	08-89-031



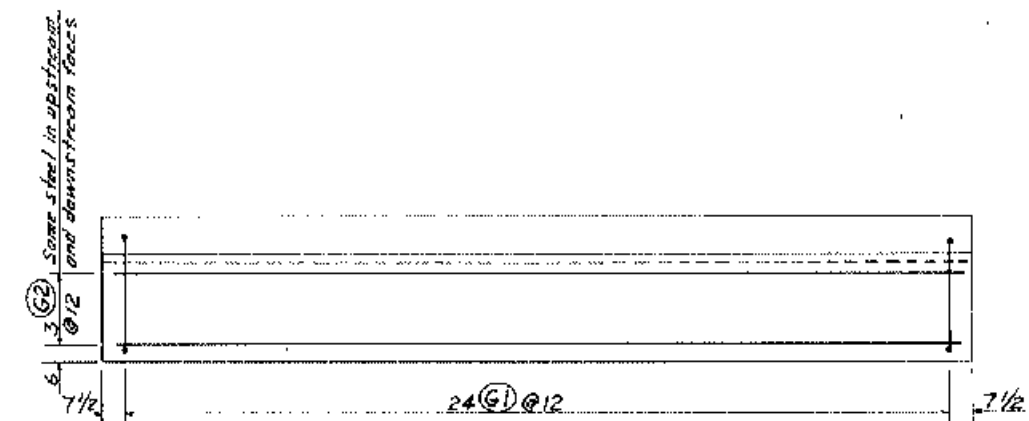
STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN BOTTOM FACE
SECTION 1 - 1



STEEL IN PARTIAL FLOOR BLOCK
SECTION 2 - 2



UPSTREAM ELEVATION OF CUTOFF WALL

AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

Notes:

1. For details of floor block layout, see sheet 32.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.



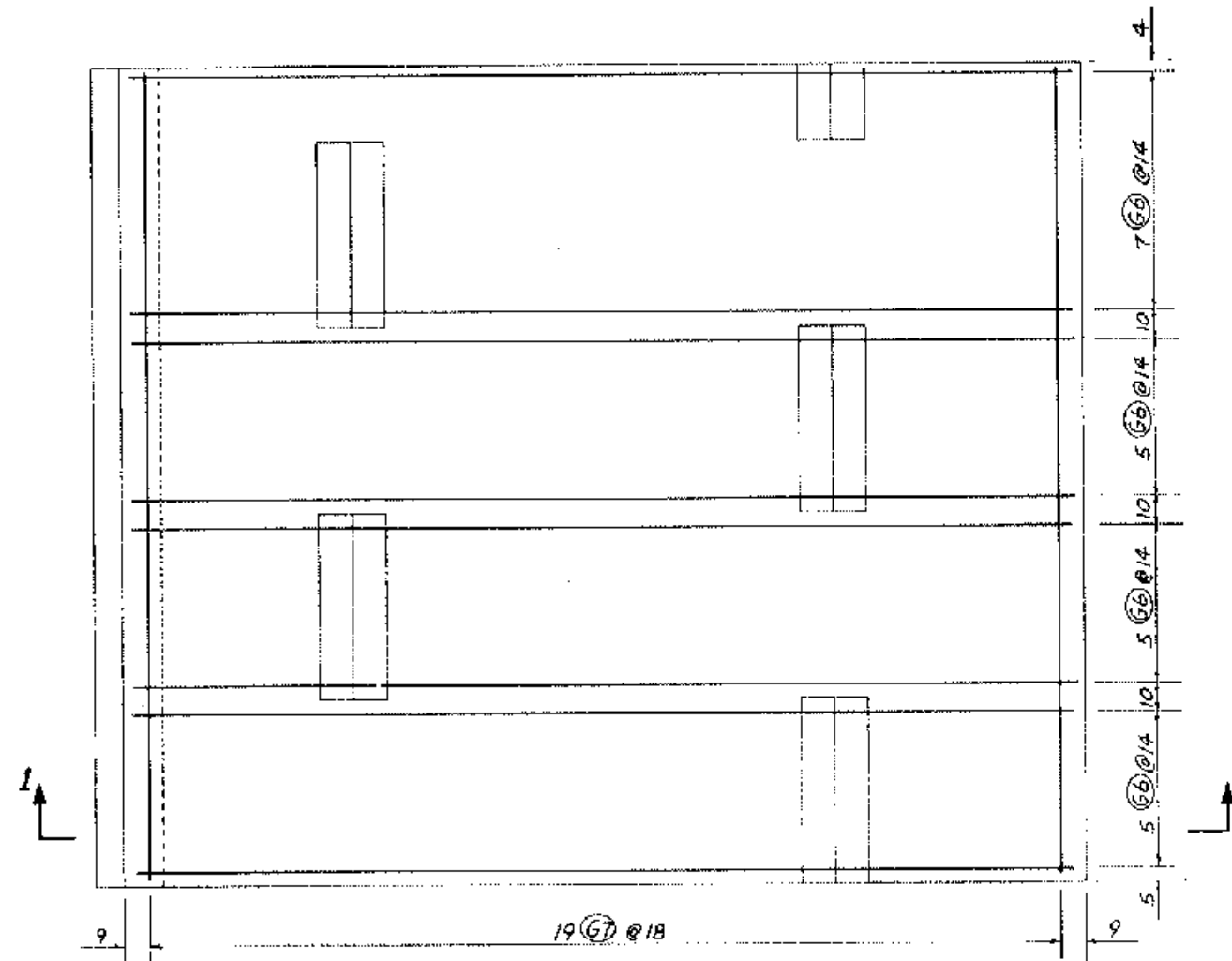
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

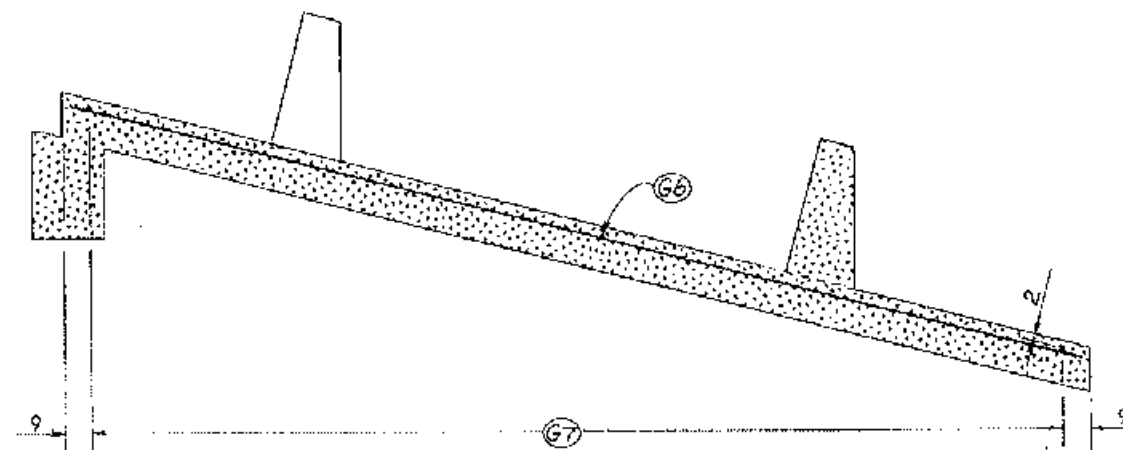
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JEN NESTOS	Date	1/89	Approved by	
Drawn	GEORGE WATISER	Date	1/89	Title	
Traced		Date		Project No.	
Checked	DENNIS REEP	Date	5/89	Project No.	08-89-031



STEEL IN TOP FACE
PLAN VJFW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
A. NO CHANGE
Comp. Date 1-23-91

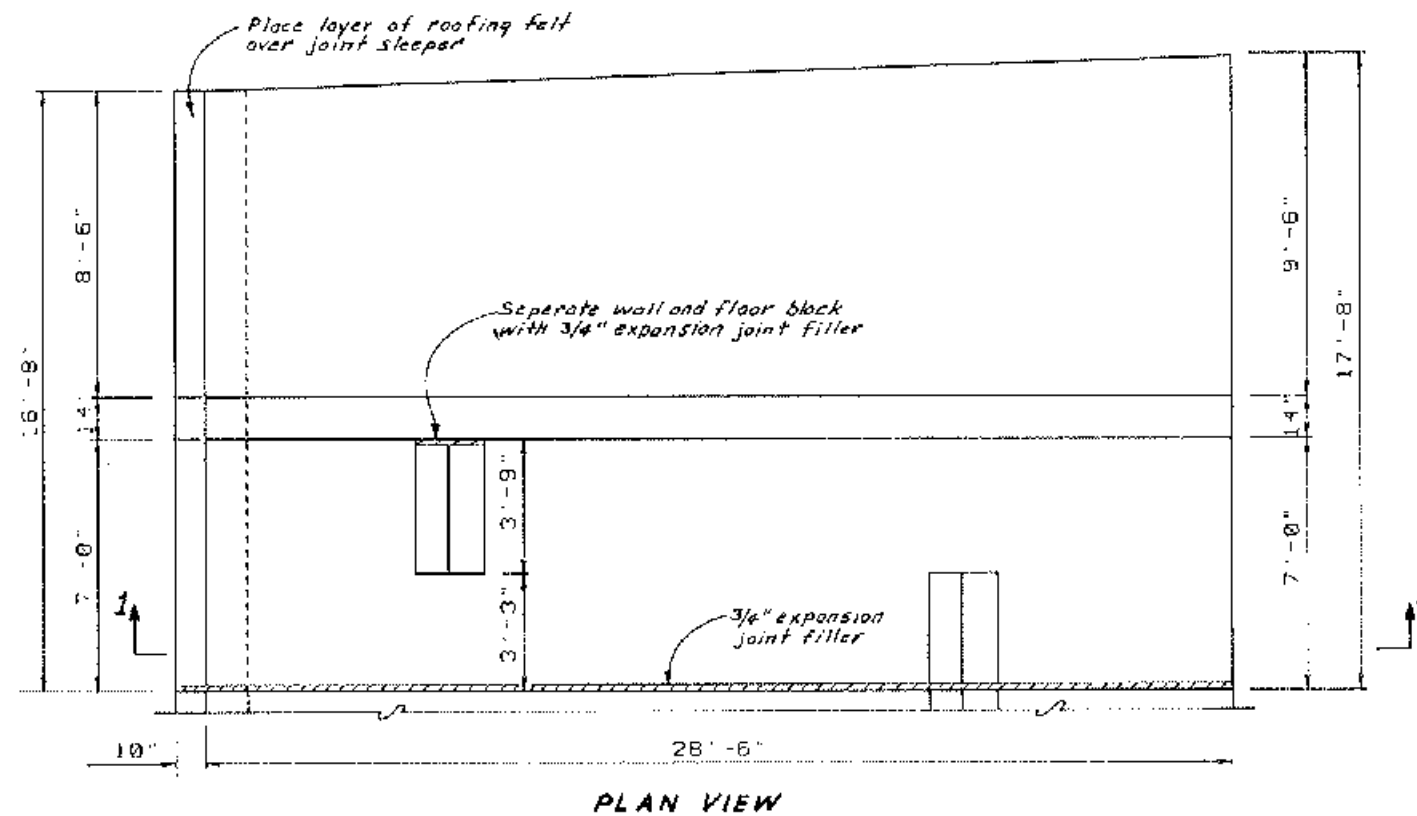
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

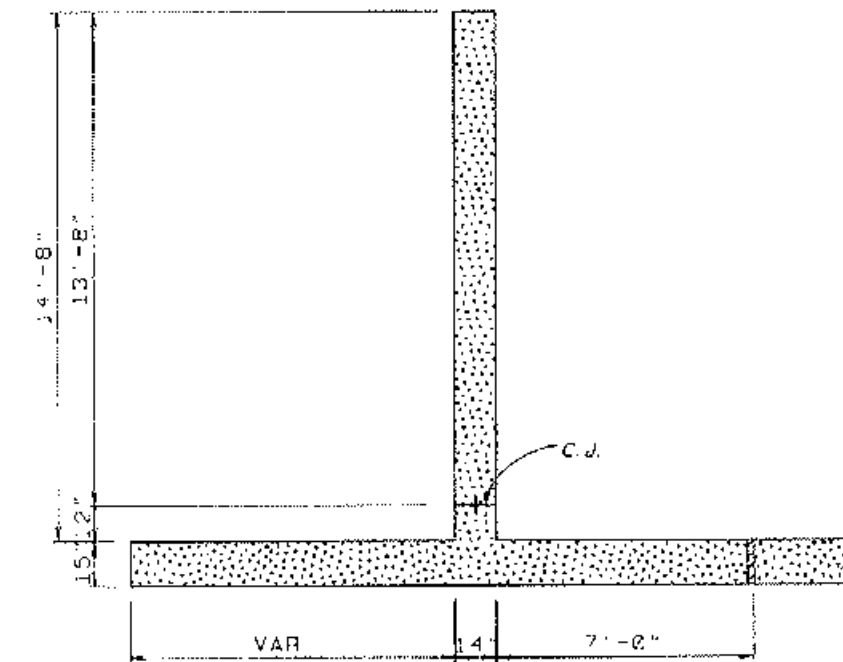
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

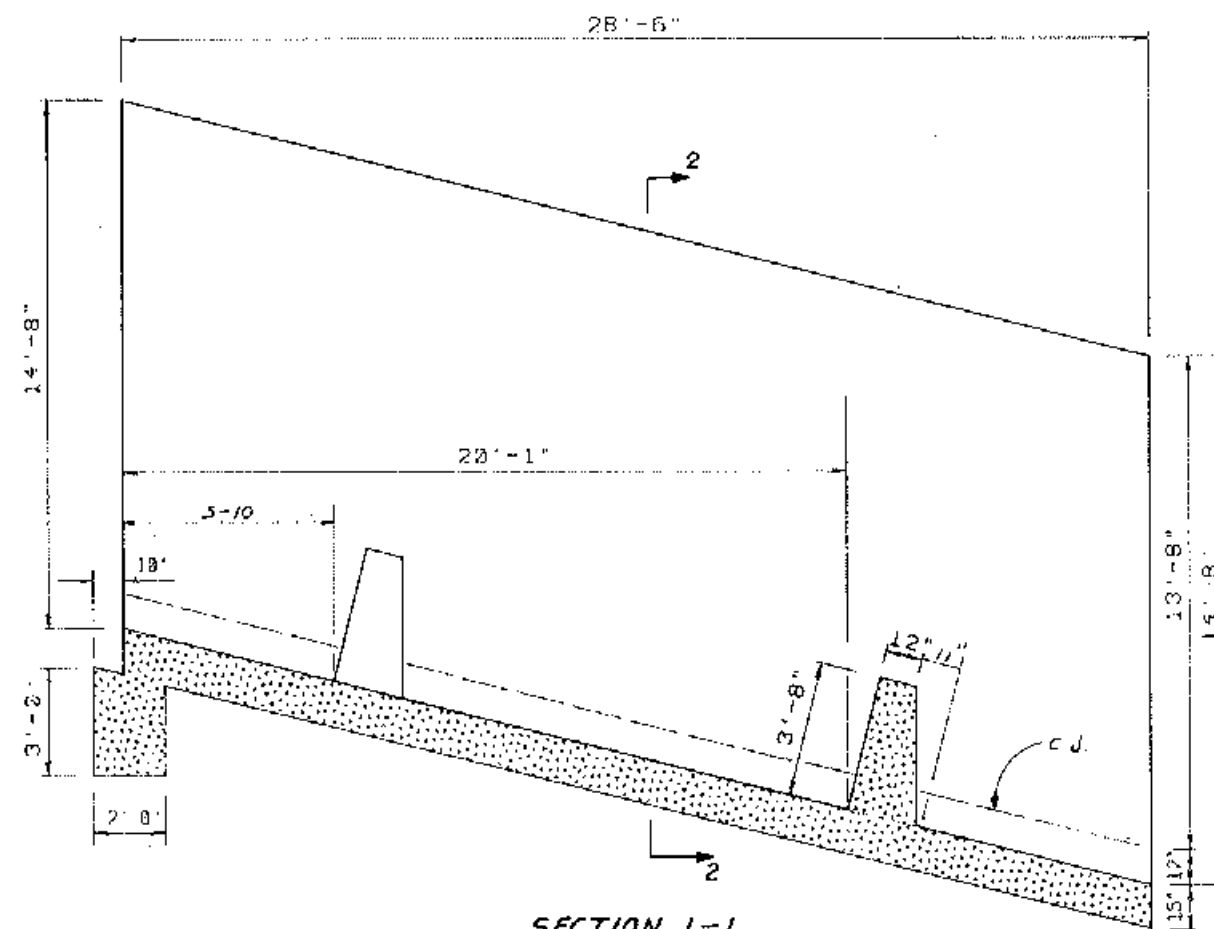
Designed	JON NESTOS	DATE	5/89	Approved By	
Drawn	GEORGE WALISER	DATE	5/89	Title	
Traced				Sheet	
Checked	UPKNIS REEP	DATE	6/89	Sheet No.	08-89-031



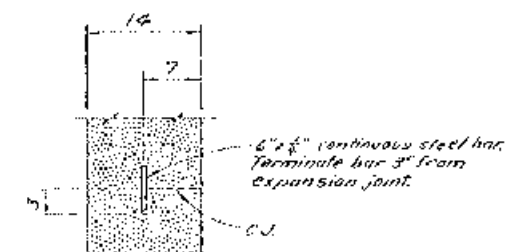
PLAN VIEW



SECTION 2-2



SECTION 1-1



DETAILS OF PLATE
CONSTRUCTION JOINT

Notes:

1. For details of transverse and longitudinal joints, see sheets 39 and 40.
2. For details and locations of drain outlets, see sheets 34 thru 36.



AS BUILT PLANS

NO CHANGE

Comp. Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY - J#1 TO J#2

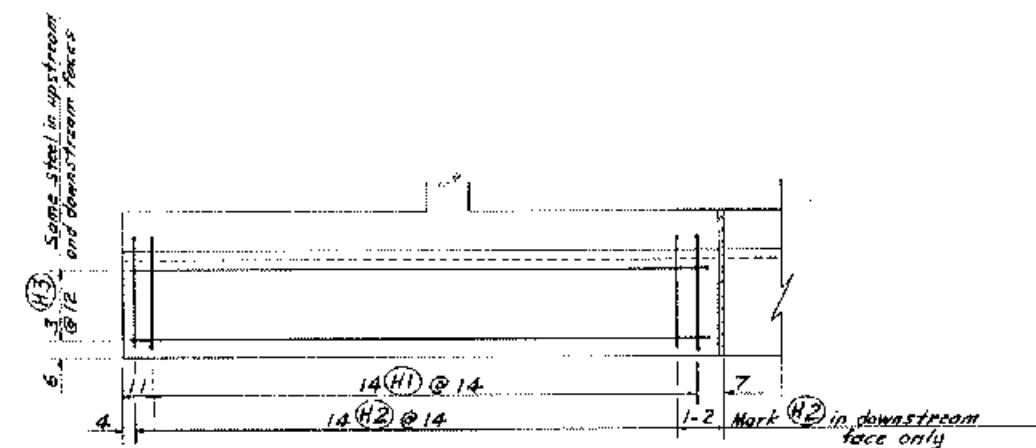
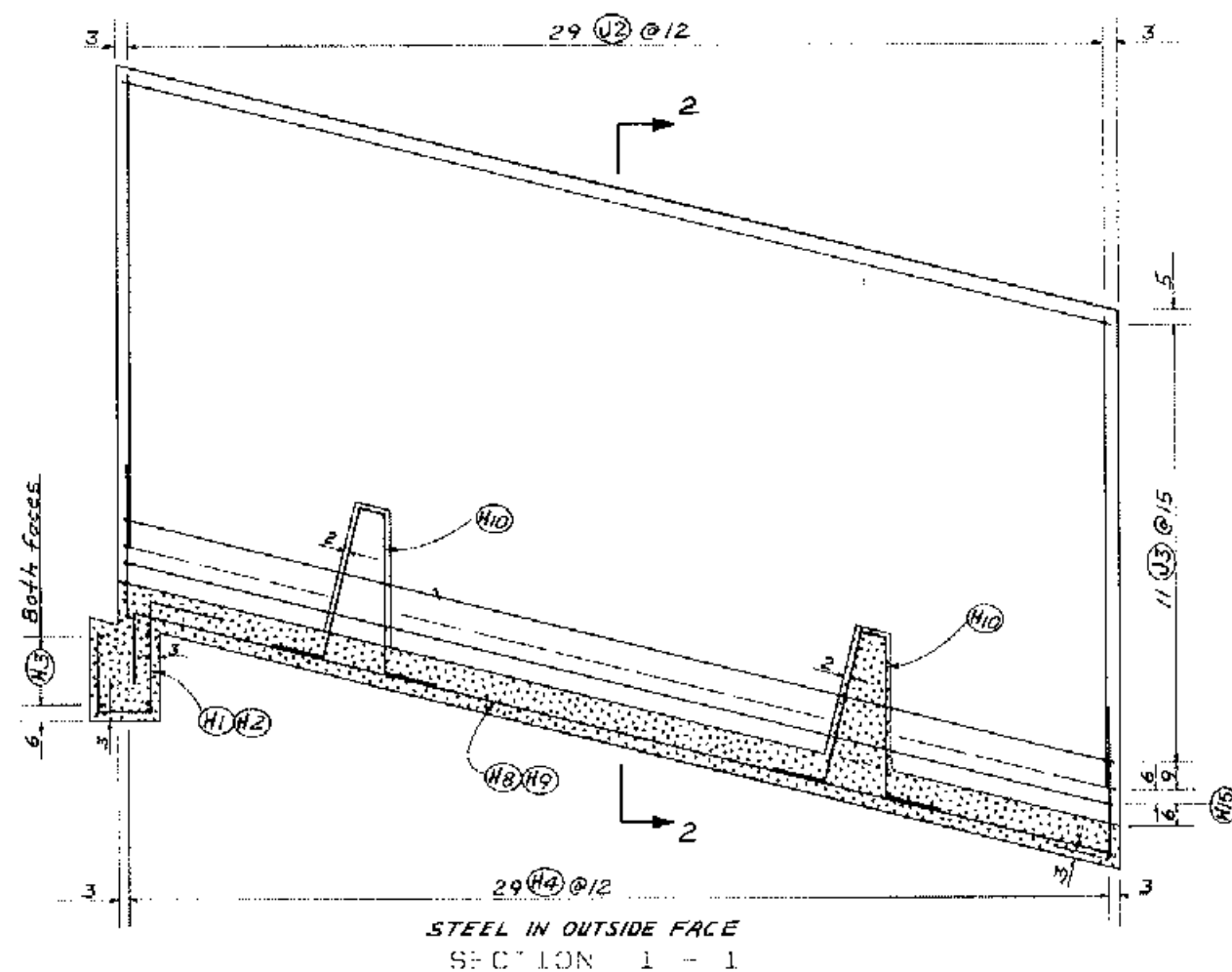
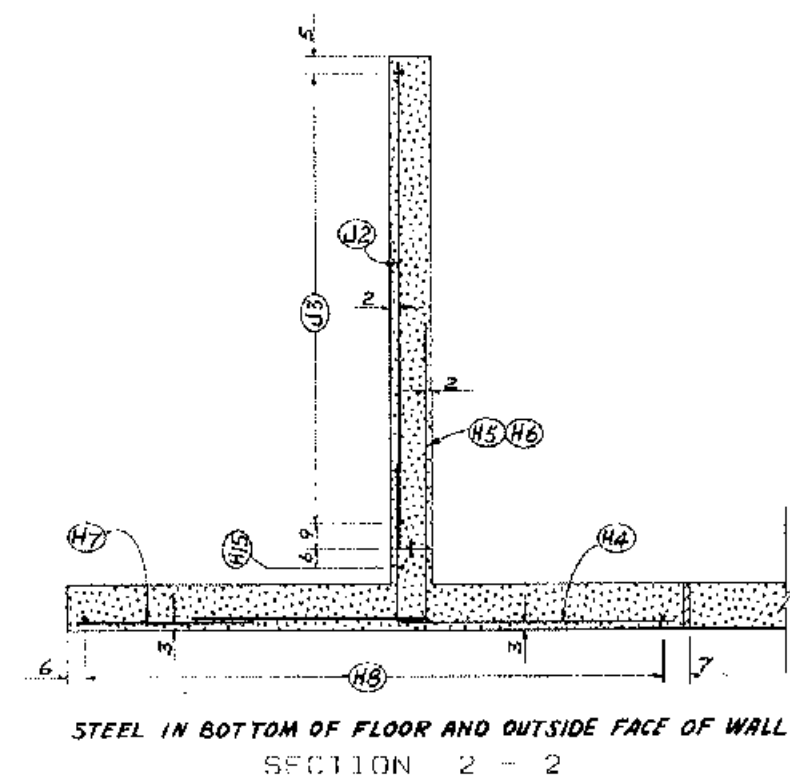
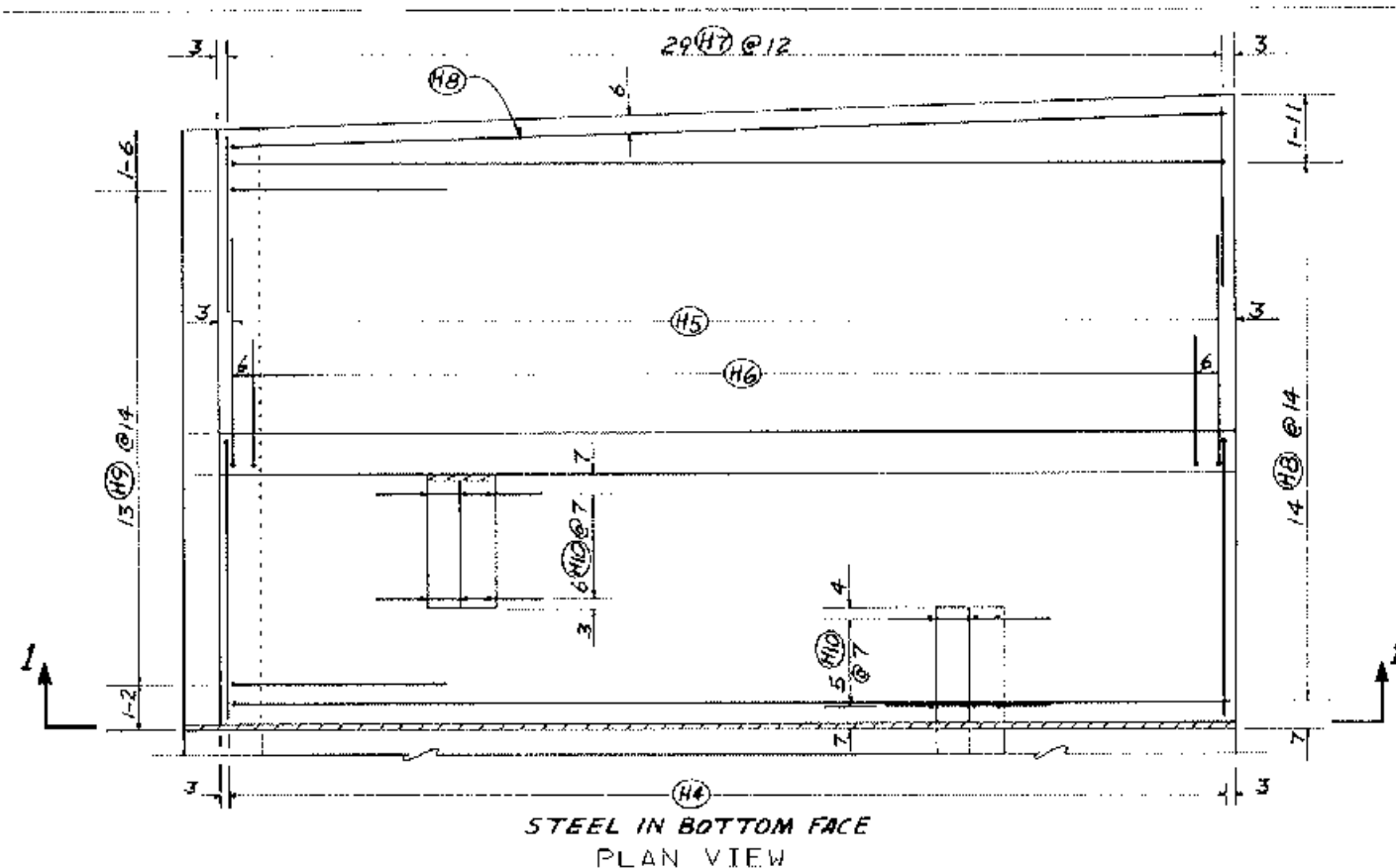
FLOODWATER RETARDING STRUCTURE

ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

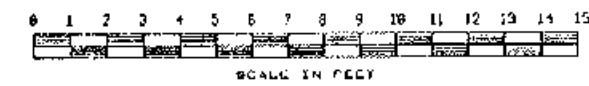
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JON. MESIUS 3/28/89	Drawn	G. J. WALSER 3/28/89	Traced		Checked	CENNIS REEF 4/29/89	Approved By		08-89-031
Title		Scale		Sheet		Drawn No.				

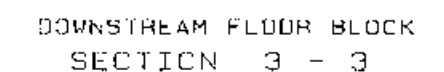
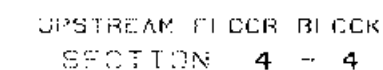
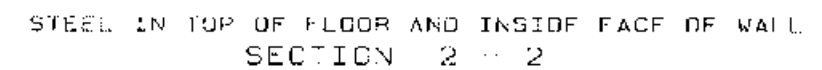
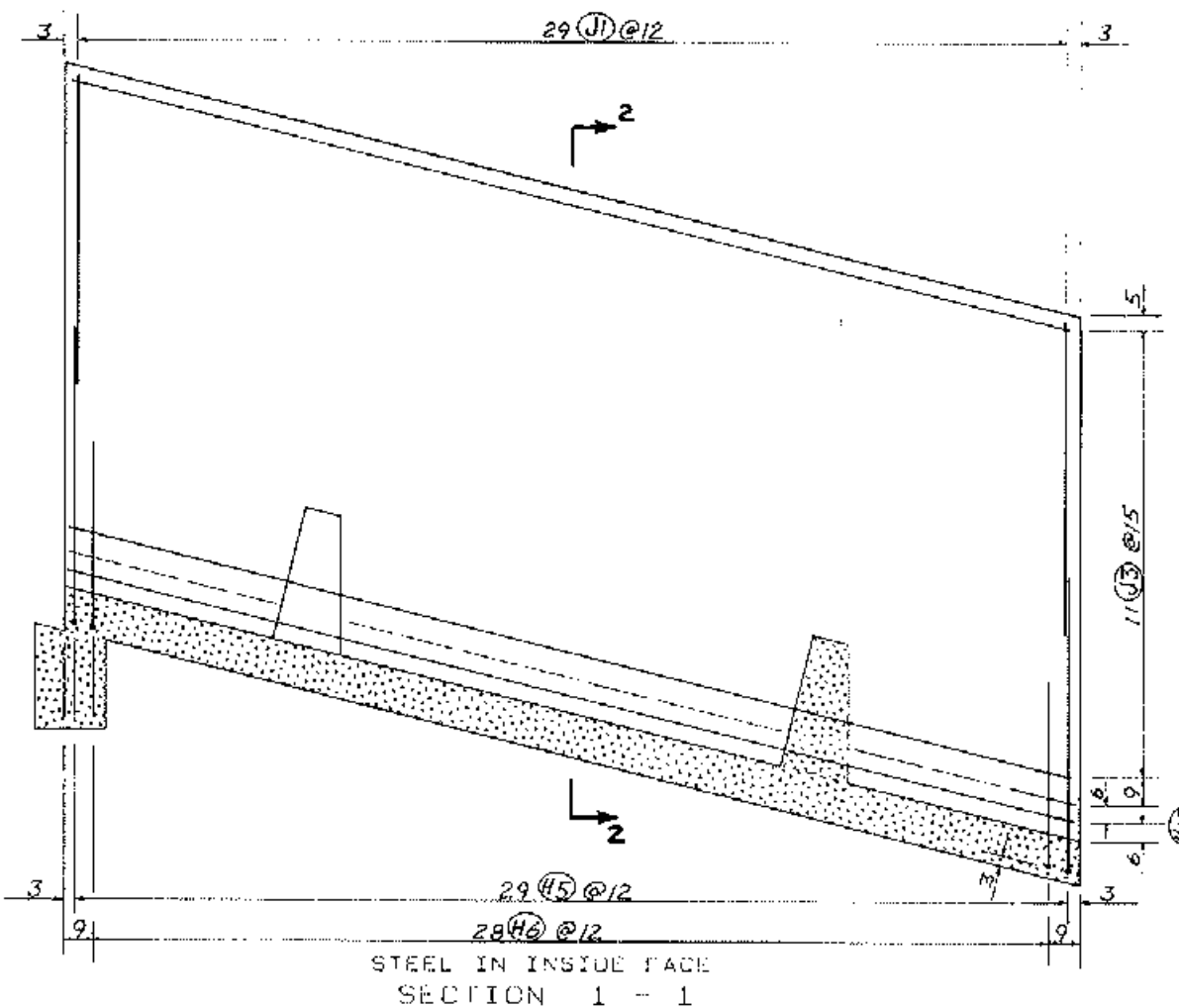


AS BUILT PLANS
NO CHANGE
Revised Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY - J#1 TO J#2
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



Designed	JON NESTOS	DATE	3/88	Approved By	
Drawn	G.F. WALISER	DATE	3/88	Title	
Traced		DATE		Sheet	
Checked	DENNIS REEP	DATE	6/89	Drawing No.	08-89-031



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

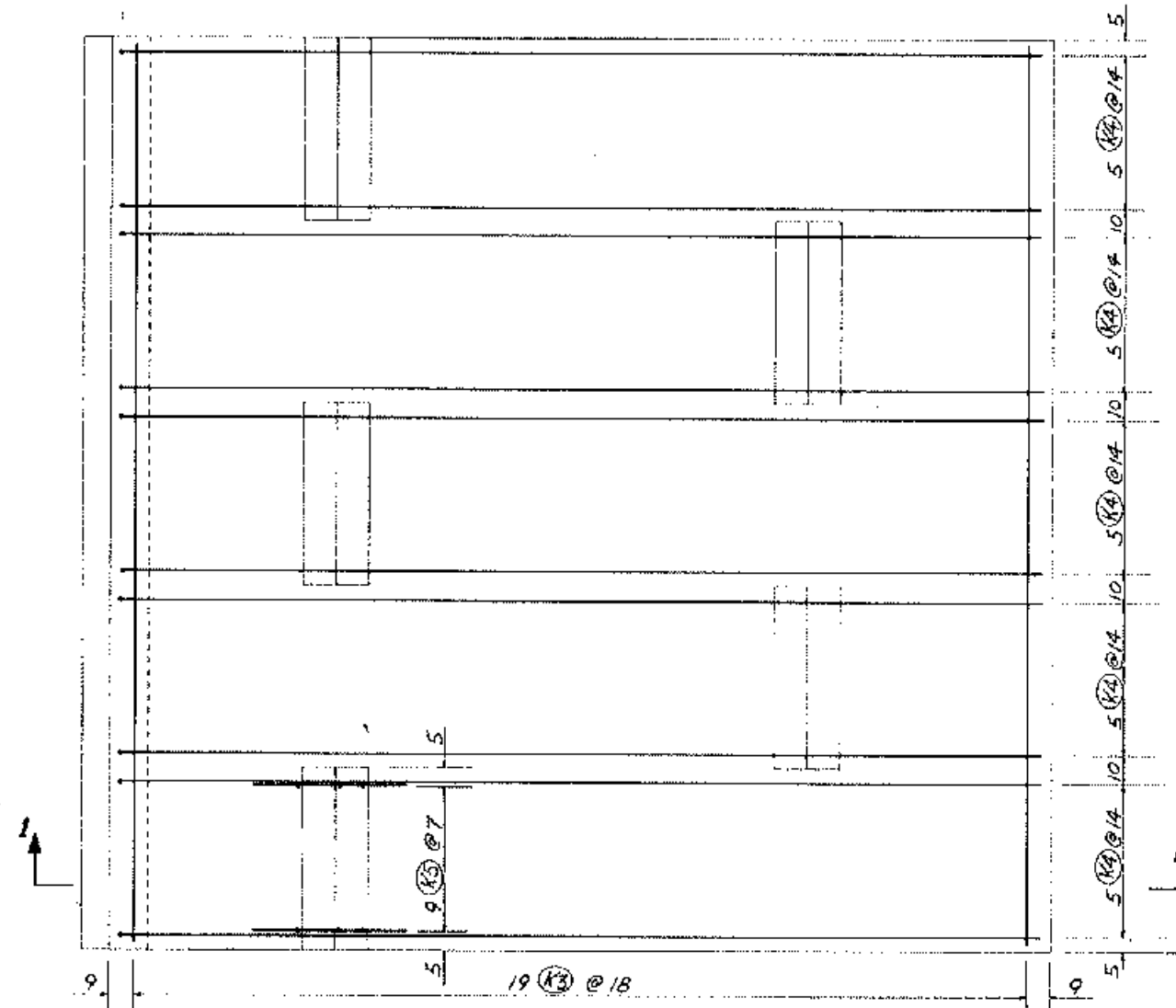
WALL SEGMENT
CHUTE SPILLWAY - J#1 TO J#2

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

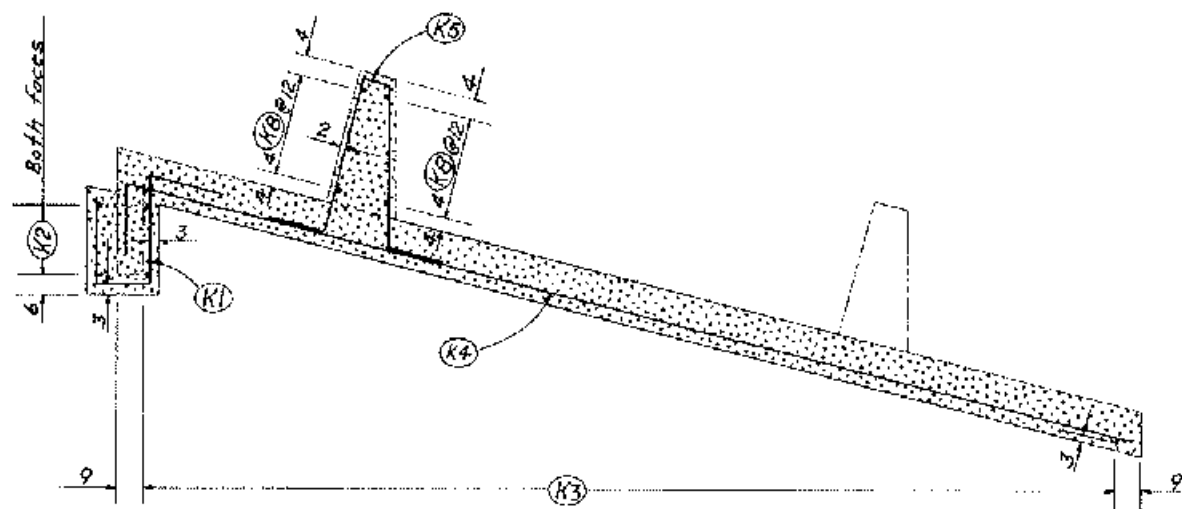
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



Designed	JON NESTOSS	DATE	3/2/89	Approved By	
Drafted	G.F. WALISER		3/2/89	Title	
Trained				Title	
Checked	DENNIS RIEP		6/89	Sheet	
				of	
				Drawn/Proj. No.	08-89-031

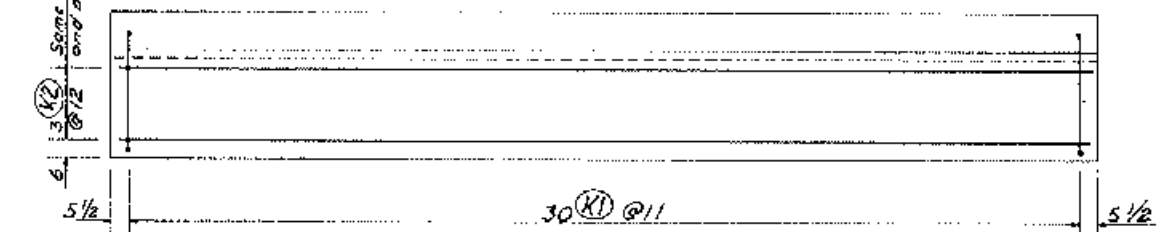


STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN BOTTOM FACE
SECTION 1 - 1

Some steel in upstream
and downstream faces



UPSTREAM ELEVATION OF CUTOFF WALL

AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

Notes:

1. Floor block layout shown is for the segment on the structure centerline. For dimensions and layout of this and adjacent interior segments, see sheet 33.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.



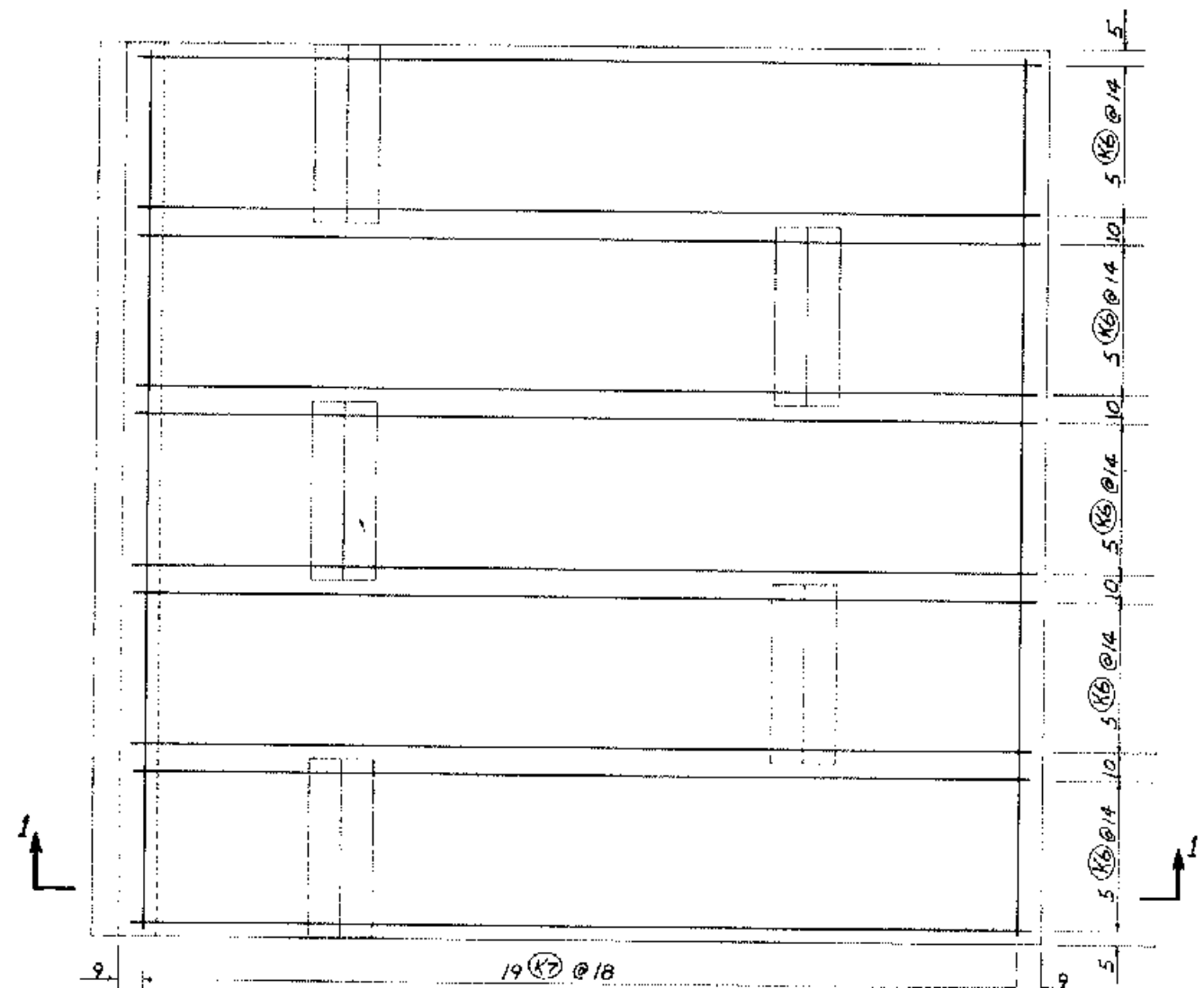
PAVEMENT SLAB - INTERIOR SEGMENT
CROUTE SPILLWAY J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

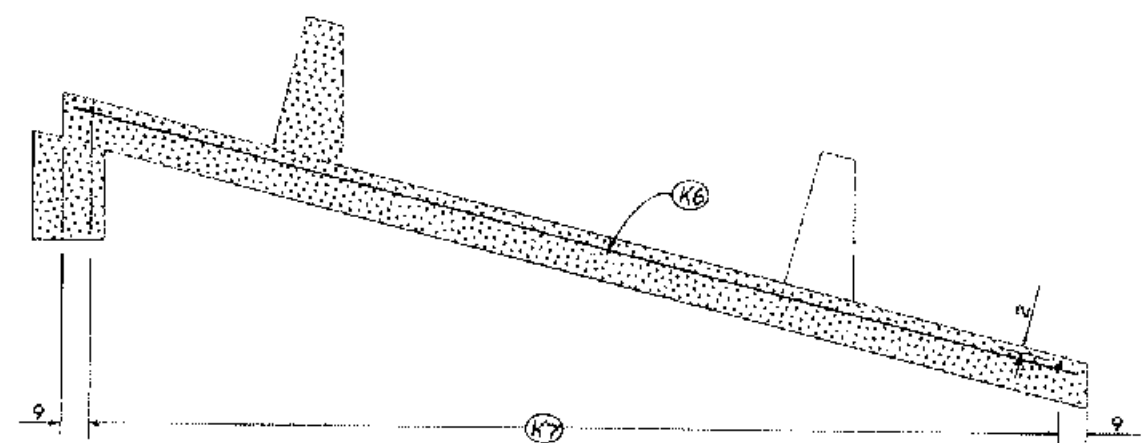
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

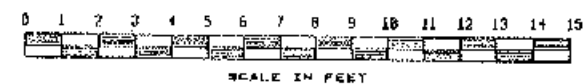
Designed	JON NESTOSS	5/89	Approved By	
Drawn	GEORGE WALISER	5/89	Title	
Traced			Scale	
Checked	DENNIS REED	5/89	Sheet	08-89-031



STILL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

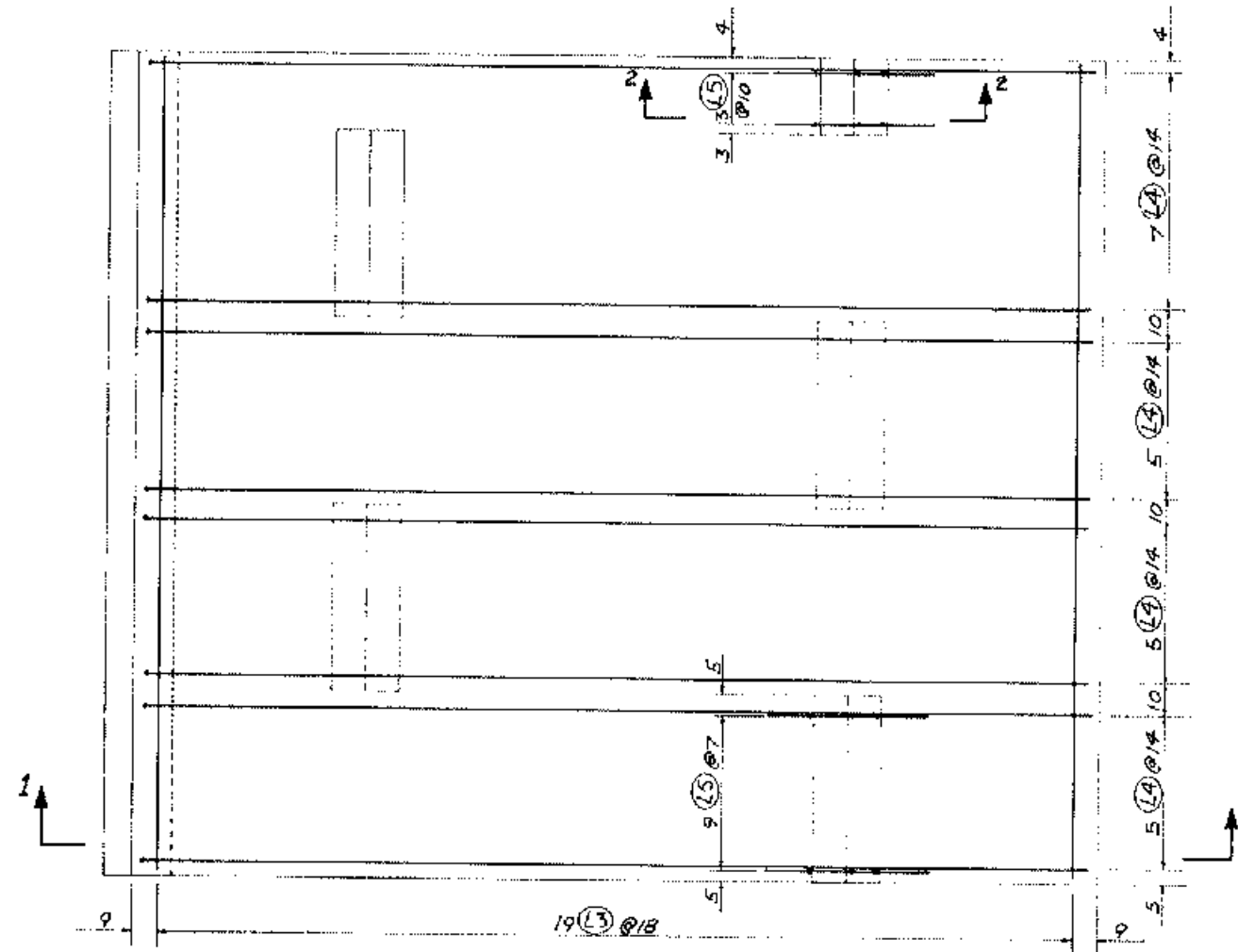
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

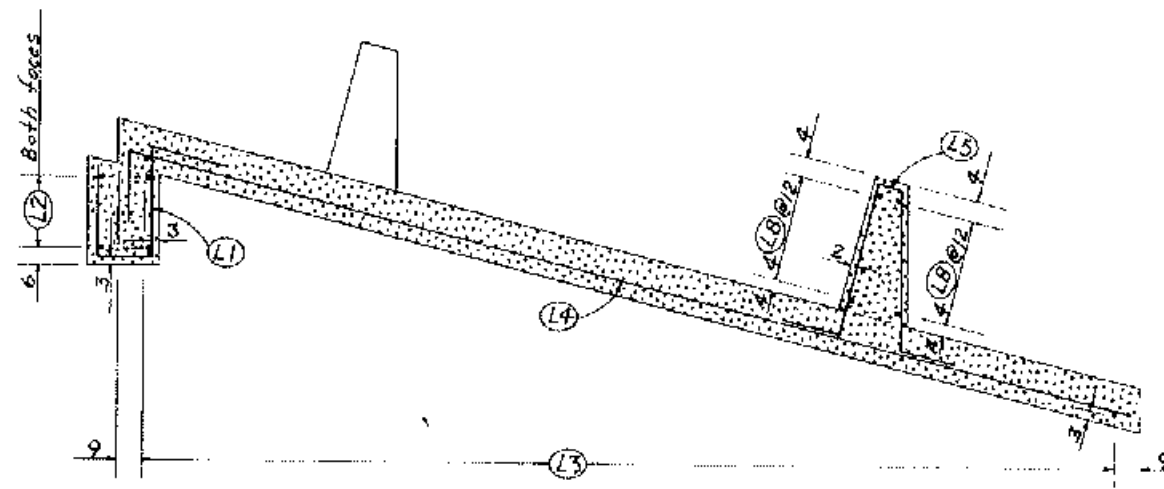
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

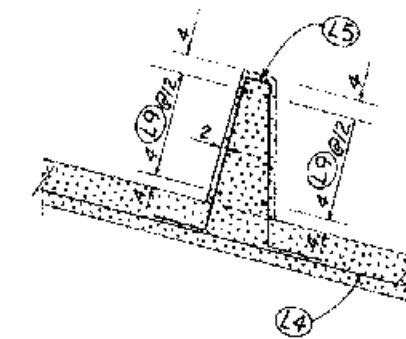
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Drawn	GEORGE WALISER	DATE	5/89	TITLE	
Traced		DATE		SCALE	
Checked	DENNIS REEP	DATE	4/89	Sheet No.	08-89-031



STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN BOTTOM FACE
SECTION 1 - 1



STEEL IN PARTIAL FLOOR BLOCK
SECTION 2 - 2

Some steel in upstream
@ 12" and downstream faces



UPSTREAM ELEVATION OF CUTOFF WALL

Notes:

1. For details of floor block layout, see sheet 39.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.

AS BUILT PLANS
NO CHANGE
Date 1-23-97

PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY J#2 TO J#3

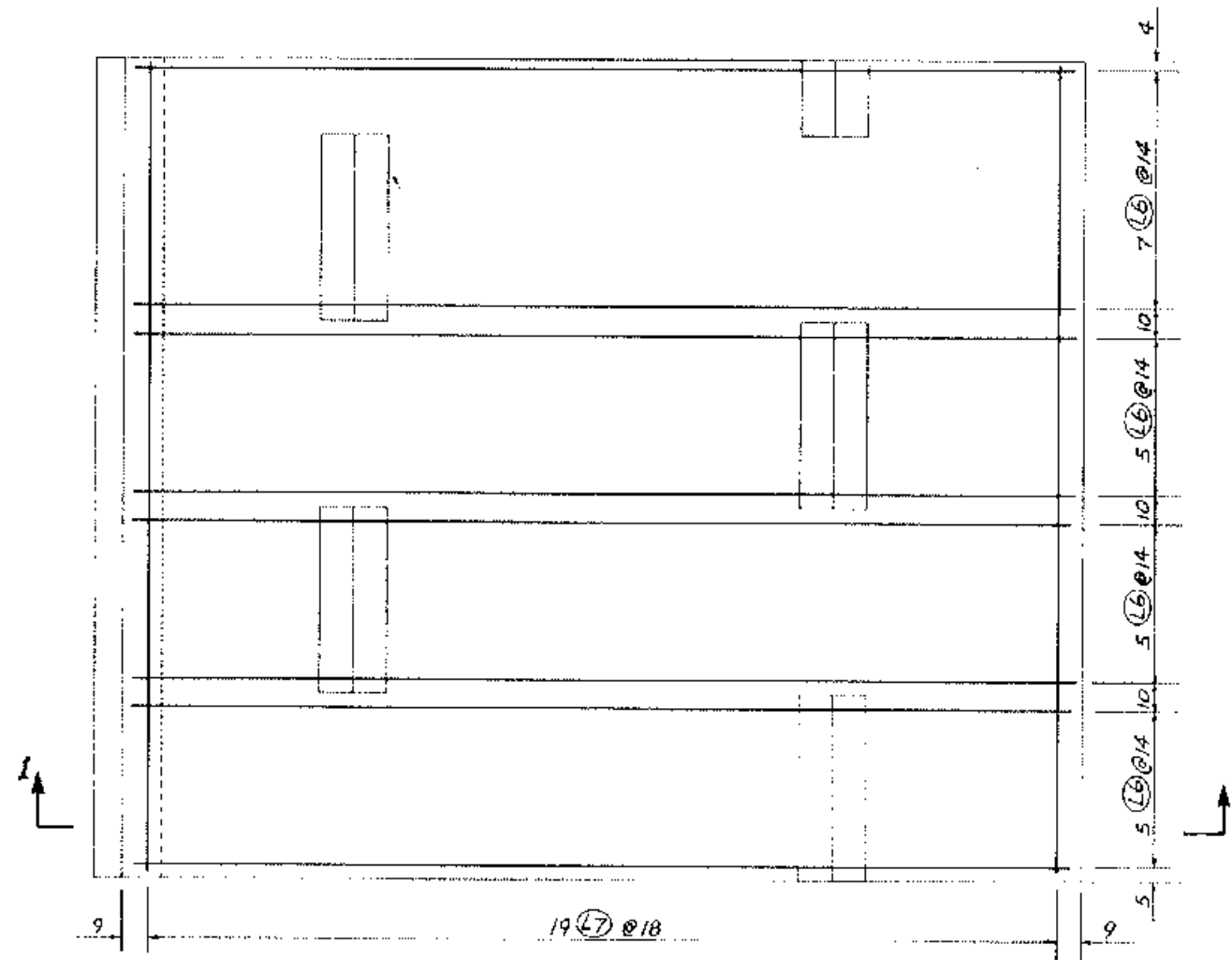
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

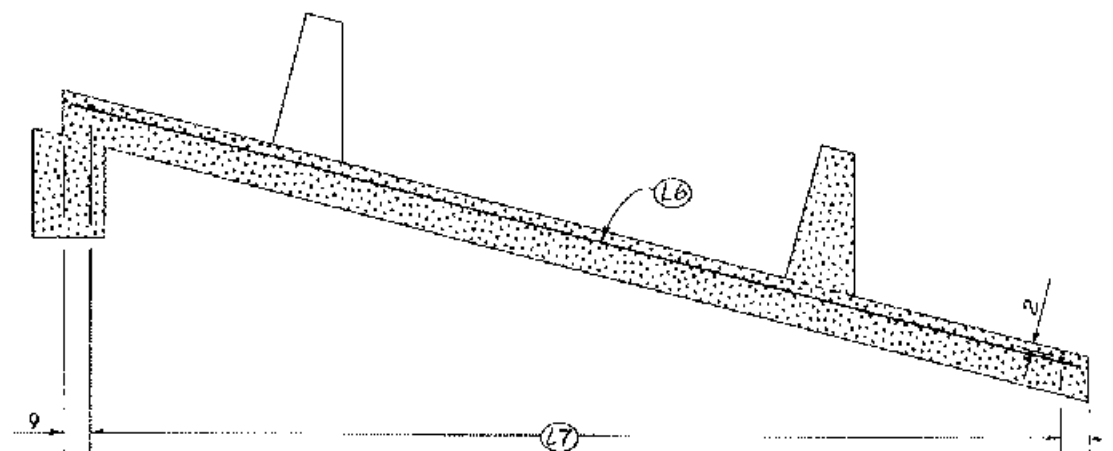
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



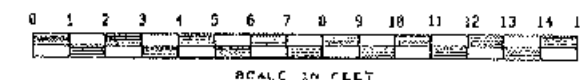
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Drawn	GEORGE WALISER	4/89	Checked	
Traced			Sheet	Drawing No.
Checked	DENNIS REEP	6/89	6/88	08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

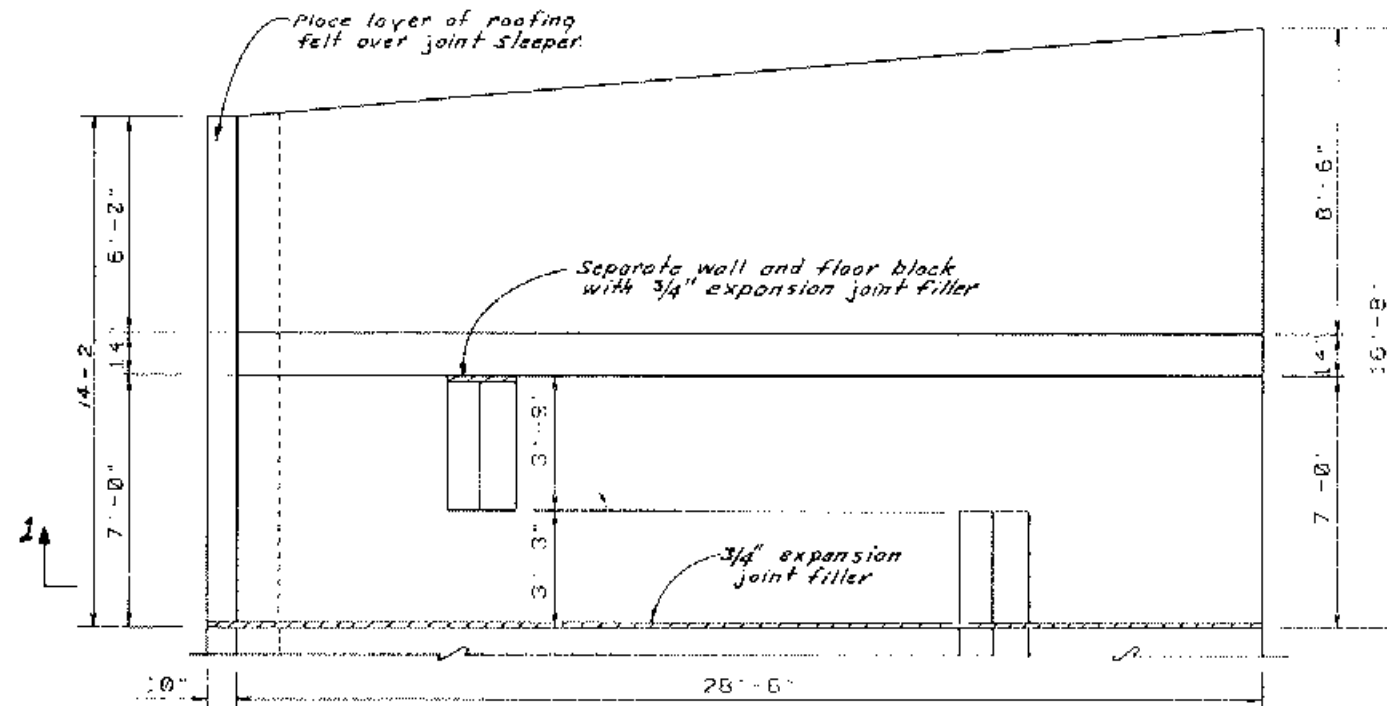
PAVEMENT SLAB - EXTERIOR SEGMENT
CIUTE SPILLWAY J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

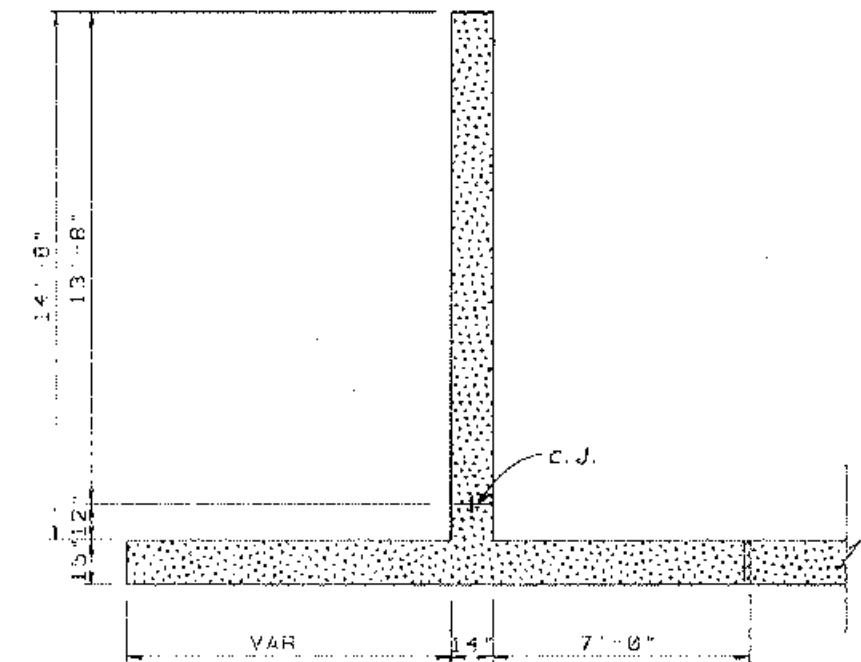
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

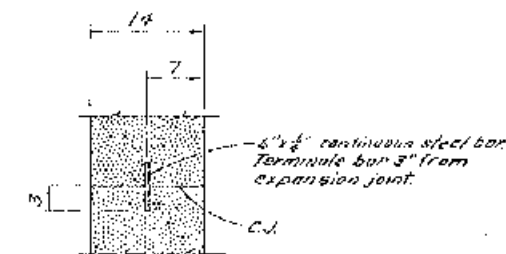
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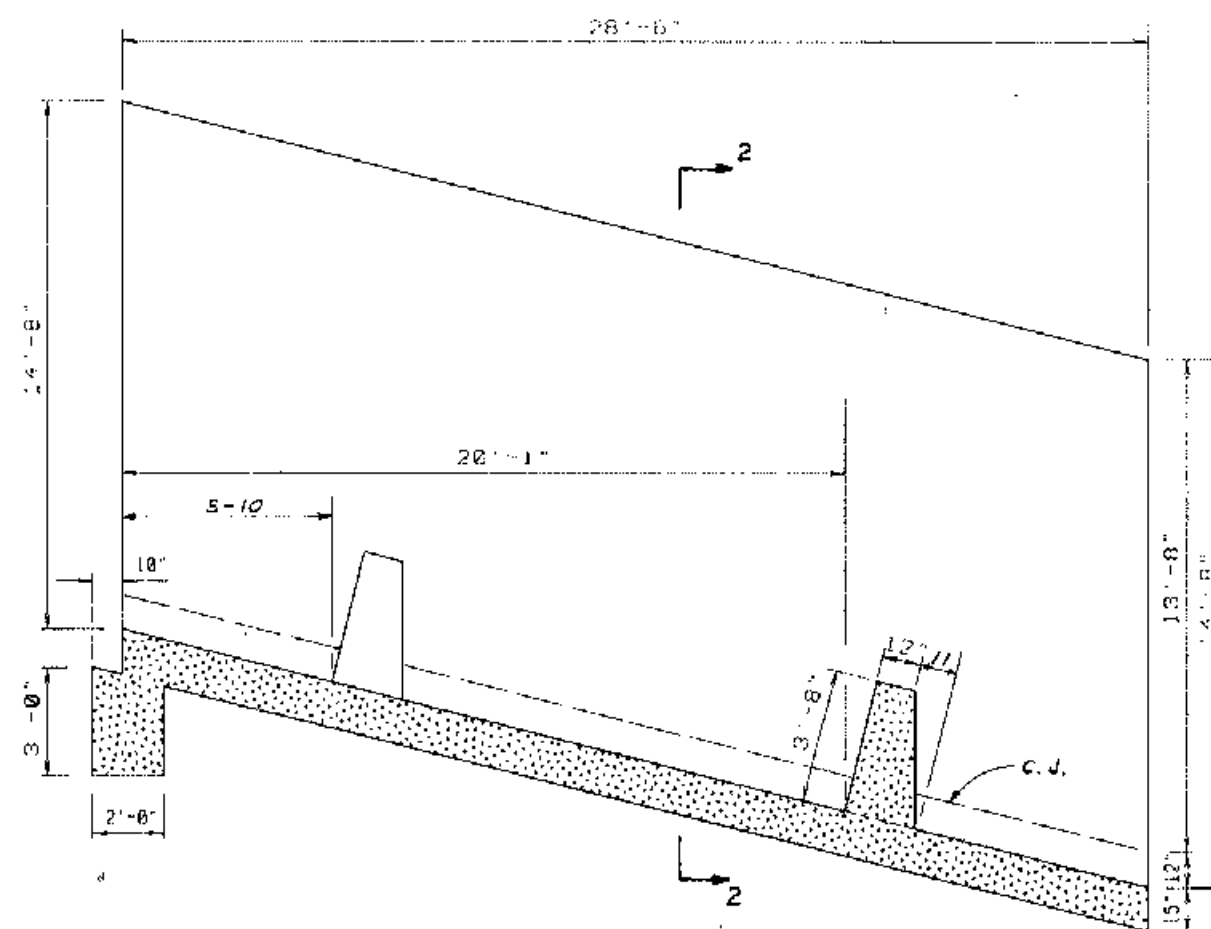
PLAN VIEW



SECTION 2-2



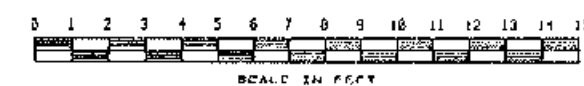
DETAILS OF PLATE CONSTRUCTION JOINT



SECTION 1-1

Notes:

1. For details of transverse and longitudinal joints, see sheets 34 and 40.
2. For details and locations of drain outlets, see sheets 34 thru 36.

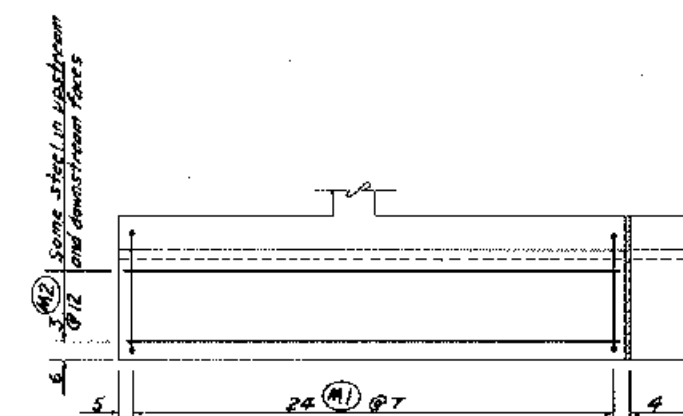
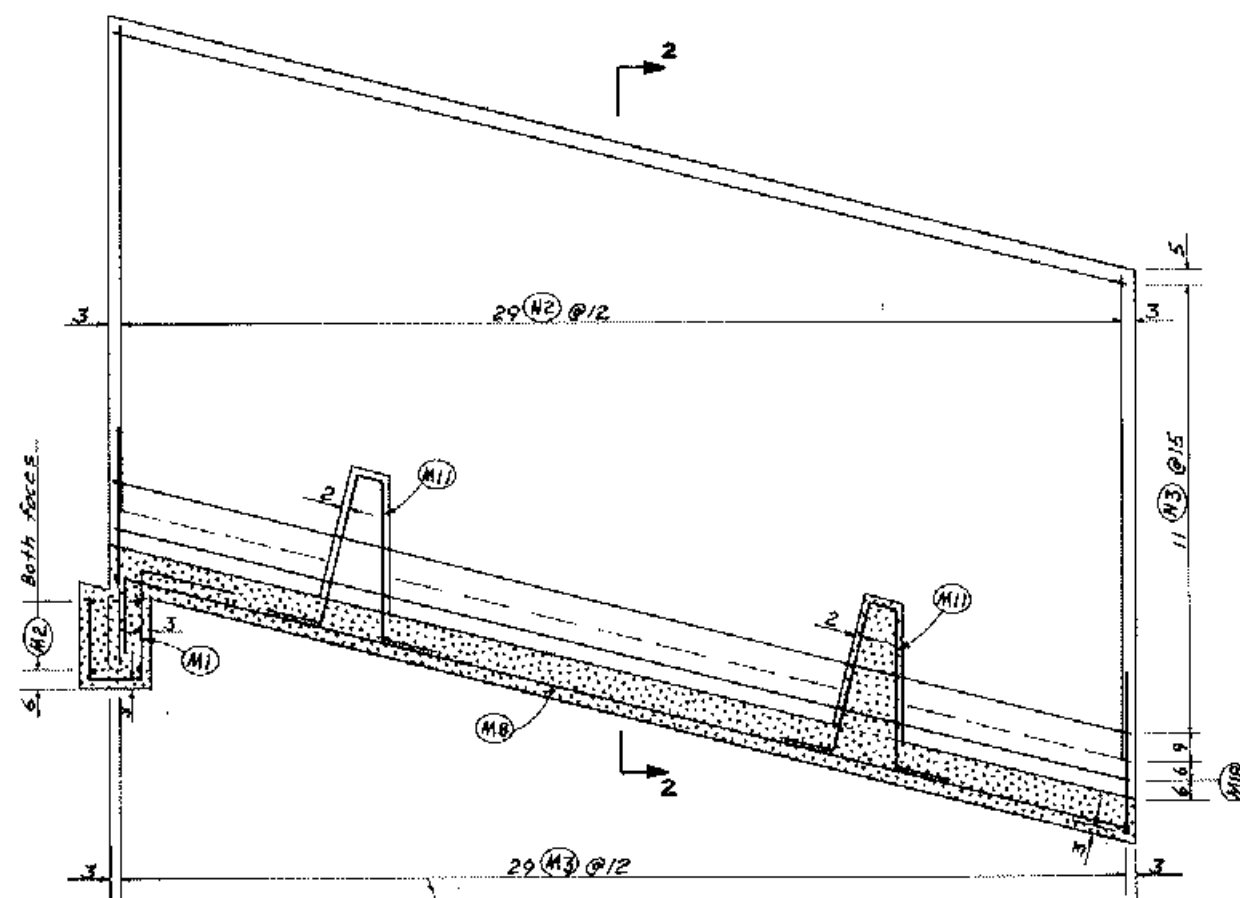
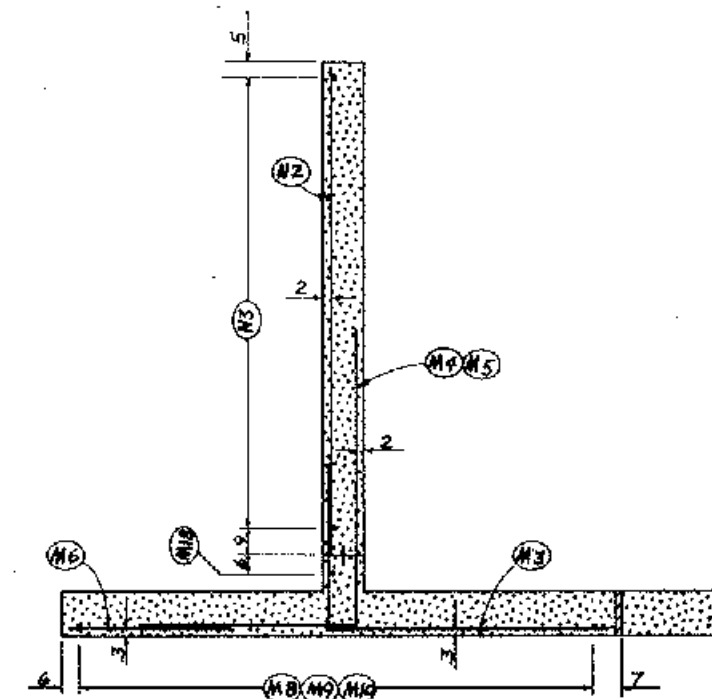
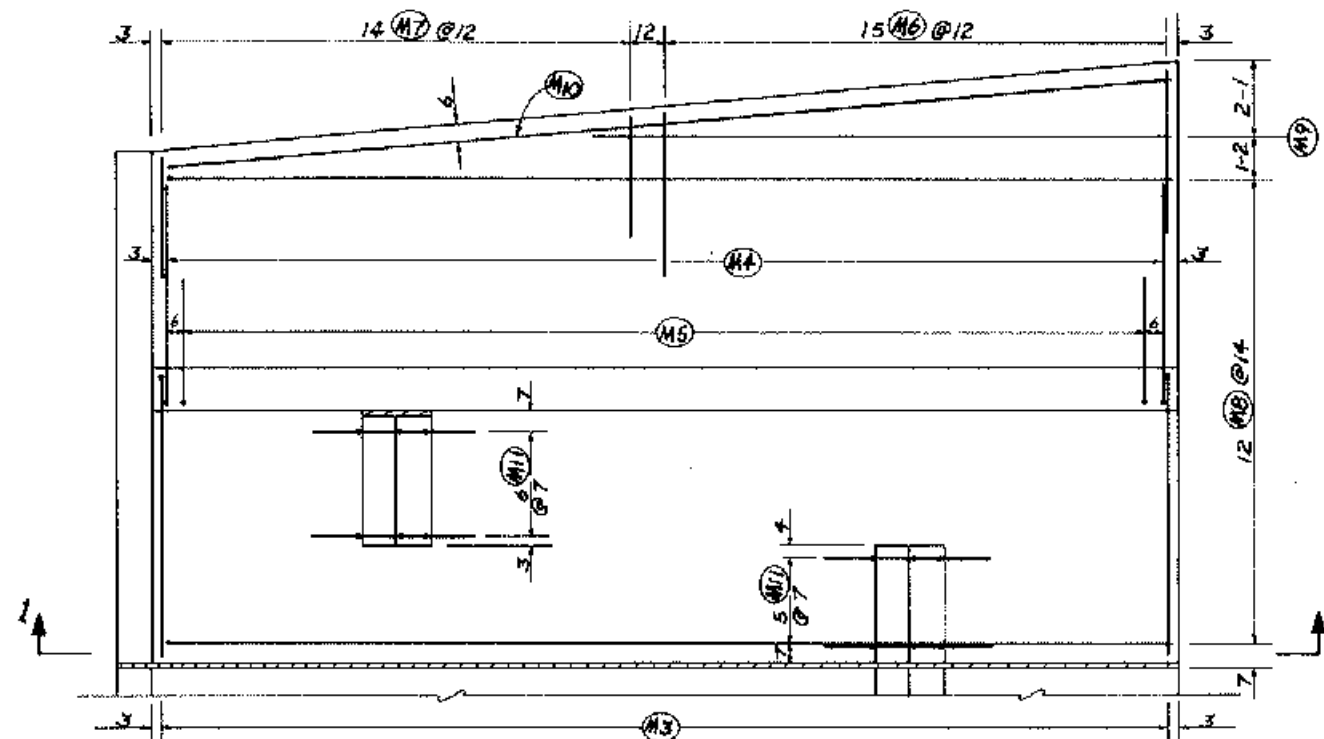


AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY - J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed JCN NE91095 3/2/88	DATE	Approved By
Drawn G.F. WALISER 3/2/88	TITLE	
Traced	DATE	
Checked QENNIE REEF 5/2/89	Sheet 62 of 88	Drawing No. 08-89-031



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

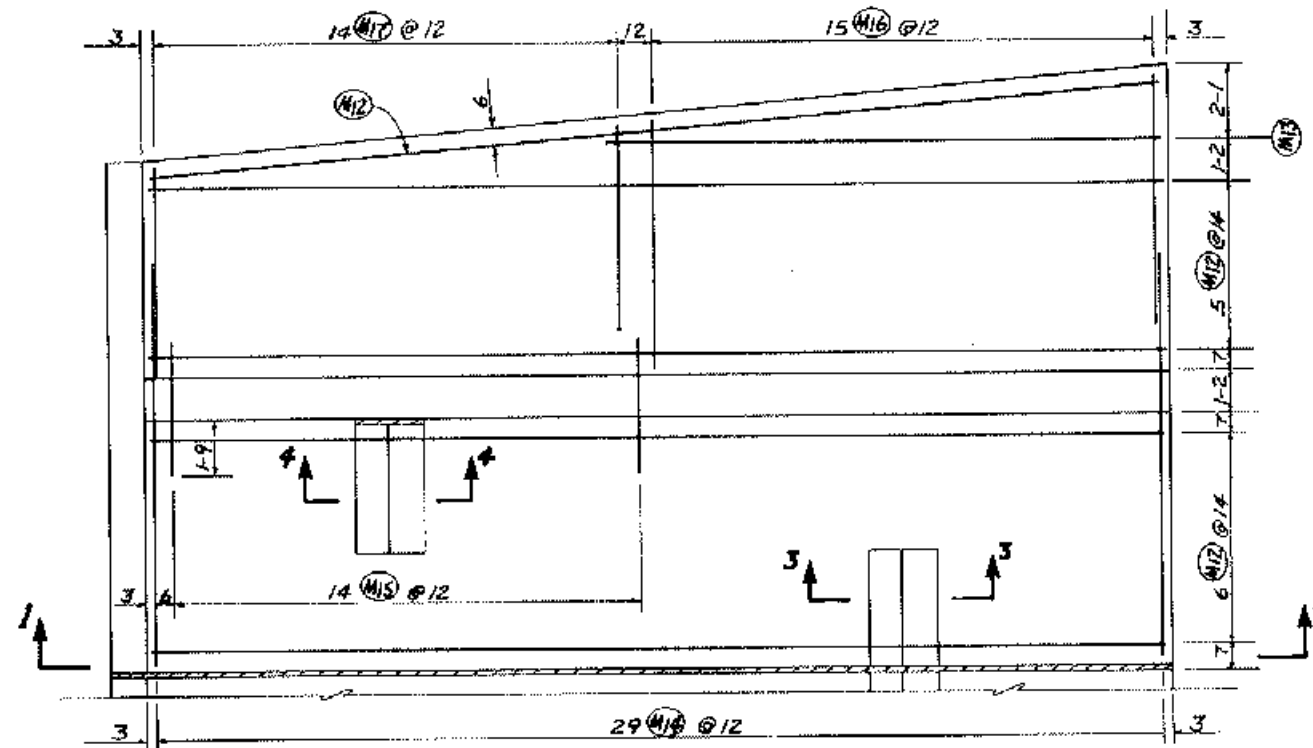
WALL SEGMENT
CHUTE SPILLWAY - J#2 TO J#3

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

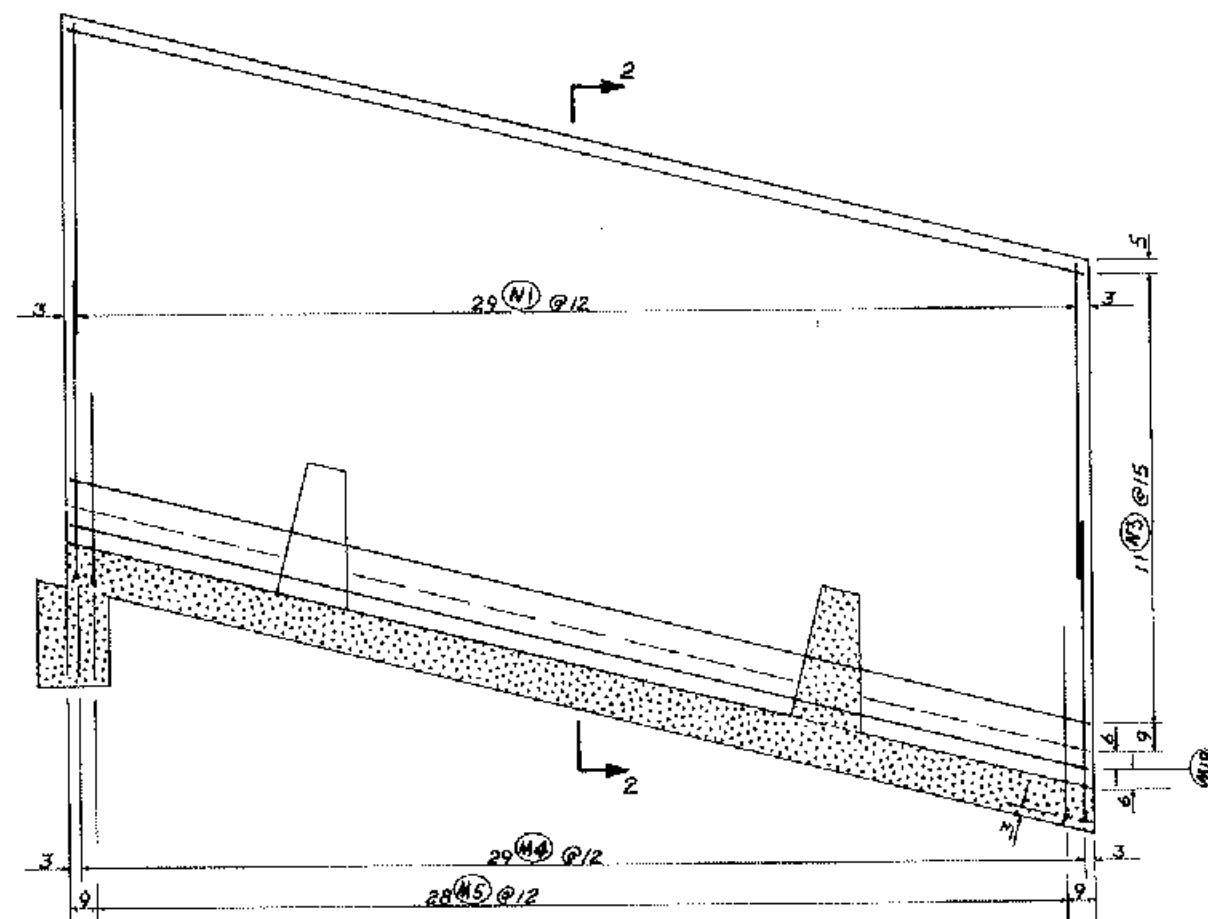
 U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DATE		Approved By	
Designed JON NESTOSS 3/2/88		JSTW	
Drawn G.F. WALISER 3/2/88		T-52B	
T-52B		Drawing No.	
Checked DENNIS BEEP 3/2/88		HP 63 OF 88	
		08-89-031	



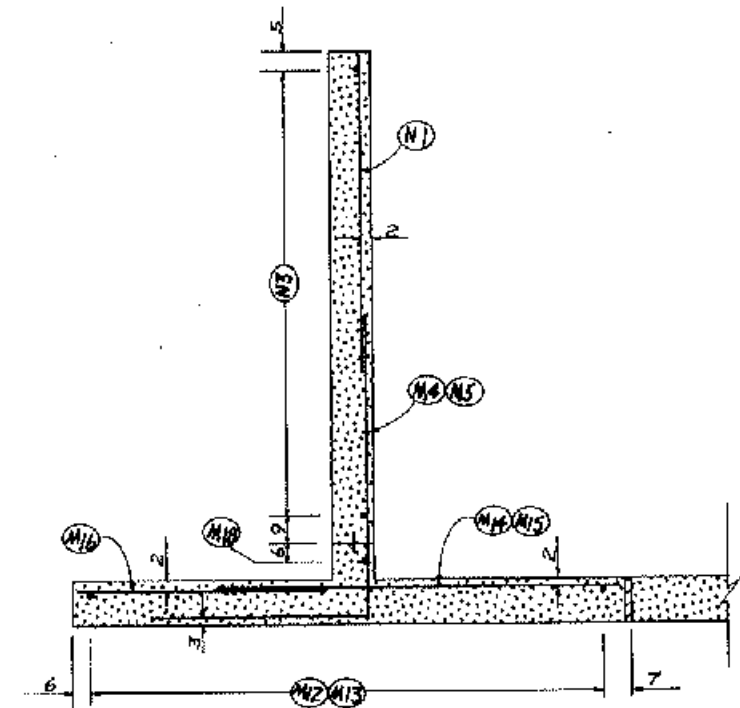
STEEL IN TOP FACE

PLAN VIEW



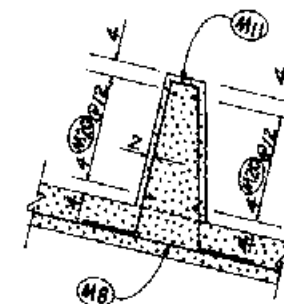
STEEL IN INSIDE FACE

SECTION 1 - 1



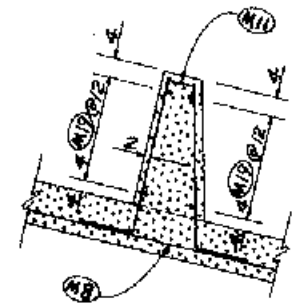
STEEL IN TOP FLOOR AND INSIDE FACE OF WALL

SECTION 2 - 2



UPSTREAM FLOOR BLOCK

SECTION 4 - 4



DOWNSTREAM FLOOR BLOCK

SECTION 3 - 3

AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY - J#2 TO J#3

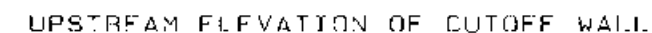
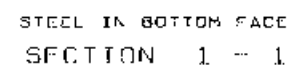
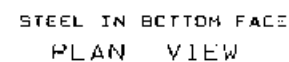
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed JON NESIDSS 2/89	Approved By
Drawn G. E. WALISER 2/89	Title
Traced	Title
Checked DENNIS BLEP 4/89	Sheet No. 88 of 88
	Project No. 08-89-031





- Naktes:

1. Floor block layout shown is for the argument on the structure centerline for the dimensions and layout of this and adjacent interior segments, see sheet 33.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

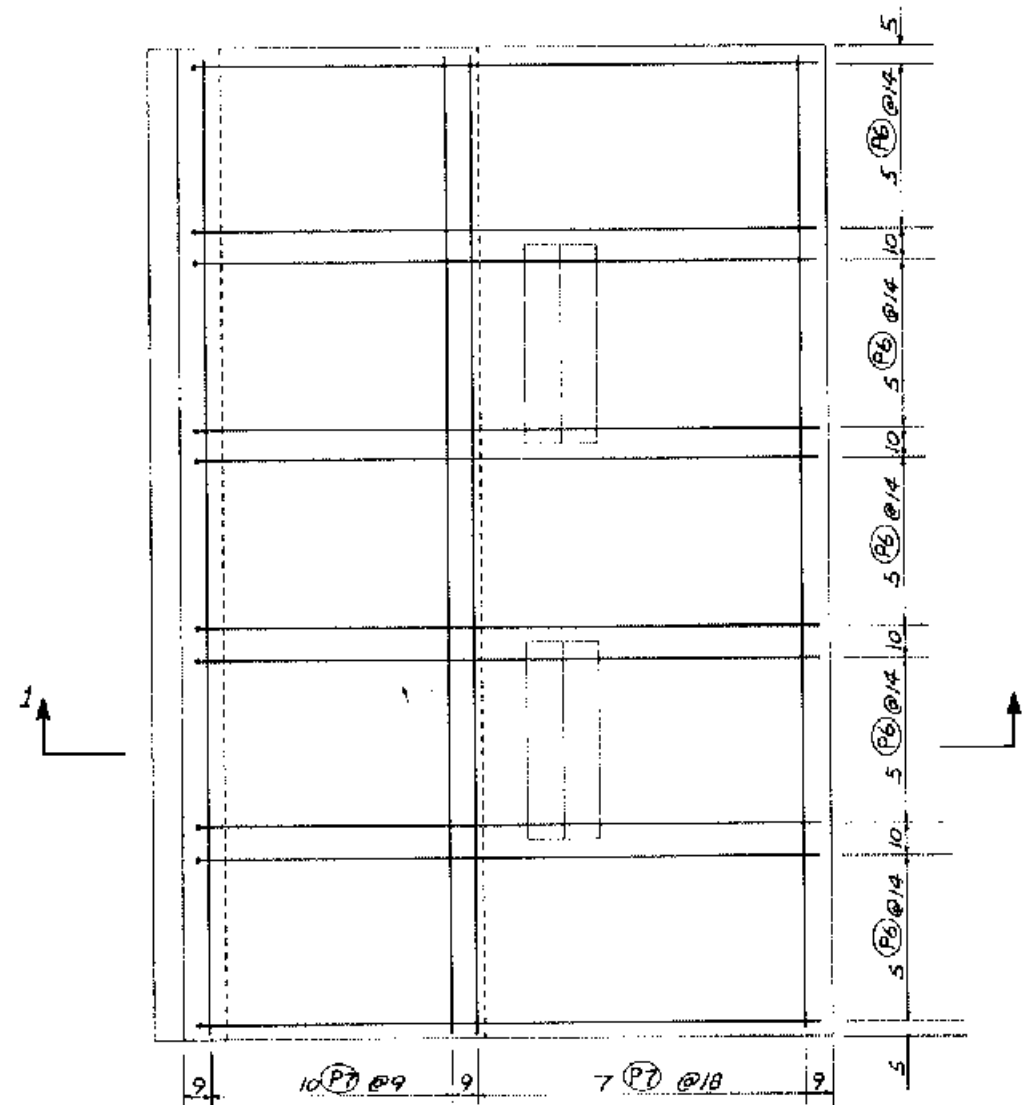
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

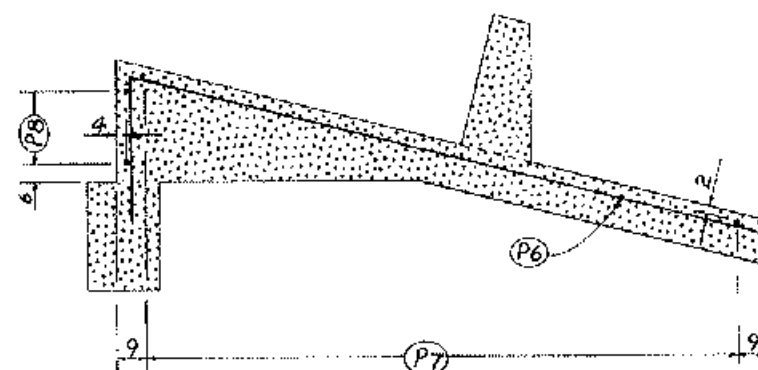
GRAND FORKS COUNTY	NORTH DAKOTA
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JON NESTISS	4/77	Approved By	
		4/88	Title	
Drawn	GEORGE WALISER	4/89		
Traced			Sheet	Drawing No.
Checked	DENNIS REEP	6/89	35	08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Comp. Date 1-22-91

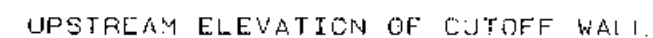
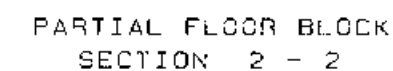
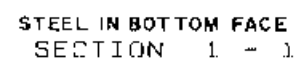
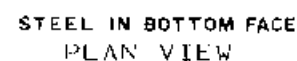
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

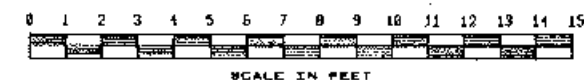
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Drawn	GEORGE VALISER	4/88	Title	
Traced			Title	
Checked	DENNIS REEP	4/89	Sheet	66
			Dr. 88	08-89-031



AS BUILT PLANS
NO CHANGE
Estim. Date 1-23-91

- Notes:

1. For details of floor block layout, see sheet 33.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.



PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH CREEK WATERSHED

GRAND FORKS COUNTY	NORTH DAKOTA
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

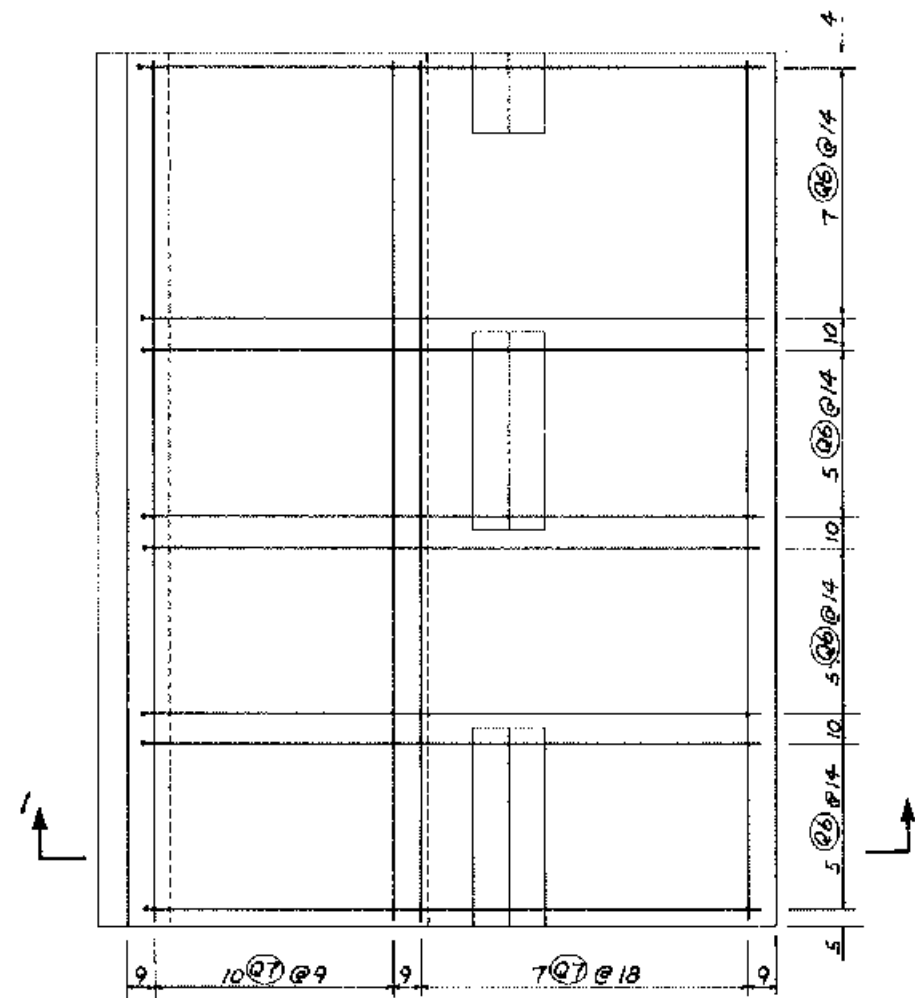
IBM NESTLES	DATE 4-9-99	Approved By
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Designated	JON NESTLUS	4/89
Title	Asst. Dir. for Int. Affairs	
Designated	JEFFREY HALL	4/89
Title	Asst. Dir. for Int. Affairs	

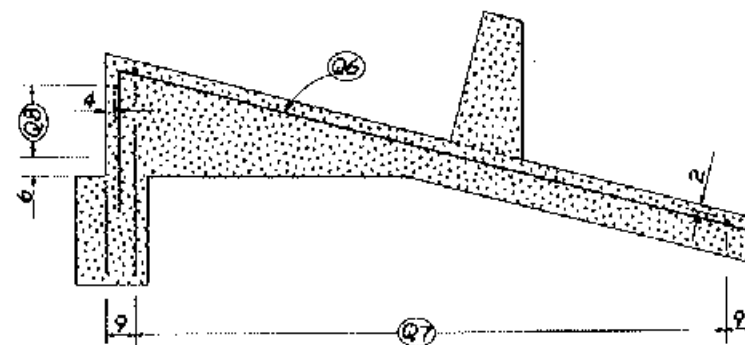
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Title _____

Traced	Sheet	Drawing No.
	67	

Checked	CENNIS REEP	4/22/88	08-89-031
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STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

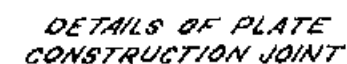
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed JON NESTOSS 4/89	Approved By
Drawn GEORGE WALISER 1/89	Title
Traced	Check
Checked DENNIS REEP 6/91	Drawing No. 08-89-031



- ## Notas:

1. For details of transverse and longitudinal joints, see sheets 39 and 40.
2. For details and locations of drain outlets, see sheets 34 thru 36.

AS BUILT PLANS
NO CHANGE
Comp. Date 1-23-91

WALL SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

BRAND FORKS COUNTY NORTH DAKOTA

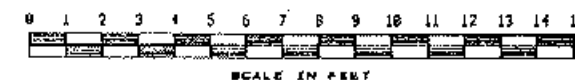
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SOIL CONSERVATION SERVICE

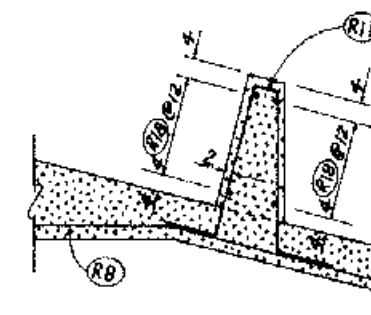
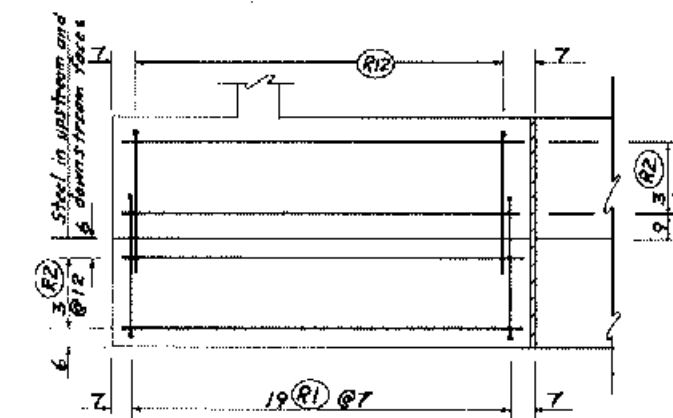
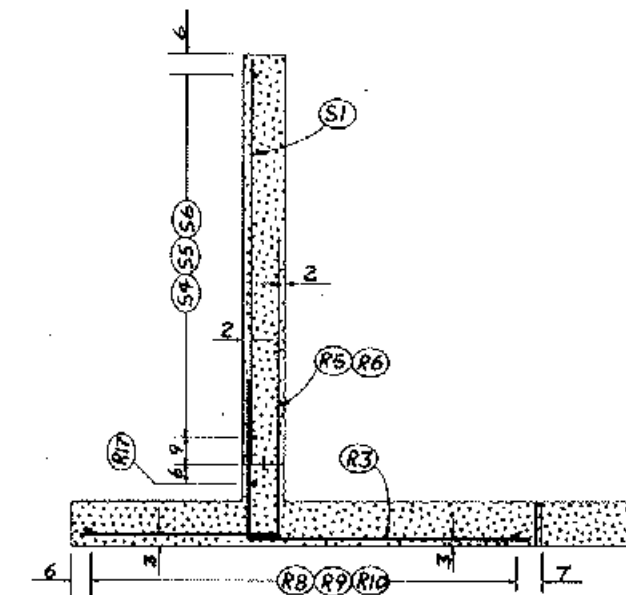
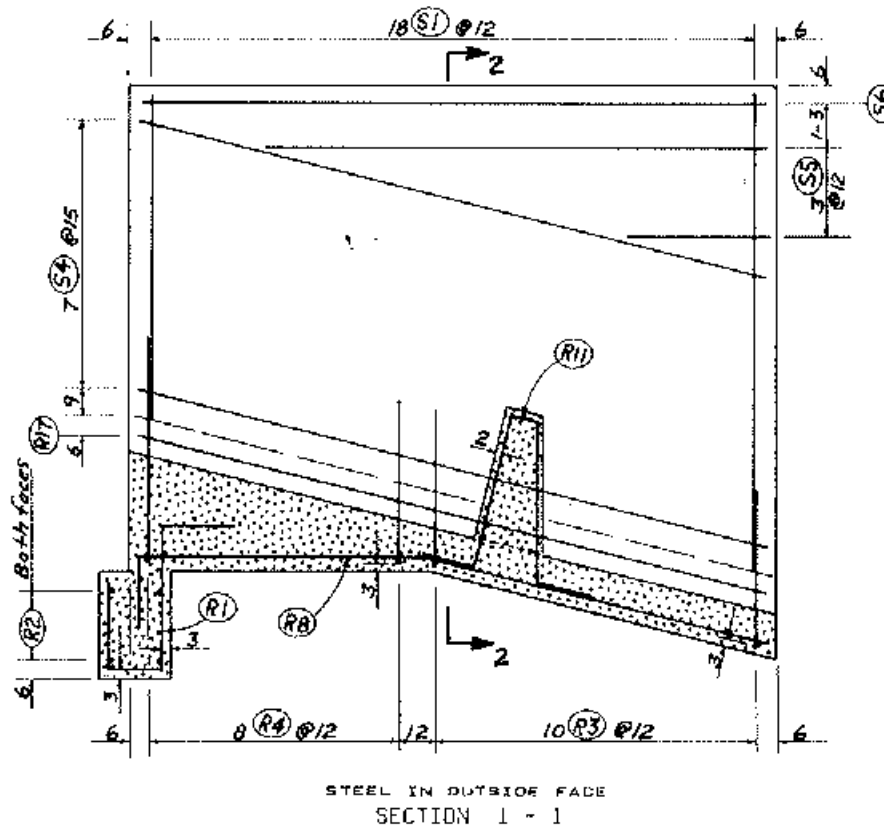
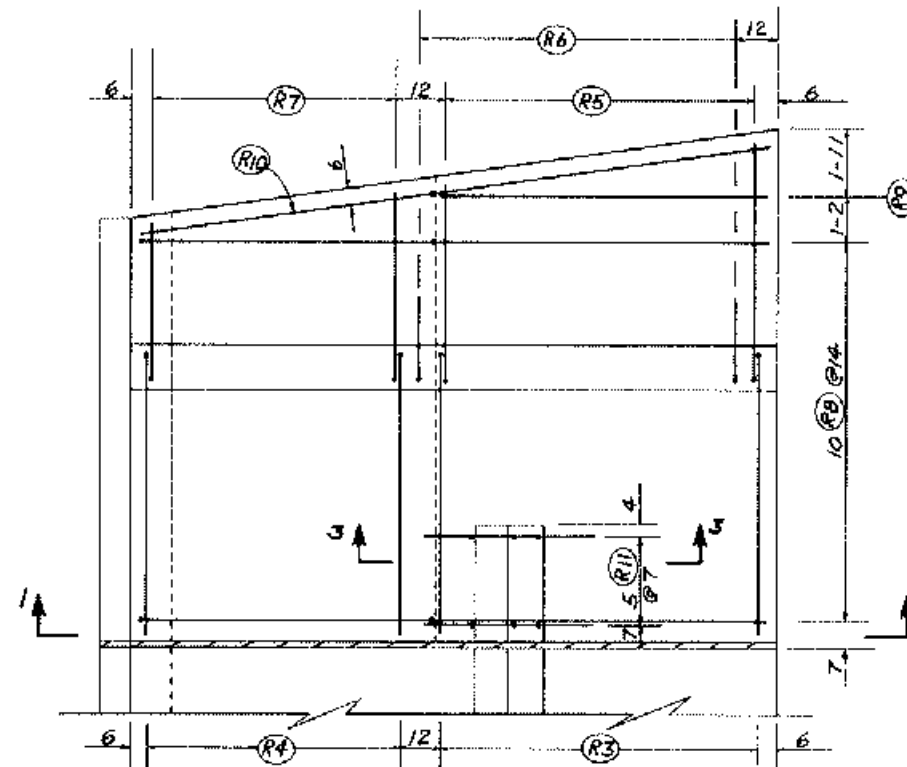
DATE 3/89
Designed by JON NESYOSS Approved by

Drawn G.F. WALISER 3/89

Traced	Task
	Sheet Drawing No.

CHECKED DENNIS REEP 6/20 NO 69 OF 88 08-89-037





AS BUILT PLANS
A NO CHANGE
Comp. Date 1-23-97

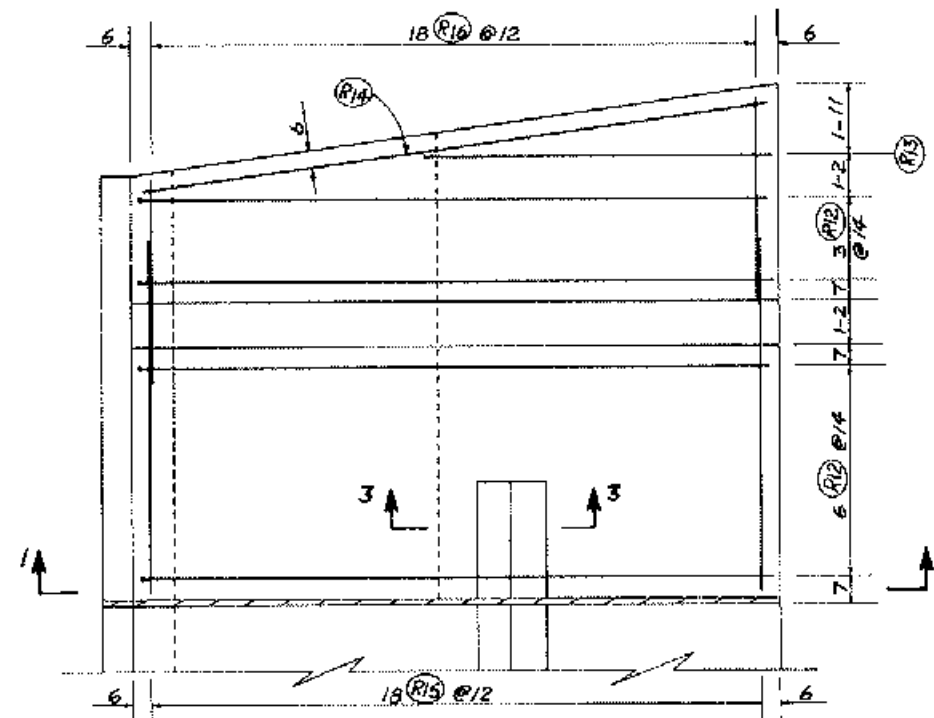
WALL SEGMENT
CHUTE SPILLWAY - J#3 TO J#4

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

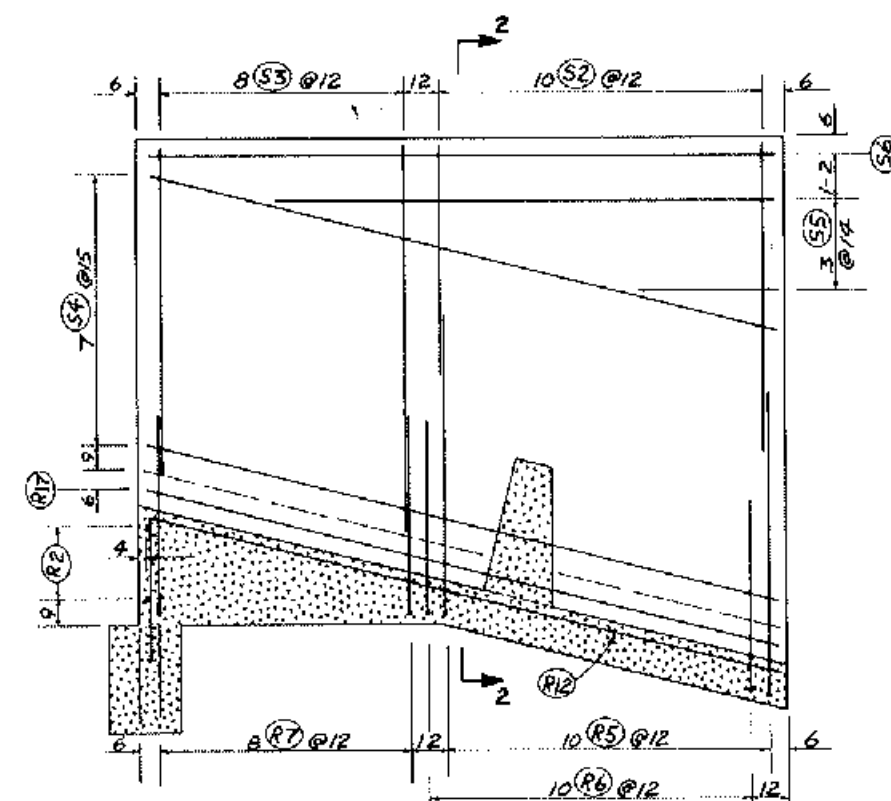
GRAND FORKS COUNTY NORTH DAKOTA

 U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

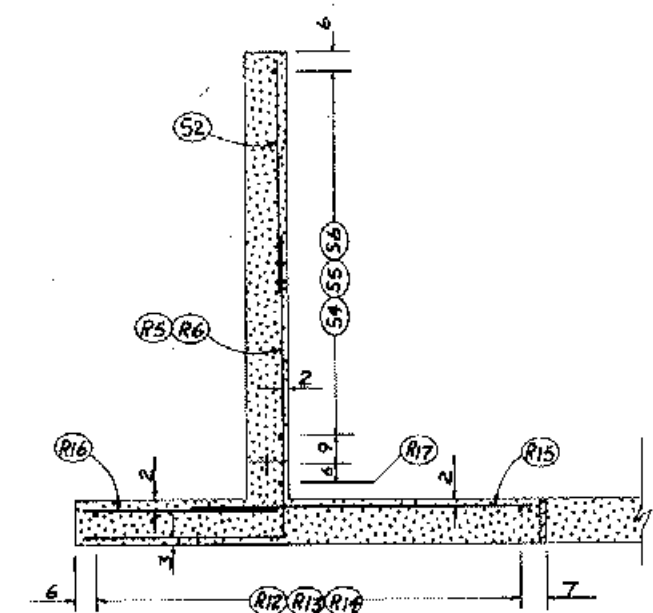
DESIGNED JON NESTOR DATE 3/89 Approved By _____
 Title _____
 DRAWN G. F. WALISER 3/89 _____
 Title _____
 CHECKED _____
 Title _____
 Project No. 08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN INSIDE FACE
SECTION 1 - 1



STEEL IN TOP OF FLOOR AND INSIDE FACE OF WALL
SECTION 2 - 2



AS BUILT PLANS
NO CHANGE
Comp. Date: 1-23-71

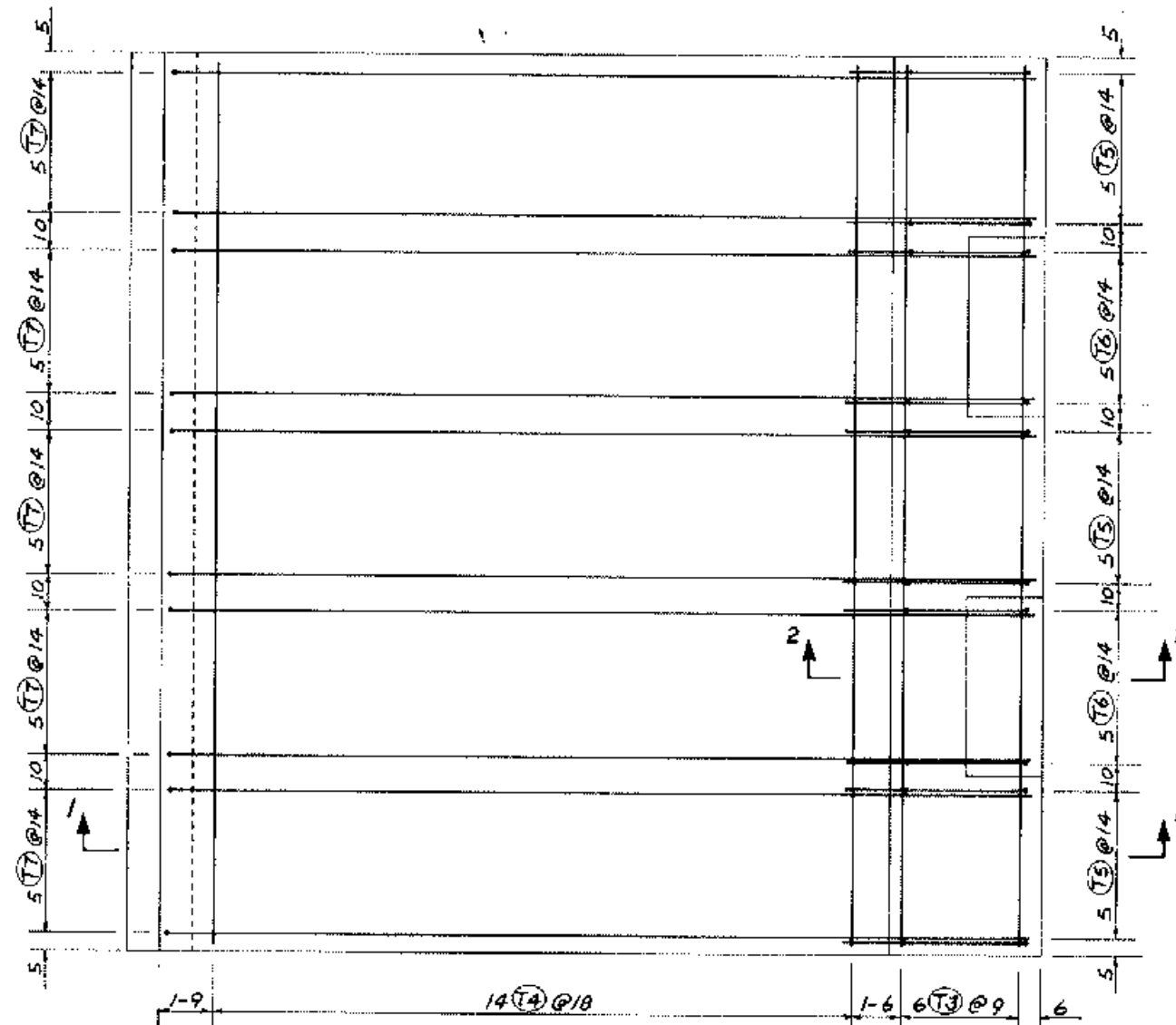
WALL SEGMENT
CHUTE SPILLWAY - JWG TO JWA

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

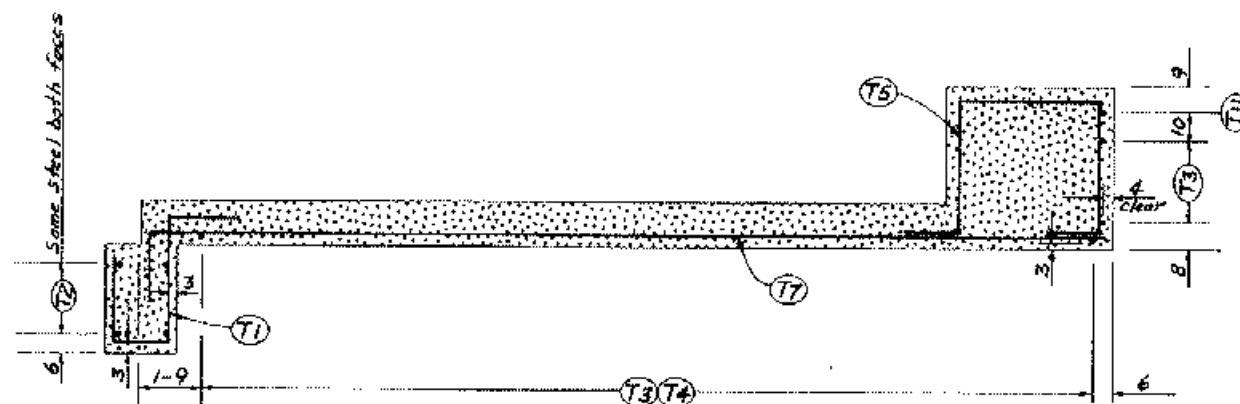
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

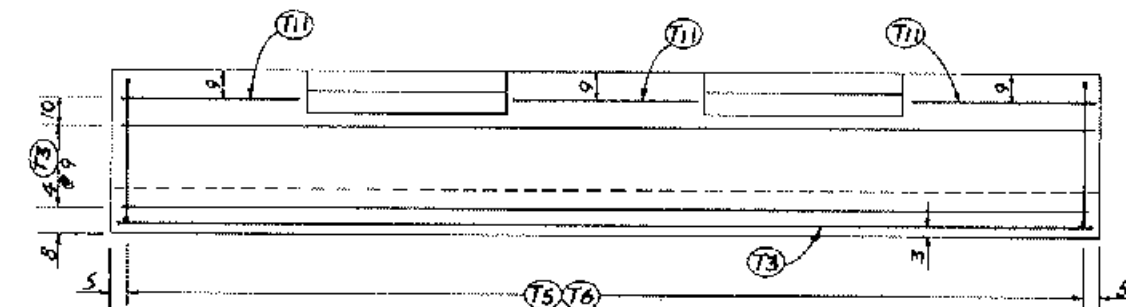
Designed	JUN NESTORS	DATE	3/89	Approved By	
Drawn	G.F. VALISER	DATE	3/89	Checked	
Traced		DATE		Project	
Checked	DENNIS REEP	DATE	4/88	Drawing No.	08-89-031



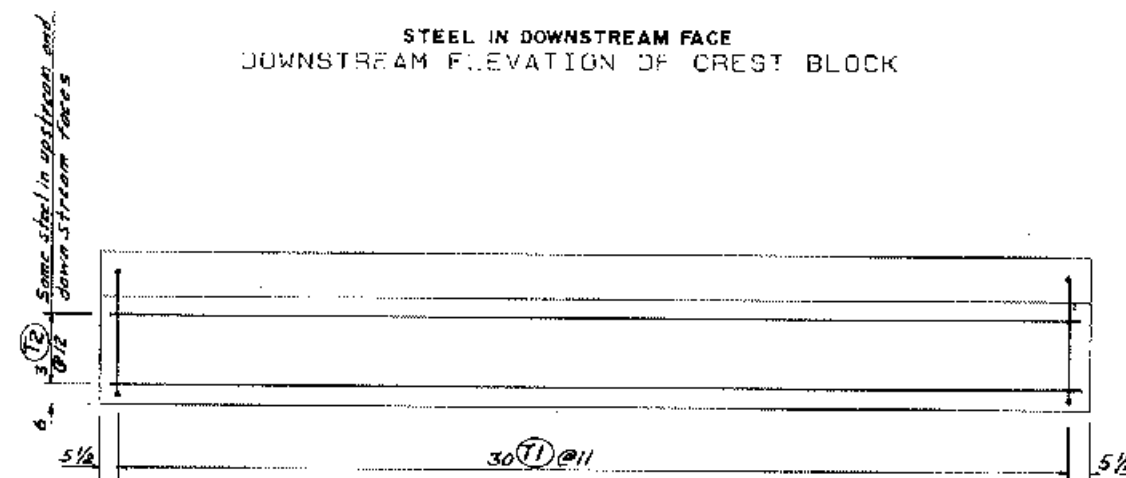
STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN BOTTOM FACE
SECTION 1 - 1



STEEL IN DOWNSTREAM FACE
DOWNSTREAM ELEVATION OF CREST BLOCK



UPSTREAM ELEVATION OF CUTOFF WALL

Notes:

1. Crest block layout shown is for the segment on the structure centerline. For dimensions and layout of this and adjacent interior segments, see sheet 39.
2. For typical pavement slab layout, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.

PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - J#4 TO J#5

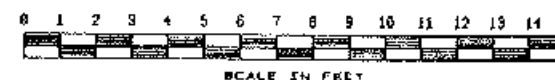
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

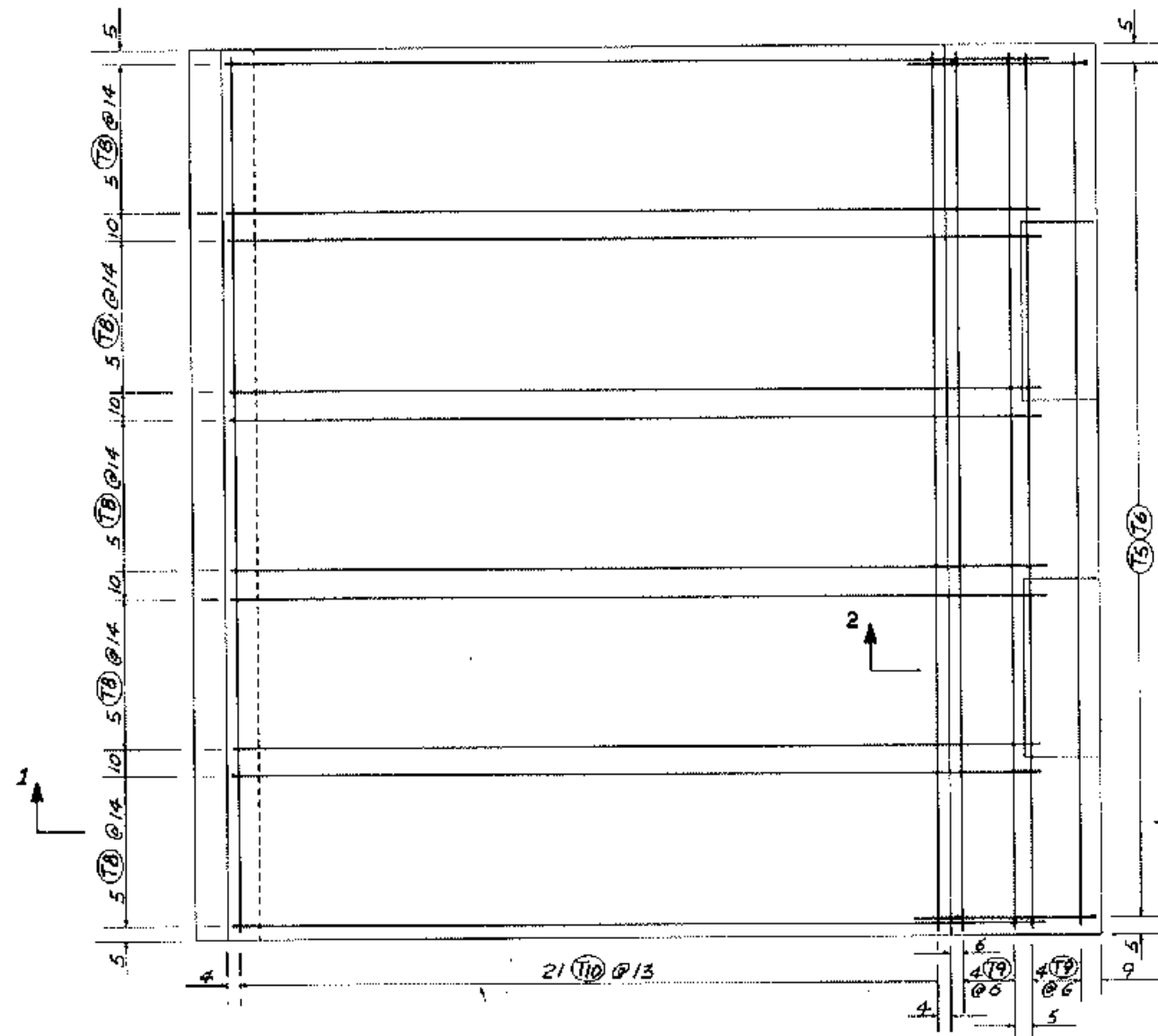
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

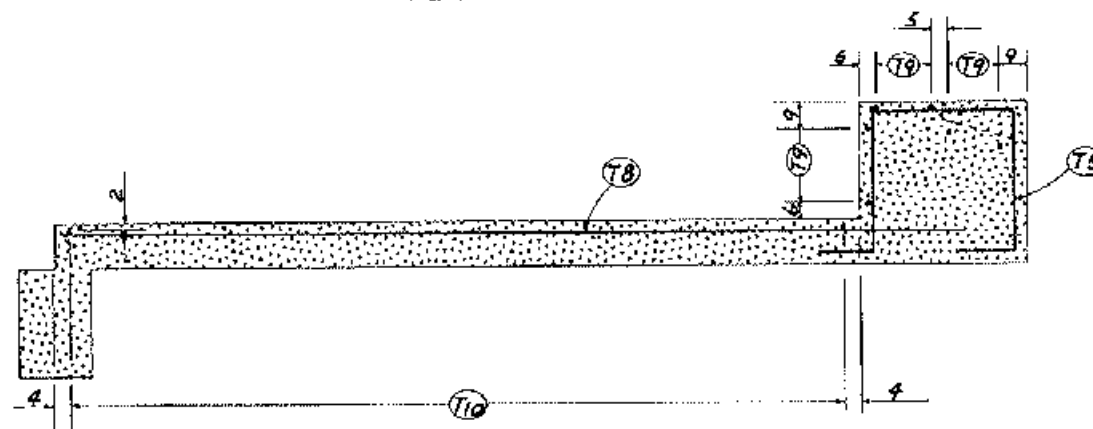
Designed	JDM HESTOSS	Date	4/89
Drawn	GEORGE WALISER	Date	4/89
Traced		Date	
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Project No.	08-89-031		

SECTION 2 - 2
AS BUILT PLANS
NO CHANGE
Comp. Date 1-28-91

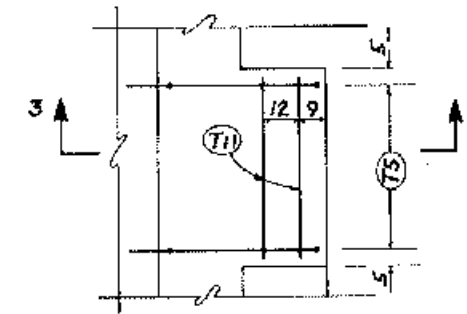




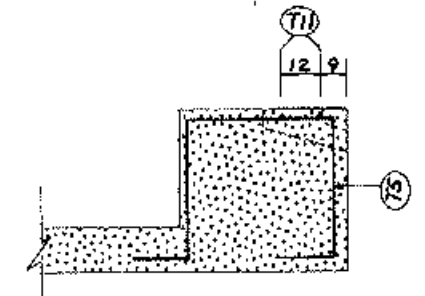
STEEL IN TOP FACE
PLAN VIEW



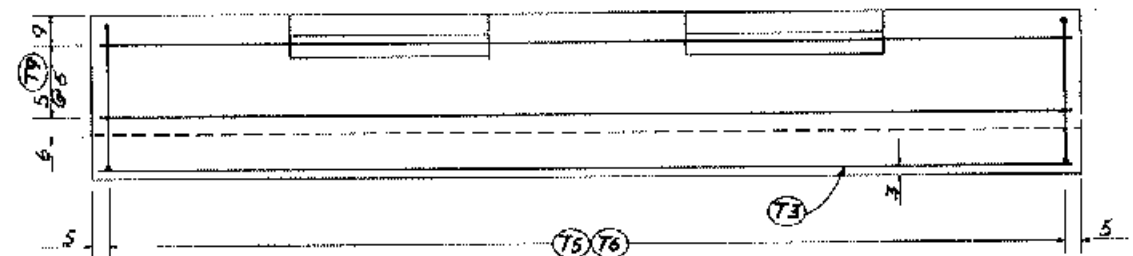
STEEL IN TOP FACE
SECTION 1 - 1



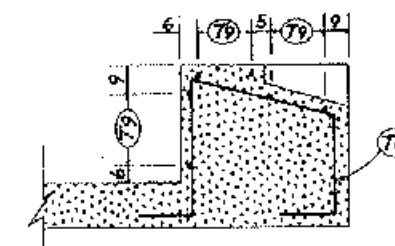
PARTIAL PLAN VIEW SHOWING
ADDITIONAL STEEL IN TOP FACE
OF CREST BLOCK



ADDITIONAL STEEL IN TOP FACE
OF CREST BLOCK
SECTION 3 - 3



STEEL IN UPSTREAM FACE
DOWNSTREAM ELEVATION OF CREST BLOCK



SECTION 2 - 2

AS BUILT PLANS
NO CHANGE
Revised Date 1-21-97

PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - J#4 TO J#5

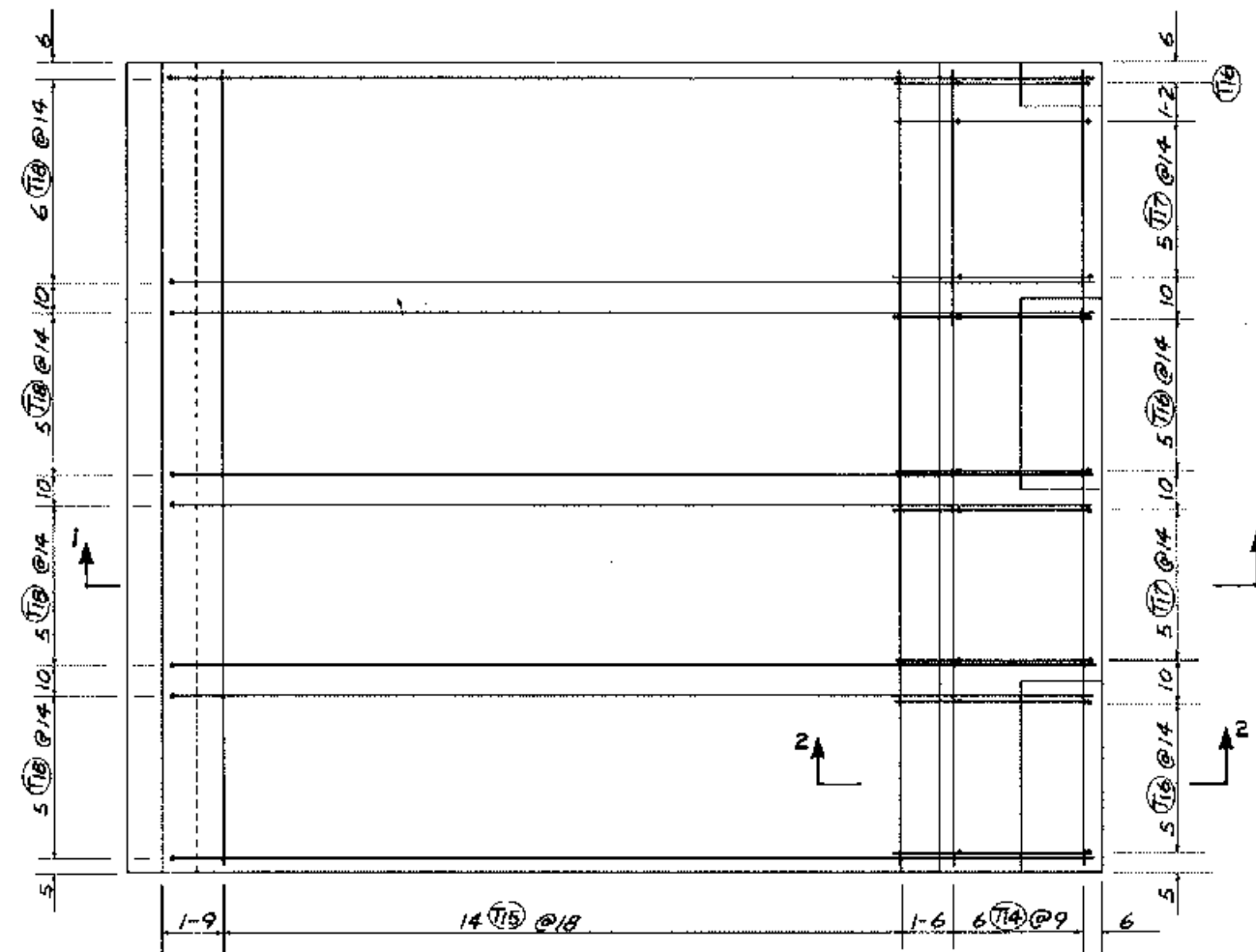
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

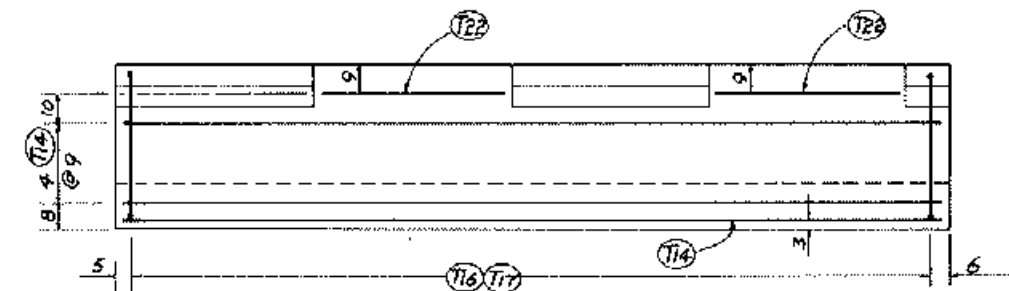
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JUN NESTROSS	DATE	4/89	Approved By	
Drawn	GEORGE WALISER	DATE	4/89	Title	
Traced		DATE		Sheet	
Checked	DENNIS REEP	DATE	6/89	Drawing No.	08-89-031

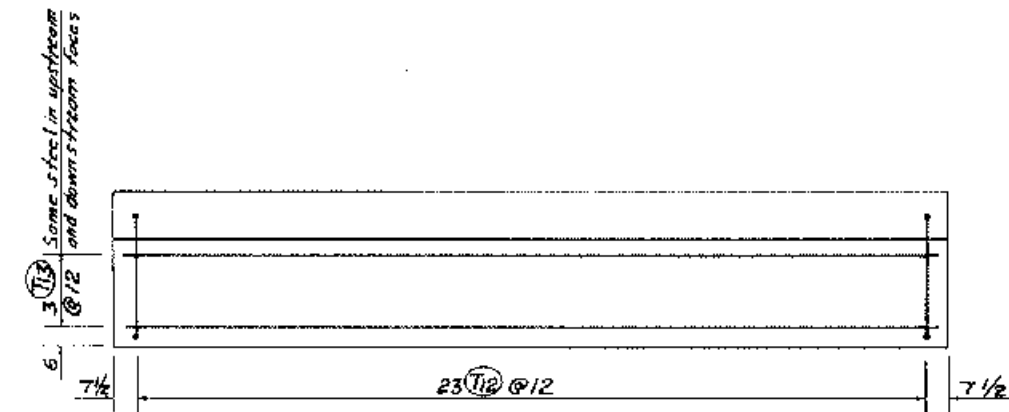




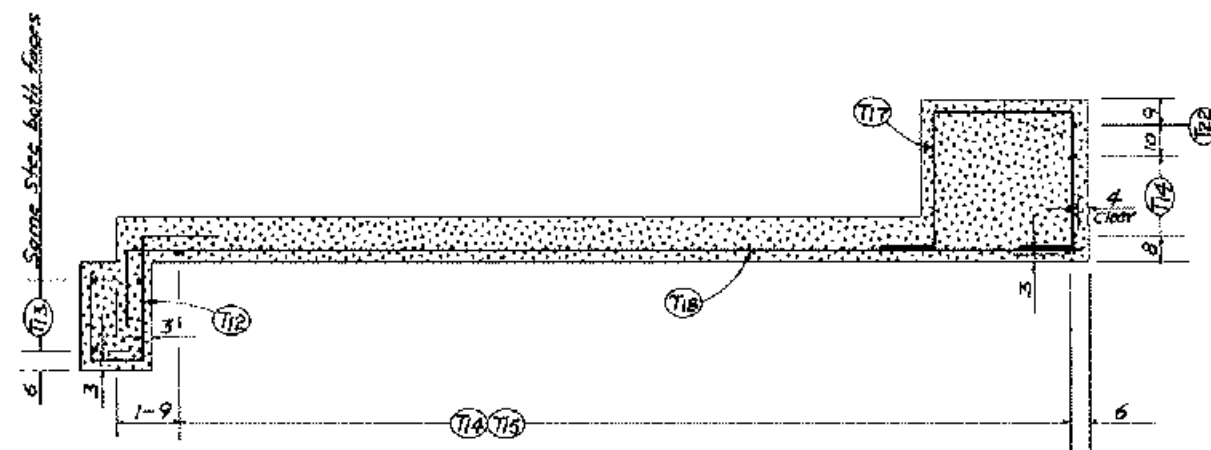
STEEL IN BOTTOM FACE
PLAN VIEW



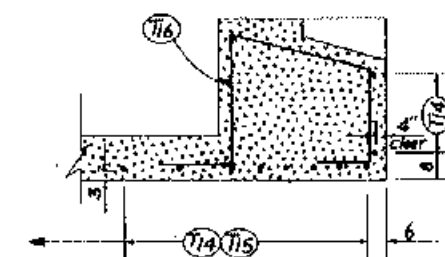
STEEL IN DOWNSTREAM FACE
DOWNSTREAM ELEVATION OF CREST BLOCK



UPSTREAM ELEVATION OF CUTOFF WALL



STEEL IN BOTTOM FACE
SECTION 1 - 1



SECTION 2 - 2

Notes:

1. For details of crest block layout, see sheet 39.
2. For typical pavement slab section, see sheet 41.
3. For details of transverse and longitudinal floor joints, see sheet 40.

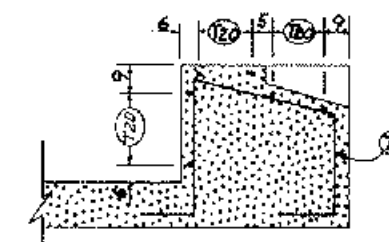
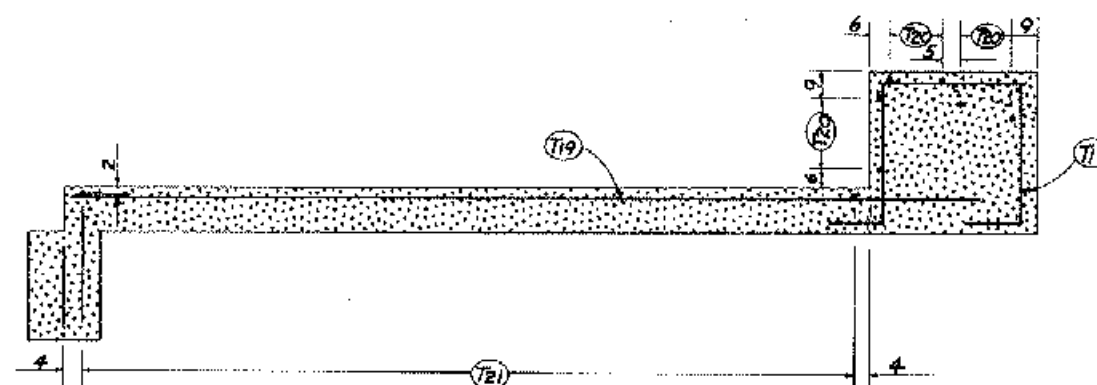
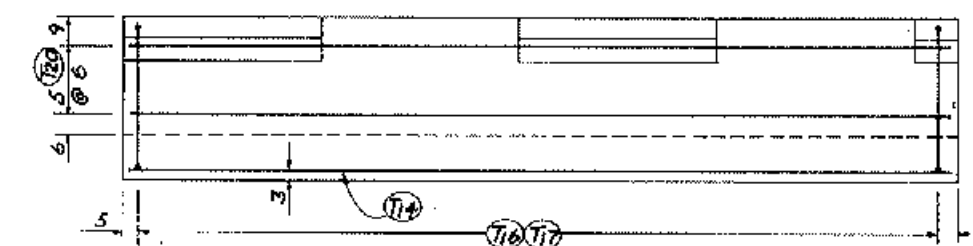
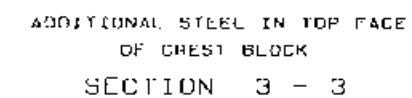
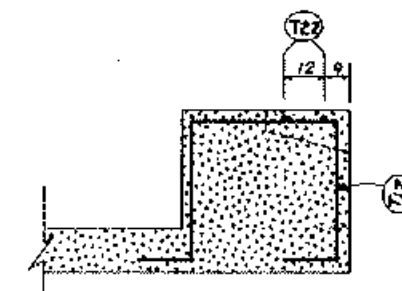
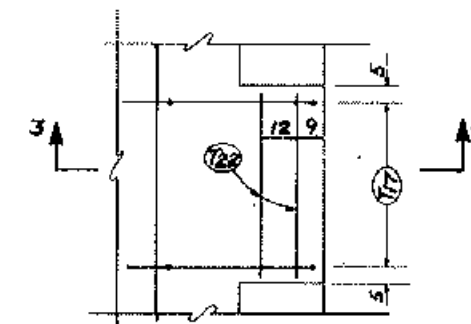
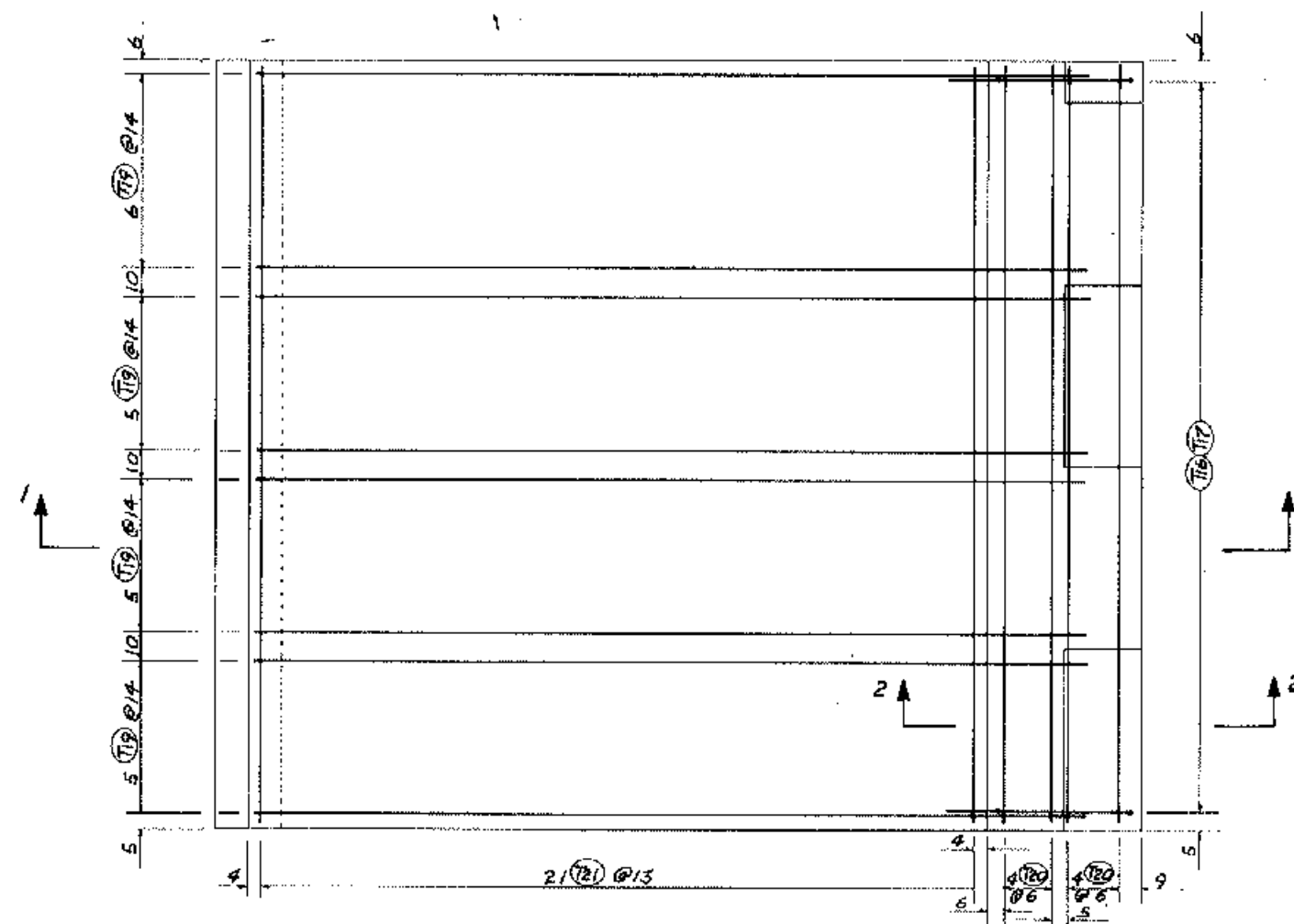
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - J#4 TO J#5

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JON NESTOSS	DATE	1/89	Approved By	
Drawn	GEORGE WALISER	DATE	4/89	Title	
Traced		DATE		Sheet	
Checked	DENNIS REEP	DATE	6/89	Drawing No.	08-89-031



AS BUILT PLANS
NO CHANGE
Comp. Date 1-28-91

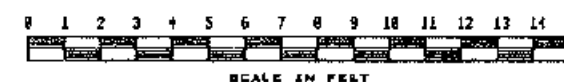
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - J#4 TO J#5

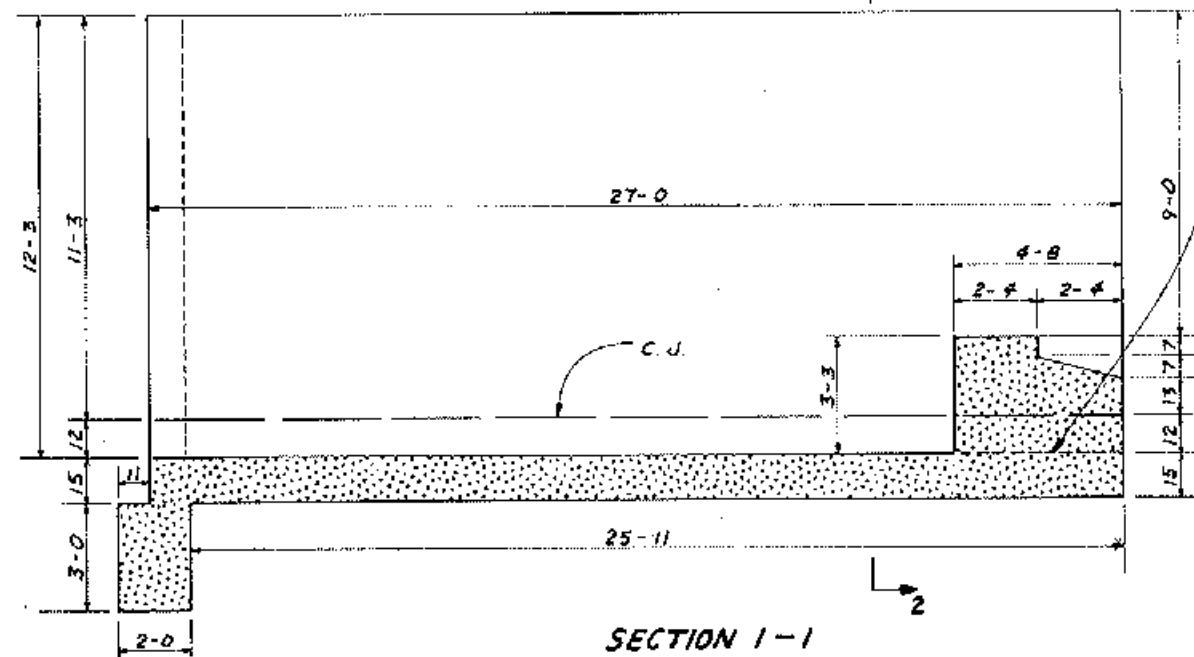
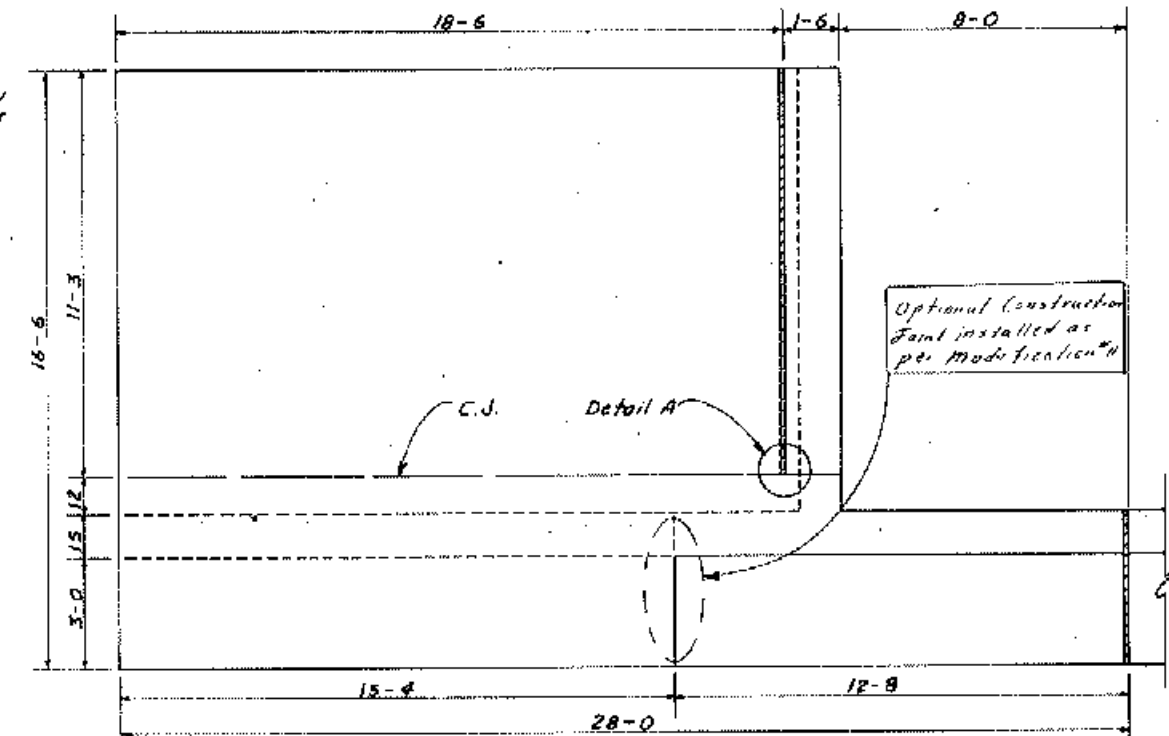
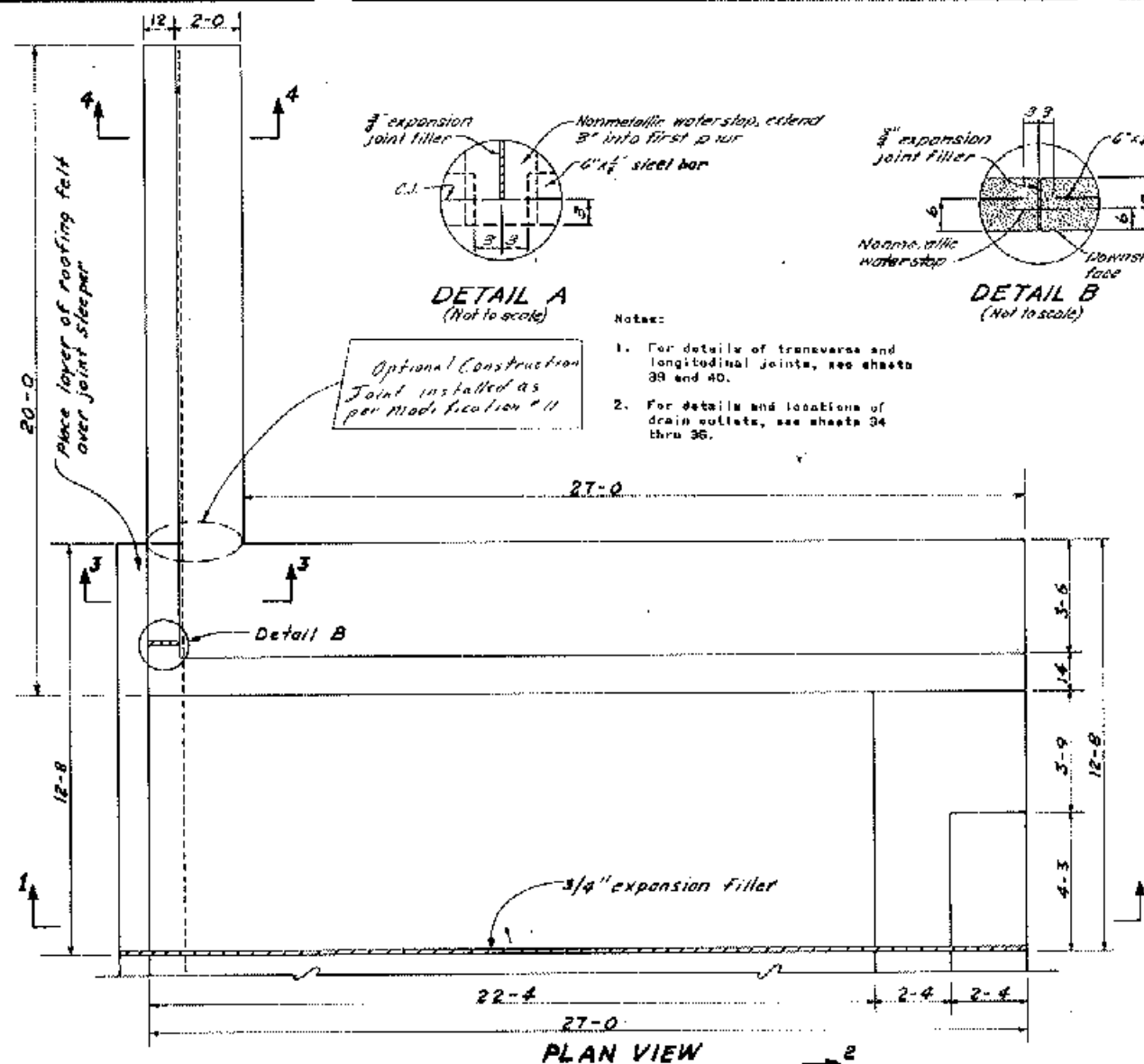
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

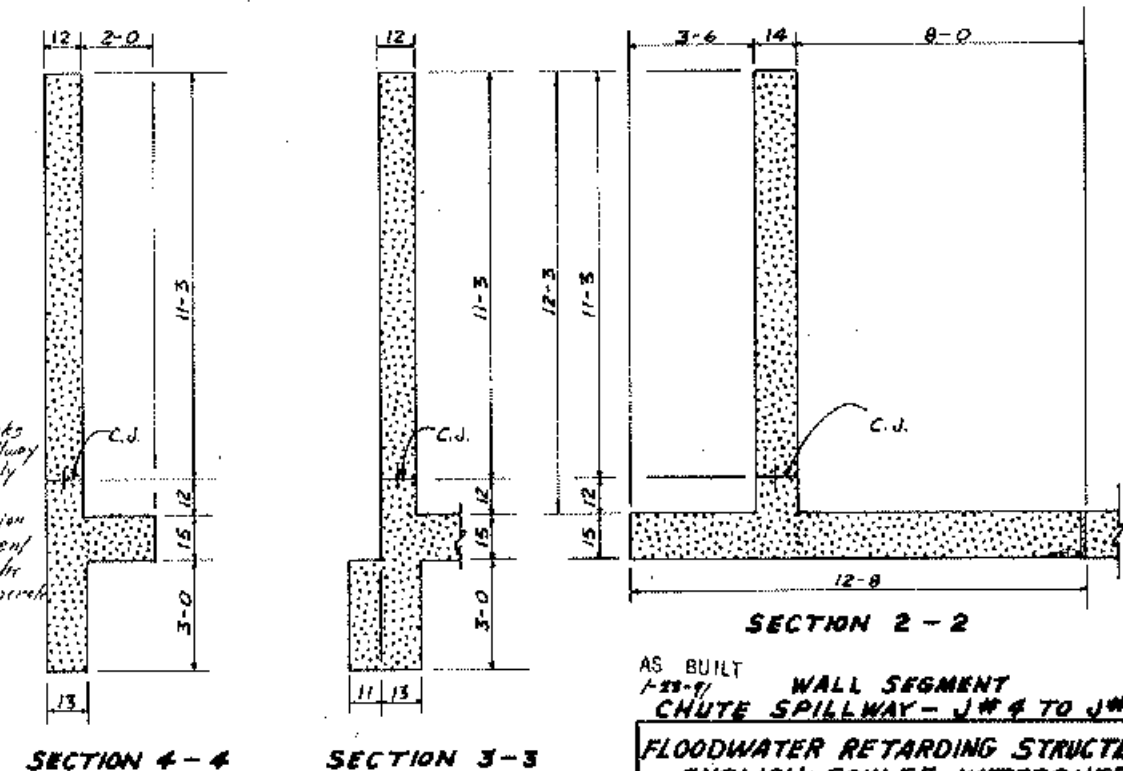
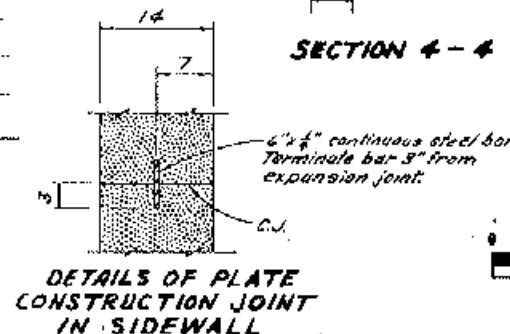
 U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JOH. NESTOSS	DATE	4/89	Approved By	TR 43M
Drawn	GEORGE WALISER		4/89		
Traced				Scale	
Checked	DENNIS REEP		4/89	Sheet	Drawing No.
					08-89-031





The Crest Blocks for the Chute Spillway were poured separately from the floor slabs during the construction phase. A bonding agent was then applied to the joint prior to the concrete pour.



AS BUILT
1-23-91

**WALL SEGMENT
CHUTE SPILLWAY - J#4 TO J#5**

**FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

GRAND FORKS COUNTY, NORTH DAKOTA

**U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

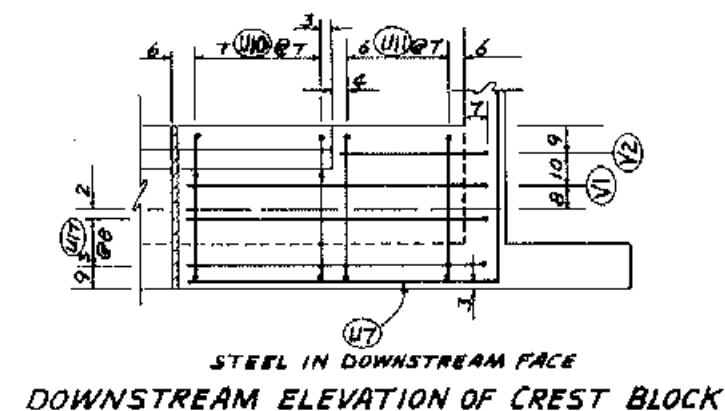
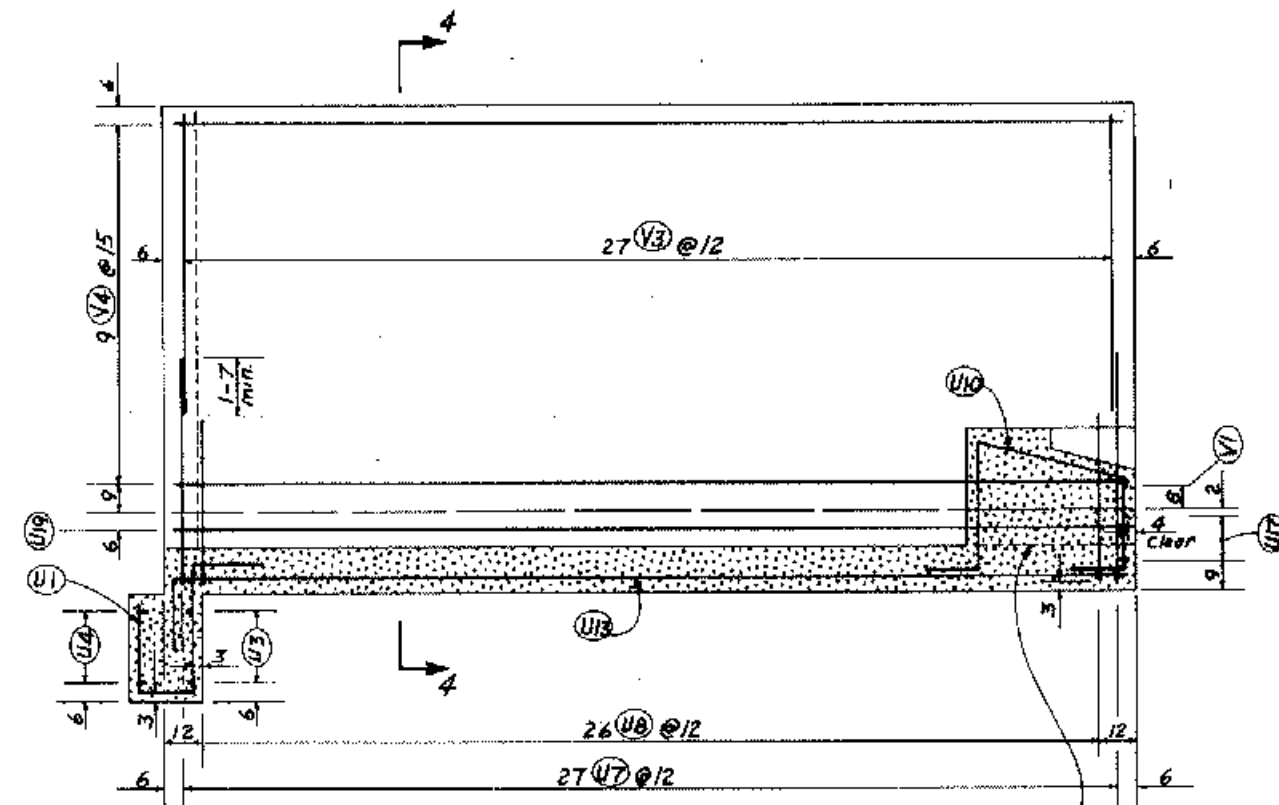
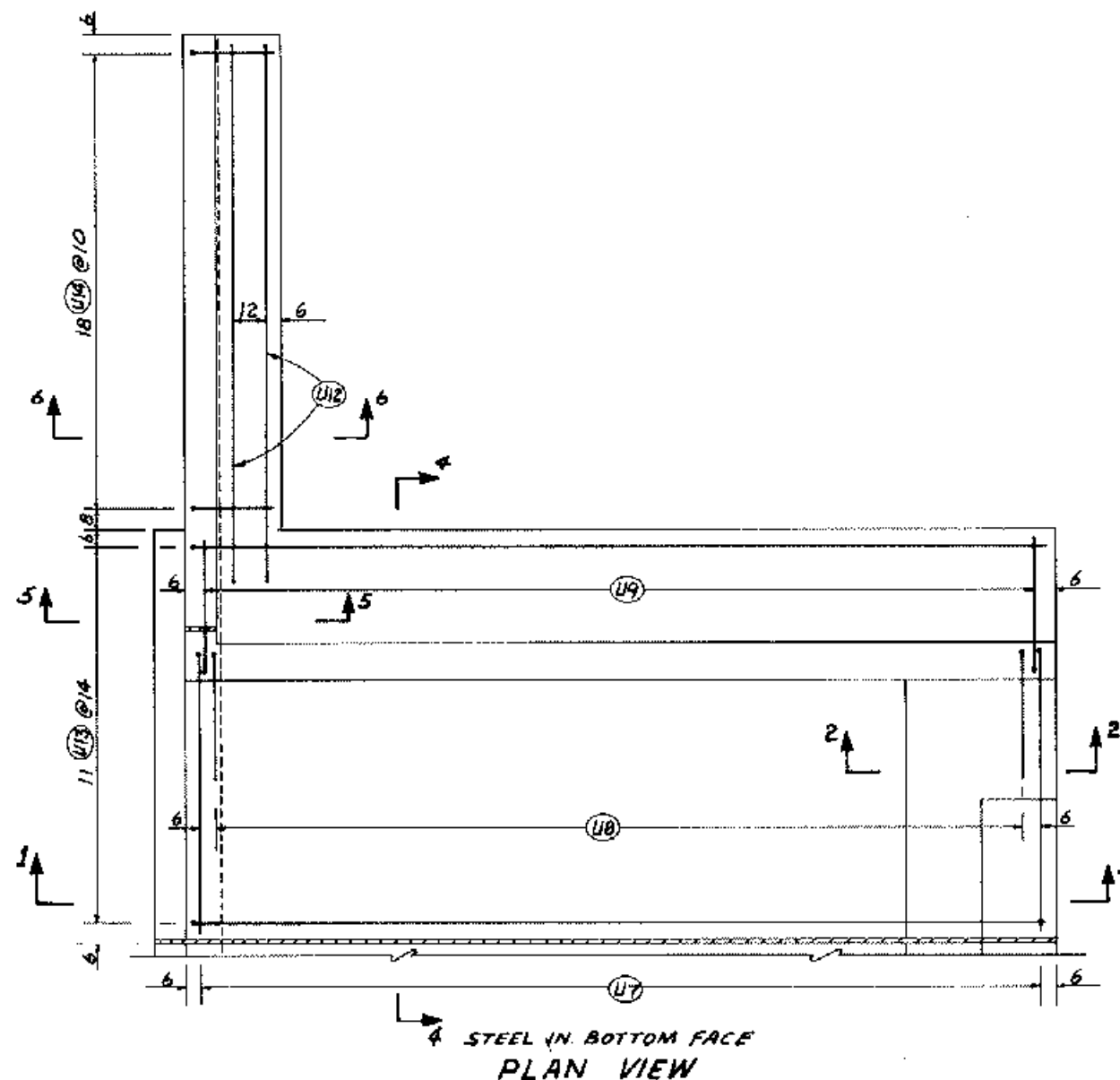
Designed: **WAT. NEB. 5599** Date: **5/89** Approved by: **5/89**

Drawn: **GEORGE A. WILKINSON** Title: **5/89**

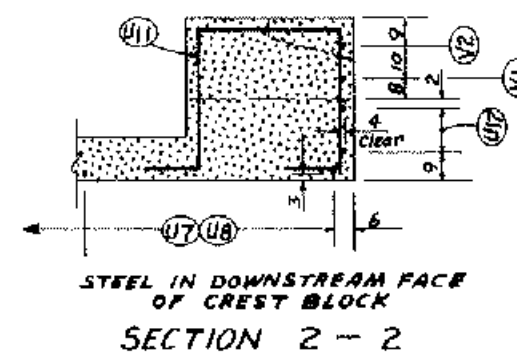
Traced: **5/89** Title: **5/89**

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08-89-031

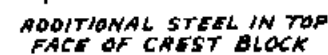
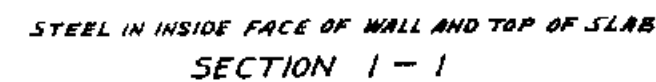
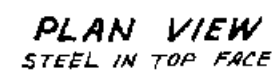


The Crest Blocks for the Chute Spillway were poured separately from the floor slabs during the construction phase. A bonding agent was then applied to the joint prior to the concrete pour.



AS BUILT
1-23-91
WALL SEGMENT
CHUTE SPILLWAY - J#4 TO J#5
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed: JON NESTASS 4/89	Approved by:
Drawn: George Maliser 5/89	Title:
Typed:	Checked:
Checked: DEAN R. REED 4/89	08-89-031

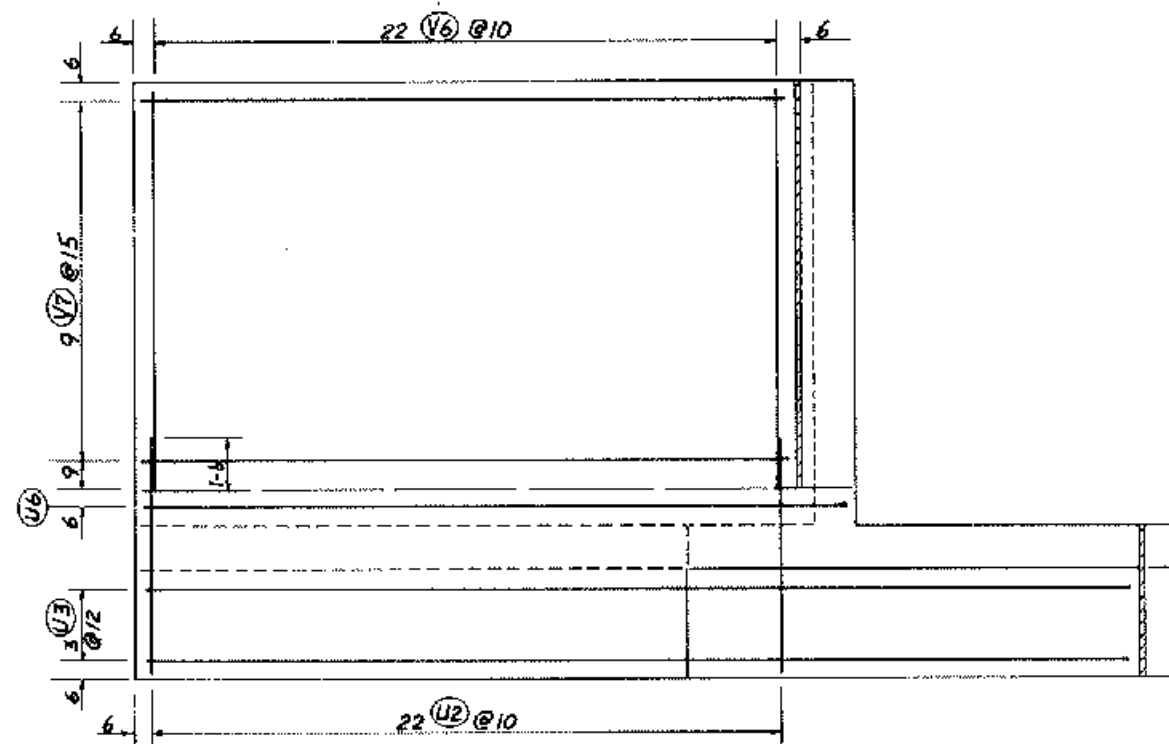


AS BUILT PLANS
NO CHANGE
Comp Date 1-28-91

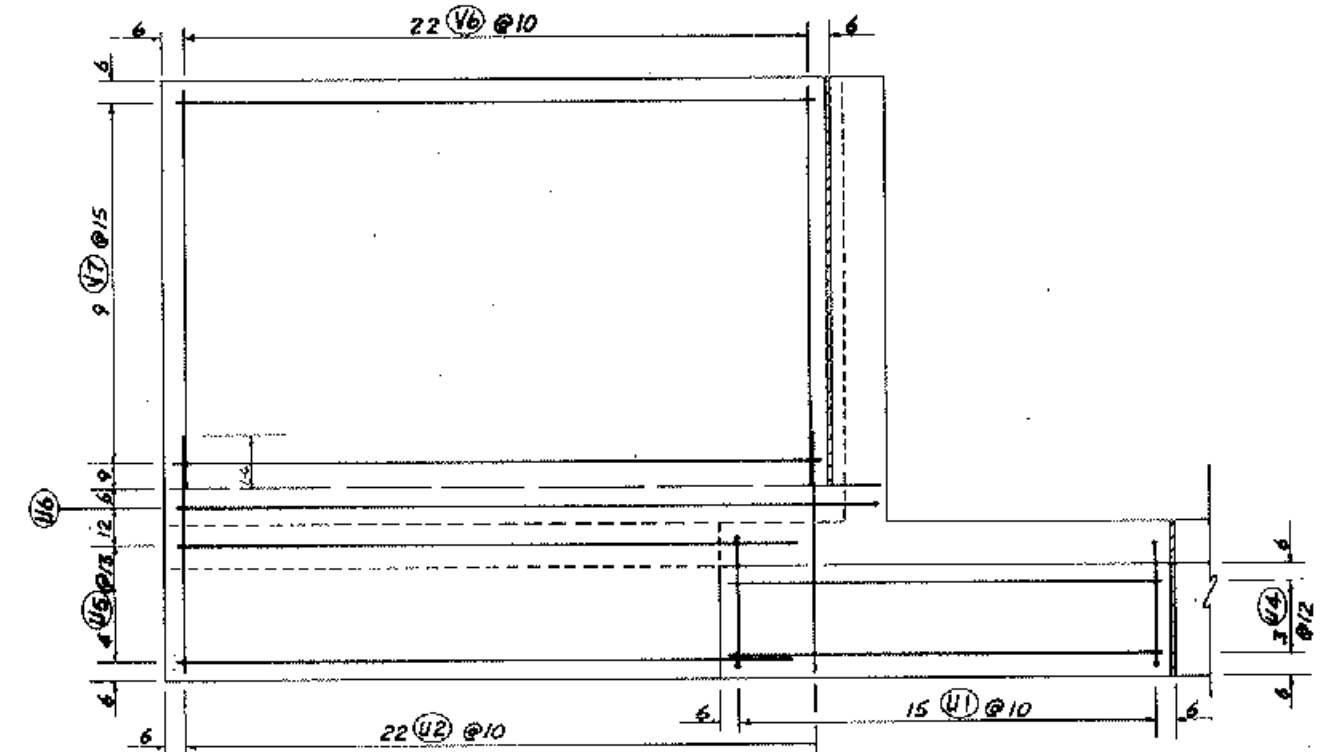
WALL SEGMENT
CHUTE SPILLWAY - J#4 TO J#5
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

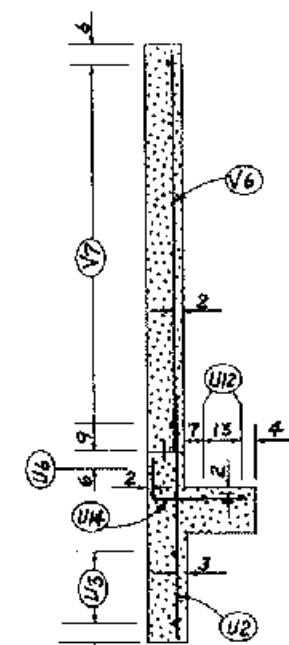
Date		Approved by	
Designed <i>Jan Nestor</i>		Title	
Drawn <i>Georgs. Waliser</i>		Title	
Traces		Revised	Drawing No.
Checked <i>Dennis Fox</i>		Date <i>Jan 78</i> of <i>24</i>	<i>08-84-031</i>



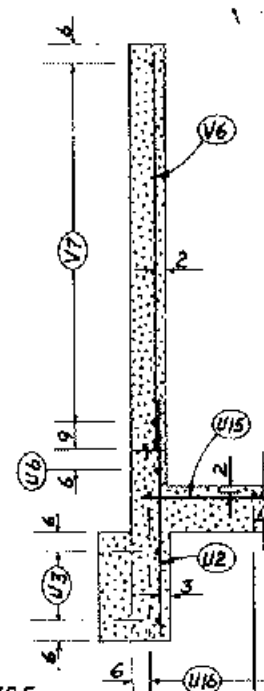
STEEL IN DOWNSTREAM FACE
UPSTREAM ELEVATION OF ANTISEEP COLLAR



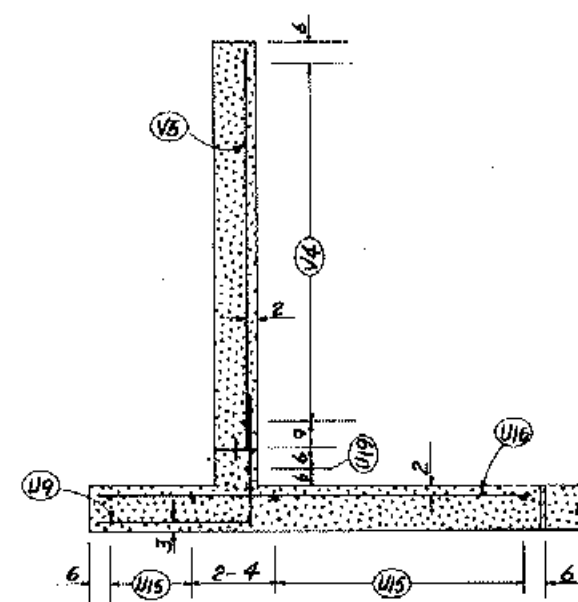
STEEL IN UPSTREAM FACE
UPSTREAM ELEVATION OF ANTISEEP COLLAR



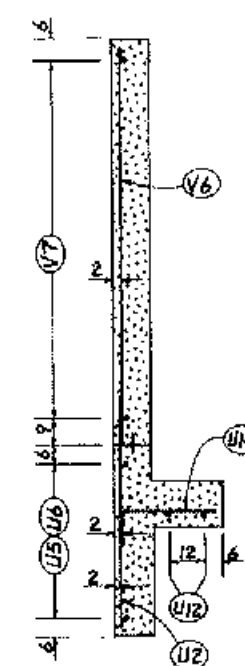
STEEL IN DOWNSTREAM FACE
SECTION 6 - 6



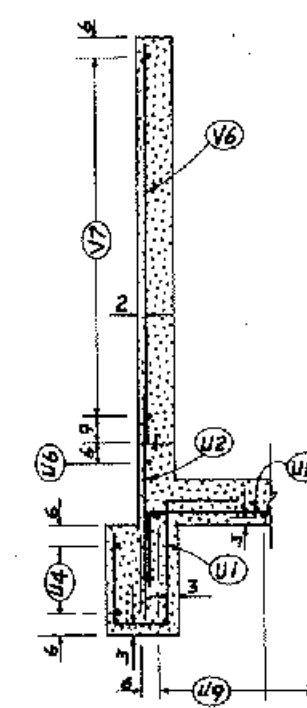
STEEL IN DOWNSTREAM FACE
SECTION 5 - 5



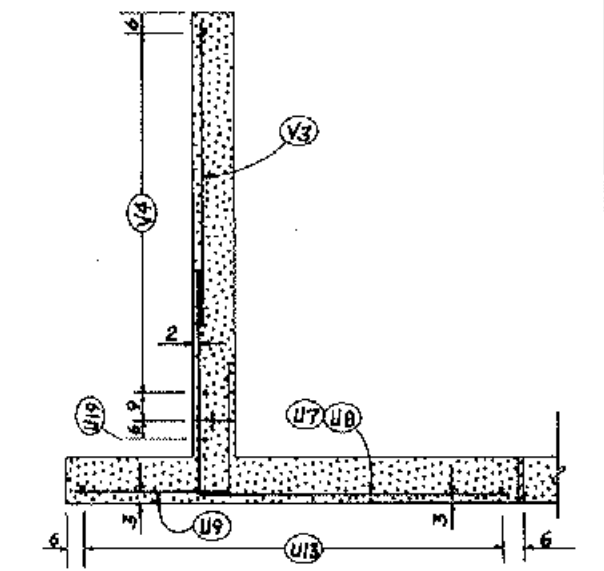
STEEL IN INSIDE FACE OF WALL AND TOP OF SLAB
SECTION 4 - 4



STEEL IN UPSTREAM FACE
SECTION 6 - 6



STEEL IN UPSTREAM FACE
SECTION 5 - 5



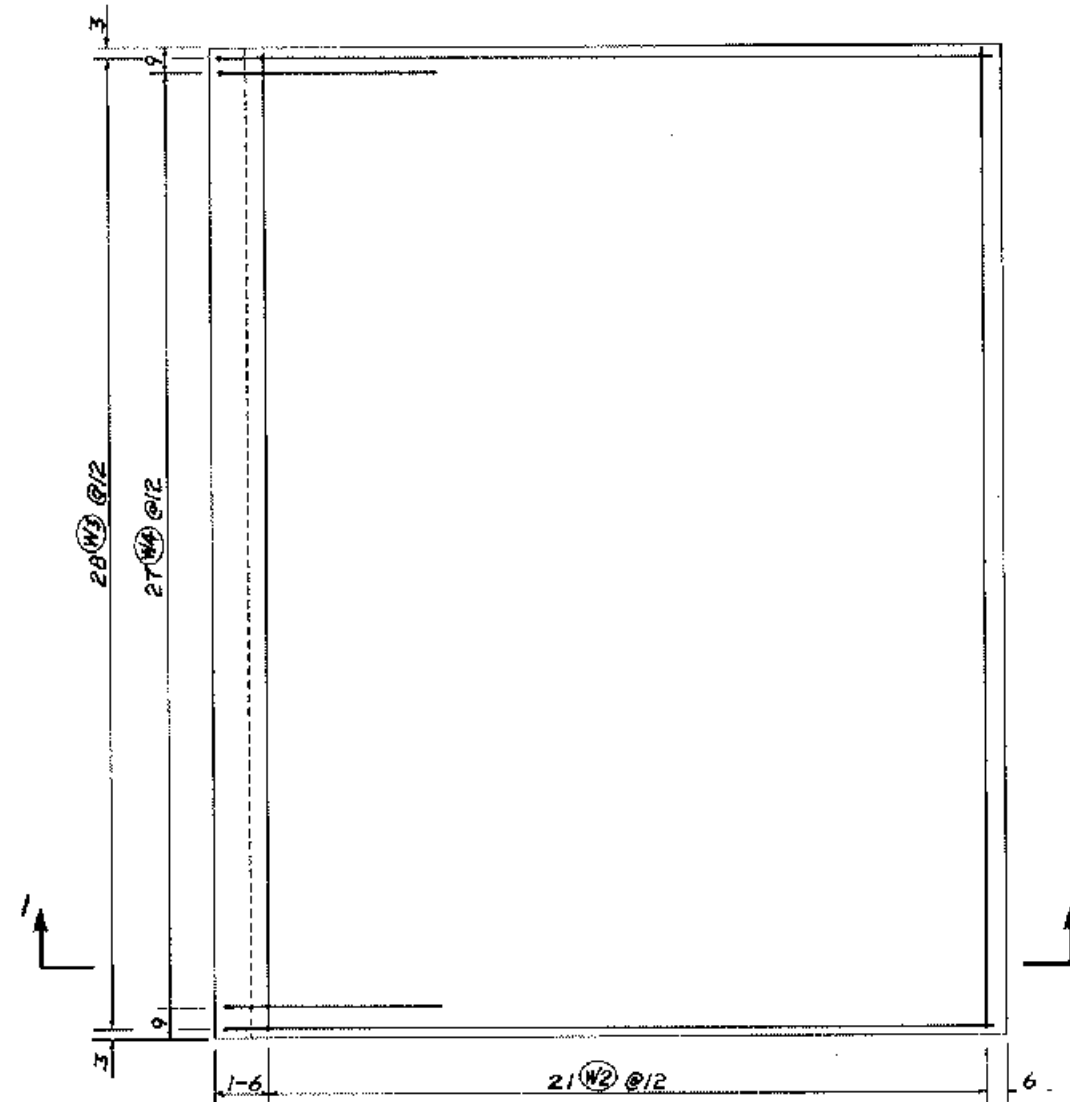
STEEL IN OUTSIDE FACE OF WALL AND BOTTOM OF SLAB
SECTION 4 - 4



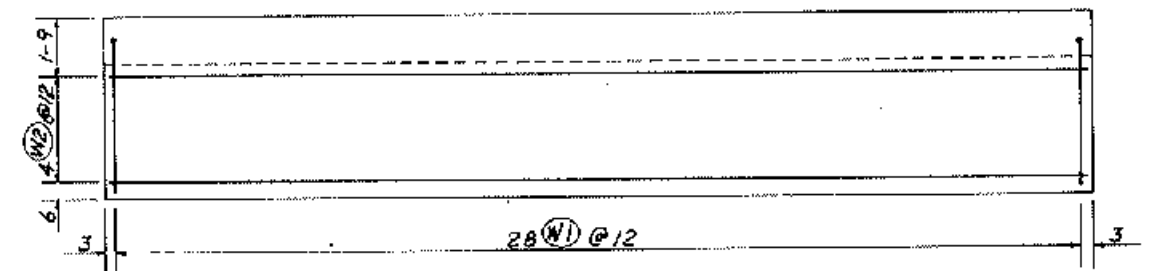
AS BUILT PLANS
NO CHANGE
Date 1-28-97

WALL SEGMENT
CHUTE SPILLWAY - J#4 TO J#5
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

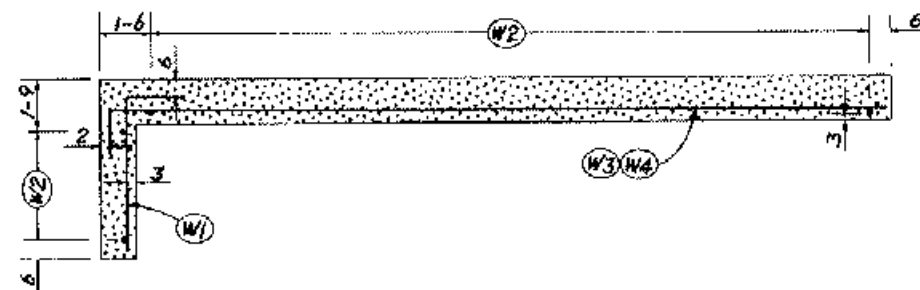
Designed by SHORT, NESTOR & ASSOCIATES	Approved by [Signature]
Drawn by GEORGE W. HALL	Checked by [Signature]
Traced by [Signature]	Shaded by [Signature]
Checked by DAVID R. R. R.	Shaded by [Signature]



STEEL IN BOTTOM FACE
PLAN VIEW



STEEL IN DOWNSTREAM FACE
UPSTREAM ELEVATION OF CUTOFF WALL



STEEL IN BOTTOM FACE OF FLOOR AND
DOWNSTREAM FACE OF CUTOFF WALL
SECTION J - 1



AS BUILT PLANS
NO CHANGE
COMP. DATE 1-23-91

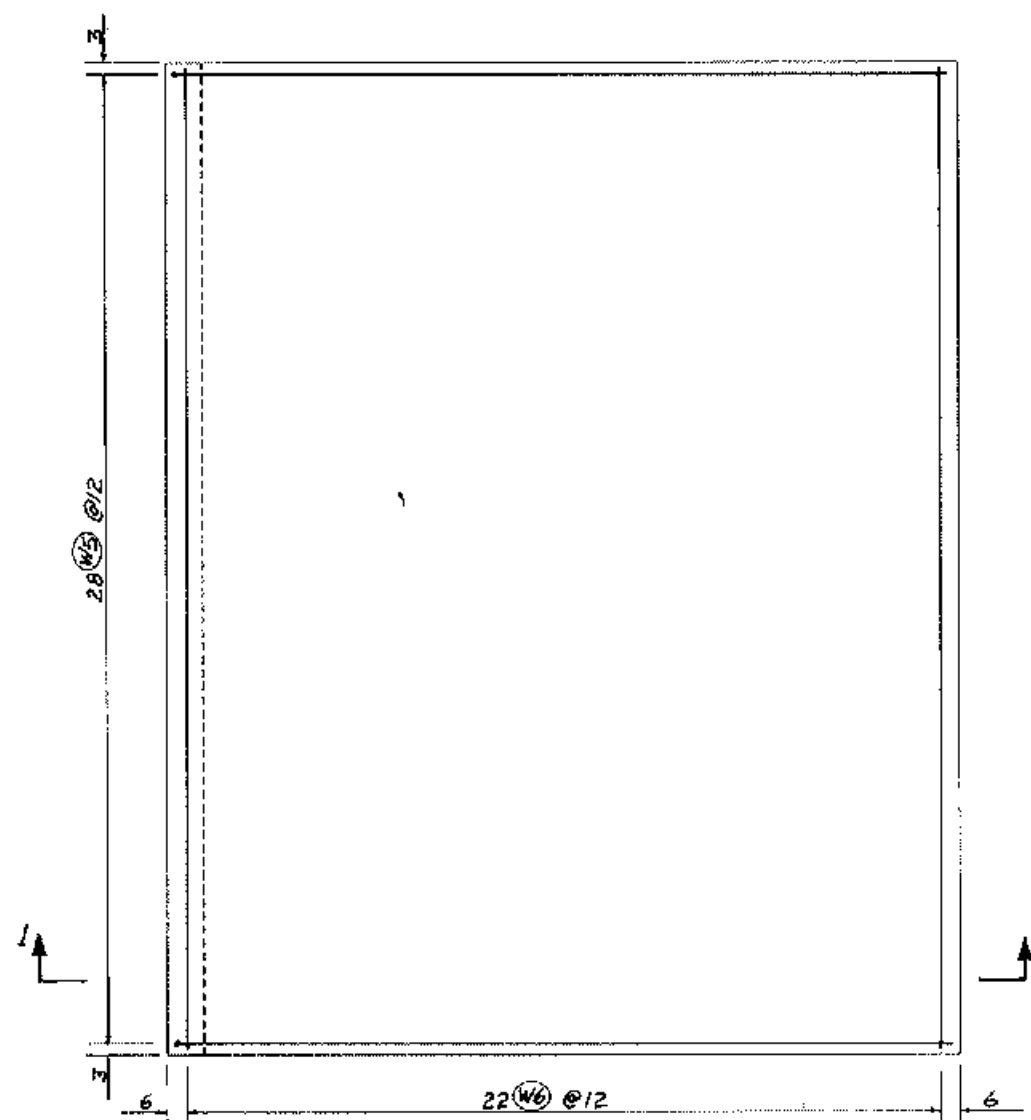
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - JWS TO INLET

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

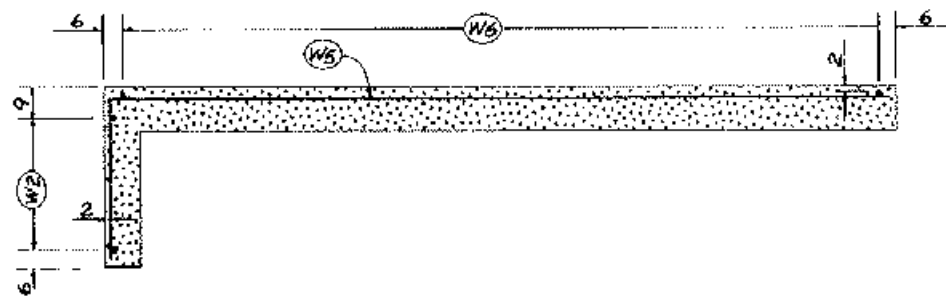
GRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

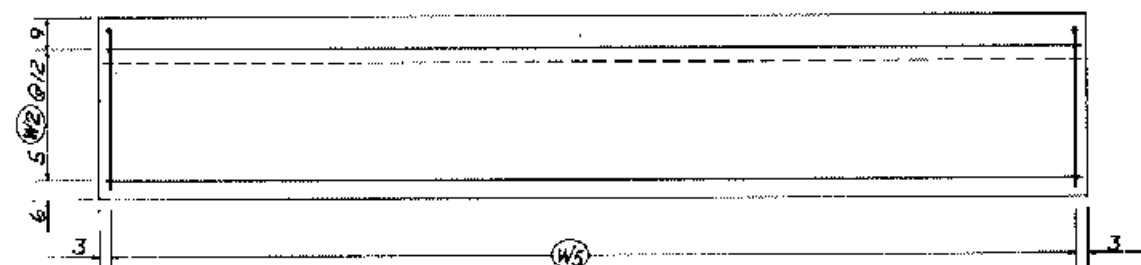
Designed	JON NESTOSS	Date	4/89	Approved By	
Drawn	GEORGE WALISER	Date	4/89	Title	
Traced		Date		Checked	
Checked	DENNIS REED	Date	4/89	Sheet	08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN TOP FACE OF FLOOR AND
UPSTREAM FACE OF CUTOFF WALL
SECTION 1 - 1



STEEL IN UPSTREAM FACE
UPSTREAM ELEVATION OF CUTOFF WALL

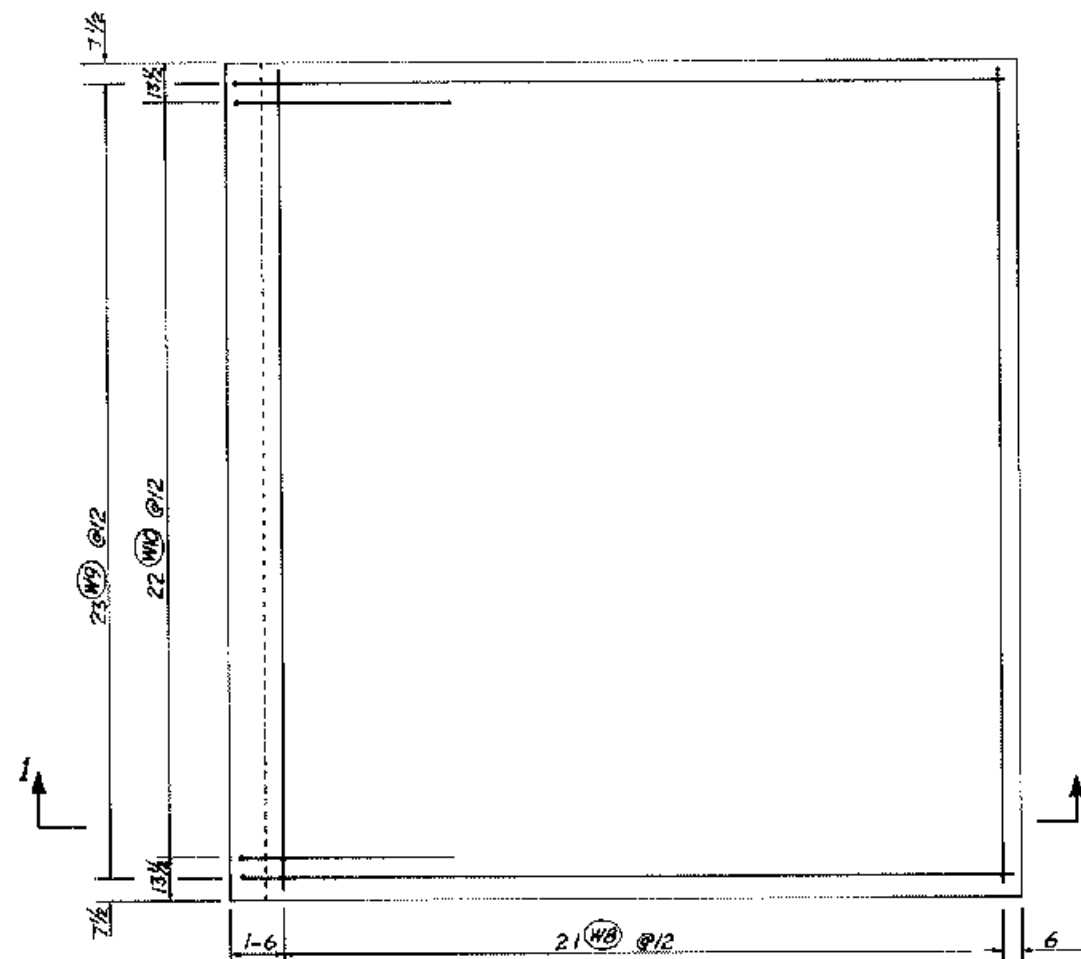


AS BUILT PLANS
NO CHANGE
Comp. Date 1-28-91

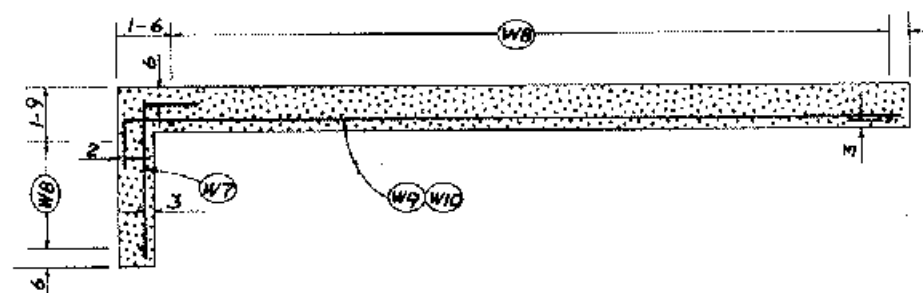
PAVEMENT SLAB - INTERIOR SEGMENT
CHUTE SPILLWAY - JWS TO INLET

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED
GRAND FORKS COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

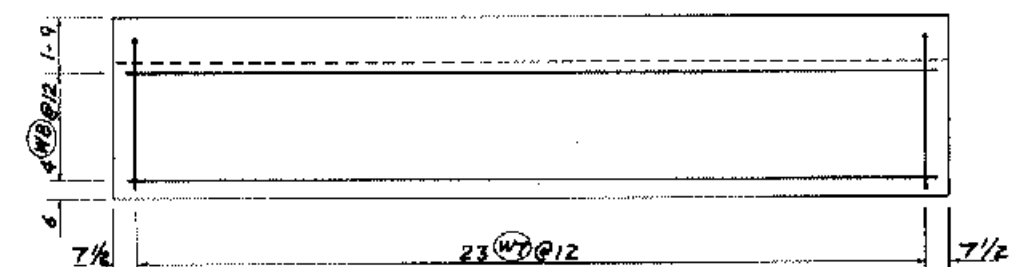
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Drawn	GEORGE WALTZER	1/89	Title	
Traced			Sheet	
Checked	DENNIS REEP	4/89	Sheet	08-89-031



STEEL IN BOTTOM FACE
PLAN VIEW



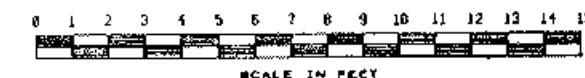
STEEL IN BOTTOM FACE OF FLOOR AND
DOWNSTREAM FACE OF CUTOFF WALL
SECTION 1-1



STEEL IN DOWNSTREAM FACE
UPSTREAM ELEVATION OF CUTOFF WALL

Notes:

1. For typical pavement slab section, see sheet 41.
2. For details of transverse and longitudinal floor joints, see sheet 40.



AS BUILT PLANS
NO CHANGE

Comp. Date 1-23-91

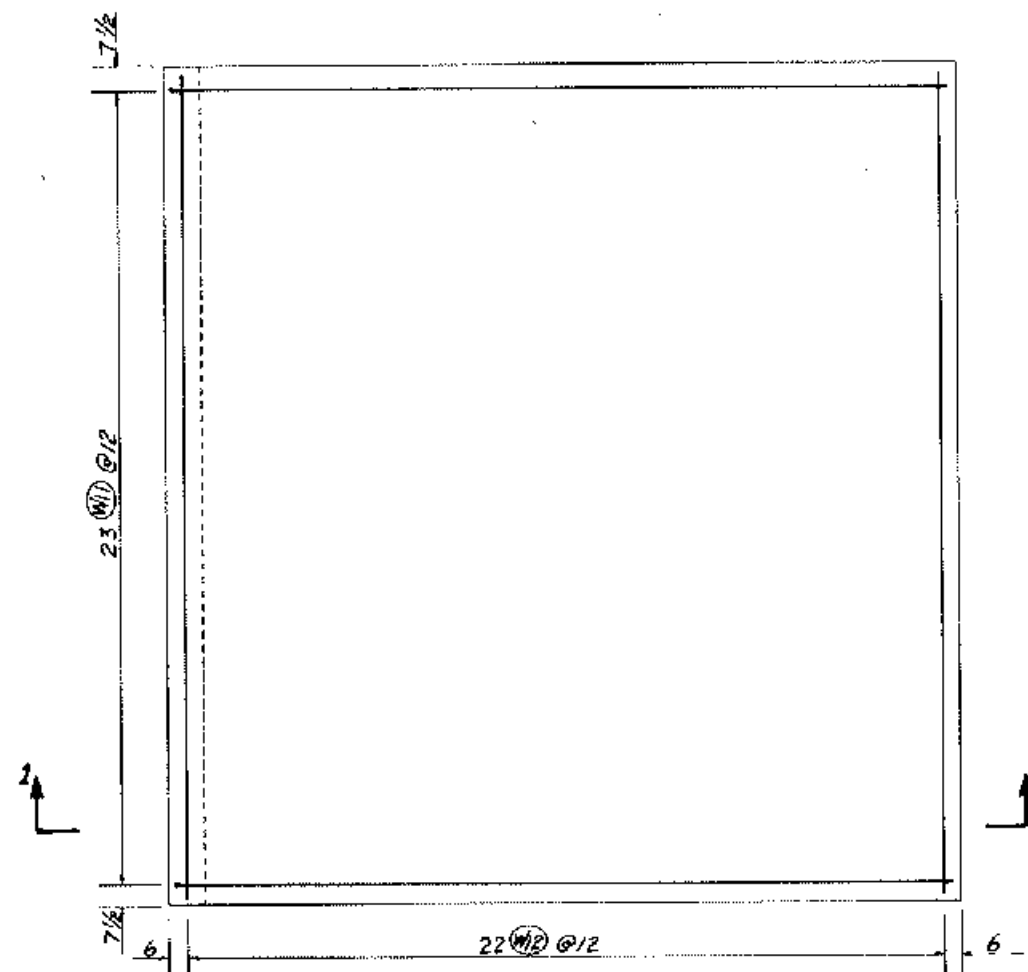
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - J#5 TO INLET

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

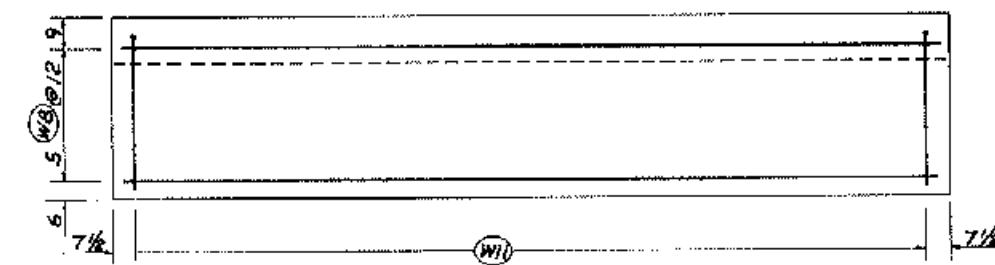
BRAND FORKS COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

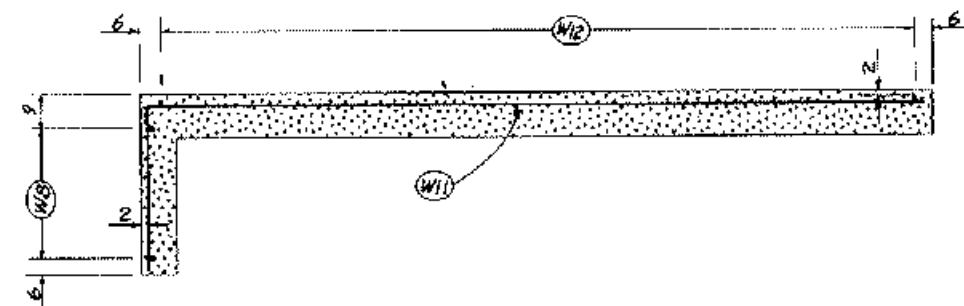
Designed JON NESTOSS	DATE 4/89	Approved By	
Drawn GEORGE WALLSER	4/89	Title	
Traced		Sheet	
Checked DENNIS REEP	6/89	Sheet No. 82 of 88	Drawing No. 08-89-031



STEEL IN TOP FACE
PLAN VIEW



STEEL IN UPSTREAM FACE
UPSTREAM ELEVATION OF CUTOFF WALL



STEEL IN TOP FACE OF FLOOR AND
UPSTREAM FACE OF CUTOFF WALL
SECTION 1 - 1



AS BUILT PLANS
NO CHANGE
Comp. Date 1-25-91

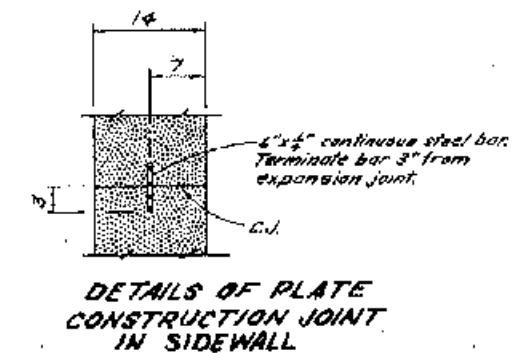
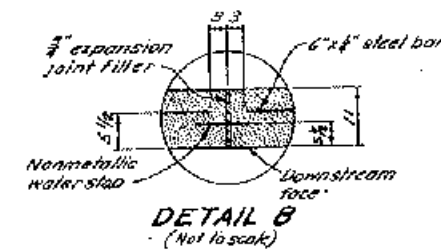
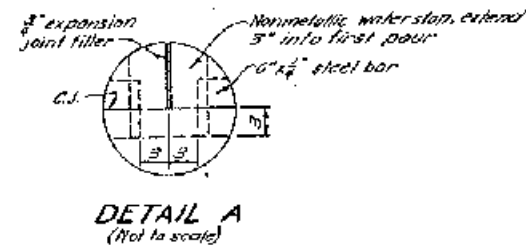
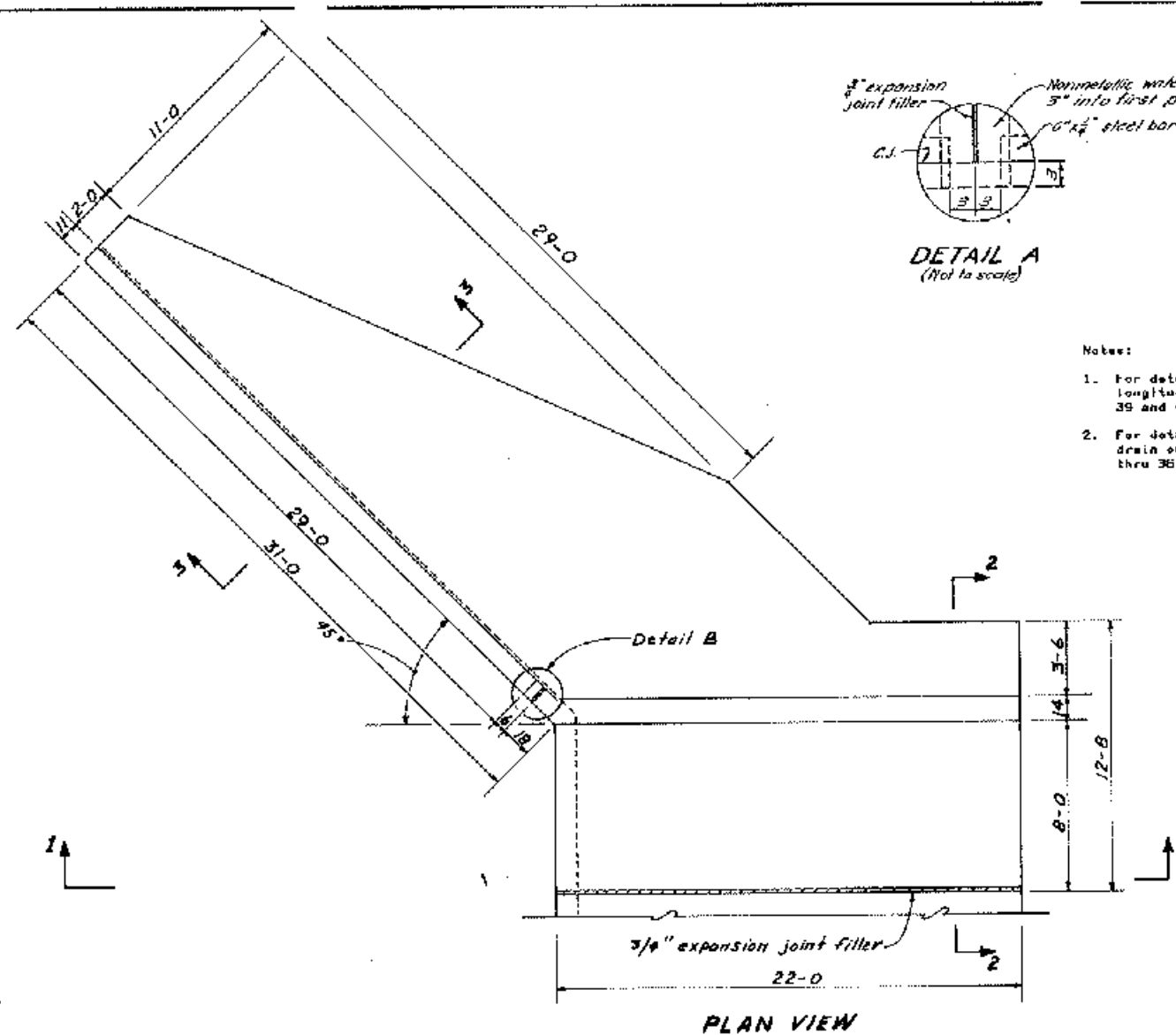
PAVEMENT SLAB - EXTERIOR SEGMENT
CHUTE SPILLWAY - JWS TO INLET

FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED

GRAND FORKS COUNTY NORTH DAKOTA

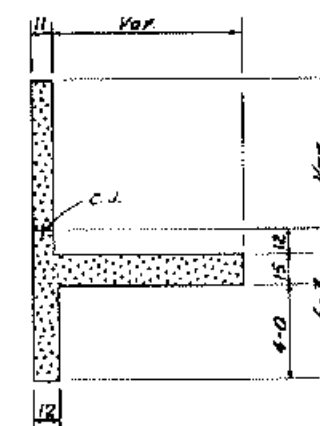
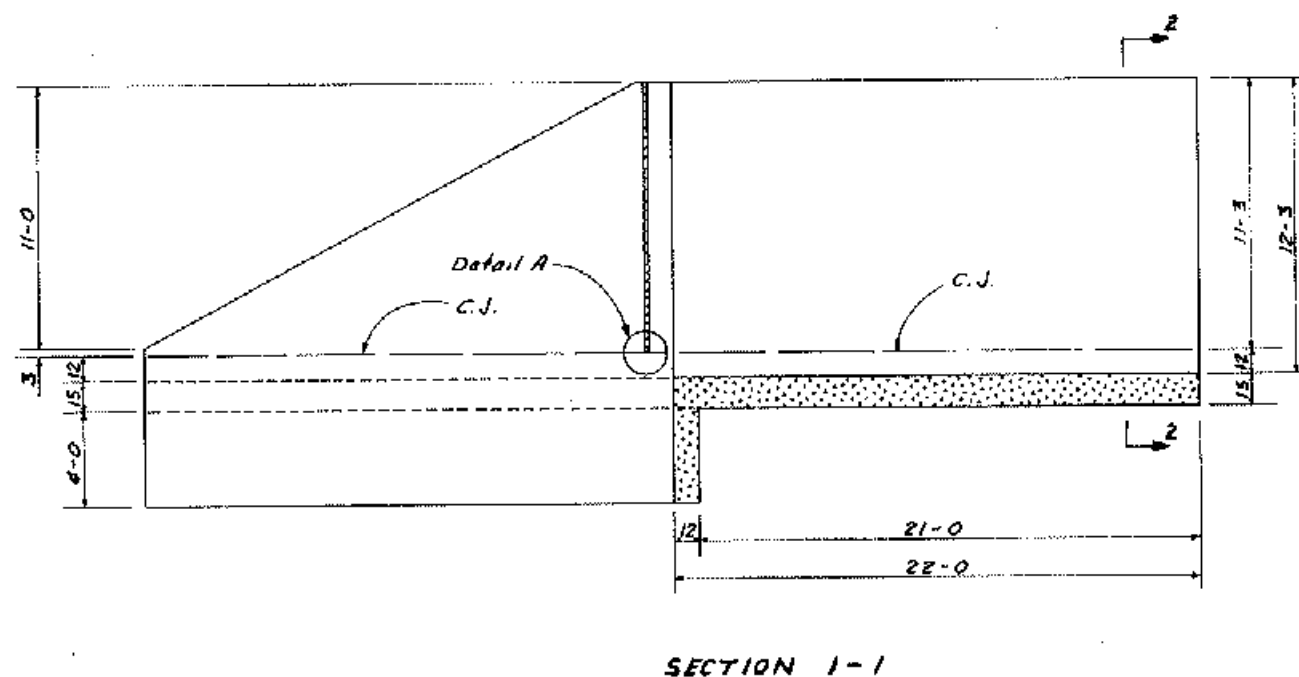
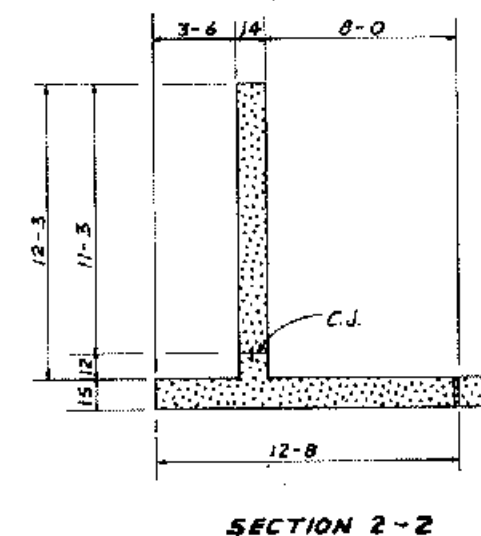
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	JON NISTOSS	DATE	4/89	Approved By	
Drawn	GEORGE WALISER	DATE	4/89	Title	
Trace		DATE		Sheet	
Checked	DENNIS REEP	DATE	4/89	Sheet	08-89-031



Notes:

1. For details of transverse and longitudinal joints, see sheets 39 and 40.
2. For details and locations of drain outlets, see sheets 34 thru 38.



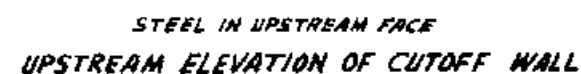
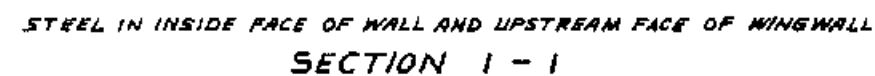
AS BUILT PLANS
NO CHANGE

Comp. Date 1-23-91

**WALL SEGMENT
CHUTE SPILLWAY - J#5 TO INLET
FLOODWATER RETARDING STRUCTURE
ENGLISH COULEE WATERSHED**

**GRAND FORK COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE**

Designed Jan. Mertens, S/As	Date	Approved by
Drawn George. Melzer, SAs	Time	
Traced	Sheet	Drawing No.
Checked Dennis. Riser, Asst	No. 469	QB-89-031



1. Location of Section 1-1 is shown on sheet 88.
2. Section 2-2 and Section 3-3 are shown on sheet 88.
3. Section 5-5 is shown on sheet 85.



Designated <u>SA Mr. Neff</u> <u>589</u> Office <u>George McKee</u> <u>589</u> Trained _____ Directed <u>Debbie Ross</u> <u>442</u>		Approved by _____ Title _____ Date _____ Special Agent in Charge _____ Mr. Tolson _____ Mr. DeLoach _____ Mr. Mohr _____ Mr. Bishop _____ Mr. Casper _____ Mr. Callahan _____ Mr. Conrad _____ Mr. Felt _____ Mr. Gale _____ Mr. Rosen _____ Mr. Sullivan _____ Mr. Tavel _____ Mr. Trotter _____ Tele. Room _____ Mr. Holmes _____ Miss Gandy _____	
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