



USDA NRCS Bismarck State Office

Dam Assessment Report

Upper Turtle River Dam No. 5

Grand Forks County, North Dakota



February 2021

Prepared for: Grand Forks County Water Resources District
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**United States
Department of
Agriculture**



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Section 11, T152N-R56W

Grand Forks County, North Dakota

National Inventory of Dams ID: ND00388

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REPORT

1 INTRODUCTION AND PURPOSE

The purpose of this report is to provide an assessment of Upper Turtle River Dam No. 5 (UTR 5) in the 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, 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 Resource District (WRD) in determining future actions concerning potential rehabilitation of the dam that would extend the service of the dam and meet current dam safety criteria.

NRCS provided technical and financial assistance for the planning, design, and construction of UTR 5 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 2023. 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

Upper Turtle River Dam No. 5 is located approximately four miles east of the city of Niagara, North Dakota in Section 11, T152N-R56W, Grand Forks County. UTR 5 is an unattended flood control structure located on a tributary of the North Branch Turtle River. UTR 5 is currently classified as Class C high-hazard structure by the NRCS and a Class V high-hazard by the NDSWC. An aerial, location, and a USGS quadrangle maps of UTR 5 and its accompanying watershed are shown on the following pages in Figures 1, 2, and 3, respectively. Additionally, As-built drawings are provided in Appendix A. Elevations provided in the As-builts are in NGVD 29 while all elevations presented in this report will be in NAVD 88 unless otherwise noted (NGVD 29 + 1.21 feet = NAVD 88).

UTR 5 was designed by the Soil Conservation Service, now known as the Natural Resource Conservation Service (NRCS), and finished construction in 1975 to provide flood control within the Turtle River Basin, see Appendix A for the As-built drawings. UTR 5 has a contributing drainage area of 7.39 square miles and is capable of 1,925 ac-ft of storage with a corresponding reservoir surface area of 75.2 acres at the

top of embankment at 1295.0 ft. The embankment consists of a dual zoned earthen fill with a total length of 2,130 feet. According to a field survey conducted during the 2020 annual inspection, the upstream embankment from elevation 1247 to 1260 is at a 4:1 slope and 1260 to 1295 is at a 3:1 slope. The downstream embankment is at a 2.5:1 slope with a 50-foot-wide stability bench at a negative four percent slope. The effective top of embankment was observed, in the 2020 annual inspection, to be located on the SW portion of UTR 5 at an elevation of 1295.0 feet. While the crest elevation did vary, the crest elevation through the significant embankment fill remained above 1296.0 feet. The designed, post-settlement, crest elevation was to be at 1295.21 feet.

UTR 5 has a principal spillway (PSW) that is uncontrolled and consists of a reinforced concrete low-stage inlet (Low-stage), reinforced concrete riser tower (Riser), and a 24" outlet conduit. All locations where water could flow into the PSW are protected with metal trash racks. A summary of specific design data is presented in Table 1 at the end of this section.

The Low-stage has a 15" footing depth with 7'6" by 8'2" footprint and 10" thick side walls. The Low-stage side walls are 12-feet tall with a 24" outlet conduit at the sump and 12" by 9" orifice at a crest elevation of 1248.21 feet. An 8" thick concrete slab sits atop the side walls with a solid manhole to complete the Low-stage.

The Riser has a 2-foot thick footing and varying sidewall thickness of 15", 12", and 10". The two 35-foot Riser side walls each have a 6" chamfer which acts as the primary weir crest at an elevation of 1272.21 feet. One 24" reinforced concrete conduit, from the Low-stage, enters the Riser and one 24" reinforced concrete conduit exits the tower from the opposite side as the Outlet conduit.

The 24" Outlet conduit upstream of the Riser (Upstream conduit) is approximately 96-feet in length with four anti-seep collars located no closer than 2.5-feet from a conduit joint. The Upstream conduit was constructed with varying pipe slope ranging from 1 to 2 percent with 7 sections of pipe from 8- or 16-foot in length. The 24" Outlet conduit downstream of the Riser (Downstream conduit) is approximately 360-feet in length with 9 anti-seep collars located no closer than 2.5-feet from a conduit joint. The Downstream conduit was constructed with varying pipe slopes ranging from 1 to 3.5 percent with 22 section of pipe from 16- to 24-foot in length. Both the Upstream and Downstream conduits are laid in a concrete cradle.

The National Engineering Handbook Part 628, Chapter 50, states that the auxiliary spillway (ASW) should be divided into bays of 200 feet or less to prevent wide velocity variations within the spillway cross sections. UTR 5 has an unregulated earthen (ASW) with a 400-foot width. The level section is approximately 850 in length. According to the as-built drawings, the ASW was over excavated by 6" to accommodate the placement of topsoil for the establishment of vegetative cover. However, an area near the end of the level section, on the left side of the ASW, was originally constructed on fill. From the control section, ASW drops 28.6 feet in 550 feet, a 5.2% slope, to a flat bench at elevation 1261.6.

Available data utilized in the compilation of this report includes:

- Structure As-built (1977)
- Emergency Action Plan (2016)
- Operation and Maintenance Agreement (1973)
- Past Operation and Maintenance Inspection Report (2010, 2015, & 2020)
- Geology Report (1972)

- Red River LiDAR (2008-2010)
- Red River of the North Basin-Wide HEC-HMS Model
- NRCS Technical Release No. 60
- NRCS Technical Release No. 56
- NRCS National Engineering Handbook Part 628, Chapter 50
- NRCS National Engineering Handbook Part 628, Chapter 52
- NRCS National Engineering Handbook Part 650, Chapter 7

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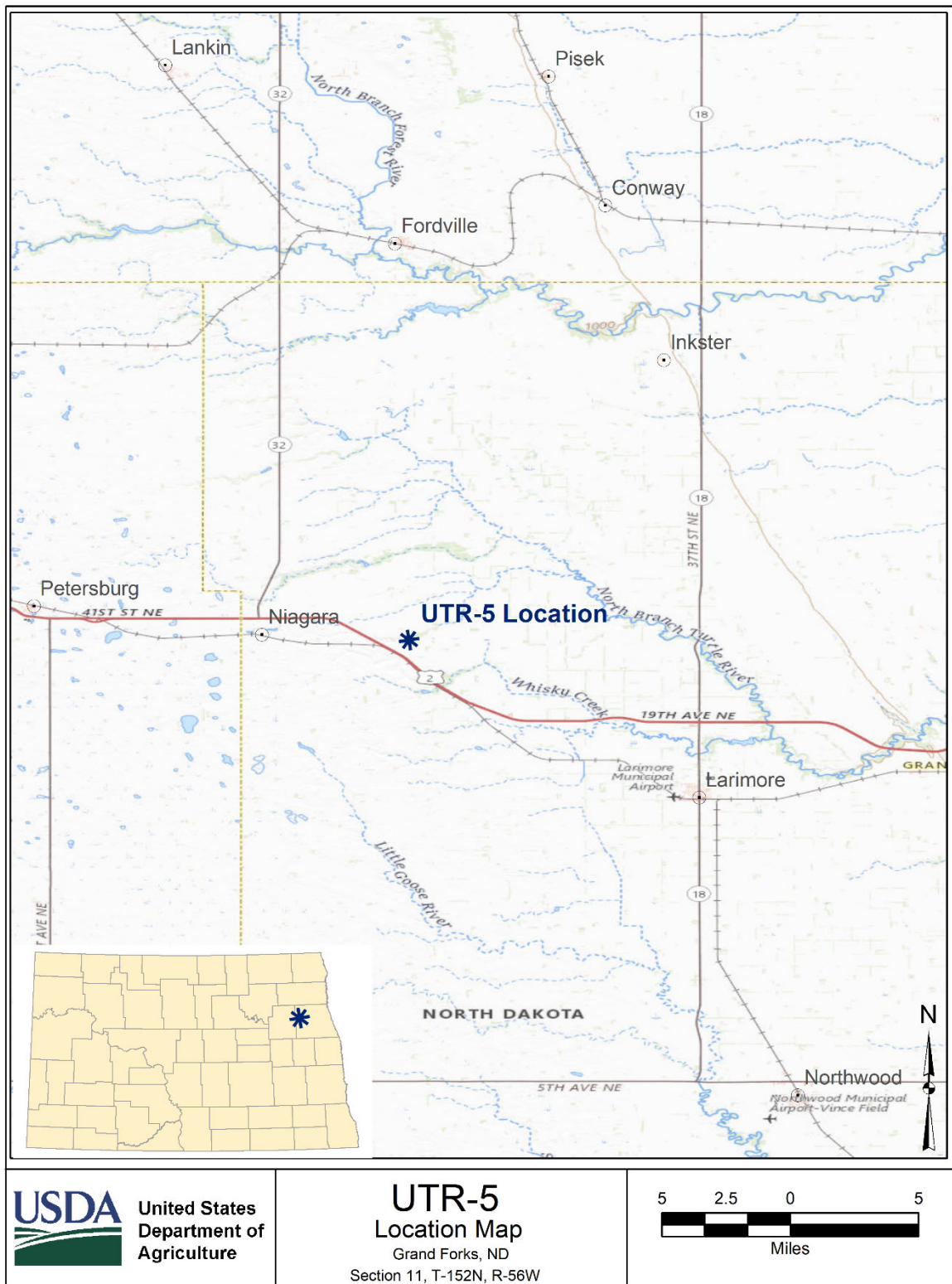


Figure 1. Location Map of UTR 5

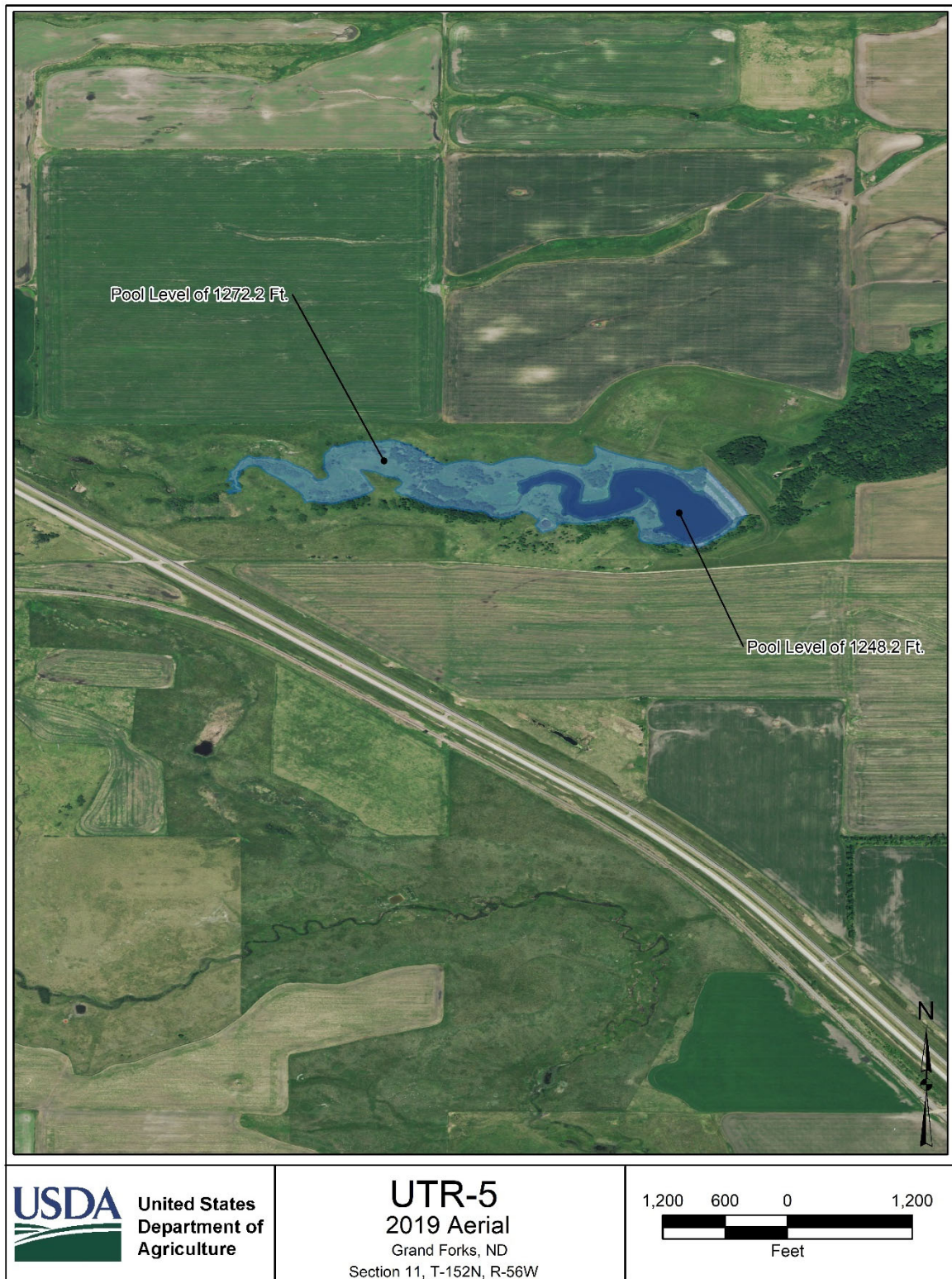


Figure 2. 2019 Aerial Photo of UTR 5

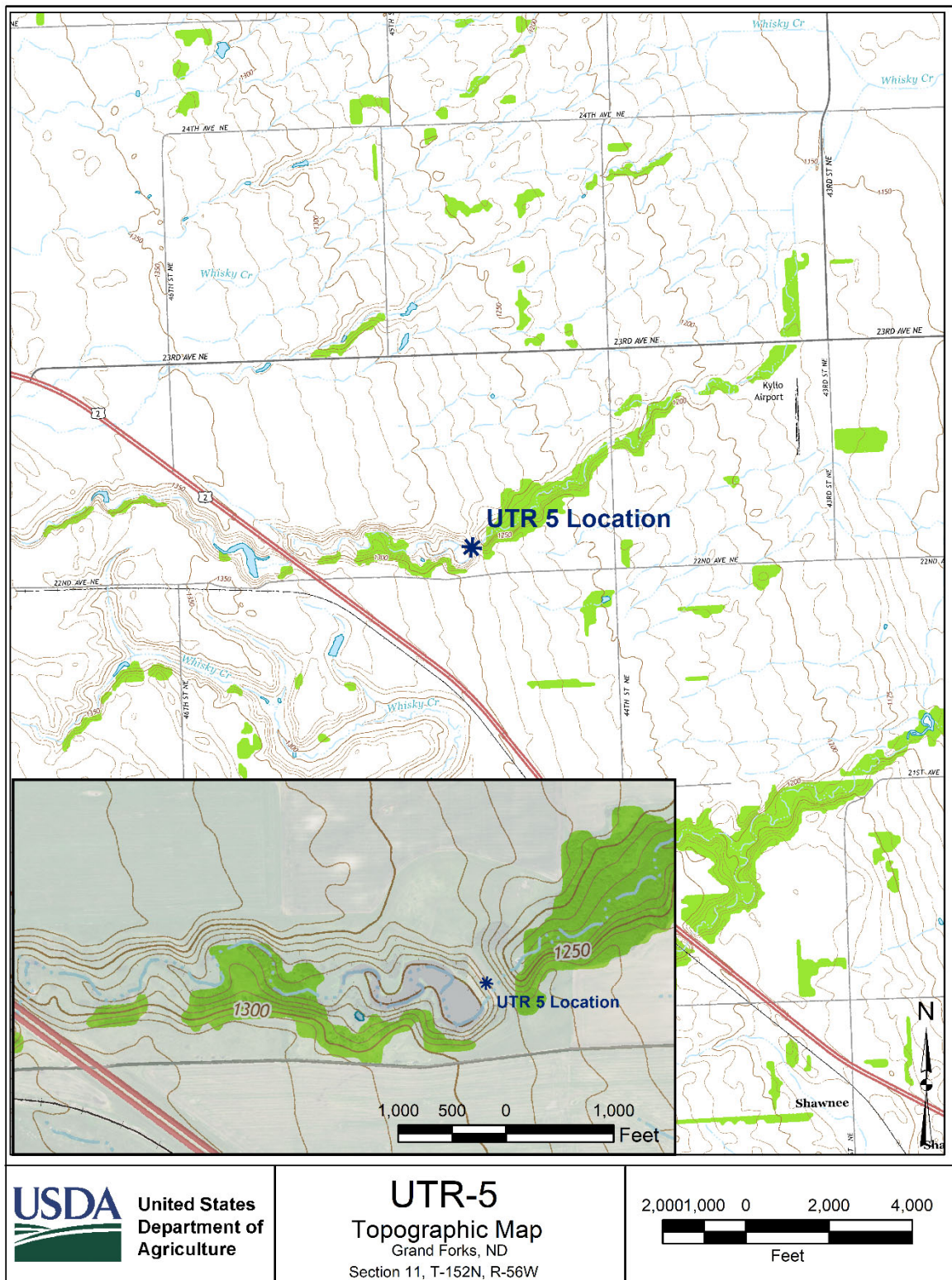


Figure 3. Topographic Map of UTR 5

Table 1. As-Built Design Data for UTR 5

Description	Value
General Data	
Year Designed	1973
Years of Construction	1974-1975
Purpose	Flood Control
Original Hazard Classification	High
Current Hazard Classification	High
Design Life based on Watershed Work Plan	50 Years
Original Design Drainage Area	5,440 ac (8.50 Sq. Mi)
Revised Drainage Area	4730 ac (7.39 Sq. Mi)
Original Time of Concentration	4.0 (Hrs)
Revised Time of Concentration	13.8 (Hrs)
Dam Height (Along Centerline)	70 ft
Embankment Length	2130 (Ft)
Embankment Top Width	20 (Ft)
Embankment Upstream Slope	3:1
Embankment Downstream Slope	2:1
Critical Elevations (NAVD 88-Ft)	
Top of Dam Zone 2 Fill	1295.0
Top of Internal Zone 1 Fill (Based off As-built)	1272.2
ASW Crest	1290.2
PSW Weir Crest	1272.2
PSW Low-Stage Riser Crest	1248.2
PSW Conduit Outfall Invert	1227.2
Storage Capacities	
PSW Low-Stage Crest (Low-Stage Inlet)	74.6 Ac-Ft
PSW Primary Weir Inlet	560 Ac-Ft
ASW Crest	1,538 Ac-Ft
Top of Dam	1,925 Ac-Ft
Pool Surface Areas	
PSW Low-Stage Inlet	8.7 Ac
PSW Second Stage Inlet	36.5 Ac
ASW Crest	69.1 Ac
Top of Dam	75.2 Ac
Other Features	
PSW Conduit Diameter	24 (In)
PSW Conduit Length	362 (Ft)
PSW Weir Crest Length	12 (Ft)
ASW Width	400 (Ft)

3 SITE INSPECTION SUMMARY & OPERATION AND MAINTENANCE

UTR 5 was inspected on September 9, 2020 by NRCS staff. Inspection details, observations, and photographs are provided in the Dam Inspection Report in Appendix B. A summary of the major areas of concern that were found are noted below:

- The dam crest has rutted and unvegetated areas present.
- A wet area is present on the downstream embankment bench.
- Rutting from livestock and sparsely vegetated areas are present within the auxiliary spillway.
- The low-stage riser exterior is deteriorated.
- Flow from beneath principal spillway conduit was observed.

A review of the 2010, and 2015 annual inspections was conducted, and significant findings are detailed below:

- 2010 Review
 - Growth of woody vegetation growing on the face of the dam.
- 2015 Review
 - Growth of woody vegetation on the upstream slope and encroaching trees along the abutments at both ends of the upstream and downstream slopes. Woody vegetation was observed encroaching onto the upper portion of the downstream slope at the north end of the embankment.
 - Three slides on the lower portion of the downstream slope of the dam. (Repaired by the GFWRD in October of 2015).
 - Cattails and standing water on the downstream slope stability bench along the entire length of the embankment. Noted that since stability bench is above normal pool, likely due to surface runoff that doesn't drain well. Standing water along the bottom toe of all three sides. Undetermined if the water at the toe of the dam is related to surface runoff or seepage through the dam.
 - Livestock paths on the downstream slope in the vicinity of the slides as well as on the upstream slope along the top of the riprap. Fencing is planned to prevent livestock use of that space.
 - Large area of bare ground along the north side of the spillway channel, approximately 200 feet from the downstream end of the channel. Bare ground was approximately 115 feet long by 50 feet wide.
 - Livestock presence in the auxiliary spillway channel.

An operation and maintenance agreement (O&M Agreement) signed on March 7, 1973 is provided in Appendix C. The O&M Agreement for UTR 5 applies to other dam sites within the Upper Turtle River Watershed as well. The O&M Agreement explicitly calls out the control of grazing to insure proper vegetative cover that was noted to be deficient during the annual inspection above. It is recommended that the owner maintain records of maintenance activities completed on UTR 5, as well as high water event stages and durations. An Emergency Action Plan (EAP) was last completed for UTR 5 by Pribula Engineering in August of 2016 and was noted to be updated at least once a year. No tabletop EAP exercise could be recalled from the WRD.

4 HYDROLOGIC AND HYDRAULIC ANALYSES

Hydrologic and hydraulic analyses were conducted to determine whether the existing dam meets current NRCS and ND SWC standards. The watershed analysis conducted on UTR 5 yielded a 7.39 mi² watershed based upon the 2008-2010 Red River Valley LiDAR (LiDAR). The LiDAR is quality level 3 with a vertical accuracy root mean square of 15.0 cm and horizontal accuracy error less than or equal to 1 meter. The complete LiDAR metadata can be found at <http://lidar.swc.nd.gov>. Utilizing the velocity approach method, the time of concentration was determined to be 13.8 hours and validated with the US Army Corps of Engineers Red River Basin Study. The 100-year frequency rainfall data was obtained from the most recent version of NOAA Atlas 14 data for the city of Niagra, ND. The Probable Maximum Precipitation (PMP) design storms were obtained using the North Dakota Statewide PMP study data. The preceding data was utilized in accordance with the procedures outlined in the latest version of *Technical Release No. 60 Earth Dams and Reservoirs* (TR-60).

The stage-storage relationship for the UTR 5 reservoir was calculated utilizing LiDAR data for elevations above the Low-stage inlet of 1248.2 feet. A stage-storage relationship was unable to be determined from LiDAR for elevations below the Low-stage inlet and thus was gathered from the As-Built survey. Actual rates of sedimentation were not considered in this assessment, however during the 2020 annual inspection it was noted that any accumulated sediment was below the Low-stage and thus occupying solely the dead storage allocation of the reservoir. The stage-discharge rating curve was evaluated utilizing the NRCS SITES software for a two-stage inlet and the results are shown below in Table 2.

Table 2. Stage - Storage – Discharge Rating

Stage (Ft)	Storage (Ac-Ft)	Principal Spillway Q (CFS)		Auxiliary Spillway Q (CFS)
1248.2	70.3	0	Weir	---
1248.6	74.4	0.9		---
1250	88.4	4.0		---
1252	111.7	6.5	Orifice Control ↓	---
1254	138.6	8.2		---
1256	169.4	9.6		---
1258	204.2	10.9		---
1260	243.3	12.1		---
1262	286.9	13.1		---
1264	335.2	14.1		---
1266	388.6	15.0		---
1268	447.1	15.8		---
1270	511.1	16.7		---
1272	580.7	17.5		---

Stage (Ft)	Storage (Ac-Ft)	Principal Spillway Q (CFS)	Auxiliary Spillway Q (CFS)
1273.5	636.0	71.7	---
1274	656.2	71.1	---
1276	737.9	72.6	---
1278	825.9	74.1	---
1280	920.5	75.6	---
1282	1021.9	77.0	---
1284	1130.4	78.4	---
1286	1246.1	79.8	---
1288	1369.3	81.2	---
1290	1500.3	82.6	---
1290.2	1513.8	82.7	0
1292	1639.2	83.9	527
1294	1786.3	85.2	5,053
1295	1863.1	85.8	7,604

Outlet Pipe Control
↓

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 the NRCS SITES (SITES) software program. The SITES analyses involved the evaluation of the 1- and 10-day, 100-year frequency and the 6- and 24-hr PMP design storms in accordance with procedures outlined in the latest version (March 2019) of *Technical Release 210- 60 Earth Dams and Reservoirs* (TR-60). The SITES input and output files for NRCS High Hazard classification is presented in Appendix D.

TR-60 requires the principle spillway hydrograph (PSH), for a high hazard dam, to utilize the 1- and 10-day, P_{100} precipitation data. During the routing of these hydrographs, the auxiliary spillway is not allowed to flow. Additionally, the principal spillway should empty at least 85 percent of the PSH routed through the reservoir in 10 days or less. Upon review of UTR 5's SITES model, the PSH provided a max water surface elevation (WSE) of 1283.3 ft and a 10 day draw down elevation of 1272.03 ft. Based on UTR 5's multiple-stage PSW (Low-stage at 1248.2 and principal tower weir at 1272.2) and the reservoirs storage curve, the 10 day draw down to remove 85% of the PSH is at elevation 1259 feet. UTR 5's 10 day draw down, from the 1283.3 ft peak, is 1270.03 ft. Currently the PSW does draw down 57% of the PSH and thus doesn't meet the recommendation of 85% drawdown within 10 days. Since the 10-day PSH drawdown to 1270.03 is above the Low-stage weir at 1248.2 ft, the elevated 10-day PSH WSE of 1270.03 ft will be used as the starting point for the Stability Design Hydrograph (SDH) and Freeboard Hydrograph (FBH). The key parameters used in the hydrologic analysis of UTR 5 are presented in Table 3.

Within SITES, a grassed ASW can be modeled with a vegetal (VEG) retardance curve class of A through E. According to North Dakota design standards, a vegetal retardance curve index value of D should be chosen as the controlling class, but an index value of C will persist throughout most of the growing season. For this reason, both numbers will be present in Table 3.

Table 3. Key SITES Hydrologic Modeling Parameters

INPUT PARAMETER		INPUT VALUE	
TOP OF DAM		1295	
AUXILIARY SPILLWAY CREST		1290.2	
WATERSHED AREA		7.39 SQ. MI.(1)	
WEIGHTED CURVE NUMBER		74 ⁽²⁾	
TIME OF CONCENTRATION, T _c		13.8 HOURS ⁽²⁾	
Principal Spillway Hydrograph			
100-YEAR, 6-HOUR RAINFALL		4.24 INCHES	
100-YEAR, 24-HOUR RAINFALL (3)		5.65 INCHES	
100-YEAR, 10-DAY RAINFALL (3)		8.08 INCHES	
Stability Design Hydrograph			
SDH RAINFALL, 6-HOUR		8.17 INCHES	
SDH RAINFALL, 24-HOUR		10.31 INCHES	
Freeboard Hydrograph			
FBH RAINFALL, 6-HOUR		19.36 INCHES	
FBH RAINFALL, 24-HOUR		23.57 INCHES	
OUTPUT PARAMETER		OUTPUT VALUES	
MAX PSH WSE		1283.3	
10-DAY PSH DRAWDOWN ELEVATION		1272.03	
DOES PSH ACTIVATE ASW		NO, 2183.3 < 1290.2	
		VEG-C	VEG-D
MAX 6-HR SDH WSE		1292.48	192.28
MAX 24-HR SDH WSE		1292.86	1292.63
MAX WAVE HEIGHT		1.65 FEET	
DOES MAX SDH + WAVE HEIGHT OVERTOP DAM ⁽⁵⁾		NO, 1294.51 < 1295.0	
MAX 6-HR FBH WSE		1294.43	1294.2
MAX 24-HR FBH WSE		1294.52	1294.28
DOES MAX FBH OVERTOP DAM ⁽⁶⁾		NO, 1294.52 < 1295	

(1) Watershed area delineated based upon the 2008-2010 Red River LiDAR collect.

(2) The weighted curve number and the time of concentration are calculated values based upon the USDA Web Soil Survey and the velocity approach method, respectively, and values validated by the HEC-HMS Red River model originally prepared by the USACE.

(3) The time of concentration is approximately 14 hours; therefore 24-hour duration precipitation events were used for the ASH and FBH. The 24-hr duration was obtained from NOAA Atlas 14. The 6- and 24-hr duration, Probable Maximum Precipitations (PMP) are 19.36 and 23.57, respectively, which were obtained from North Dakota Statewide PMP Study.

(4) The critical storm type is local (in comparison to general or cool-season) and the 5-point distribution was used according to guidance in TR-60.

- (5) *In accordance with TR-60 criteria, the SDH plus the required wave height must not overtop the embankment. The max wave height of 1.65 feet is below the available 2.4 feet (see Appendix E).*
- (6) *In accordance with TR-60 criteria, the FBH shall not overtop the existing embankment with an effective top of dam at 1295.0 feet.*

Wave height was calculated using guidance found in TR-56 (A Guide for Design and Layout of Vegetated Wave Protection for Earthen Embankments and Shorelines) where the potential wave height of a body of water can be calculated by determining the effective fetch, overland wind velocity, and overwater wind velocity. The fetch along the surface of the reservoir water surface is analyzed at the elevation of the maximum SDH water surface elevation. The resulting wave height was calculated to be 1.65 feet and is below the available 2.1 feet of freeboard available. See Appendix E for the wave analysis.

In considering either wave height or frost conditions for the addition to the SDH maximum water surface elevation, the larger of the two is used. Frost considerations consider frost cracking at the crest of the dam and with particular emphasis on propagating cracks which may start at the crest of the dam and extend down the sides of the embankment. If cracks extend far enough down the embankment sides and extend through the embankment, there may be risk of water infiltration and piping when the reservoir water surface elevation reaches the level of cracks. No cracks were observed along the crest or abutments that would suggest a frost cracking condition found along the dam crest. Frost considerations were therefore not accounted for and the wave height parameter was used in assessing the SDH maximum water surface elevation as seen above in note 6.

The dam crest elevation of 1295.0 feet exceeds both the ASH and FBH requirements, satisfying the TR-60 hydraulic requirements.

5 AUXILIARY SPILLWAY STABILITY AND INTEGRITY ANALYSIS

According to TR-60, the 6-Hr SDH must not erode any material from the ASW. To analyze this, the hydraulic shear stress must be less than the maximum shear stress provided by the soil and vegetation.

During the 2020 Annual Inspection of UTR 5, an unvegetated portion of the ASW was noted downstream of the control section. In addition to this unvegetated portion, heavy animal tracking was present throughout the ASW that could greatly reduce the vegetation's ability to resist the shear stress caused by the activation of the ASW, referred to as current condition. However, as noted previously in the O&M agreement, reseeding of poor stands and strict control of grazing to insure proper vegetative cover are agreed upon. Thus, the ASW was additionally analyzed based upon an as-designed model run.

The current condition (Maintenance Code 3) and as-designed condition (Maintenance Code 1) were modeled in SITES to determine stress values needed for input into stability worksheets found in Appendix F. Contained in Table 4 below, are the output values obtained from SITES.

Table 4. SITES 6-HR SDH Stress Output

	Allowable Stress	Current Condition (Maintenance Code 1)	As-designed Condition (Maintenance Code 3)
Effective Stress - Veg C	0.120 psf	0.088 psf	2.003 psf
Effective Stress - Veg D	0.120 psf	0.123 psf	1.748 psf
Total Stress - Veg C	4.20 psf	3.29 psf	3.29 psf
Total Stress - Veg D	3.33 psf	2.87 psf	2.87 psf

For the current condition analysis, the ASW's unvegetated portion provides no vegetal stress resistance. Thus, under the current condition's analysis, the soil is the only component responsible to resist the stresses realized. With no vegetal support, the soil effective stresses realized under the SITES Veg C and Veg D runs are 2.00 psf and 1.75 psf, respectively. The allowable stress provided by the soil is 0.12 psf. Thus, the soil will erode since the effective soil stress exceeds the allowable soil stress and is considered deficient.

A retardance curve index value of 5.6 (vegetal retardance class C) represents growing season vegetation conditions in the ASW and is the most restrictive condition regarding capacity. A retardance curve index value of 4.4 (vegetal retardance class D) represents early spring (nongrowing season) vegetation conditions in the ASW when grass is dead and laying on the ground, after having been laid down by snow and ice for the winter. Depending on the year, this condition may last for 3-4 weeks after the ground has thawed and may occur anywhere from April to mid-June. Retardance Class D is the most restrictive condition regarding effective soil stress and is therefore utilized to analyze those factors. Table 4 provides a summary of those results, which indicates that the ASW exceeds criteria in that non-growing season event. See Appendix F for the analysis on allowable stress for both vegetation conditions and both maintenance conditions.

TR-60 also requires the 24-Hr FBH to be analyzed so that any erosion will not advance beyond the upstream edge of the level crest and breach the ASW. For SITES to adequately determine if a breach occurred, the proper soil input parameters were required. According to the initial design report and soil borings, an alluvium overburden, with a maximum depth of 10.5 feet, mantled a Niobrara Shale bedrock. From the As-builts and a November 1972 geological report, further discussed in Chapter 7 of this report, boring 108 provides the most representative boring for determining the soil stability of the ASW. Borings 105 and 106 were taken downstream of the control section of the ASW but were unable to be located and thus 108 was the nearest boring able to be located. See profile of ASW contained within the As-builts for exact locations. Boring 108 contained a lean clay material with D_{75} of 0.15mm (0.006 in), a plasticity index of 25, and a clay content of 30 percent. The dry density (DD) of the material was determined to be 116.5 pcf. During a field visit to UTR 5, a density was taken on the ASW, below the control section, and determined to have a DD value of 92 pcf. Thus, the DD of 92 was used during the SITES analysis. A schematic profile of the modeled ASW from the SITES output is presented below in Figures 4 and 5. Figure 4 represents the modeled erosion with a vegetal cover C and Figure 5 represents the modeled erosion with a vegetal cover of D. Erosion parameters were inputted based upon the original soil investigation completed for UTR 5. It is important to note that UTR 5 control section is approximately 800 feet in length at elevation 1290.2 Ft. Additionally, the 800-foot control section is

located along a bend so if erosion initiates any considerable distance, the control section within the bend will become effective.

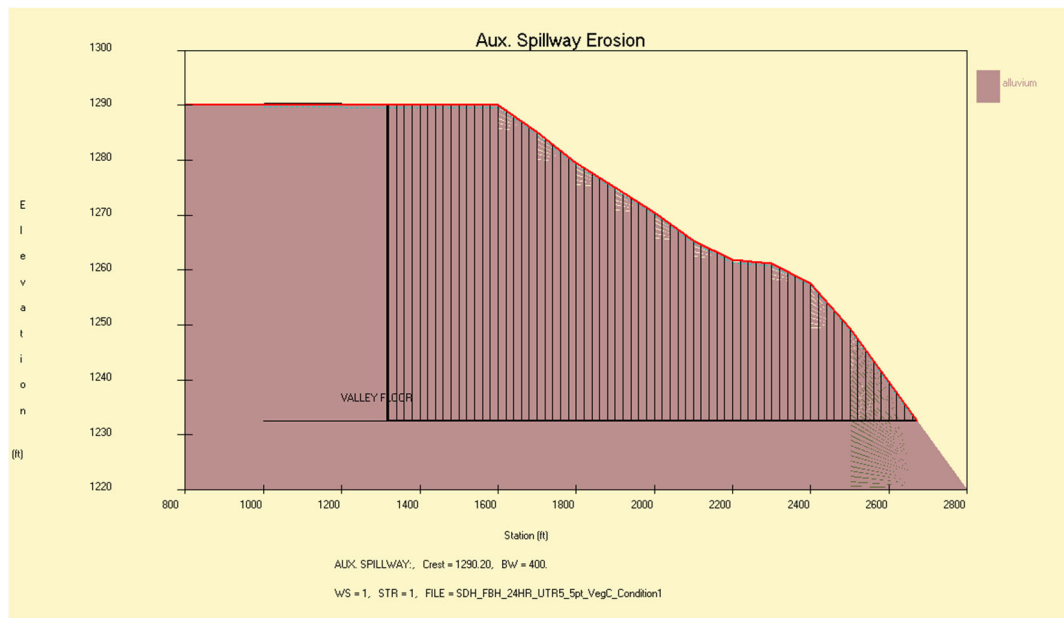


Figure 4. ASW Erosion – Veg C - 24 Hr.

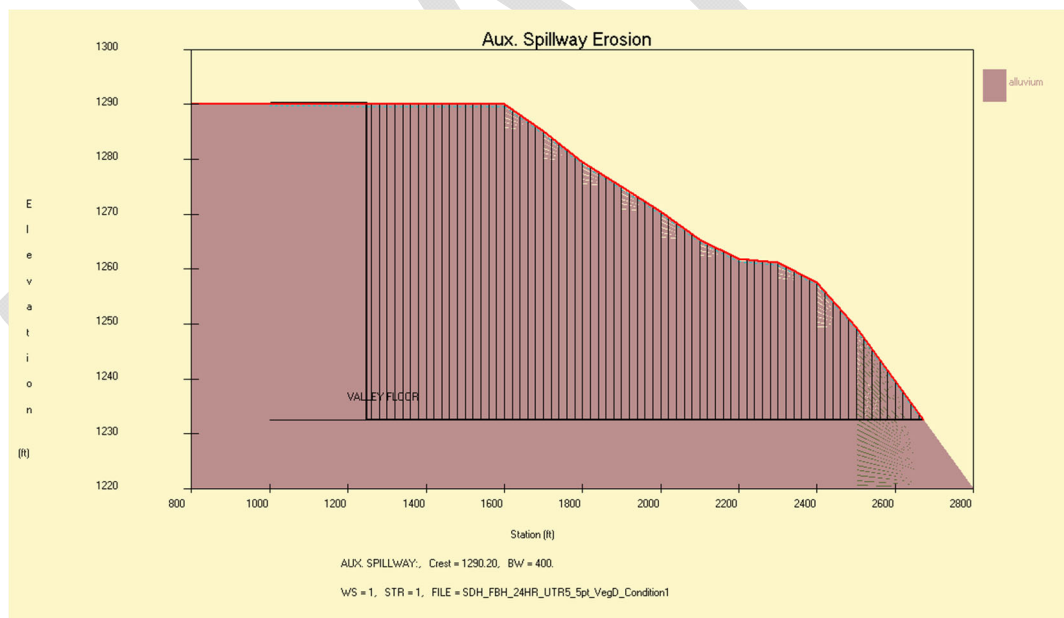


Figure 5. ASW Erosion – Veg D - 24 Hr.

Notes:

- Hatch lines indicate erosion
- Flow is from left to right
- Top of dam is at elevation 1295.0 Ft
- ASW crest is at elevation 1290.2 Ft

The results of the SITES model indicate that erosion of the ASW does not advance beyond the upstream edge of the level crest at elevation 1290.2 Ft. When the 6-Hr FBH was analyzed for vegetal cover class C and D, less erosion was identified and thus was not seen as relevant information to report. The complete SITES input and output for the ASW integrity analyses is presented in Appendix D.

The NDSWC recommends permissible velocities for vegetated ASW to be below 4 ft/sec for spillway slopes greater than 5% with a mixture of sod forming and bunch grasses. To evaluate this recommendation, the NDSWC provides the rainfall amount to be used based upon the height and hazard classification of the dam. For UTR 5, the NDSWC high hazard class 5 designation requires 40% of the PMP storm event. The 6-hr .4 PMP yielded a maximum velocity of 5.8 ft/s and the 24-hr .4 PMP yielded a maximum velocity of 7.2 ft/s. These values are above the permissible velocities of 5 ft/s for vegetated ASW according to the NDSWC Dam Design Handbook.

Historically, UTR 5's auxiliary spillway has never been activated. The highest it has ever gotten was in 2000 but did not activate. Thus, no past performance is known for UTR 5's auxiliary spillway.

6 DAM FAILURE INUNDATION MAPPING

A dam failure hydraulic analysis was performed using the U.S. Army Corps of Engineers' HEC-RAS 5.0.7 to determine the downstream inundation limits of the flood wave created by a sudden breach of the embankment. A 2 dimensional 150-foot downstream mesh was created using LiDAR to act as the receiving area for the breach inundation.

The breach modeled had a final bottom width of 90 feet, bottom elevation of 1232 (the 100-year floodplain elevation in the receiving channel), and 2.5:1 breached side slope. The reservoir was at the maximum capacity of 1295.0 feet (max WSE from the FBH was 1294.8 feet) when the simulated breach occurred in a half hour. The peak breach discharge was approximately 100,000 CFS based upon the Peak Breach Discharge Criteria in TR-60.

One of the ways in which an embankment can be considered high hazard is if the breach inundation mapping shows a water depth of 3 feet or more at a residence structure or if the depth times velocity is greater than 4 at a residence structure according to 210-NEM-520.14. Through the hydraulic analysis completed for UTR 5, 1 residence was identified to be in exceedance of these thresholds and thus UTR 5 meets the classification of a Class C high hazard embankment. Table 4 below contains the residence and accompanying depth and depth times velocity. Contained within Appendix G are a series of inundation maps showing both max depth and max depth times velocity.

Table 5. Downstream Residences

Address	Depth (ft)	Depth x Velocity (ft ² /s)
4311 NE 23rd Ave	4.2	31.7

Additionally, as can be seen in the maps in Appendix G, Grand Forks County Road 16 experiences a peak depth of 19.3 feet and a peak velocity of 12.1 feet per second.

7 REVIEW OF AVAILABLE GEOTECHNICAL INFORMATION

The original geological investigation (November 15, 1972) and as-built drawings were analyzed. The original exploration included the drilling of soil borings along the centerlines of the proposed auxiliary spillway, dam embankment, principal spillway, and proposed borrow sites for use in the construction of the embankment. Documented laboratory results of this original geological investigation include material gradation, Atterberg limits, dispersion percentages, soil classification, and soluble salts.

Through soil borings completed for the original geological investigation, it is noted that all test holes terminated in Cretaceous Niobrara Shale. Niobrara Shale was noted to have a low consolidation potential. Generally, cobbles and boulders occurred at the contact of the glacial drift and the Niobrara Shale. Breaks between the glacial drift and alluvium were abrupt between centerline stations 11+10 and 11+50 and it was noted as an area where differential settlement could occur.

The alluvium and glacial drift were determined to be primarily CL while the Niobrara Shale, when broken down, was classified as MH according to grain size and Atterberg limits. The density of the alluvium was in the range of 1.4 to 1.48 g/cc and the density of the Niobrara shale ranged from 1.34 g/cc to 1.22 g/cc in the top 4 or 5 feet. The alluvium had a total shear stress strength parameters of; $\Phi = 13.5^\circ$, $c = 1400$ psf, and the effective stress strength parameters are $\Phi = 21.5^\circ$, $c = 925$ psf. The bedrock was expected to be as strong or stronger than the alluvium.

The alluvium and glacial drift contain about 60 to 70 percent fines with plasticity limits of 25 to 46. The Niobrara Shale samples dispersed for hydrometer analyses show from 97 to 100 percent finer than 0.05mm, and 54 to 67 percent finer than 0.002 mm. Liquid limits range from 55 to 80 and PI's range from 25 to 47. Additionally, dispersion of the clay fraction is low and the soluble salt content in shale samples was in the range from about 1.5% to 3.3%.

Left Abutment: Portions of the left abutment are mantled with glacial drift. Alluvium mantles the base of the left abutment and the valley floor and depths to bedrock are shallow. The alluvium consists primarily of Niobrara Shale fragments higher on the slopes and sand and gravel size Pierre Shale fragments near the bottom. A blow count of over 100 blows per foot at the 15-foot depth was recorded near the bottom of the left abutment.

Right Abutment: The right abutment has a thin mantle of alluvium above the Niobrara Shale.

Principal Spillway: The Principal Spillway is located at the centerline Station 12+50 and depth to bedrock varies from 5.5 to 8 feet. The overburden is alluvium composed largely of small fragments and chunks of Niobrara Shale. It is worth noting that water was encountered in one test hole and there was enough water to record a water level reading.

Auxiliary Spillway: A thin mantle of clayey glacial drift mantles the auxiliary spillway and most of the material excavated was Niobrara Shale. The greatest thickness of glacial drift is at the entrance section to the auxiliary spillway and is near a thickness of 10.5 feet.

UTR 5 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. Prior to any potential modifications to the structure, appropriate instrumentation should be installed 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.

There are several geotechnical related elements of the construction of this dam, which do not meet TR-60 requirements that deal mainly with drainage and filtering of seepage. The principal spillway conduit is equipped with seepage collars that originally were intended to slow the progress of seepage along the principal spillway conduit, but do not act as a barrier against piping and internal erosion of sediment along the seepage path. Thus, seepage collars have been declared as being insufficient in preventing seepage failure along the principal spillway conduit. Filter diaphragms are now used to prevent piping and internal erosion along the principal spillway conduit. UTR 5 was not constructed with a filter diaphragm.

The dam has an existing foundation drainage system in-place which creates a drainage path for seepage at the level of the foundation. This drainage system is intended to gather seepage at the foundation level and effectively allow for ease of flow of that seepage water to exit at the toe of the dam at a specified drainage channel. TR-60 requires all significant and high hazard potential embankments to have filtration and drainage features, which include, *“...chimney filters and drains that extend high enough in the embankment to intercept seepage from usual and unusual loading conditions and potential defects that could result from faulty construction, cracking resulting from differential settlement, foundation settlement upon wetting, hydraulic fracturing, desiccation, frost heave, or separation that could occur at embankment-appurtenance contacts.”* UTR 5 was not constructed with nor currently have a chimney filter.

Along with not having the required drainage and filtration systems, there is an uncertainty of the foundation drain filtration compatibility with the surrounding soil and how the filter material was placed or possibly segregated. TR-60 requirements apply a filter design which considers compatibility between drainage material and surrounding soil to ensure that infiltration of sediment does not occur, but the ongoing infiltration of seepage water does. Based upon the as-built drawings and geological investigation it is difficult to determine if there is compatibility between the drainage material and the surrounding embankment soil.

Seismic effects on the stability of the structure were considered by utilizing the USGS Unified Hazard Tool. The tool produced a Peak Ground Acceleration of $0.02 \text{ g (m/s}^2\text{)}$ which is less than the $0.07 \text{ g (m/s}^2\text{)}$ limit, in TR-60, that requires a seismic analysis. Thus, it was determined that the structure's performance would not be affected by expected seismic activity.

8 FAILURE AND RISK INDICES

The Population at Risk (PAR) is an assessment of the quantity of the adjacent population which would be at risk during a dam failure event. There are three conditions that are used to determine the PAR and include a count conducted for a static loading failure, a hydrologic loading failure, and seismic loading failure. The static and hydrologic loading failures are a time of failure when the water surface elevation of the reservoir is at or above the invert of the lowest open channel auxiliary spillway. For these two runs on UTR 5, the water surface was set to top of dam. The seismic loading failure (or sunny day failure) mimics a dam failure at a time when the water surface elevation of the reservoir is at or above

the invert of the lowest non-gated spillway, which for UTR 5 is the Low-Stage inlet at 1248.2 feet. At each of these failures, the dam breach inundation water depths are assessed for each structure which is inundated by water from the breach.

Once the PAR number for each type of event is determined, the results are incorporated into the Evaluation of Potential Rehabilitation Projects procedure to determine the Failure and Risk Index for the Dam. This procedure considers the condition of the dam's embankment geology, embankment seepage, and residual spillway integrity. The hydrologic loading of the dam structure is also considered for the risk of failure. See Appendix H for the summary and results of the failure and risk evaluation.

The resulting maximum PAR is 5.

The Total Failure Index for the dam is 192.

The Total Risk Index for the dam is 38.

9 POTENTIAL REHABILITATION ALTERNATIVES

Additional investigation and monitoring of the observed seepage on the principal spillway is strongly recommended to determine the cause. A dye test may be helpful, and NRCS will work with the GFWRD to try and set that up in 2021 if so desired by the GFWRD. A sediment trap and weir would need to be constructed beneath the PSW outlet where the conduit daylight. The lack of a filter diaphragm, as current design criteria requires, generates particular concern. The as-built drawings and slopes validated in the field for the emergency spillway are above 5% and TR-60 recommends a maximum slope of 4%. The nearly 800-ft level crest is much longer than required, TR-60 requires a minimum length of 30-ft. If the level crest length was reduced, and still maintained outside of the bend, the resulting ASW downstream gradient could be reduced to allow for ASW slopes under 4%. The dam is nearing the end of its 50-year lifespan, as evidenced by the concrete deterioration on the low stage riser, even though the remotely operated vehicle (ROV) investigation indicated that the condition conduit is satisfactory overall. In addition, the recommended minimum conduit size of 30-inch for a yielding foundation was not met, although the minimum size 24-inch for a nonyielding foundation would be met. Given that UTR 5 has been in place for over 45 years, it could be considered akin to a nonyielding foundation. Whether or not replacement of the principal spillway or its components through a Watershed Rehabilitation Project is warranted, or whether maintenance activities can be completed to address the seepage, is dependent upon further investigation. If significant issues are present, and a rehabilitation project were to be undertaken, likely alternatives to fully bring the dam up to current criteria would include:

- Regrade ASW to slopes under 4% by reducing spillway crest width (reduce length by approximately 165 ft).
- Install 30-in PSW conduit and construct filter diaphragm.
- Install blanket drain on downstream slope.

Note that if maintenance work is done to address seepage and structural issues with the principal spillway, in lieu of a full rehabilitation project, then future assessments should be completed if agency or state policy changes such that the structure no longer meets pertinent dam safety criteria, rehabilitation should be re-evaluated for this dam. Any potential rehabilitation efforts should include measures to

address the seepage concerns and recommended minimum sizing deficiencies of the principal conduit along with the auxiliary spillway outlet slope.

10 COST ESTIMATES OF REHABILITATION ALTERNATIVES

A very approximate estimate of construction costs would be \$700,000 as detailed below. Assuming a mobilization cost of \$100,000 and erosion control cost of \$30,000.

- Regrade ASW by lengthening the spillway by 165 feet to be at a 4% slope. To lengthen the spillway and not have the control section on a bend, the existing control section will need to be transitioned to the west. This will incur approximate costs of:
 - Land acquisition (4.25 acs) – \$25,000
 - Common excavation (132,000 cy) - \$330,000
 - Topsoiling (12,000 cy) - \$30,000
- Remove existing 24" PSW and replace with 30" PSW. Install filter diaphragms for new PSW outlet works. This will incur approximate costs of:
 - Common excavation (25,000 cy) - \$62,500
 - 30" RCP (362 ft) - \$40,000
 - Filter Diaphragm (600 cy) – \$11,000
 - Topsoiling (400 cy) – \$1,000
- Install filter blanket on downstream embankment to elevation 1273 feet. This will incur approximate costs of:
 - Filter Blanket (3,000 cy) - \$60,000
- Install splitter dike in ASW and potential widening of ASW to account for lost flowage area. This will incur an approximate cost to only install the splitter dike of:
 - Splitter dike (6,000 cy) - \$100,000

11 CONCLUSIONS AND RECOMMENDATIONS

UTR 5 appears to meet key current Class C (high hazard) hydraulic criteria per TR-60 requirements. UTR 5 is hydraulically able to draw down below the principal spillway weir inlet within 10-days of a 100-year event. The dam also hydraulically does provide ample freeboard for wave runoff when a 6- or 24-hr SDH is routed and is not overtopped during the FBH. Additionally, the ASW geometry allows the designed vegetation class C to provide enough shear strength to resist the activation flows of the SDH but not for the vegetation class D. Finally, the FBH does not cause erosion significant enough to breach the upstream control section of the ASW based on TR-60 technical guidance. According to ND SWC criteria, however, the ASW velocity exceeds permissible limits for vegetated spillways. The NEM and TR-60 requires that applicable state and local dam safety regulations be met. ND SWC is currently working on revising their dam safety criteria and it is unknown whether criteria for vegetated ASWs may change.

The hazard classification of the dam should remain as a High Hazard Potential class, because of the depths and velocities experienced at a residence downstream of the dam, located at the toe of the beach ridge where the channelized valley is allowed to spread out in the expansive floodplain.

Additionally, Grand Forks County Road 16 is overtopped, and overtopping velocities are well above 10 ft/s.

In addition to not meeting the ND SWC ASW criteria, there are maintenance and design deficiencies that result in the dam not meeting current TR-60 requirements. In addition, there are limitations related to the scope of this assessment.

Maintenance Items: Multiple maintenance related deficiencies were noted that need to be addressed. Failure to do so has the potential to seriously compromise the safety of the structure. These include:

- **M1** – Repair rutting on the crest by adding appropriate fill, compacting, and revegetating. Motorized traffic should be restricted on the dam crest, especially with wet ground conditions, to prevent future deterioration.
- **M2** – Monitor a wet area on the downstream embankment bench (Elevation 1262). This wet area is likely from inadequate drainage of surface runoff since the bench elevation is above the normal operating pool level of 1248.2. If drainage of this area is considered, the NRCS recommends shallow grading to direct flow away from the ASW.
- **M3** – Repair animal rutting and restore uniform vegetation within auxiliary spillway. As discussed earlier in this report, vegetative cover is needed to provide erosion resistance during activation of the ASW. The lack of vegetation and animal rutting, which compromises the vegetation, will not provide the erosion protection needed during the modeled design events.
- **M4** – The low-stage concrete riser exterior shows signs of degradation, that if not fixed will lead to corrosion of the structural steel and the compromise of the low-stage riser. Grouting the current degradation would stall further deterioration, it is however unknown if the current structural steel has been compromised.
- **M5** – Investigate the flow observed beneath the principal spillway conduit. The installation of a small weir beneath the conduit would allow the seepage flow rate to be determined along with the small reservoir upstream of a weir could help to identify any transported material from within the embankment.

Design Deficiencies: Multiple design related deficiencies, regarding differences in the current dam design requirements of TR-60 and the original design, were found during this assessment. These include:

- **D1** - The use of seepage collars as seepage control along principal spillway conduits, per NRCS requirements shall no longer be used in design of dams. Although at the time that UTR 5 was designed, seepage collars were utilized. This is considered a design deficiency.
- **D2** - A replacement to seepage collars is an installation of a filter diaphragm around the conduit at the downstream side of the embankment. This acts as a barrier to seepage related piping and internal erosion by collecting sediment and at the same time allowing water to continue to seep through the filter. The lack of a filter diaphragm is considered a design deficiency.
- **D3** - The dam is equipped with a foundation drainage system, but the system does not meet the filtration and drainage requirements for Significant and High Hazard dams, per TR-60. See section 7 for more information regarding the required filtration and drainage systems. The lack of these filtration and drainage systems is considered a design deficiency.

- **D4** - There is no instrumentation installed on the dam that would monitor seepage or embankment movement or settlement. The lack of this monitoring equipment is considered a design deficiency.
- **D5** – The recommended minimum outlet size from TR-60 is 30-inch for a yielding foundation. Although, TR-60 recommends a minimum size is 24-inch for a nonyielding foundation. UTR 5 is comprised of a yielding foundation even though it could be considered akin to a nonyielding foundation since it has been in place for over 45 years. The current outlet conduit size is considered a design deficiency.
- **D6** – The recommended ASW slope from TR-60 should not exceed 4%, while the ASW for UTR 5 does have slopes above 4%. These steeper slopes are considered a design deficiency.
- **D7** – NEH Part 628, Chapter 50 recommends dividing the spillway width into bays of 200 feet or less to prevent concentrated flows. The 400-foot current ASW width is considered a design deficiency.
- **D8** – TR-60 requires that all State regulations be considered when assessing a dam structure. The North Dakota Dam Design Handbook suggests design criteria for determining permissible ASW velocities. Based upon a mixture of sod forming and bunch grasses, the permissible velocity, given the exit slope of the ASW over 5% and activation of the ASW less than 1%, is to be 5 ft/s or less. The maximum velocity within the auxiliary spillway determined by this assessment was 7.2 ft/s with Class C retardance and 8.4 ft/s with Class D retardance, which are greater than the permissible velocity allowed by the North Dakota Dam Design Handbook.

Recommendations: Although, there are no major rehabilitation measures proposed at this time, there are still a few minor recommendations that need to be noted. These include the following:

- **R1** – It is recommended that monitoring instrumentation be installed upon the dam, which would include, at a minimum, piezometer wells to monitoring pore water pressures in the dam to assess active seepage and monitor the surface movement of the embankment.
- **R2** – It is recommended that the Emergency Action Plan (EAP) be updated with a new document, based upon the dam breach inundation specifics of this assessment.

Assessment Limitations: There are limitations to the assessment that should be note. These include:

- 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 and extensive field geologic exploration and material testing.
- The analysis of the auxiliary spillway is dependent upon the assumed material properties of the underlying soil beyond the extents of the original geological investigation soil boring which was drilled within the spillway exit section. For assurance and verification of these assumptions a more extensive exploration of the subsurface soil would have to be conducted.

Prepared By:

Brian Mager, P.E.
Civil Engineer
North Dakota NRCS

Approved By:

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



Appendix A
Site Inspection Report

UPPER TURTLE RIVER WATERSHED

GRAND FORKS AND NELSON COUNTIES, NORTH DAKOTA

FLOODWATER RETARDING STRUCTURE NO. 5

SPONSORING AGENCIES:

NELSON COUNTY SOIL CONSERVATION DISTRICT
 WEST GRAND FORKS COUNTY SOIL CONSERVATION DISTRICT
 NELSON COUNTY WATER MANAGEMENT DISTRICT
 GRAND FORKS COUNTY WATER MANAGEMENT DISTRICT

WITH ASSISTANCE BY

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

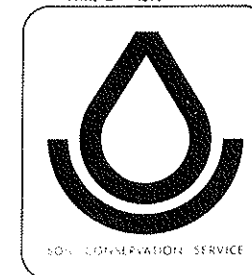
Construction Started: June 4, 1974
 Construction Completed: August 20, 1975
 Contractor: Phillip N. Stremick
 Box 512
 Wahalla, North Dakota 58282
 Project Engineers: Robert S. Fisher
 Larry A. Kuseske
 Project Inspector: Elmer M. Bittner
 Bench Mark: Elev. 1287.96 MSL
 Brass Cap set in concrete
 Upstream side near Sta 15+50
 Steel Post near tree line

INDEX TO DRAWINGS

SHEET NO.	DESCRIPTION
1	COVER SHEET
2	TABLE OF QUANTITIES LOCATION MAP RESERVOIR CAPACITY TABLE
3 AND 4	TOPOGRAPHIC MAP OF RESERVOIR AREA
5 AND 6	TOPOGRAPHIC MAP OF DAM SITE AREA
7	PROFILE ALONG CENTERLINE OF DAM AND EMERGENCY SPILLWAY
8	MAXIMUM CROSS SECTION OF DAM RIPRAP DETAIL EMBANKMENT MATERIALS LOG OF ADDITIONAL BORINGS
9	CROSS SECTION OF DAM ALONG CENTERLINE OF PRINCIPAL SPILLWAY
10 AND 11	FOUNDATION DRAIN
12 THRU 15	STANDARD COVERED RISER AND STEEL DETAILS
16	SECOND STAGE TRASH RACK FOR STANDARD COVERED RISER DETAILS OF PLATE CONSTRUCTION JOINT DETAILS OF MANHOLE FRAME AND LID
17 THRU 19	DETAILS OF FIRST STAGE INLET
20	DETAILS OF ORIFICE TRASH RACK
21	CRAPLE AND ANTISEEP COLLAR DETAILS
22	CANTILEVER OUTLET

ATTACHMENT
 5, R-10,000, 47 SOIL LEGEND AND SYMBOLS

AS BUILT
 JAN. 20 1977



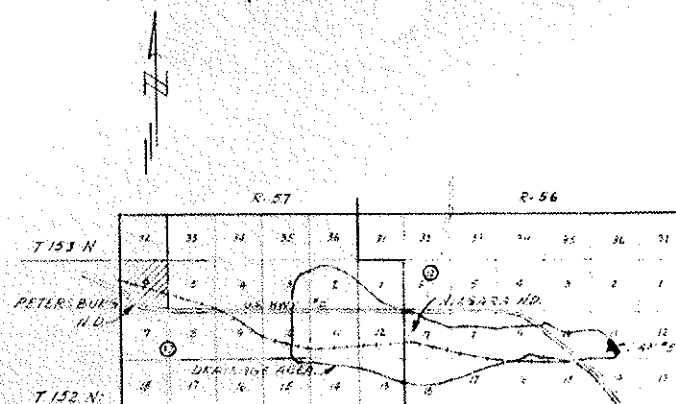
I CERTIFY THAT THE PLANS AND DETAILED SPECIFICATIONS FOR THIS PROJECT WERE DEVELOPED BY THE SOIL CONSERVATION SERVICE AND ARE APPROVED.

Robert S. Fisher
 STATE CONSERVATION ENGINEER

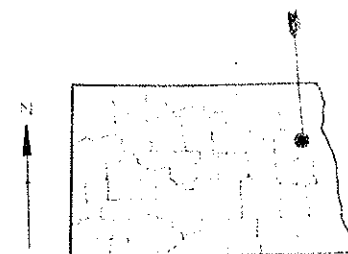
9-2-73
 DATE

Elmer M. Bittner
 HEAD, ENGINEERING AND WATER-
 SHED PLANNING UNIT

10-24-73
 DATE



LOCATION MAP
 1/4 = 0.5 square miles
 1 0 1 2 3
 Scale in miles



LOCATION IN NORTH DAKOTA

RESERVOIR CAPACITY TABLE

	ELEVATION	AREA - ACRES	ACRE FEET	ACCUMULATED ACRE FEET
	1227.0	0	0	0
	1230.0	0.27	0.4	0.4
	1235.0	1.43	4.3	4.7
	1240.0	3.88	13.3	17.9
	1245.0	7.18	27.7	45.6
FL. of orifice	1247.0	—	—	62.0 + 20
	1250.0	11.12	43.9	91.5
	1255.0	15.90	67.7	159.2
	1260.0	20.06	89.9	249.0
	1265.0	26.70	116.9	366.0
	1270.0	34.58	153.2	519.0
Crest of 2nd stage	1271.0	—	—	560.0
	1275.0	42.26	192.1	711.0
	1280.0	49.51	229.4	941.0
	1285.0	59.58	272.7	1213.0
Emg. Spill. Crest	1289.0	—	—	1400.0
	1290.0	68.18	319.4	1533.0
Top of dam	1294.0	—	—	1810.0
	1295.0	77.13	363.3	1896.0

ADD 20 AC/FT FOR EXCAVATED POOL
 TOTAL 82 AC/FT SED. POOL

TABLE OF QUANTITIES *

ITEM	UNIT	QUANTITY
EXCAVATION, COMMON: DEBRIS BASIN	CU. YD.	462.1
CUTOFF TRENCH	CU. YD.	627.6
PIPE TRENCH (Prim. Spwy.)	CU. YD.	4896.3
FOUNDATION DRAIN	CU. YD.	268
OUTLET CHANNEL (Includes Plunge Pool)	CU. YD.	12,579
EMERGENCY SPILLWAY	CU. YD.	227,536
EARTH FILL EMBANKMENT, CLASS A	CU. YD.	209,431
CLEARING	LUMP SUM	266,415
CLEARING & GRUBBING	LUMP SUM	104,144
SALVAGING & SPREADING TOP SOIL	SG. YD.	104,144
REINFORCED CONCRETE, CLASS 4000, AIR ENTRAINED	CU. YD.	175.8
STEEL REINFORCEMENT	LBS.	17969
24" DIA. REINFORCED CONCRETE PIPE WITH CORNER FRAMES AND STEEL JOINTS	LIN. FT.	456
24" DIA. SPIGOT WALL FITTING	EACH	2
TRASH RACKS	LUMP SUM	—
MANHOLE FRAMES & COVERS	LUMP SUM	—
SEEDING (Includes Fertilizing and Mulching)	ACRE	33.2
DIVERSIONS	LIN. FT.	1300
DRAIN FILL	CU. YD.	228.3
LOOSE ROCK RIPRAP WITH BEDDING: PLUNGE POOL	CU. YD.	152.4
FACE OF DAM	CU. YD.	3357.2
6" DIA. CLASS 150 ASBESTOS CEMENT PIPE, PERFORATED	LIN. FT.	121
6" DIA. CLASS 150 ASBESTOS CEMENT PIPE, NON PERFORATED	LIN. FT.	136
6" 45° CAST IRON ELBOW	EACH	2
6" CAST IRON TEE	EACH	1

* ALL QUANTITIES ARE ESTIMATED

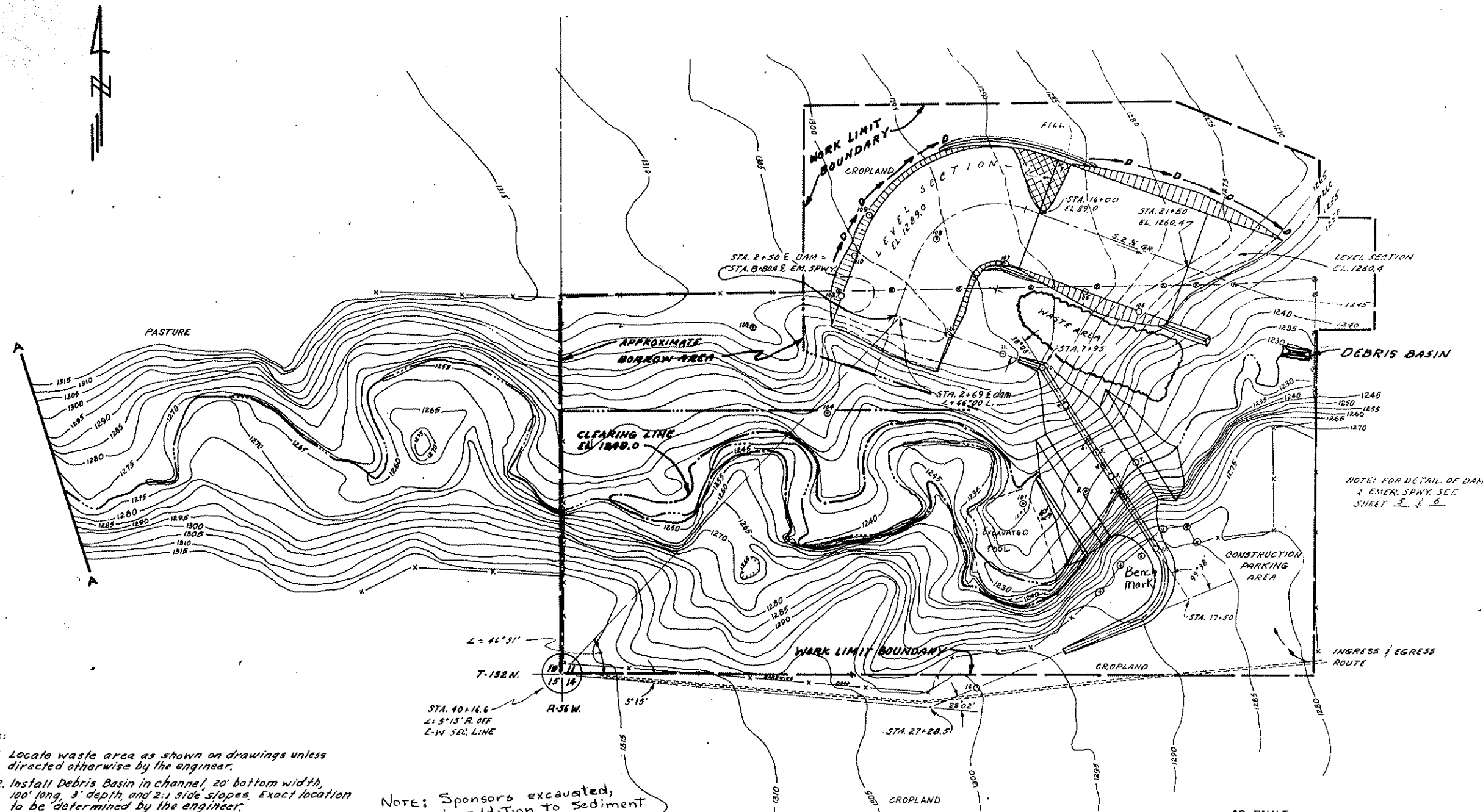
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FLOODWATER RETARDING STRUCTURE
 NO. 5

UPPER TURTLE RIVER WATERSHED
 Grand Forks & Nelson County, North Dakota

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

Date	Approved by
Designed by R. E. Sande, P.E. 8/76	Title
Drawn by J.R.D. 5/77	Title
Traced by	Sheet No. 2 of 22
Checked by Leland M. Soels 8/75	Drawing No. 5, E-32, 356



NOTES:

1. Locate waste area as shown on drawings unless directed otherwise by the engineer.
2. Install Debris Basin in channel, 20' bottom width, 100' long, 3' depth, and 2:1 side slopes. Exact location to be determined by the engineer.
3. Excavate Debris Basin prior to clearing and grubbing and stripping.

Note: Sponsors excavated, in addition to Sediment Pool, for fisheries. The Quantity was 32,247.4 cu. yds. This was done at Sponsors Cost. Bottom ELEV. varies from 1226 msl to 1229 msl. 20 Ac/FT.

TOPOGRAPHIC MAP OF RESERVOIR AREA

Scale in feet
200 100 0 100 200

TOP OF DAM EL. 1294.0
EMERGENCY SPWY EL. 1289.0
2nd STAGE EL. 1271.0
1st STAGE EL. 1247.0
CLEARING LINE
BORROW LIMITS
WORK LIMITS
FENCE REMOVAL
LOCATION SOIL TEST HOLES
DIVERSION LOCATION

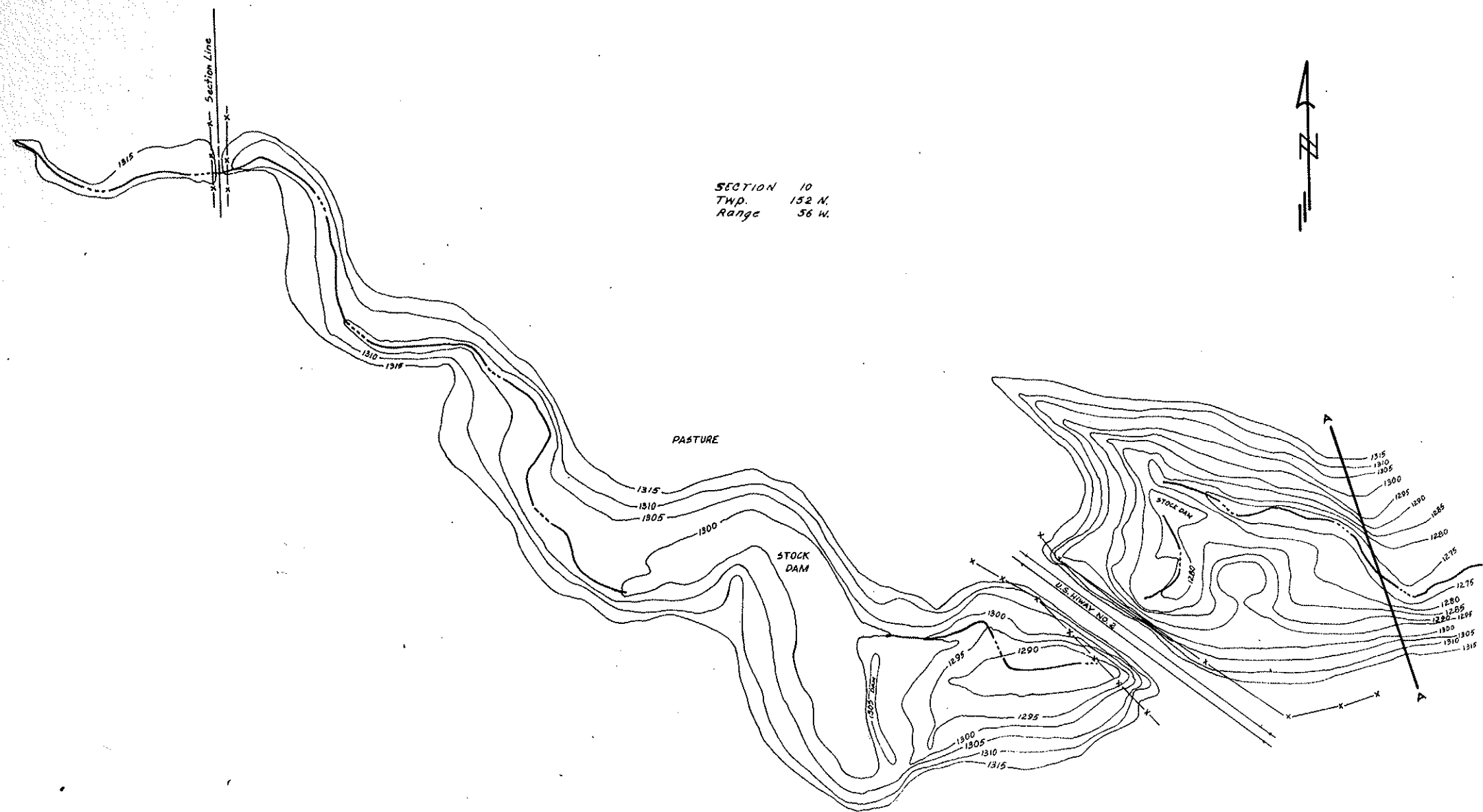
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JAN 20 1977

FLOODWATER RETARDING STRUCTURE NO. 5

UPPER TURTLE RIVER WATERSHED
Grand Forks Co. North Dakota

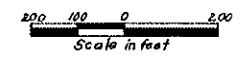
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by R. D. Sauer, R. S. E. 1/2, 1/2
Drawn by J. R. D. N. B. D. 11/71
Traced by
Checked by Leland M. Saele 8/73
Date
Approved by
Title
Sheet No. 3
Drawing No. 5, E-32, 356

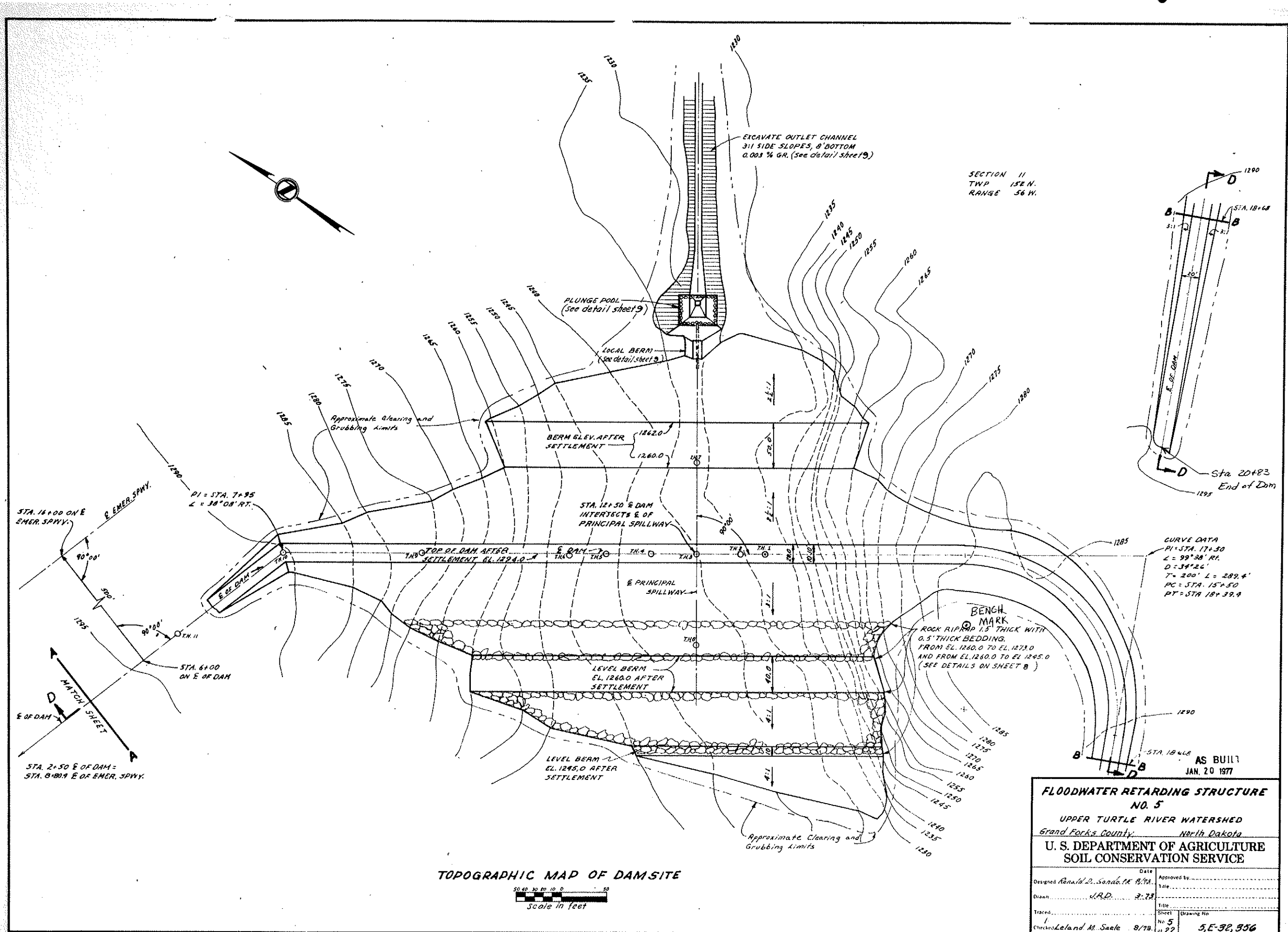


SECTION 10
TWP. 152 N.
Range 56 W.

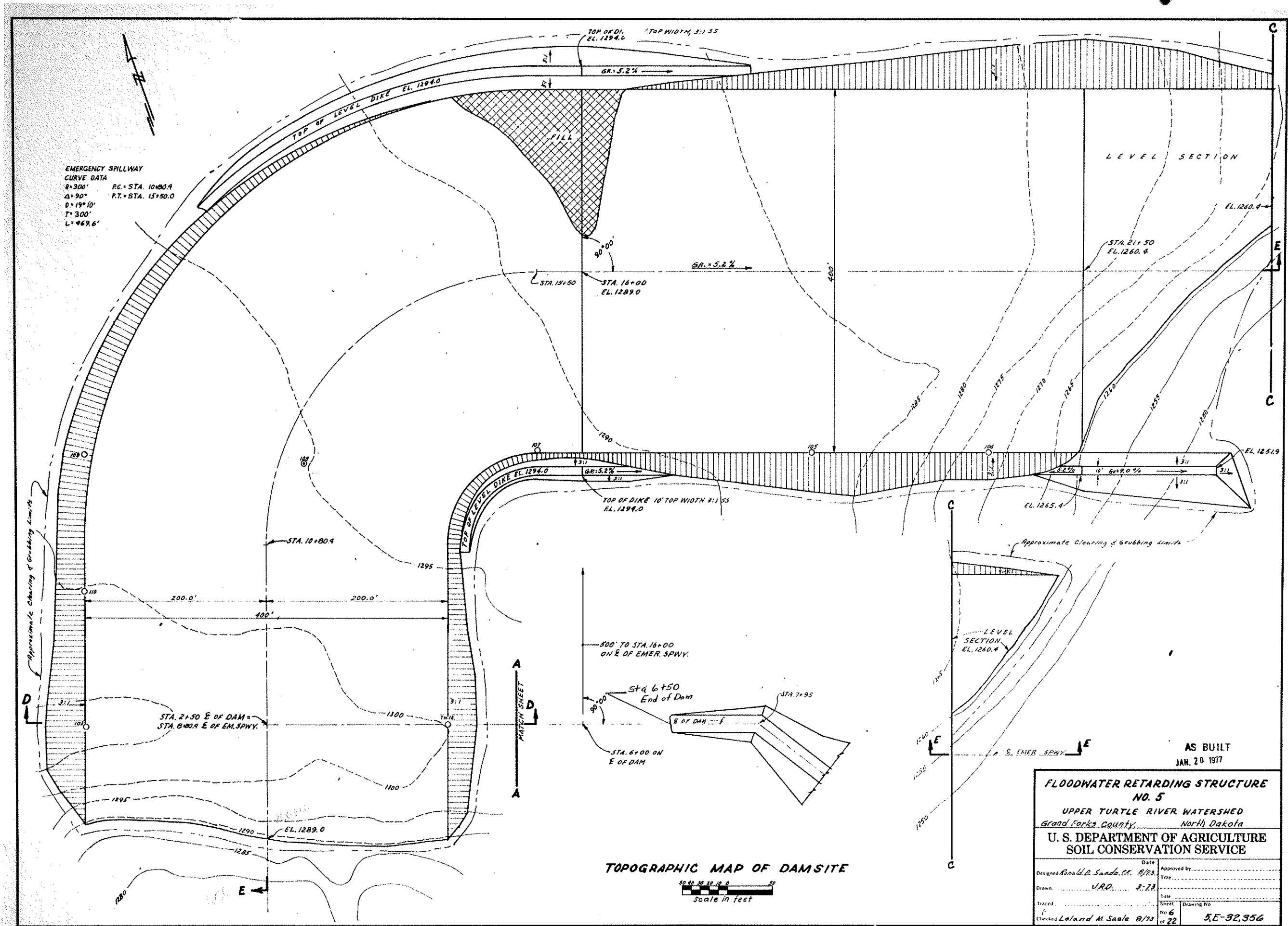
TOPOGRAPHIC MAP OF RESERVOIR AREA



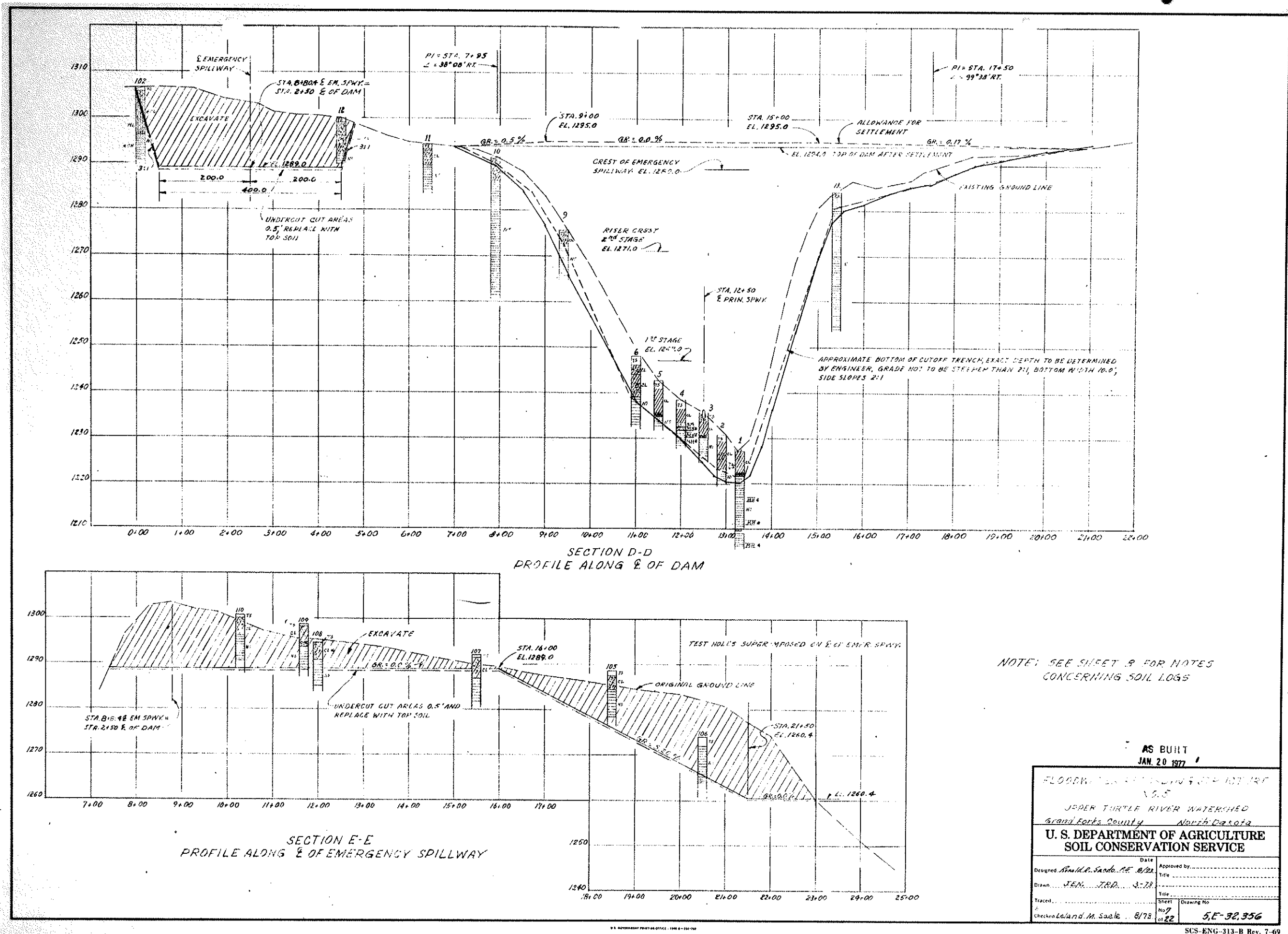
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JAN 20 1977	
FLOODWATER RETARDING STRUCTURE NO. 5	
UPPER TURTLE RIVER WATERSHED	
Grand Forks Co.	North Dakota
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed by <i>Ronald D. Sanda</i>	Date <i>8/73</i>
Drawn by <i>N.B.D.</i>	Type <i>1/71</i>
Checked by <i>Leland M. Saala</i>	Scale <i>8/73</i>
Drawn by <i>22</i>	Drawing No. <i>5, E-32, 356</i>

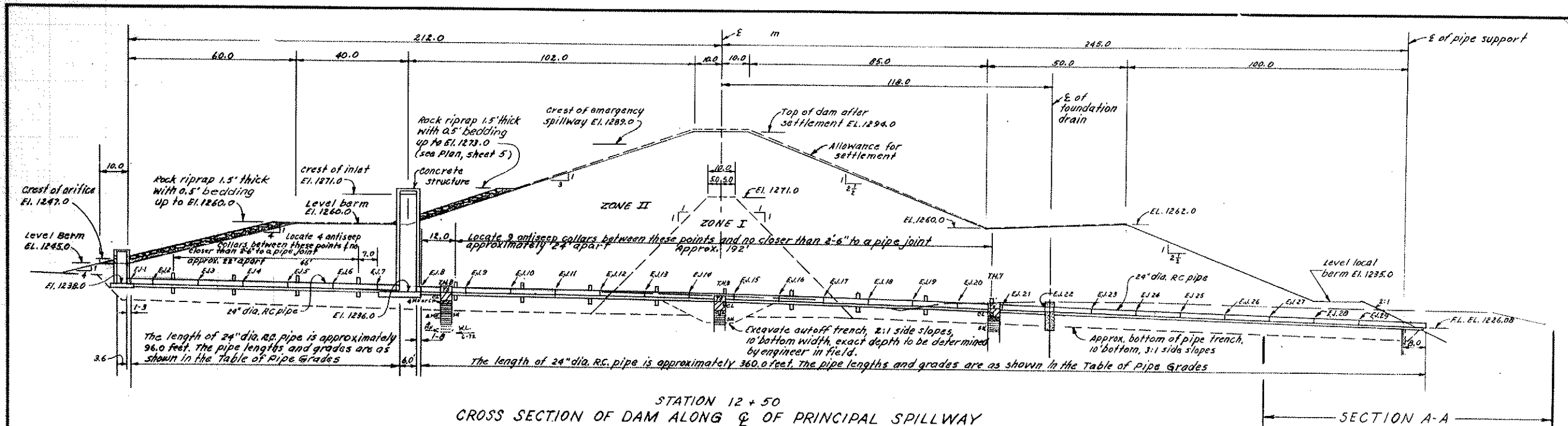


FLOODWATER RETARDING STRUCTURE NO. 5			
UPPER TURTLE RIVER WATERSHED			
Grand Forks County, North Dakota			
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE			
Designed	Ronald D. Sandvik	Date	8/78
Drawn	J.R.D.	Title	3.73
Traced		Sheet	No 5
Checked	Leland M. Saele	Date	8/78
		Drawing No.	5E-32, 356



Designed <i>Reed L. P. Sandoz</i> 8/75		Approved by _____	
Drawn <i>U.R.D.</i> 4-77		Title _____	
Traced _____		Sheet _____	
Checked <i>Leland M. Sandoz</i> 8/77		Drawing No. 5E-32,356	





STATION 12+50
CROSS SECTION OF DAM ALONG $\bar{C}$ OF PRINCIPAL SPILLWAY

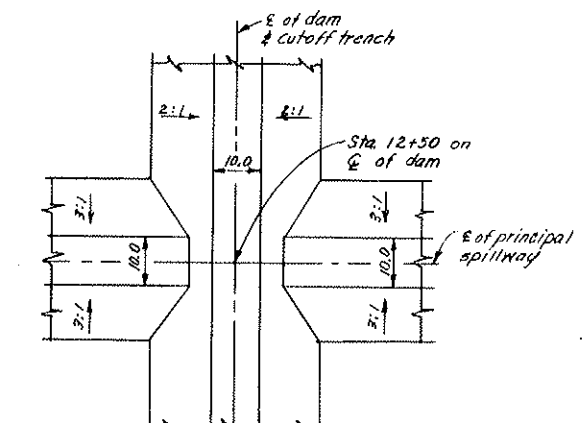
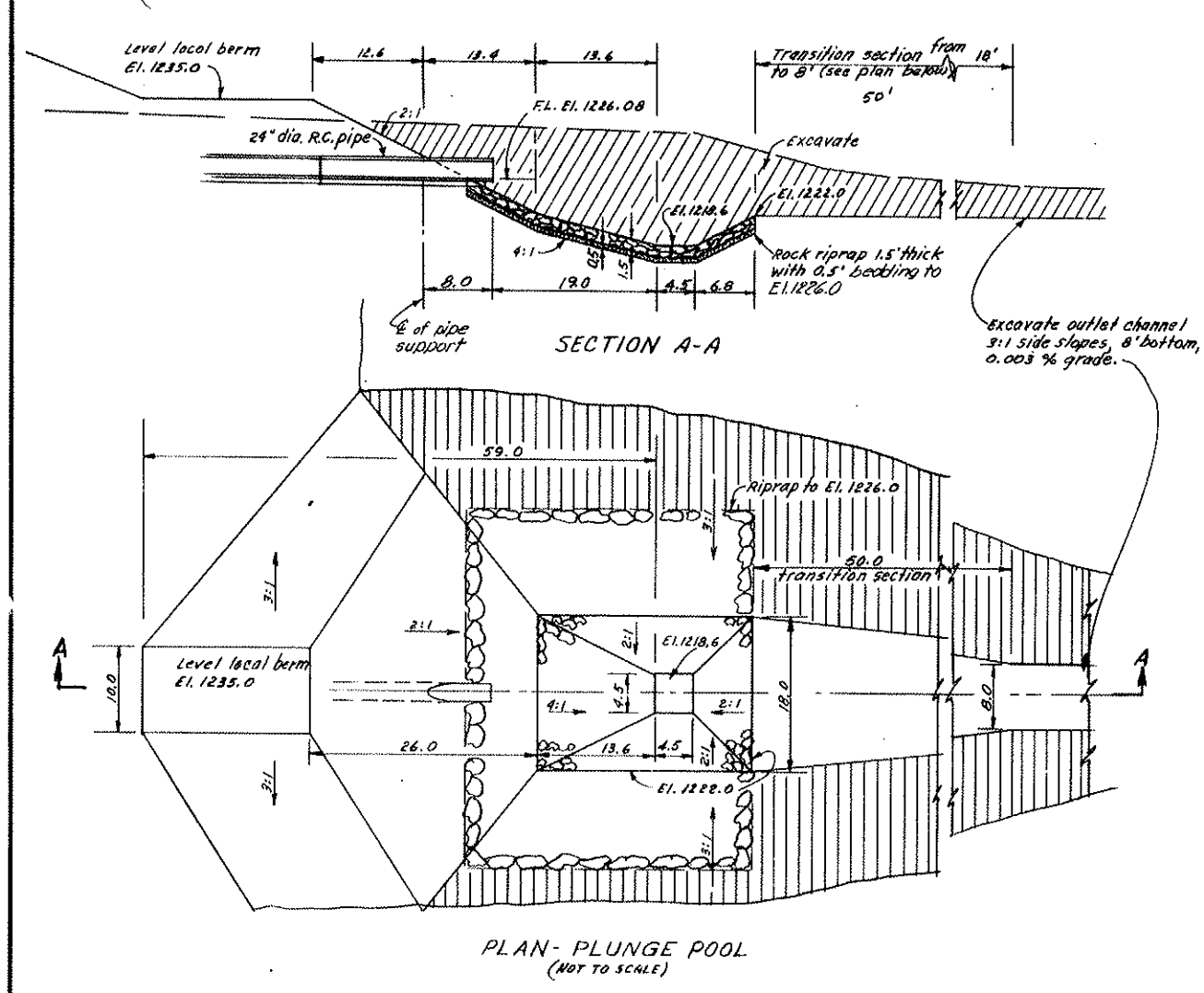


TABLE OF PIPE GRADES

LOCATION	LENGTH	GRADE	ELEVATION
INLET			
E.J. #1	1-3	1.0 %	1238.00
E.J. #2	8-0	1.25 %	1237.99
E.J. #3	16-0	1.75 %	1237.61
E.J. #4	16-0	1.75 %	1237.33
E.J. #5	16-0	1.75 %	1237.05
E.J. #6	16-0	1.75 %	1236.77
E.J. #7	16-0	1.75 %	1236.49
OUTLET	8-0	2.0 %	1236.33
UPSTREAM RISER FLOOR			1236.00
OUTLET			
RISER FLOOR			1236.00
E.J. #8	1-8	1.0 %	1235.98
E.J. #9	16-0	1.25 %	1235.78
E.J. #10	16-0	1.50 %	1235.58
E.J. #11	16-0	1.50 %	1235.30
E.J. #12	16-0	1.75 %	1235.02
E.J. #13	16-0	2.0 %	1234.70
E.J. #14	16-0	2.25 %	1234.38
E.J. #15	16-0	2.50 %	1234.02
E.J. #16	16-0	2.75 %	1233.66
E.J. #17	16-0	3.0 %	1233.30
E.J. #18	16-0	3.25 %	1232.90
E.J. #19	16-0	3.50 %	1232.50
E.J. #20	16-0	3.75 %	1232.10
E.J. #21	16-0	4.0 %	1231.62
E.J. #22	16-0	4.25 %	1231.06
E.J. #23	16-0	4.50 %	1230.50
E.J. #24	16-0	4.75 %	1229.98
E.J. #25	16-0	5.0 %	1229.46
E.J. #26	16-0	5.25 %	1228.94
E.J. #27	16-0	5.50 %	1228.42
E.J. #28	16-0	5.75 %	1227.90
E.J. #29	16-0	6.0 %	1227.38
OUTLET	24-0	6.25 %	1226.86

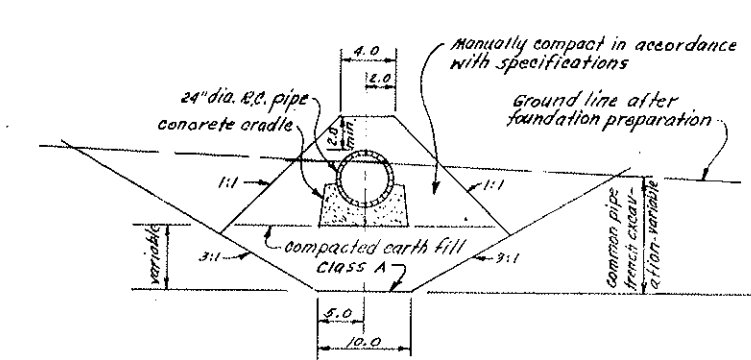


DIAGRAM OF BACKFILL FOR 24" PIPE

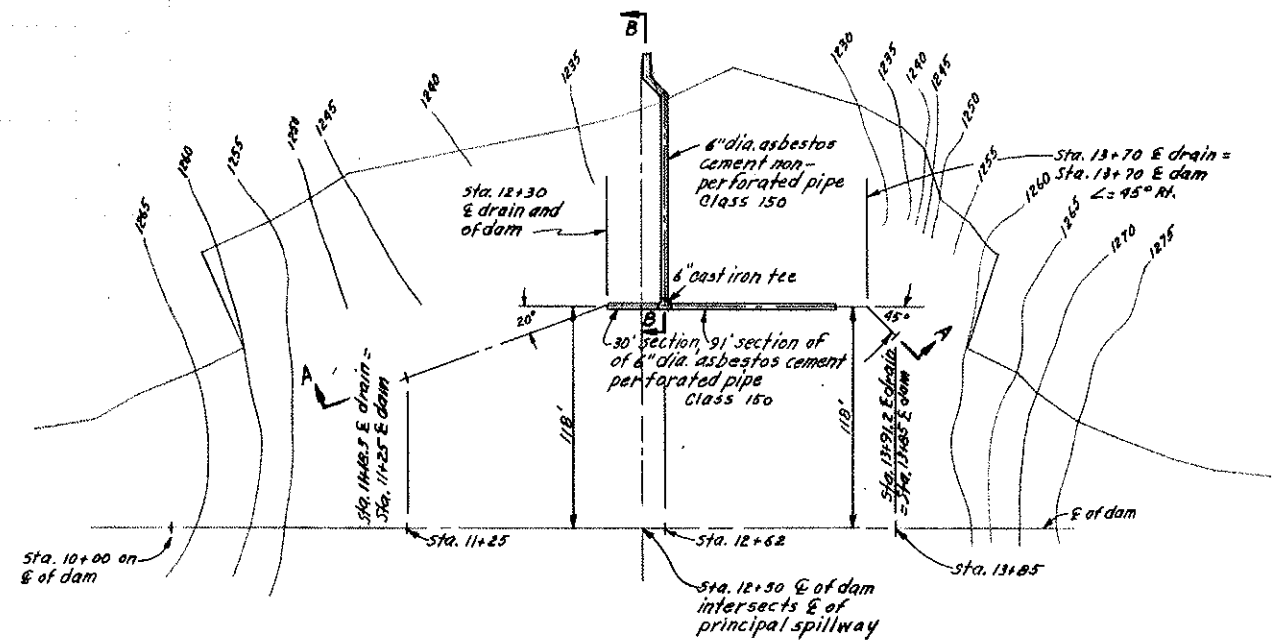
FLOODWATER RETARDING STRUCTURE
NO. 5
UPPER TURTLE RIVER WATERSHED
Grand Forks Co. North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

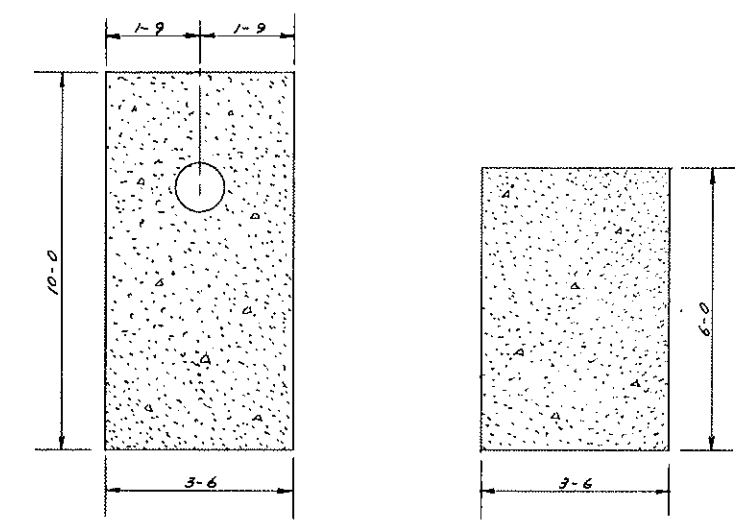
Designed *Paul H. P. Sank* P.E. 9/70
Drawn *J.R.D. 8/13*
Traced *J.R.D. 8/13*
Checked *Leland M. Sank* P.E. 8/13

Date *Aug 20, 1977*
Approved by *J.R.D. 8/13*
Title *5, E-32, 356*

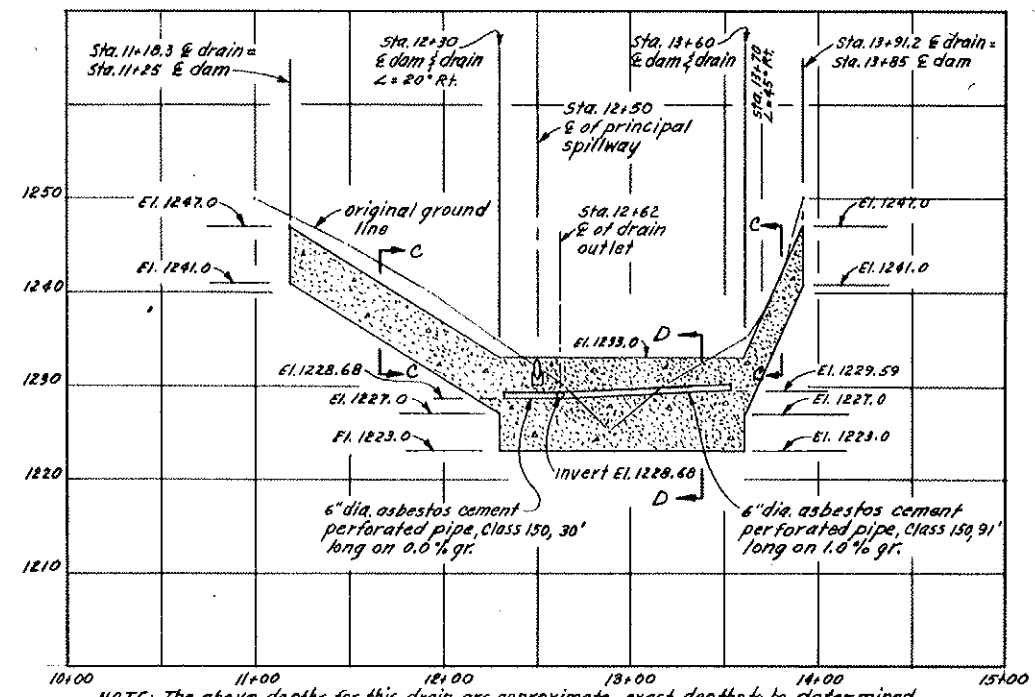
Sheet *9* of *22*
Drawing No. *5, E-32, 356*



PLAN OF BASE OF DAM SHOWING FOUNDATION DRAIN



SECTION D-D
SECTION C-C
DETAILS OF FOUNDATION DRAIN
N.T.S.



NOTE: The above depths for this drain are approximate, exact depths to be determined by engineer in field

SECTION A-A
PROFILE ALONG E OF TRANSVERSE FOUNDATION DRAIN

DRAIN FILTER MATERIAL GRADATION

SIEVE NO.	% PASSING
1"	100
3/4"	90-100
1/2"	65-100
3/8"	30-75
4"	5-25
8"	0-10
16"	0-5
200"	0-5

TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
EXCAVATION FOR FOUNDATION DRAIN	CU. YD.	268
FILTER MATERIAL	CU. YD.	280
6" DIA. PERFORATED ASBESTOS CEMENT PIPE CLASS 150	LIN. FT.	121
6" DIA. NONPERFORATED ASBESTOS CEMENT PIPE CLASS 150	LIN. FT.	136
6" 45° CAST IRON ELBOW	EACH	2
6" CAST IRON TEE	EACH	1

NOTES:

1. Provide animal guard at outlet end of outlet pipe
2. Plug upper end of pipe with 6" concrete or prefabricated cap.
3. The depth of fill over drain pipe shall be at least 2' before passing heavy equipment over pipe.
4. Where drain trench is above ground line, place compacted earth fill to elevation at top of drain and excavate drain in compacted fill.

AS
COMPLETION
DATE: JAN 20, 1977

FLOODWATER RETARDING STRUCTURE
NO. 5
UPPER TURTLE RIVER WATERSHED
GRAND FORKS COUNTY, NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed: Barry D. Sande, PE Date: 8/73 Approved by: _____
Drawn: J.R.D. 2/73 Title: _____
Traced: _____ Title: _____
Checked: ALAN M. SABLE 8/73 Sheet: 10 of 22 Drawing No: 5E-32, 356

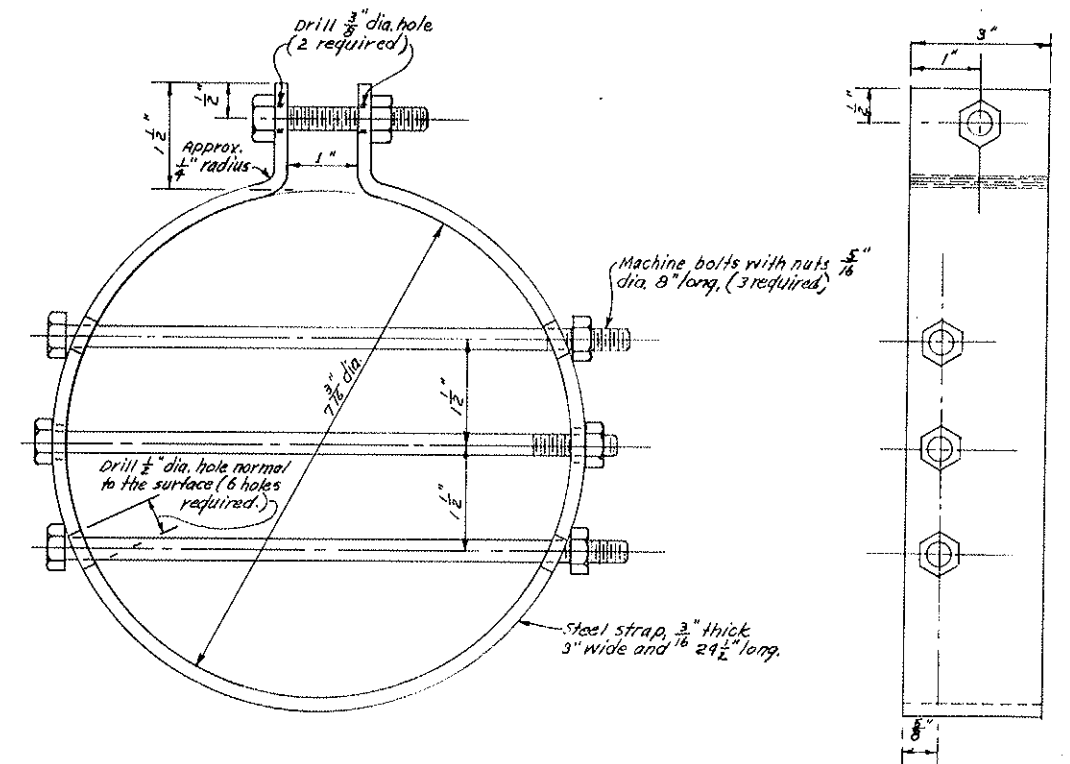
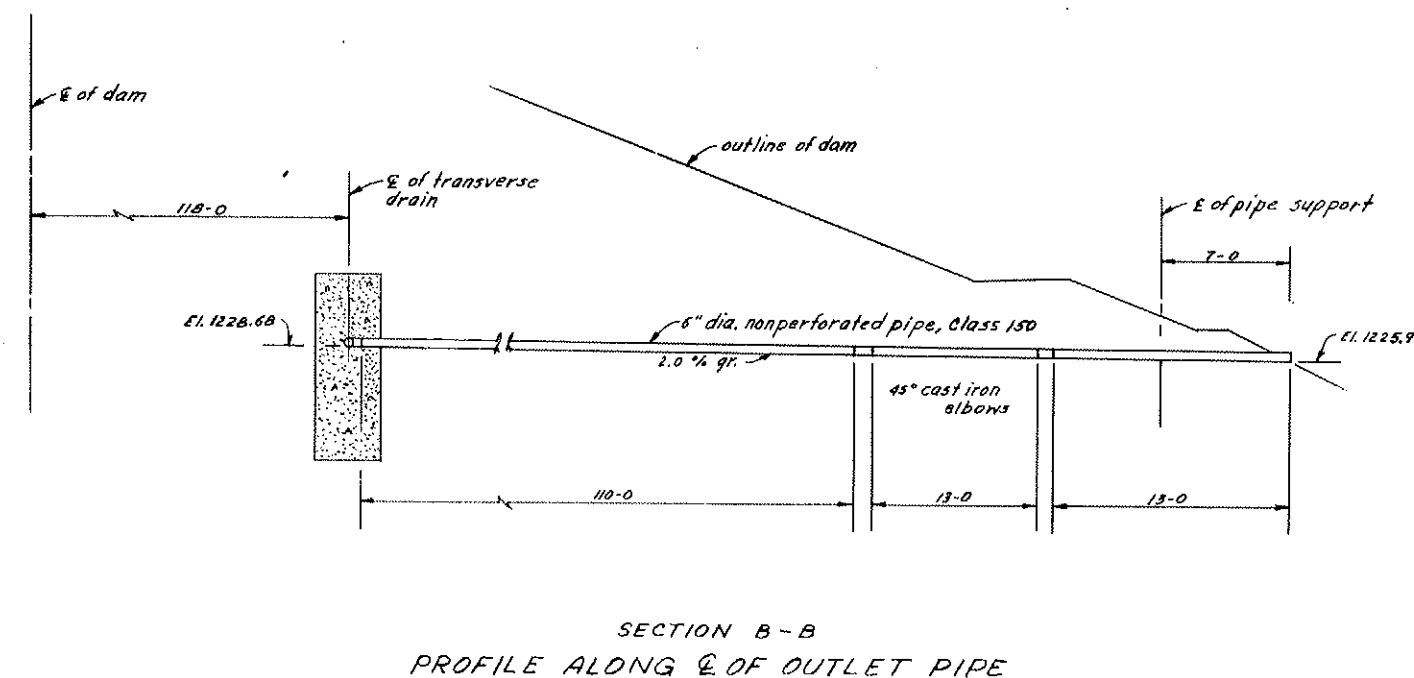
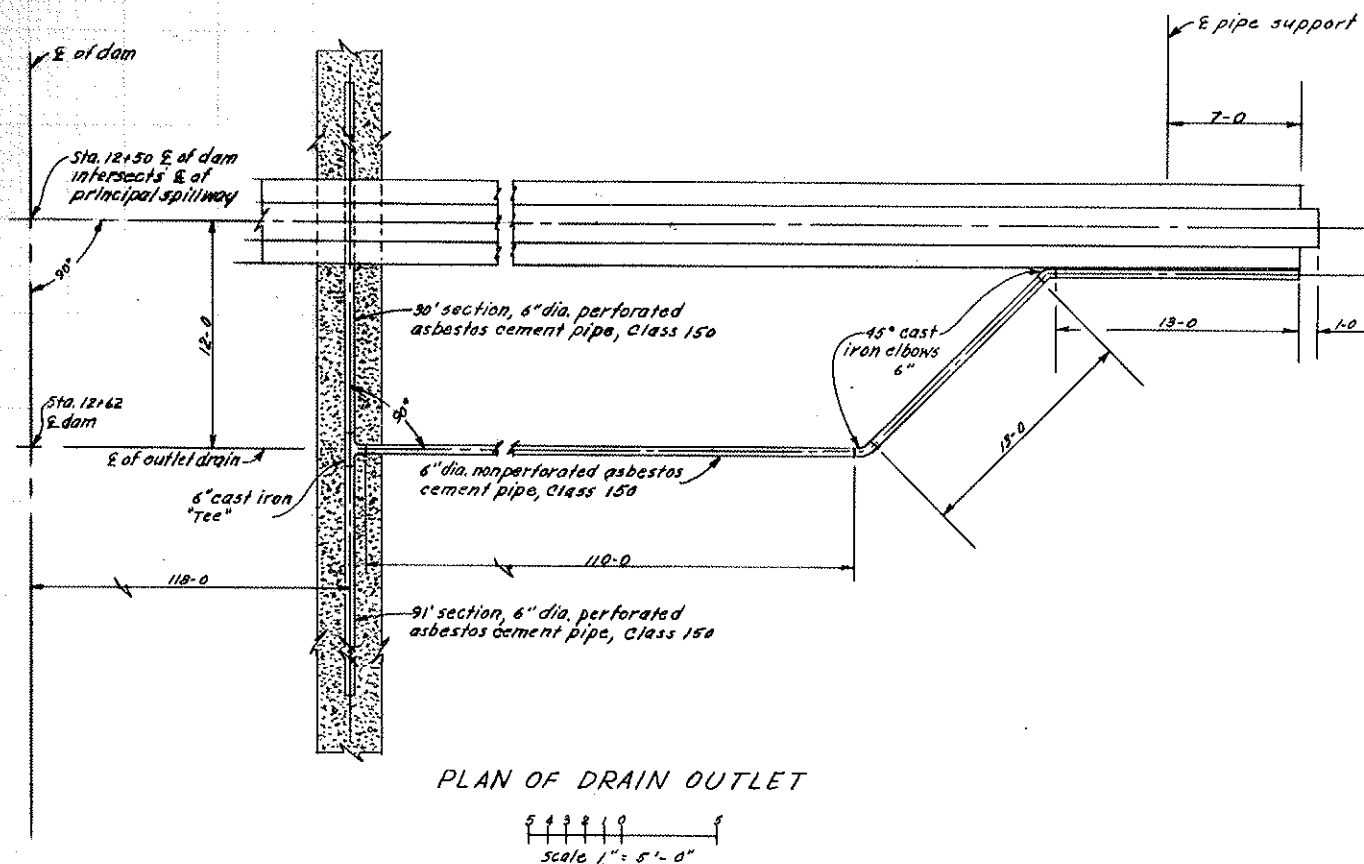


TABLE OF QUANTITIES

ITEM	UNIT	QUANTITY
Hex. head machine screw 5/16" dia. 2" long with nut	each	1
Machine bolt 3/16" dia. 8" long w/nuts	each	3
Steel strap, 3/16" x 3"	inch	24 1/2

Note: All parts to be galvanized

ANIMAL GUARD FOR 6" DIA. ASBESTOS CEMENT OUTLET DRAIN PIPE

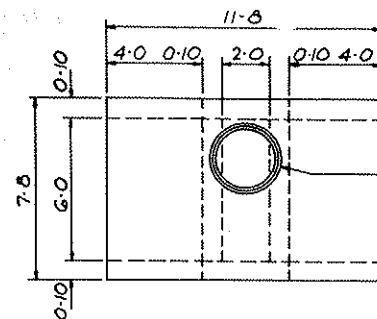
Note:

Animal guard to be installed over end of outlet drain pipe. Guard bolts shall be placed against pipe end.

AS BUILT
COMPLETION
DATE: JAN 20, 1977

FLOODWATER RETARDING STRUCTURE
NO. 5
UPPER TURTLE RIVER WATERSHED
GRAND FORKS CO. NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

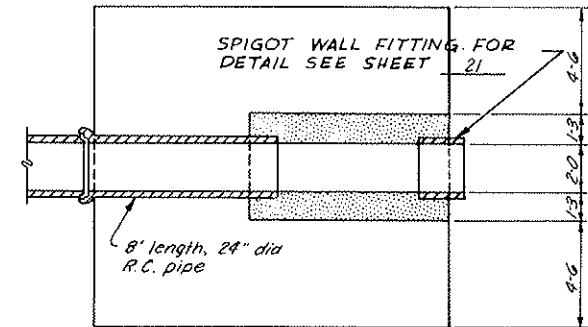
Designed: *David R. Saele* Date: *8/73*
Drawn: _____
Traced: _____
Checked: *L. ELAND M. SAELE* 8/73
Approved by: _____
Title: _____
Drawing No: *5, E-32, 356*



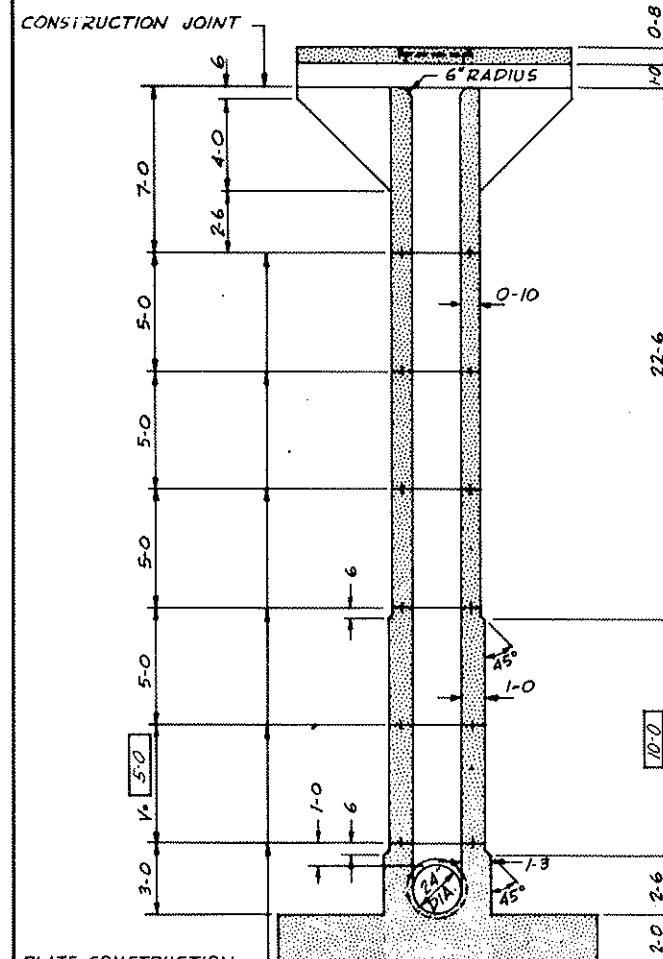
MANHOLE FRAME FOR
DETAIL SEE SHEET 16

FOR DETAIL OF TRASH-
RACK ANGLES AND GRATING
SEE SHEET 16

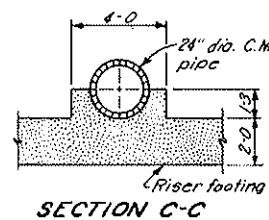
TOP PLAN



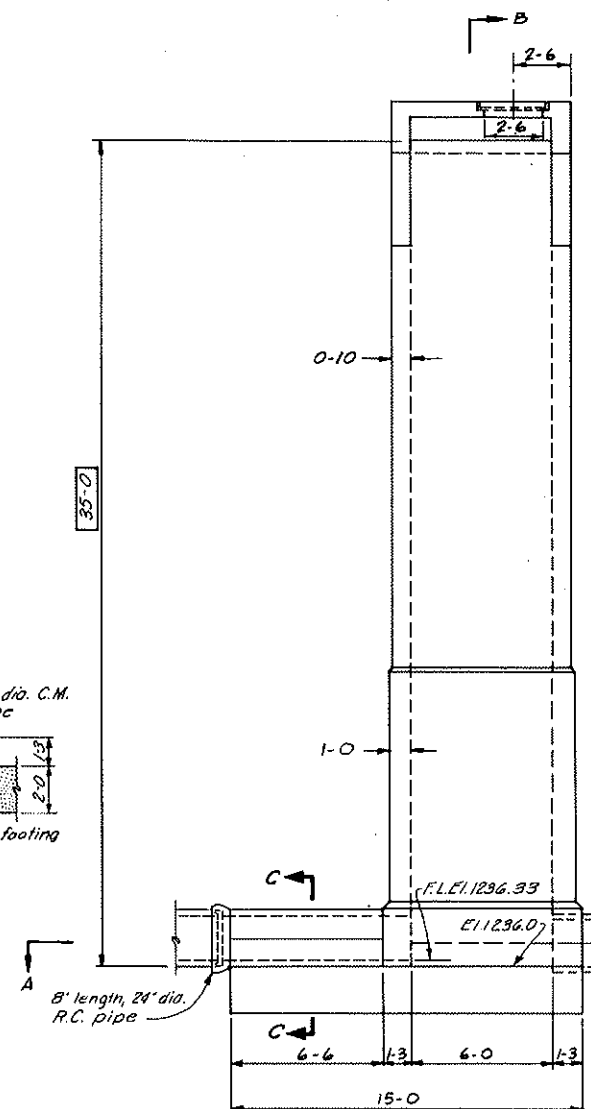
SECTION A-A



SECTION B-B



SECTION C-C



SIDEWALL ELEVATION

STL								SCHEDULE							
MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH	MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	15	13-0	1	-	-	195-0								
B2	6	14	14-6	1	-	-	203-0								
B3	7	26	9-9	1	-	-	253-6								
B4	8	20	7-3	21	3-2	4-1	145-0								
B5	6	14	14-6	1	-	-	203-0								
B6	6	10	13-0	1	-	-	130-0								
B7	7	9	13-0	1	-	-	117-0								
B8	6	2	5-9	1	-	-	11-6								
B9	5	5	5-0	21	1-0	4-0	25-0								
B10	5	3	7-1	21	1-0	6-1	21-3								
B11	5	10	7-1	21	1-0	6-1	70-10								
B12	7	10	7-1	21	1-0	6-1	70-10								
B13	5	2	5-0	21	1-0	4-0	10-0								
B14	6	8	6-8	1	-	-	53-4								
B15	5	4	2-8	1	-	-	10-8								
B16	5	10	7-10	21	2-11	4-11	78-4								
B17	5	4	5-9	21	0-10	4-11	23-0								
B18	5	4	5-7	21	0-8	4-11	22-4								
B19	5	2	6-5	21	1-6	4-11	12-10								
B20	7	4	8-0	21	3-0	5-0	32-0								
B21	7	20	4-4	1	-	-	86-8								
B22	5	5	3-8	1	-	-	18-4								
B23	5	2	3-8	1	-	-	7-4								
B24	5	2	2-5	1	-	-	4-10								
B25	5	2	2-7	1	-	-	5-2								
R1	5	12	11-7	1	-	-	139-0								
R2	7	4	12-3	1	-	-	49-0								
R3	5	16	9-6	1	-	-	132-0								
R4	7	8	9-6	1	-	-	76-0								
R5	5	20	6-8	1	-	-	133-4								
R6	5	10	2-8	1	-	-	26-8								
R7	7	40	8-0	21	3-0	5-0	320-0								
R8	6	14	6-8	1	-	-	93-4								
R9	5	10	2-8	1	-	-	26-8								
R10	6	36	7-8	21	2-10	4-10	276-0								
R11	5	16	3-8	1	-	-	58-8								
R12	5	8	3-8	1	-	-	29-4								
R13	6	4	7-4	21	2-8	4-8	29-4								
R14	5	10	11-7	1	-	-	115-10								
R15	5	4	11-7	1	-	-	46-4								
R16	5	12	11-7	1	-	-	139-0								
R17	5	6	11-7	1	-	-	69-6								
R18	6	14	6-8	1	-	-	93-4								
R19	5	8	2-8	1	-	-	21-4								
R20	6	40	7-4	21	2-8	4-8	293-4								
R21	5	12	6-8	1	-	-	80-0								
R22	5	8	2-8	1	-	-	21-4								
R23	6	28	7-4	21	2-8	4-8	205-4								
R24	5	10	6-7	1	-	-	65-10								
R25	5	4	6-7	1	-	-	26-4								
R26	5	12	6-7	1	-	-	79-0								
R27	5	6	6-7	1	-	-	39-6								
R28	5	8	6-8	1	-	-	53-4								
R29	5	8	2-8	1	-	-	21-4								
R30	5	24	7-0	21	2-6	4-6	168-0								
T1	5	10	6-6	1	-	-	65-0								
T2	5	6	8-3	1	-	-	49-6								
T3	5	10	6-9	1	-	-	67-6								
T4	5	6	8-3	1	-	-	49-6								
T5	5	12	6-8	1	-	-	80-0								
T6	5	4	2-8	1	-	-	10-8								
T7	5	2	3-8	1	-	-	7-4								
T8	5	2	6-2	1	-	-	12-4								
T9	5	2	8-8	1	-	-	17-4								
T10	5	2	11-2	1	-	-	22-4								
T11	5	24	7-0	21	2-6	4-6	168-0								
T12	5	4	4-8	1	-	-	8-8								
T13	5	4	3-5	1	-	-	13-8								
T14	5	4	2-2	1	-	-	8-8								
T15	5	4	7-3	19	1-8	5-7	29-0								
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T17	5	2	6-2	1	-	-	12-4								
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T19	5	2	11-2	1	-	-	22-4								
T20	5	4	4-8	1	-	-	18-8								
T21	5	4	3-5	1	-	-	13-8								
T22	5	4	2-2	1	-	-	8-8								
T23	5	4	7-3	19	1-8	5-7	29-0								
T24	5	2	11-2	1	-	-	22-4								
T25	4	12	6-8	1	-	-	80-0								
T26	4	2	3-2	1	-	-	6-4								
T27	4	6	11-2	1	-	-	67-0								
T28	4	4	4-3	1	-	-	17-0								
T29	5	20	5-11	21	1-5	4-6	118-4								
T30	5	2	4-10	21	1-5	3-5	9-8								
T31	5	2	2-3	21	1-5	0-10	4-6								
T32	5	2	11-2	1	-	-	22-4								
T33	4	6	11-2	1	-	-	67-0								
T34	4	4	4-3	1	-	-	17-0								
															</

AS BUILT
JAN. 20 1977

QUANTITIES

STEEL

*4 BARS	254-4	170 LBS.
*5 BARS	2748-3	2866 LBS.
*6 BARS	1786-6	2683 LBS.
*7 BARS	1005	2054 LBS.
*8 BARS	145	387 LBS.
		8160 LBS.

CONCRETE = $38.7 + 0.74 V = 43.07$ CU. YDS.

LENGTH OF #5 BARS = $(2297-3) + (\text{LENGTH OF BARS R1, R3, R5 \& R6})$
 LENGTH OF #7 BARS = $(705-0) + (\text{LENGTH OF BARS R2, R4 \& R7})$

STANDARD COVERED RISER		
DESIGN CONSTANTS	$f'_c = 4000$ psi	$f'_c = 1600$ psi
	$n = 8$	$f_s = 20,000$ psi
STANDARD DWG. NO.	ES-3024-3530 E	
DATE	5-66	SHEET 1 OF 4

0 2 4 6
SCALE IN FEET

LOEWER, SARGENT & ASSOC.
ARCHITECTS & ENGINEERS
3720 FARRAGUT AVE. KENSINGTON, MD.

FLOODWATER RETARDING STRUCTURE
NO. 5

UPPER TURTLE RIVER WATERSHED
Grand Forks County North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

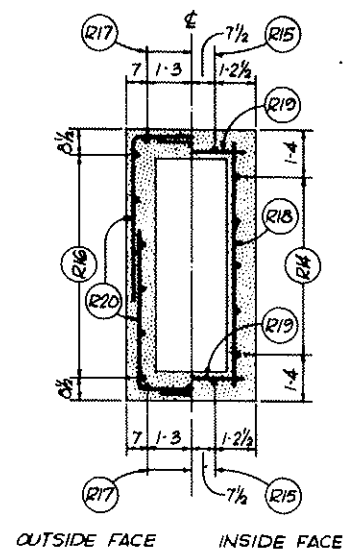
Designed	Ronald D. Sando	Date	3-77	Approved By	
Drawn		Title			
Traced		Sheet			
Checked	J.E.N.	No.	12	Drawing No.	5E-32,356
		of	22		



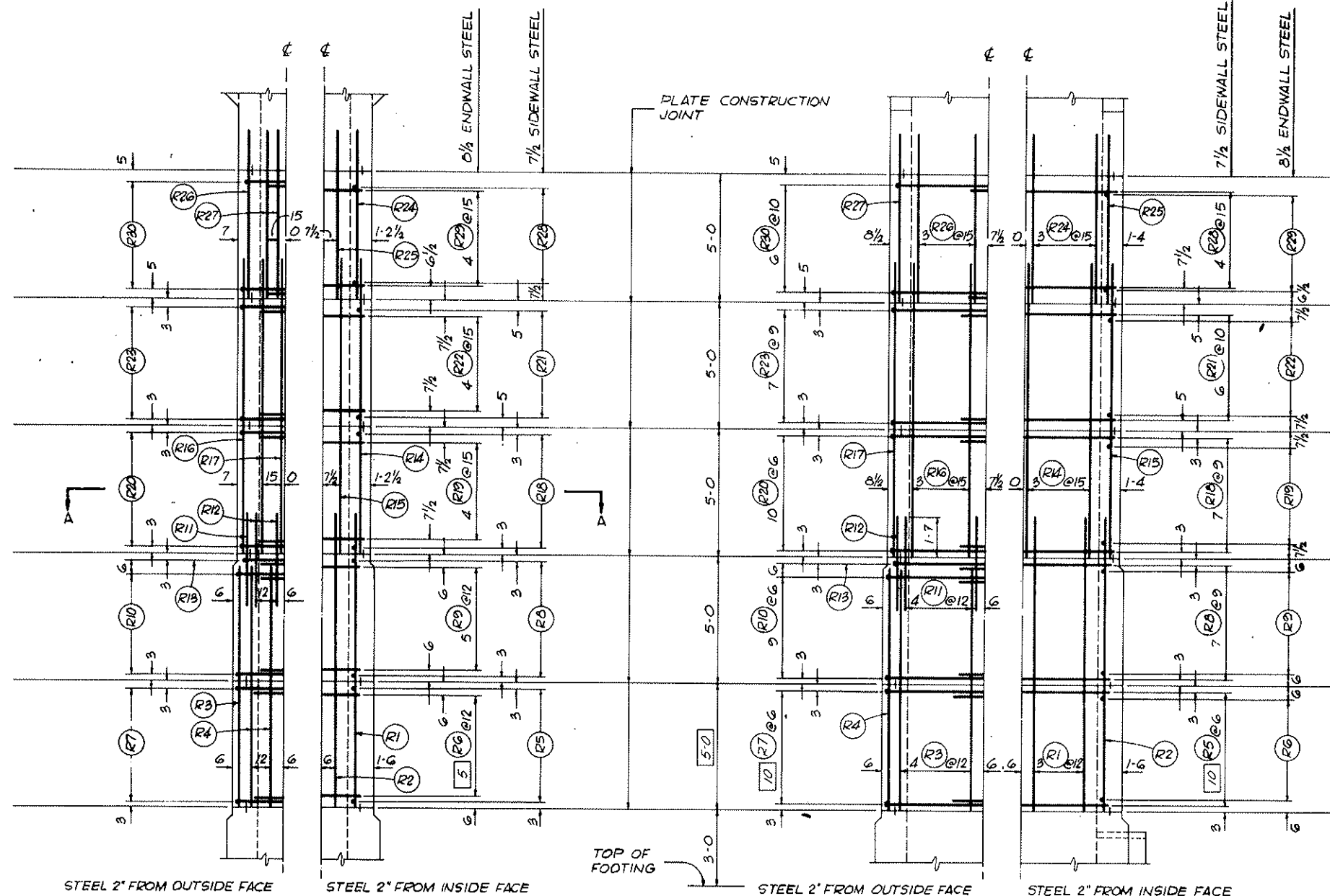
SIDEWALL ELEVATION AS BUILT
JAN. 20 1977

Date		Approved by	
Designed <i>Renzil D. Sando</i> 3-73		Title	
Drawn		Title	
Traced		Sheet	
Checked <i>L. M. S.</i> 8-73		Drawing No	
No. of		13	
22		5E-32, 356	

A horizontal number line is shown with the label "SCALE IN FEET" centered below it. There are four major tick marks labeled 0, 2, 4, and 6 from left to right.



SECTION A-A
OTHER SECTIONS SIMILAR



ENDWALL ELEVATION

SIDEWALL ELEVATION

STANDARD COVERED RISER		
DESIGN CONSTANTS	$f'_c = 4000$ psi	$f_c = 1600$ psi
	$n = 8$	$f_s = 20,000$ psi
STANDARD DWG. NO.	ES-3024-3530E	
DATE	5-66	SHEET 3 OF 4

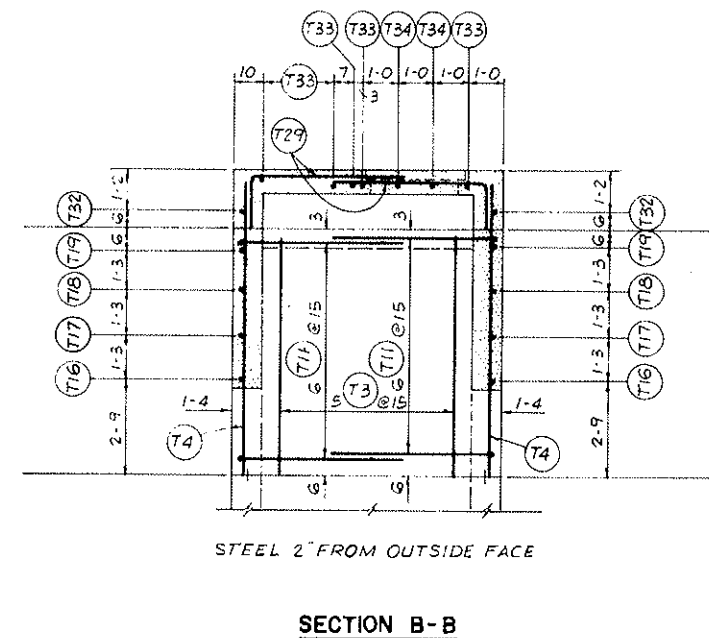
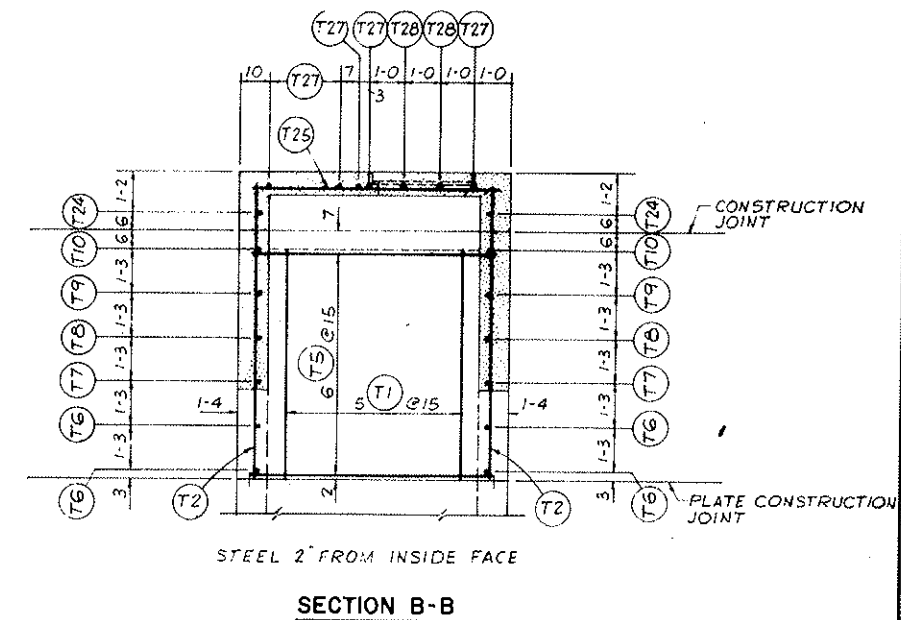
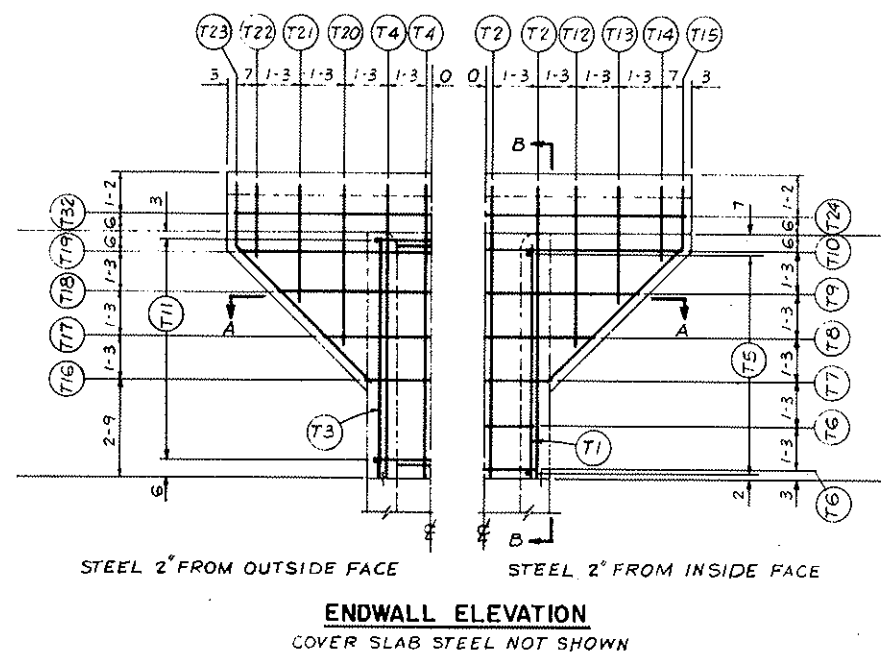
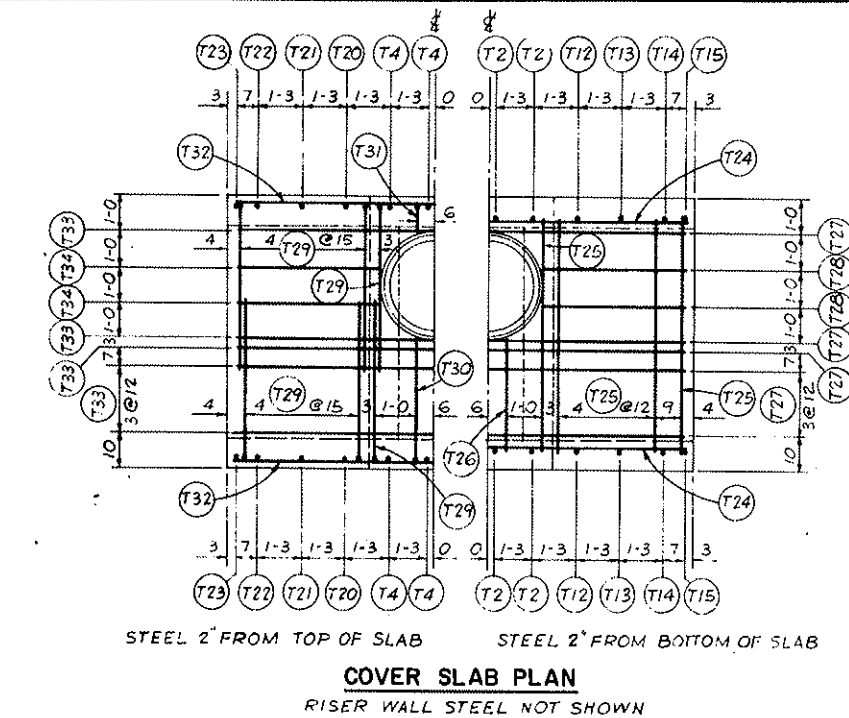
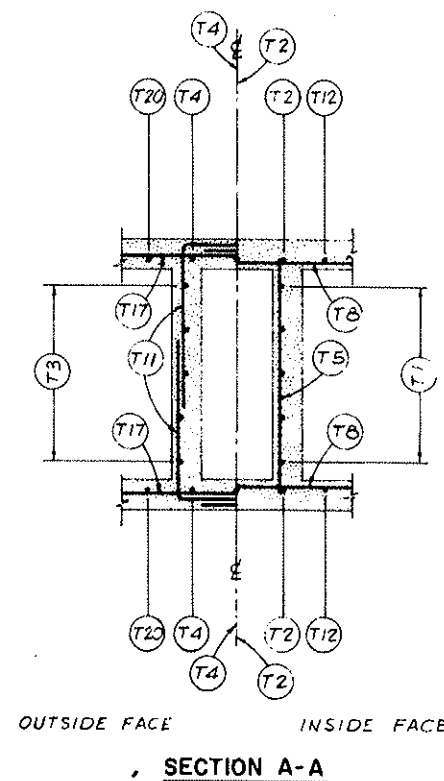
0 2 4 6
SCALE IN FEET

AS BUILT
JAN. 20 1977

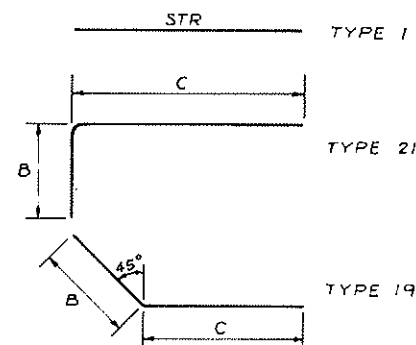
FLOODWATER RETARDING STRUCTURE NO. 5
UPPER TURTLE RIVER WATERSHED
Grand Forks County North Dakota

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

Designed <i>Ronald D. Sando</i>	Date <i>3-73</i>	Approved by _____
Drawn _____	Title _____	
Traced _____	Title _____	
Checked <i>L. M. S.</i>	Date <i>8-73</i>	Sheet <i>14</i> of <i>22</i>
		Drawing No. <i>5, E-32, 356</i>



BAR TYPES



NOTE:

1. BAR DIMENSIONS ARE OUT TO OUT OF BAR
2. RADIUS OF BENDS
= 3 BAR DIAMETERS FOR SIZES $\leq \#7$
= 4 BAR DIAMETERS FOR $\#8$
3. THE 2" AND 3" DISTANCES FROM SPECIFIED CONCRETE SURFACES ARE CLEAR DISTANCES

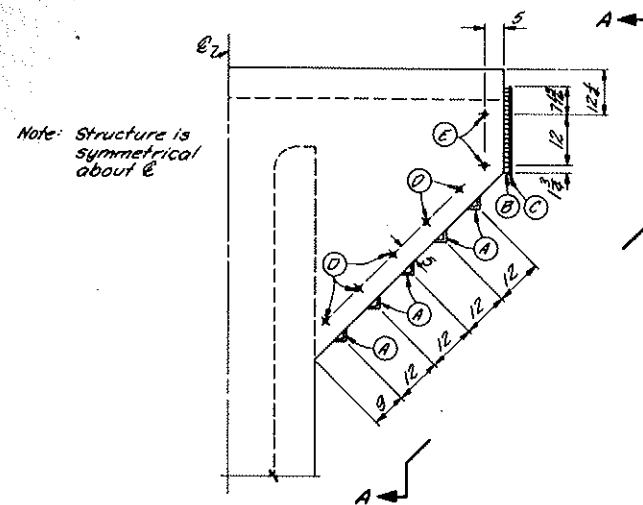
STANDARD COVERED RISER			
DESIGN CONSTANTS	$f'_c = 4000 \text{ psi}$	$f'_c = 1600 \text{ psi}$	
	$n = 8$	$f_s = 20,000 \text{ psi}$	
STANDARD DWG. NO.	ES-3024-3530E		
DATE 5-66	SHEET 4 OF 4		

0 2 4 6
SCALE IN FEET

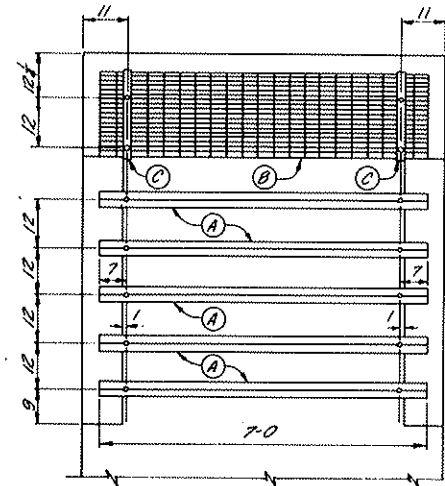
AS BUILT
JAN. 20 1977

FLOODWATER RETARDING STRUCTURE NO. 5
UPPER TURTLE RIVER WATERSHED
Grand Forks County North Dakota
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed <i>Ronald D. Sando</i>	Date <i>3-73</i>	Approved by	
Drawn		Title	
Traced		Sheet	
Checked <i>L.M.S.</i>	<i>8-73</i>	No. <i>15</i>	Drawing No. <i>5E-32, 356</i>

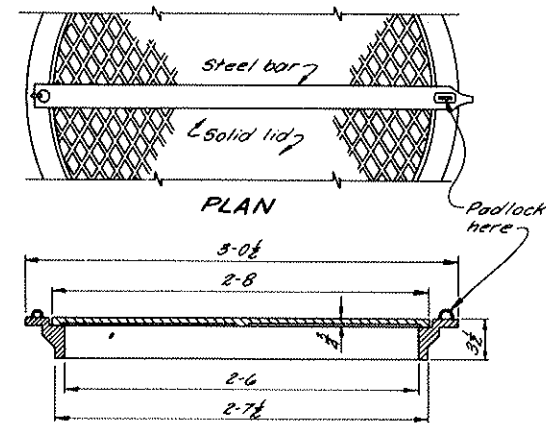


ENDWALL ELEVATION

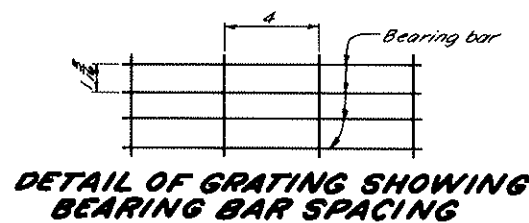


ELEVATION A-A

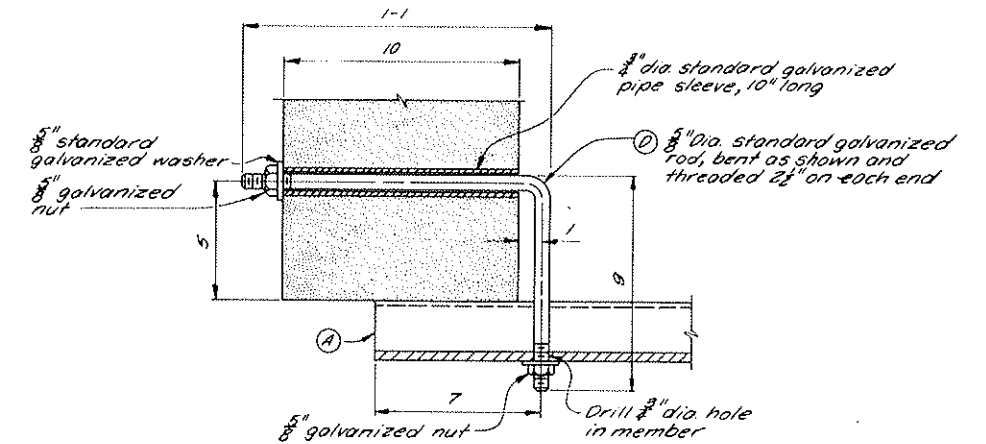
DETAILS OF SECOND STAGE TRASH RACK



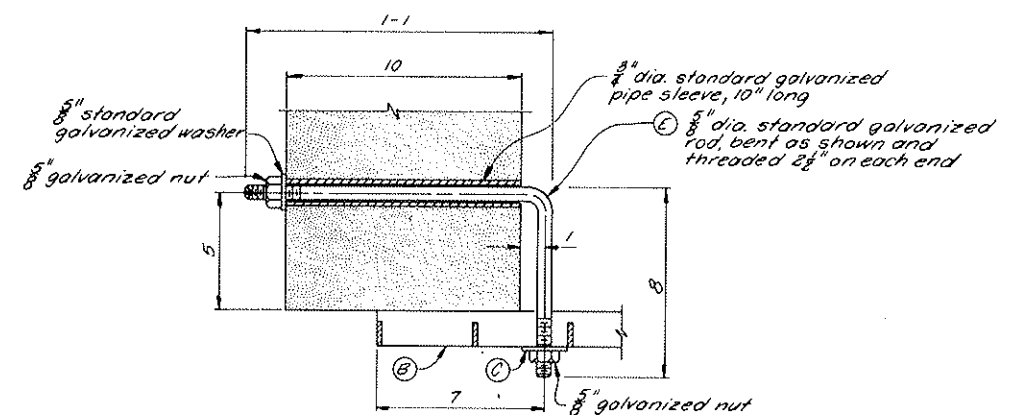
DETAILS OF MANHOLE FRAME AND LID
Steel bar not shown
Light Duty - Approximate weight 300 lbs.
(Dimensions are approximate)



DETAIL OF GRATING SHOWING BEARING BAR SPACING



DETAIL OF ANCHORAGE FOR ANGLES



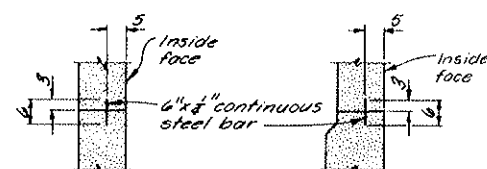
DETAIL OF ANCHORAGE FOR GRATING

MATERIAL LIST FOR SECOND STAGE TRASH RACK

MARK	ITEM	QUANTITY
A	3" X 3" X 3/8", 7'-0" LONG	10
B	GRATING: 7'-0" LONG X 1'-9 9/16" WIDE WITH 1 1/2" X 3/16" BEARING BARS GALVANIZED STEEL	2
C	BAR 2" X 1/4", 1'-9 3/4" LONG	4
D	5/8" GALVANIZED ROD, SEE DETAIL OF ANCHORAGE FOR ANGLES	20
E	5/8" GALVANIZED ROD, SEE DETAIL OF ANCHORAGE FOR GRATINGS	8

TOTAL WEIGHT OF STRUCTURAL STEEL = 571 LBS.
TOTAL WEIGHT OF STEEL GRATINGS = 284 LBS.

- NOTES: 1. ALL STRUCTURAL STEEL MEMBERS (WITH EXCEPTION OF GALVANIZED MEMBERS) TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.
2. THE NUTS ON THE 5/8" GALVANIZED RODS SHOULD BE DRAWN UP CAREFULLY TO AVOID OVER STRESSING THE RODS.



DETAILS OF PLATE CONSTRUCTION JOINTS
Plate construction joint must be continuous This can be accomplished by field welding or bolting.

AS BUILT
JAN. 20 1977
**SECOND STAGE TRASH RACK
FOR 2'-0" X 6'-0" STANDARD
COVERED RISER**

**FLOODWATER RETARDING STRUCTURE
NO. 5**

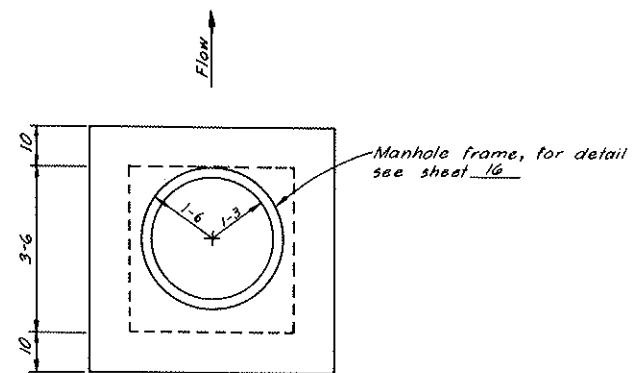
UPPER TURTLE RIVER WATERSHED

Grand Forks County

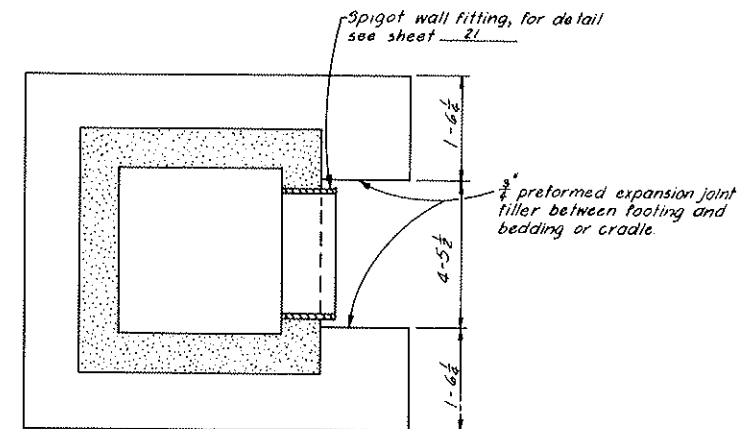
North Dakota

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed: <i>Ronald D. Sandoz</i>	Date: <i>8-79</i>	Approved by: _____	Title: _____
Drawn: _____			
Traced: _____			
Checked: <i>L.M.S.</i>	Date: <i>8-79</i>	Sheet: <i>16</i>	Drawing No: <i>5E-32,356</i>

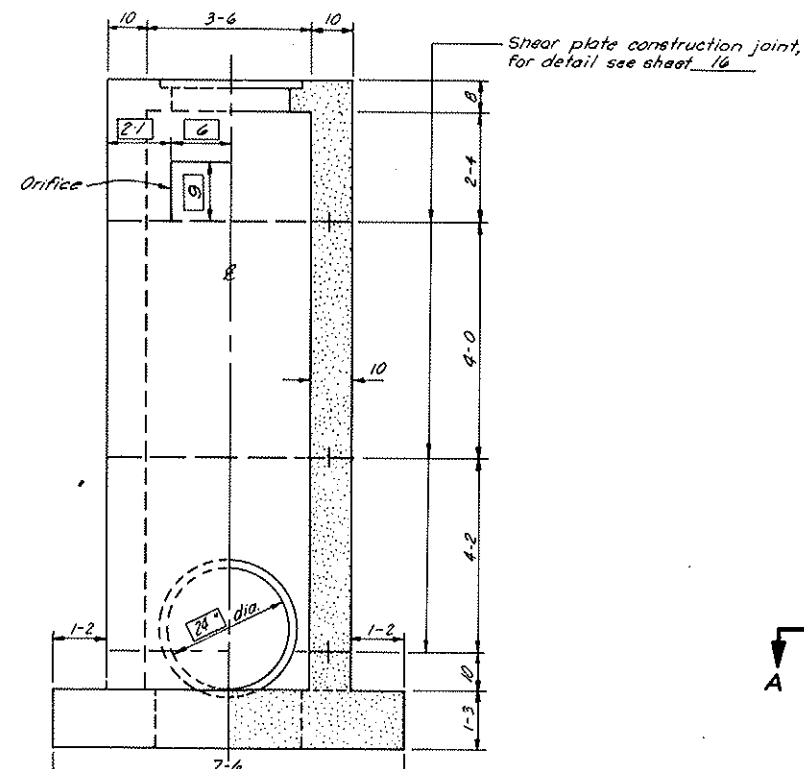


TOP PLAN

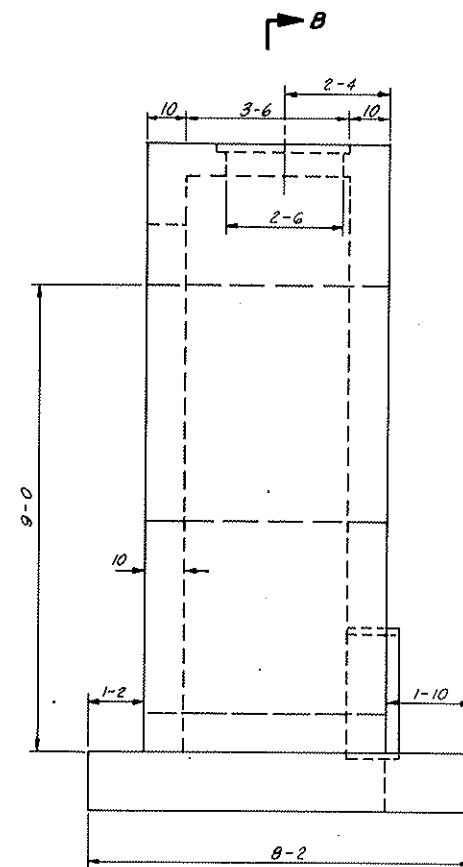


SECTION A-A

NOTE: FOR DETAIL OF TRASH RACK AND ANCHORAGE SEE SHEET 20.



HALF UPSTREAM ENDWALL
HALF SECTION B-B



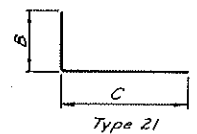
SIDEWALL ELEVATION

QUANTITIES

STEEL	
#4 BARS - 1249-3 FT. -	834 LB.
#5 BARS - 314-3 FT. -	328 LB.
#6 BARS - 56-0 FT. -	84 LB.
TOTAL	1,246
CONCRETE	9.18 CU. YDS.

BAR BENDS

Straight
Type 1



STEEL SCHEDULE

MARK	SIZE	QUANTITY	LENGTH	TOTAL LENGTH	TYPE	B	C
B1	5	8	7-0	56-0	1		
B2	5	4	1-9	7-0	1		
B3	5	6	7-9	46-6	1		
B4	5	5	6-0	30-0	1		
B5	6	7	7-0	49-0	1		
B6	6	4	1-9	7-0	1		
B7	5	6	7-9	46-6	1		
B8	5	5	6-0	30-0	1		
B9	4	12	10-0	120-0	21	3-0	7-0
B10	4	7	7-9	54-3	21	0-9	7-0
B11	4	3	4-0	12-0	1		
B12	4	10	7-6	75-0	21	0-9	6-9
B13	4	7	7-6	52-6	21	0-9	6-9
B14	4	3	4-0	12-0	1		
B15	4	2	4-0	8-0	21	0-9	3-3
B16	4	18	6-6	117-0	21	3-3	3-3
B17	4	21	4-3	89-3	1		
B18	4	4	4-6	18-0	21	1-3	3-3
T1	4	36	5-3	189-0	1		
T2	4	6	3-9	22-6	1		
T3	4	20	6-6	130-0	21	3-3	3-3
T4	4	20	4-3	85-0	1		
T5	5	10	6-0	60-0	21	2-9	3-3
T6	5	6	3-6	21-0	21	0-9	2-9
T7	5	3	2-6	7-6	21	1-3	1-3
T8	5	3	3-3	9-9	21	0-6	2-9
T9	4	17	2-9	46-9	1		
T10	4	3	1-3	3-9	1		
T11	4	14	6-6	91-0	21	3-3	3-3
T12	4	6	4-3	25-6	21	1-0	3-3
T13	4	19	4-0	76-0	1		
T14	4	17	0-9	12-9	1		
T15	4	4	2-3	9-0	1		

0 1 2 3 4
Scale in feet
AS BUILT
JAN 20 1977

DETAILS OF 3'-6" x 3'-6"
RESTRICTED FLOW RISER
10' High (Upstream Orifice)

E & WP UNIT - DESIGN SECTION LINCOLN, NEBRASKA
BASE DWG. NO. 5, E-13, 850.226
DATE APPROVED: FEB. 1971 REV. 6-71
SHEET 1 OF 3

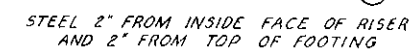
FLOODWATER RETARDING STRUCTURE NO. 5	
UPPER TURTLE RIVER WATERSHED	
Grand Forks County	North Dakota
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Designed: <i>Ronald D. Sandoz DE 3-73</i>	Date: _____
Drawn: _____	Approved by: _____
Traced: _____	Title: _____
Checked: <i>L.M.S.</i>	Sheet: <i>17</i> of <i>22</i>
	Drawing No: <i>5E-32,356</i>



SECTION A-A



UPSTREAM ELEVATION



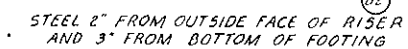
SIDEWALL ELEVATION



FOOTING PLAN



DOWNSTREAM ELEVATION



SIDEWALL ELEVATION

0 1 2 3
Scale in feet
AS BUILT
JAN. 20 1977

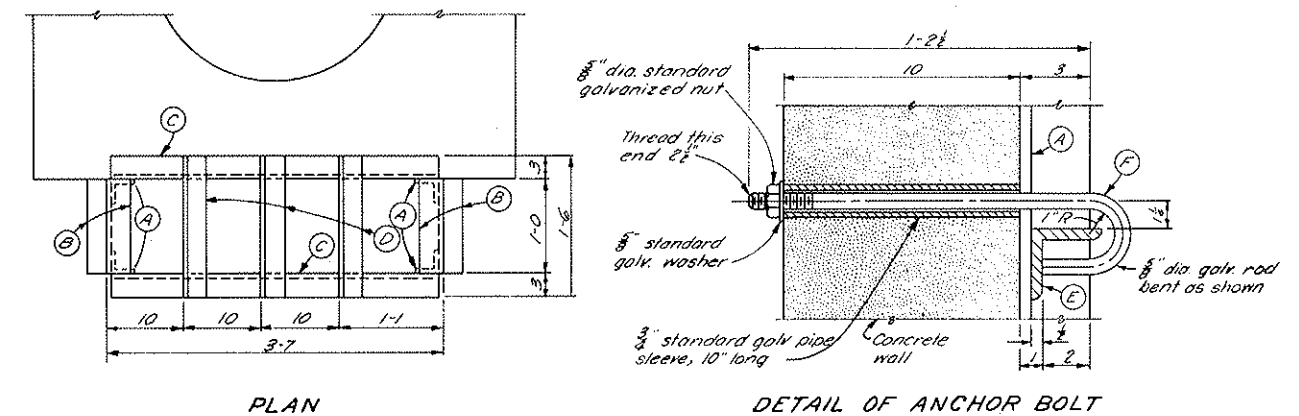
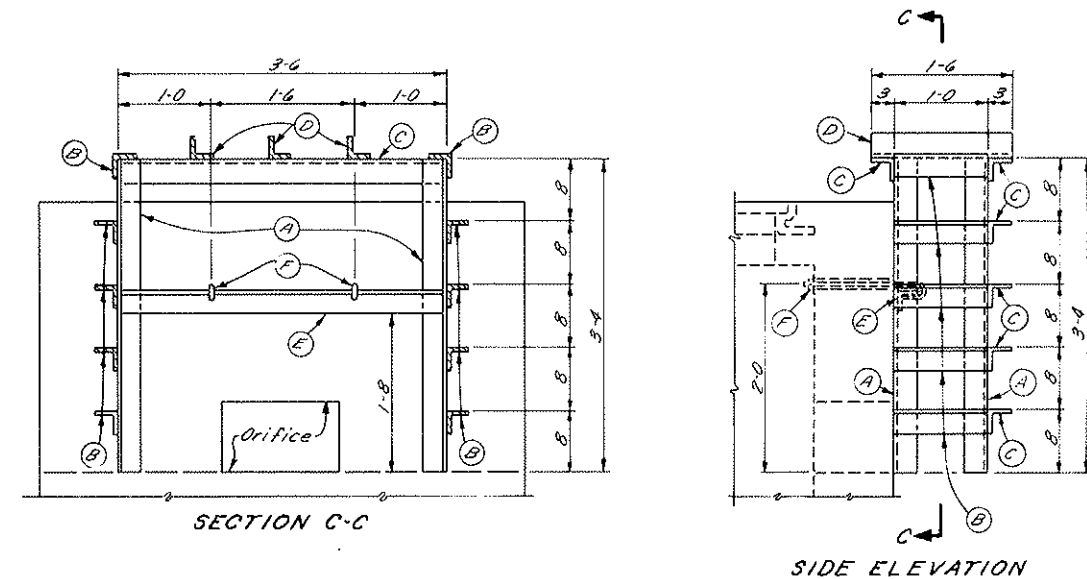
Note:
The B2, B3, B6 and B7 bars, in the downstream footing of the riser, affected by increased width in cradle, will be field cut 2" from concrete surface.

FLOODWATER RETARDING STRUCTURE
NO. 5
UPPER TURTLE RIVER WATERSHED
Grand Forks County *North Dakota*

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed <i>Ronald D. Sando PE 3-73</i>	Date _____
Drawn _____	Approved by _____
Traced _____	Title _____
Checked <i>J.E.N.</i>	Title _____
<i>4-73</i>	Sheet _____ Drawing No. <i>18</i>
	No. of <i>82</i> <i>5E-32,356</i>

Designed <i>Ronald D. Sandoz PE</i>	Date <i>5-73</i>	Approved by _____
Drawn _____	Title _____	_____
Traced _____	Title _____	_____
Checked <i>L. M. S.</i>	Sheet <i>No 10</i>	Drawing No <i>5E-32356</i>
	<i>93</i>	



TRASH RACK DETAILS

TRASH RACK MATERIAL LIST

MARK	ITEM	QUANTITY
A	ANGLE 3" X 3" X 1/2" X 3'-4" LONG	4
B	ANGLE 3" X 3" X 1/2" X 1'-0" LONG	10
C	ANGLE 3" X 3" X 1/2" X 3'-6" LONG	6
D	ANGLE 3" X 3" X 1/2" X 1'-6" LONG	3
E	ANGLE 3" X 3" X 1/2" X 3'-5" LONG	1
F	5/8" DIA. ROD, PER DETAIL	2

WEIGHT = 491 LB.

NOTES:

1. ALL ANGLE JOINTS TO BE BOLTED WITH 1/2" GALV. BOLTS.
2. TRASH RACK TO BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS.

AS BUILT

JAN. 20 1977

FLOODWATER RETARDING STRUCTURE NO. 5

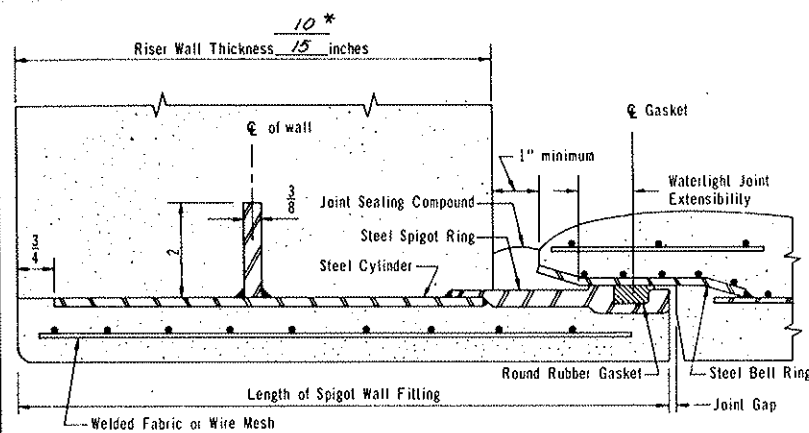
UPPER TURTLE RIVER WATERSHED

Grand Forks County

North Dakota

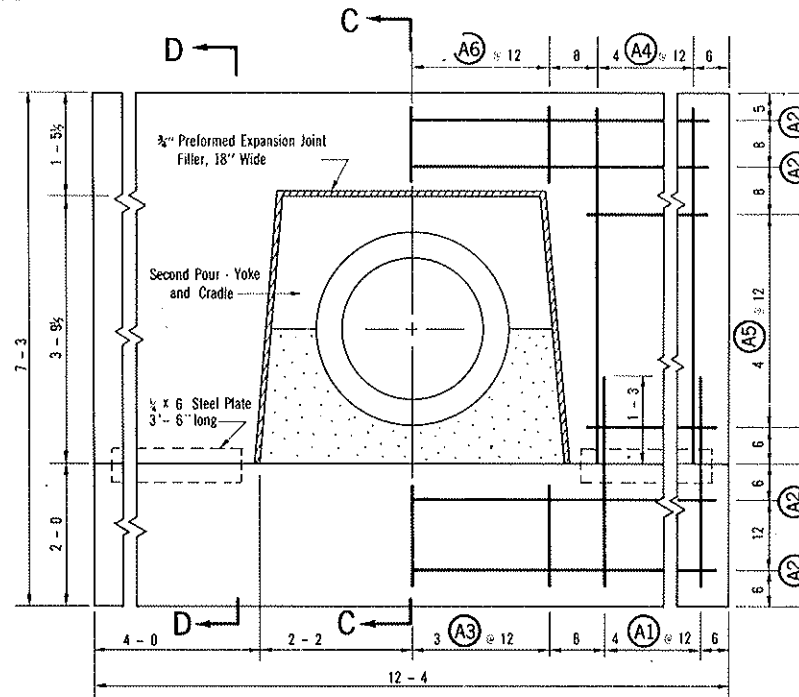
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by <i>Ronald D. Sandoz</i>	Date <i>8-73</i>	Approved by	Title
Drawn			
Traced			
Checked <i>L.M.S.</i>	Date <i>8-73</i>	Sheet <i>20</i>	Drawing No. <i>5,E-32,356</i>



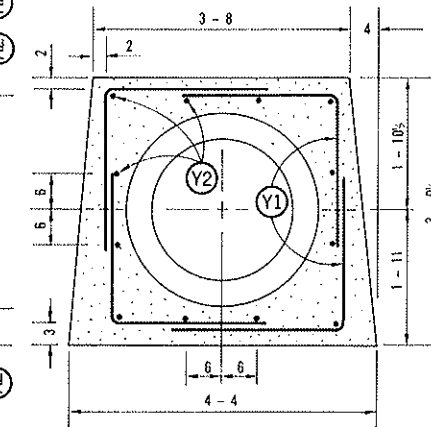
* Low slope riser

DETAIL A



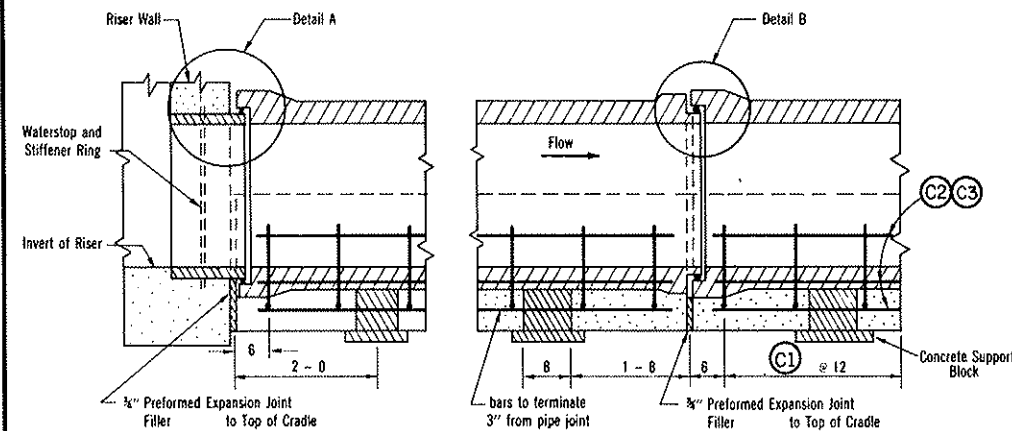
DETAIL OF ANTI-SEEP COLLAR

Yoke and cradle steel not shown.



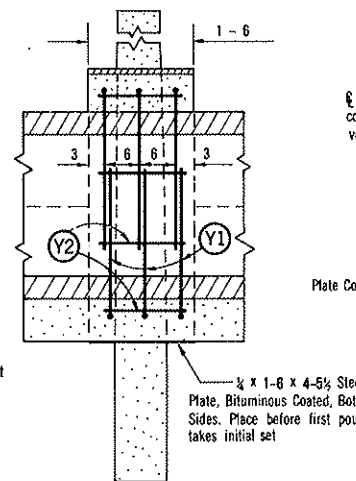
DETAIL OF ANTI-SEEP COLLAR YOKE

Cradle steel not shown, C2 bars to be continuous through yoke.



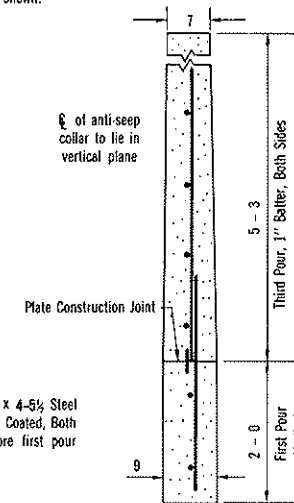
DETAIL OF SPIGOT WALL FITTING

DETAIL OF PIPE JOINT

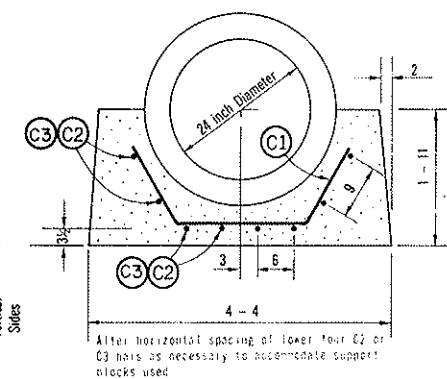


SECTION C-C

Anti-seep collar and cradle steel not shown.



SECTION D-D

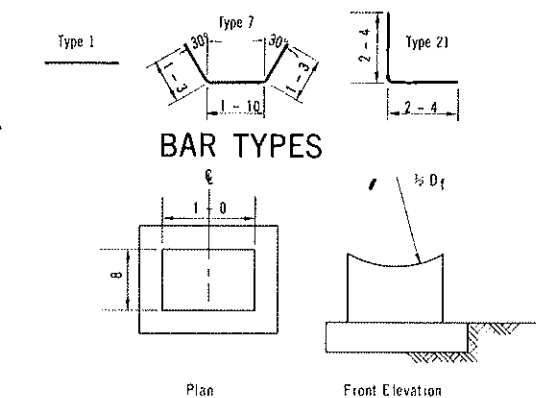


DETAIL OF CRADLE

STEEL SCHEDULE						
Anti-seep Collar and Yoke, 13 Required.						
Mark	Size	Quantity per Collar	Length	Type	Total Quantity	Total Length
A1	4	8	3'-0	1	184	512'-0
A2	4	4	11'-10	1	52	615'-4
A3	4	5	1'-6	1	65	97'-6
A4	4	8	5'-0	1	184	526'-0
A5	4	8	3'-6	1	184	364'-0
A6	4	5	1'-0	1	65	65'-0
Cradle						
Y1	4	12	4'-8	21	116	126'-0
Y2	4	12	1'-2	1	156	162'-0
Mark	Size	Total Quantity	Length	Type	Total Length	
C1	4	232	4'-4	7	1 672'-0	
C2	6	208	15'-6	1	3 224'-0	
C3	6	8	7'-6	1	60'-0	

QUANTITIES		
Concrete		Cu. Yds.
Anti-seep Collar including Yoke		2 153
• Each, Additional to Cradle		
Total		27 98
Cradle		
• Per Lineal Foot of Cradle		0 213
Total		96 33
Steel		Pounds
Anti-seep Collar including Yoke		1 326 4
Cradle		6 183 1

Concrete quantities are based on an outside diameter of pipe of 24 inches. Steel quantities do not change with outside diameter of pipe.
 * This quantity is given by $2.122 - 0.0001515 (D_f + 32) (D_f - 32)$ cu. yds.
 ** This quantity is given by $0.1923 - 0.0001010 (D_f + 32) (D_f - 32)$ cu. yds.
 D_f = outside diameter of pipe furnished, 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 required. Wedges may be used as an alternate.

AS BUILT
 JAN 20 1977
FLOODWATER RETARDING STRUCTURE NO. 5
UPPER TURTLE RIVER WATERSHED
 Grand Forks County North Dakota
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
 Designed: Ronald D. Sando, P.E. Date: 3-73
 Drawn: Title: _____
 Traced: Title: _____
 Checked: L. M. S. Date: 8-73 Sheet: 21 of 22 Drawing No: 5, E-32, 356

JOINT REQUIREMENTS			
Length of Pipe Section	Minimum Joint Length	Minimum Joint Limiting Angle	
feet	inches	radians	degrees
8	2.5		1° 30'
16	2.5		1° 30'

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 Lineal Foot of Pipe	
		Applicable Standard Specification	
inches	feet	AWWA C-301	AWWA C-300
		Load to produce 0.001 inch crack one foot long	Load to produce 0.01 inch crack one foot long
24	35	7 300	9 100

The outside diameter of pipe assumed in design is 24 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.

STANDARD CONDUIT DETAILS			
FOR REINFORCED CONCRETE PRESSURE PIPE PRINCIPAL SPILLWAY			
STANDARD DWG. NO. ES-5024-CE			
DATE	2-70	REV.	3 72
SHEET	1	OF	1

Joint length equals watertight joint extensibility plus joint gap. 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 closest point shall not exceed 3/8 inch.

STRUCTURE DATA

Class of Structure	<u>b</u>		
Drainage Area (total)	<u>5,440</u>	Ac.	<u>8.5</u> Sq.Mi.
(uncontrolled)	<u>5,440</u>	Ac.	<u>8.5</u> Sq.Mi.
Time of Concentration	<u>4.0</u>		Hours
Soil Cover Complex Number	<u>80.0</u>		For A.M.C. II
Sediment Capacity Available	<u>62</u>	Ac.Ft. below Elev.	<u>1247.0</u>
Total Sediment Capacity Available	<u>62.0</u>		Ac.Ft.
Capacity Equivalents (Vol.)	<u>0.137</u>		In.
Retarding Capacity Provided	<u>1418</u>		Ac.Ft.
Capacity Equivalents (Vol.)	<u>3.13</u>		In.
Water Supply Provided	<u>none</u>	Ac.Ft.-Identify Uses	

Principal Spillway:

Maximum Capacity (low stage) 18 c.f.s.
Maximum Capacity (high stage) 85 c.f.s.
10 Day Drawdown Elev. 1270.0

Emergency Spillway:

Percent Chance Use 2% Storm Duration 10 days
Type Vegetative "n" Value Used 0.040

Emergency Spillway Hydrograph for Class b Structures

Rainfall 5.8 in.
Runoff 3.61 in.
Peak Inflow c.f.s.
Maximum Discharge - Emergency Spillway 2,077 c.f.s.
Maximum Water Surface Elev. 1291.5
Velocity of Flow (Ve) 7.2 f.p.s.

Supplementary Data and Special Design Features:

Freeboard Hydrograph for Class b Structures

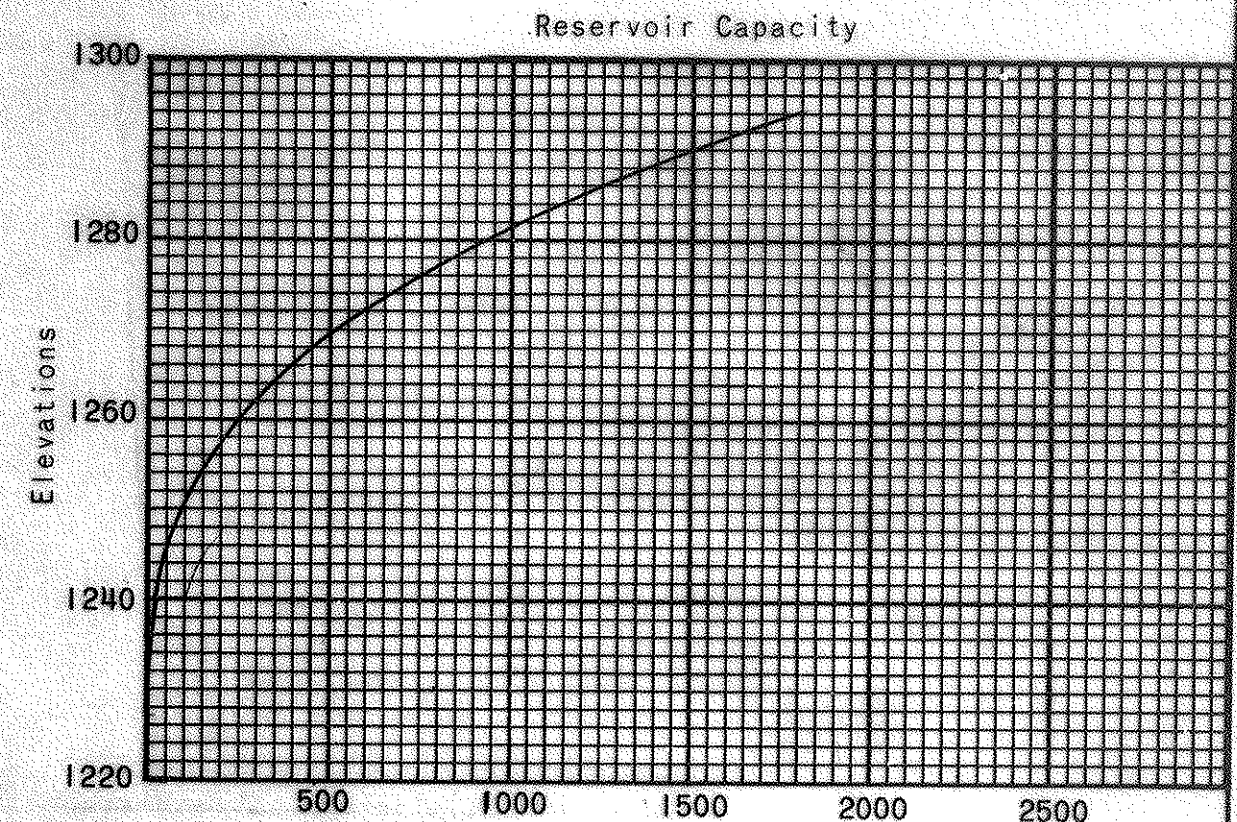
Rainfall 10.5 in.

Runoff 8.0 in.

Peak Inflow c.f.s.

Maximum Discharge - Emergency Spillway 8,111 c.f.s.

Maximum Water Surface Elev. 1293.86



Total Storage - Ac.Ft.

Supplementary Data and Special Design Features:

AS BUILT
COMPLETION
DATE: JAN 20, 1977

FLOODWATER RETARDING STRUCTURE NO. 5 UPPER TURTLE RIVER WATERSHED GRAND FORKS COUNTY, NORTH DAKOTA		
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE		
Date _____ Designed _____ Drawn _____ Traced _____ Checked _____	Approved by _____ Title _____ Title _____ Sheet No. / _____	Drawing No. 5E-32,356-E



Appendix B
Annual Inspection Report



Natural Resources
Conservation Service

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

Voice 701.530.2000
Fax 855-813-7556

November 23, 2020

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

RE: Annual NRCS Inspection of UTR Dam No. 5 - 2020

Dear Mr. Axvig:

On September 9, 2020, NRCS engineering staff performed an annual dam inspection on Upper Turtle River Dam No. 5 (UTR 5). NRCS state office staff were met onsite by Paul Bjorg with the Grand Forks NRCS office. Contained within this letter are the observations and recommendations from our office. Please note all elevations collected during the inspection are in NAVD 88 (NGVD 29 + 1.21 feet = NAVD 88).

Background

UTR 5 is currently classified as a high hazard dam. UTR 5 is located in Section 11, T152N-R56W and is listed in the National Inventory of Dams as ND00388. The O&M Agreement between NRCS and Grand Forks WRD remains active until 2022. UTR 5 has a total height of 70 feet and length of 2,130 feet. A concrete riser tower and 24-inch reinforced concrete pipe compose the principal outlet, while a 400-foot wide earth lined spillway provides an auxiliary outlet.

Inspection

No rainfall had been reported within the drainage basin of UTR 5 within the past 72-hours from the time of inspection. During the assessment of UTR 5, GPS locations and photos of various features were collected. At the time of inspection, the reservoir water surface elevation was at 1248.1 feet (NAVD 88) and the reservoir pool was observed to be lower than the low-stage riser orifice, see photo 1 in attachment 3. According to the as-builts, the low-stage riser orifice invert is at an elevation of 1247.0 feet (NGVD 29) or 1248.21 (NAVD 88) and the survey data collected during the inspection provided an orifice invert at 1248.24 (NAVD 88).

UTR 5 is actively grazed with livestock and the Grand Forks WRD recently fenced off a portion of the downstream embankment to prevent the livestock from rutting the embankment.

No flow was observed entering the low-stage riser orifice and the low-stage riser vault was dry, see photo 2 in attachment 3. Upon inspection of the principal riser tower, an undetermined amount of water was observed flowing towards the outlet, see photo 3 in attachment 3. The 24-inch principal conduit of UTR 5 was observed to be dry at the conduit outlet. However, an undetermined amount of flow was observed exiting through the embankment directly under the principal spillway conduit. The construction of UTR 5 did include anti-seep collars around the principal spillway. The flow observed was clear and visually free of fine grain embankment material.

Helping People Help the Land

An Equal Opportunity Provider, Employer, and Lender

Upstream Slope and Crest

- Weeds and cattails were present within the riprap on the upstream slope, see photo 4 in attachment 3 and map 2 in attachment 2. This unwanted vegetation can reduce the visibility of the embankment should any loss of embankment material be occurring.
- Two distinct animal trails were observed on the upstream slope. One near the right abutment leading towards the crest and another trail running parallel to the riprap, see photos 5 and 6 in attachment 3 and maps 2 and 3 in attachment 2. Neither animal trail was rutted or showed signs of root degradation. Once root degradation begins, bare soil can persist and erosion can commence.
- Tire ruts of approximately 3.5 inches deep and unvegetated soil were noted on the crest, see photos 7 and 8 in attachment 3, and map 3 in attachment 2. Rutting on the crest can provide the potential for water collection during rain events and can lead to the degradation of the vegetated cover that is meant to provide protection should the dam experience overtopping. This compromised protection can initiate erosion of the embankment and cause a breach.

Downstream Slope

- Weeds and cattails were noted on the downstream bench, see photos 9 and 10 in attachment 3, and maps 2 and 3 in attachment 2. Upon looking at the as-builts and survey data collected during the inspection, the reverse grade on the bench provides a shallow depressional area that holds water. Additionally, overland flow from the right abutment may be flowing onto the bench and could possibly be diverted down the groin to prevent additional water on the bench.
- Distinct animal hoof prints were noted throughout the downstream bench as likely saturated soils failed and pumped in the presence of animal traffic.

Abutments

- Woody vegetation was noted to be encroaching on both the upstream and downstream right abutments as well as the downstream left abutment, see photos 11, 12, and 13 in attachment 3, and maps 2 and 3 in attachment 2.
- The right downstream abutment showed active erosion that could be caused by overland sheet flow draining down the groin, see photo 14 in attachment 3, and map 3 in attachment 2. Active erosion results in the loss of embankment material which could lead to a breach of the structure.
- The right downstream abutment was noted to have cattail growth along the groin. No evidence of seepage through the dam was discovered but this area must be monitored, see photo 15 in attachment 3, and map 3 in attachment 2.

Auxiliary Spillway

- Based upon the as-builts, the total auxiliary spillway footprint was 400-feet wide with a level section elevation at 1289.0 feet (NGVD 29) or 1290.21 feet (NAVD 88). During the inspection, survey data collected showed the level section to be within two tenths of a foot to the design at 1290.21 feet (NAVD 88).
- The auxiliary spillway showed signs of heavy animal traffic throughout. The heavy animal traffic and moist soils have caused severe rutting in the auxiliary spillway, see photo 16 in attachment 3, and map 2 in attachment 2. Severely rutted vegetative cover significantly reduces the armoring characteristics of the vegetation.
- A distinct vegetation change in the auxiliary spillway was noted and is likely the result of poor drainage within the auxiliary spillway level control section, see photo 17 in

attachment 3, and map 2 in attachment 2. The varying vegetation may not meet the required armoring abilities, should the spillway be activated.

- An approximate 100-foot by 200-foot unvegetated area is present along the left side of the auxiliary spillway near the outlet. Animals tracks were found throughout the unvegetated area. This area has no vegetated armoring to prevent erosion should the spillway be activated, see photo 18 in attachment 3, and map 2 in attachment 2.

Principal Spillway

- The low-stage riser has a metal trash rack that showed signs of corrosion on the trash rack, see photo 19 in attachment 3. Corrosion could cause the metal trash rack to be compromised and no longer protect the principal spillway from debris.
- The exterior of the low-stage riser, near the water surface, has severely deteriorated. The concrete has begun to spall and crumble at a depth of 1.375 inches, see photos 20 and 21 in attachment 3. This severe deterioration has likely allowed water to compromise the reinforcing steel. If the low-stage riser sheared and separated, debris could enter and plug the outlet conduit, reducing the capacity of the principal spillway.
- The low-stage riser had observed wetting on the floor, but no standing water was observed. No evidence of moisture or cracking was observed on the interior walls as seen in photo 2 in attachment 3. The low-stage riser orifice did show degradation of the concrete and should be repaired to prevent further degradation, see photo 2 in attachment 3.
- The primary weir crest of the principal spillway tower was noted to be in good condition with no cracking or spalling noted, see photo 22 in attachment 3.
- The 24-inch outlet conduit did have some spalling near the outlet, see photo 23 in attachment 3.
- As noted above, an undetermined amount of flow was observed discharging from the embankment under the outlet conduit, see photo 24 in attachment 3.

Foundation Drain

- An animal guard was present on the foundation drain located adjacent to the principal outlet conduit and no flow was observed out of the foundation drain. Animal guards were noted to have significant surface corrosion, see photos 25 and 26 in attachment 3.

Reservoir

- Within the reservoir of UTR 5, no development was observed, see photo 27 in attachment 3, and map 3 in attachment 2.

Recommendations

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

- Spray weeds and remove woody vegetation on upstream slope.
- Monitor animal trails to prevent loss of vegetative cover.
- Repair rutting on crest and revegetate.
- Spray weeds on downstream embankment bench.
- Monitor wet area on downstream embankment bench.
- Repair animal rutting on downstream embankment.
- Remove woody vegetation encroaching on abutments.
- Repair erosion and spray weeds on right downstream abutment.
- Repair animal rutting and restore uniform vegetation within auxiliary spillway.
- Repair corroded metal on low-stage riser trash rack.

- Repair low-stage riser exterior.
- Repair concrete degradation on low-stage principal spillway weir.
- Investigate flow from beneath principal spillway conduit.
- Repair corroded metal on animal guard for foundation drain to prevent further oxidation.

If you should have any questions or comments regarding this inspection, please contact myself at brian.mager@usda.gov or 701-530-2024.

Sincerely,



Brian Mager, P.E.
ND NRCS Engineer

Enclosures (3)

- Attachment 1 - Annual Dam Inspection Checklist
- Attachment 2 - Maps
- Attachment 3 - Photos

Cc: Karen Goff (electronic) – State Water Commission
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

Appendix 1



U.S. DEPARTMENT OF AGRICULTURE Natural Resource Conservation Service		ANNUAL DAM INSPECTION CHECKLIST		ND-ENG-4 Rev. 08/20
Name of Dam	UTR 5	NRCS Hazard Class	High	NID# ND00388
Location:	Sec. 11 Township 152 Range 56	Inspection Date		9/9/2020
County	Grand Forks County	Weather		Cloudy, cool
Inspectors & Guests	Nick Reynolds - NRCS Paul	Brian Mager - NRCS		
"YES" responses need explanation added to "Remarks" section (i.e.: What? Where? Extent?). "NO" responses indicate no problems observed during				Action (R) REPAIR (M) MONITOR (I) INVESTIGATE

ITEM	Y	N	N/A	REMARKS			
1. General Conditions							
a. Alterations to Dam		X					
b. Alterations to ASW		X					
c. Recent high water marks		X					
d. Fencing adequate			X				
e. Grass Cover adequate	X						
2. Upstream Slope/Crest							
a. Erosion		X					
b. Cracks or settlements		X					
c. Seepage or boils		X					
d. Distinct Vegetation Change		X					
e. Vehicle ruts or animal trails	X			Vehicles on crest, animals above riprap			
f. Trees	X			Encroachment on right groin	X		
g. Rodent holes		X					
h. Adequate and sound riprap	X						
3. Downstream Slope							
a. Erosion		X					
b. Cracks or settlements		X					
c. Seepage or boils		X					
d. Distinct Vegetation Change	X			Cattails on bench			
e. Vehicle ruts or animal trails	X			Cattle rutting on bench			
f. Trees		X					
g. Rodent holes		X					
h. Drains or wells flowing		X					
i. Adequate and sound riprap			X				
4. PSW Intake Structure	X	Concrete		Metal	WSE		
a. Spalling, cracking, & scaling	X			low level spalling at WSE	X		
b. Exposed reinforcement		X					
c. Corrosion present		X					
d. Manhole cover present	X			bolted on			
e. Leakage	X			Low level was dry, PS minor flow, outlet dry			
f. Trash rack adequate	X						
g. Inlet or trash rack obstructed	X			obstructed non-woody vegetation			
h. Drawdown operative		Closed		Open	N/A		
i. Ladder intact			X				
j. Pedestal securely fastened			X				
k. Stem bent			X				
l. Stem guides operational			X				
m. Stem handwheel present			X				
n. Do metal parts require painting	X			low level trash rack	X		

UTR 5 Annual Dam Inspection

9/9/2020

ITEM	Y	N	N/A	REMARKS	R	M	I
5. Abutment Contacts							
a. Erosion, cracks, or slips	X			Right Downstream Abt. Erosion, see remarks	X		
b. Seepage		X					
c. Gutters intact		X					
d. Trees encroaching	X			Upstream and Downstream right abutment			
6. Auxiliary Spillway							
a. Obstructions		X					
b. Erosion, cracks, or slips	X			Bare soil, left bottom of AS			
c. Rodent holes		X					
d. Roads, ruts, or animal trails	X			Severe cattle ruts throughout	X		
e. Low areas or ditches		X					
f. Seepage/Saturation		X					
7. PSW Conduit	X			Concrete Metal			
a. Spalling, cracking, & scaling		x					
b. Exposed reinforcement		X					
c. Joints displaced or offset		X					
d. Joint material lost		X					
e. Leakage	X			flow observed beneath PS, see video			
f. Conduit misaligned		X					
8. Stilling Basin/Plunge Pool				Stilling Basin Plunge Pool			
a. Spalling, cracking, & scaling			X				
b. Exposed reinforcement			X				
c. Joints displaced or offset			X				
d. Joint material lost			X				
e. Joints leak			X				
f. Dissipater deteriorating			X				
g. Dissipater clean of debris			X				
h. Toe drains visible	X						
i. Toe drains flowing		X					
j. Toe drain animal guards	X			Corroded	X		
k. Toe drains damaged		X					
l. Earth erosion							
m. Adequate and sound riprap	X						
n. Outlet channel obstructed	X			Cattail growth in channel downstream			
9. Reservoir							
a. Buildings in floodpool							
b. Slips or erosion on banks		X					
c. Debris		X					
d. Unsecured boats/docks		X					
e. Sediment deposits		X					
10. Instruments							
a. Structure instrumented			X				
b. Monitoring performed			X				

UTR 5 Annual Dam Inspection

9/9/2020

REMARKS: 5a) Right groin is likely receiving water from upstream watershed, better drainage of surface water away from the groin would likely reduce erosion issues.

7e) Low-level intake had no flowing water and upon investigation of principal intake tower, flow was observed within the tower. However, at the dam outlet, no flow was observed exiting the conduit but a small flow was observed under the principal spillway conduit.

NRCS ENGINEER

Brian Mager

Date

9/11/2020

Signature



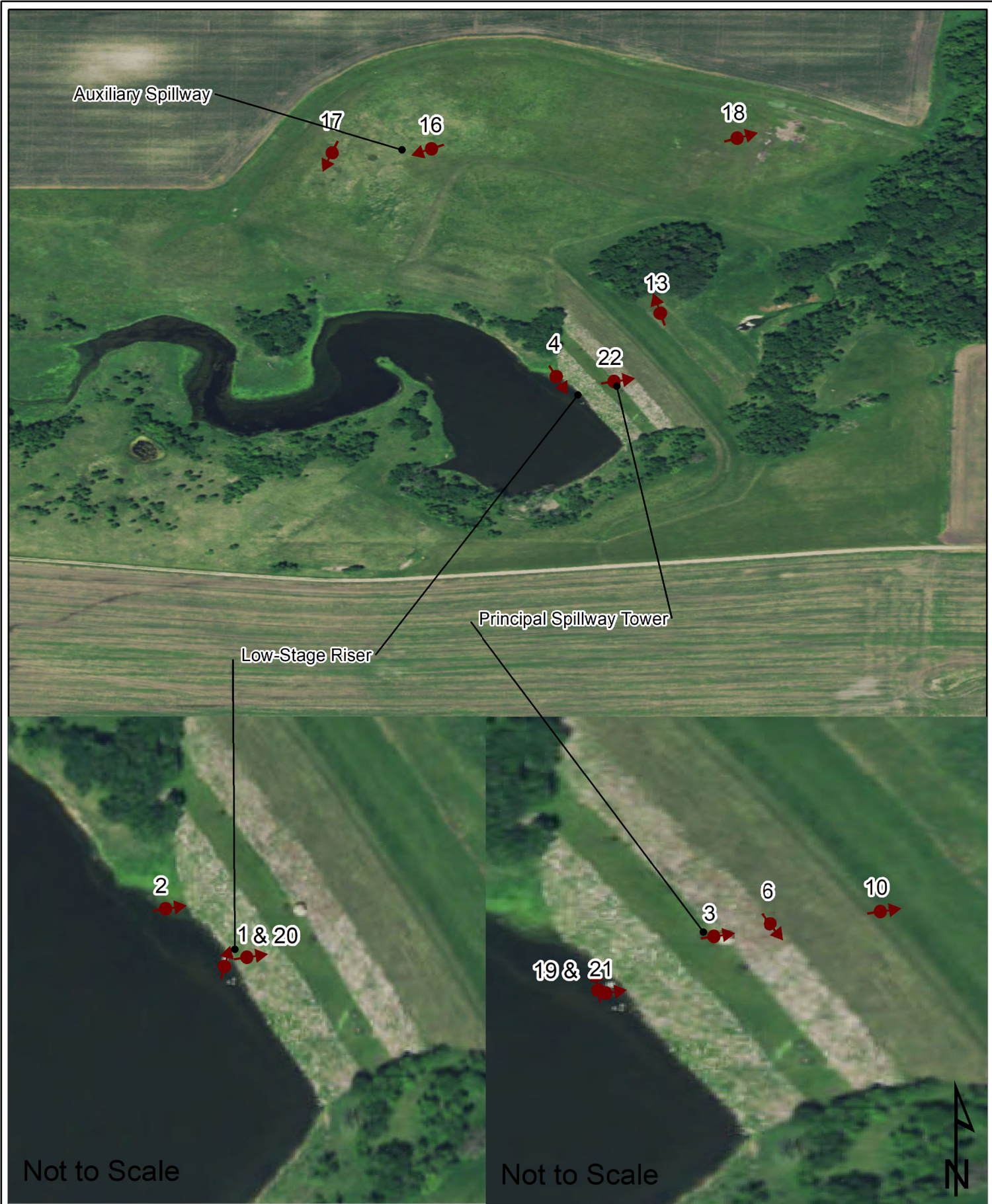
Date

11/23/20

Appendix 2



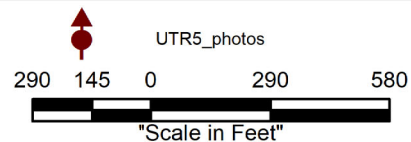




United States
Department of
Agriculture

UTR-5 Inspection Photo Locations and Directions

Grand Forks County, ND
Section 27, T-139N, R-79W



Created: BRM-10/29/20



Appendix 3





Photo 1 – low-stage riser orifice



Photo 2- low-stage riser vault



Photo 3 – principal riser tower



Photo 4 – upstream embankment looking SE



Photo 5 – animal trail near right upstream abutment



Photo 6 – animal trail along riprap looking SE



Photo 7 – rutting on the crest looking NE



Photo 8 – rutting depth on crest



Photo 9 – downstream slope bench looking NW



Photo 10 – weeds and cattails on downstream bench looking E



Photo 11 – tree encroachment on right upstream abutment looking W



Photo 12 – tree encroachment on right downstream abutment looking N



Photo 13 – encroachment on left abutment looking N



Photo14 – active erosion on downstream right groin looking S



Photo 15 – cattails along right downstream abutment



Photo 16 – rutting in auxiliary spillway



Photo 17 – distinct vegetation change in auxiliary spillway looking SE



Photo 18 – unvegetated portion of auxiliary spillway looking NE



Photo 19 – low-stage riser trash rack



Photo 20 – exterior of low-stage riser looking S

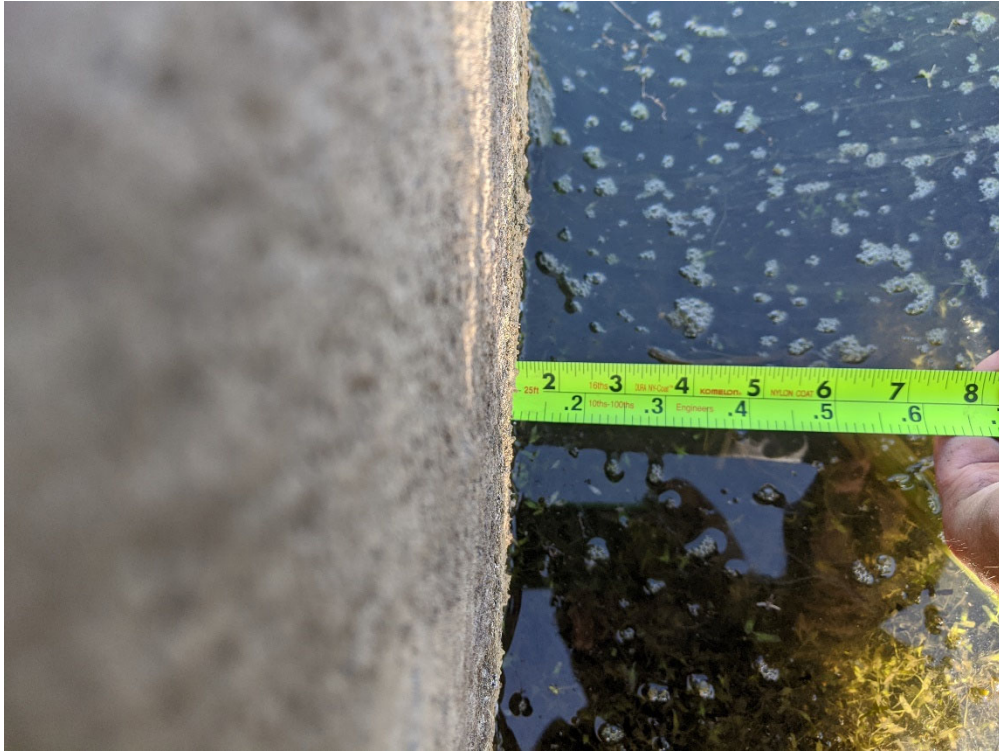


Photo 21 – gap on exterior of low-stage riser



Photo 22 – crest of principal spillway tower looking NE



Photo 23 – principal spillway conduit outlet looking S



Photo 24 – visible flow directly under principal spillway conduit at outlet



Photo 25 – principal spillway and foundation drain outlet looking W



Photo 26 – foundation drain animal guard



Photo 27 – reservoir looking NW



Appendix C
Operation and Maintenance Agreement

AMENDMENT TO
OPERATION AND MAINTENANCE AGREEMENT

FOR

STRUCTURAL MEASURES

THIS AGREEMENT made on March 7, 1973 is
between the Soil Conservation Service, United States Department of
Agriculture, hereinafter referred to as the Service, and the following
organization, hereinafter referred to as the Sponsor:

Grand Forks County Water Management District

This amendment is made to incorporate the following described structures
in the existing operation and maintenance agreement for Dam Nos.
6, 7 and 8:

Detention Dams 1, 2, 4 and 5 located
in the Upper Turtle River Watershed,
Grand Forks County, North Dakota.

Name of Sponsor Grand Forks County Water Management District

By Al Thorsalden Title Chairman

This action was authorized at an official meeting of the Sponsor named
immediately above on 2-20-73 at Grand Forks, N.D.

Attest Vincent D. Reed Title Sely Treas.

Name of Sponsor _____

By _____ Title _____

This action was authorized at an official meeting of the Sponsor named
immediately above on _____ at _____

Attest _____ Title _____

Soil Conservation Service, United States Department of Agriculture

By Charles A. Evans Title State Conservationist

Upper Turtle River Watershed
Dam Site #4, 1, 2, 5, 6, 7, 8
Operation & Maintenance

A. Operation

1. Check draw down pipe capped outlet each spring for leaks and watch for any uplift movement of draw down inlet structure generally caused by ice.
2. Confine vehicle travel to designated roads or areas. Confinement may necessitate added fencing or barriers during life of project. As much as possible regulate speed of traffic. Roadway on fill portion of dam shall be maintained at proper structure elevation.
3. Clear trash from face of structure and especially around riser and trash racks to prevent blocking of riser openings.

B. Maintenance

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 reseeding.
- b. Cut or spray with approved herbicide to remove undesirable vegetation, such as, trees from riser area, earth fill areas, and emergency spillway; or noxious weeds that affect the adequate stand of the desirable vegetation needed for the structure.
- c. Develop a schedule or program for fertilizing vegetation to maintain a vigorous stand.
- d. Strictly control grazing to insure proper vegetative cover.
- e. Mow grass at regular intervals to maintain optimum cover.

2. Earth Dam and Appurtenances

- a. Inspect drainage systems annually for proper functioning and clean out as necessary both pipe outlets and outlet channels.
- b. Maintain all riprap and replace as necessary.
- c. Remove and/or stabilize slide material as soon as practical. It may be necessary to construct a berm or flatten the slope.

- ↑
- d. Restore to proper elevation any fill of the dam or dikes that have settled, eroded, or lowered through use as a road. Roadway through the emergency spillway must be maintained at an elevation below emergency spillway control section elevation.
 - e. Maintain plunge pool and propped principle spillway outlet riprap to proper elevations and depth.
 - f. Restore concrete that has deteriorated.
 - g. Maintain fences, barriers, and guard rails in good condition for livestock and vehicular travel control.
 - h. Repaint or treat, as needed, all surfaces requiring protection by paint or treatment.
 - i. Repair and repaint or replace signs to keep them sightly and functional.
 - j. Replace eroded material and revegetate area when eroded areas are a part of the structure (emergency spillway, earth fill), it will be necessary to compact replaced material. Construct interceptor dike or drains as necessary to direct water away from eroded or recurring problem areas.

AMENDMENT TO
OPERATION AND MAINTENANCE AGREEMENT

FOR

STRUCTURAL MEASURES

THIS AGREEMENT made on April 14, 1977 is
between the Soil Conservation Service, United States Department of
Agriculture, hereinafter referred to as the Service, and the following
organization, hereinafter referred to as the Sponsor:

Grand Forks County Water Management District and Control Board

This amendment is made to incorporate the following described structures
in the existing operation and maintenance agreement for Dam No. 1, 2, ~~3~~,
4, 5, 6, 7, and 8:

Multiple purpose structure No. 9 in the
Upper Turtle River Watershed, Grand Forks
County, North Dakota.

Name of Sponsor Grand Forks County Water Management District and Control Board

By Art Thorsaldson Title Chm

This action was authorized at an official meeting of the Sponsor named
immediately above on 3/10/77 at Grand Forks, N.D.

Attest Frederick O. Keel Title Deputy Treasurer

Soil Conservation Service, United States Department of Agriculture

By Billy M. Putnam Title acting State Conservationist

OPERATION AND MAINTENANCE AGREEMENT
FOR
BASIC FACILITIES
IN A
PUBLIC RECREATIONAL DEVELOPMENT

THIS AGREEMENT made on 6-25, 19 75, is between the Soil Conservation Service, United States Department of Agriculture, hereinafter referred to as the Service, and the following organization(s), hereinafter referred to as the Sponsor:

Grand Forks County Water Management District

The Sponsor and the Service agree to carry out the plan on the attached 6 pages for the operation and maintenance of basic facilities and associated land and water areas devoted to public recreational purposes, herein referred to as the Development, in the

Upper Turtle River

Watershed Project, State of North Dakota. The Development covered by this agreement is identified as:

Public Recreational Development at the Site of
Multiple-Purpose Structure Number 9

Name of Sponsor Grand Forks County Water Management District

By Art Thorsdson Title Chairman

This action was authorized at an official meeting of the Sponsor named immediately above on 6/25/75 at Grand Forks, N.D.

Attest Vincent S. Reed Title Secretary

Soil Conservation Service, United States Department of Agriculture

By Lawrence O. Statten Title State Conservationist
Acting



Appendix D
Hydrologic and Hydraulic Modeling

SITES Summary Table Results - Veg C

	PSH	SDH & FBH 6HR Storm Condition 1	SDH & FBH 6HR Storm Condition 3	SDH & FBH 24HR Storm Condition 1	SDH & FBH 24HR Storm Condition 3
Watershed Runoff Curve Number	74	74	74	74	74
Total Watershed Drainage Area (Sq.Miles)	7.39	7.39	7.39	7.39	7.39
Watershed Time of Concentration (Hours)	13.8	13.8	13.8	13.8	13.8
SDH Rainfall Total (Inches)	N/A	8.17	8.17	10.31	10.31
SDH Rainfall Duration (Hours)	N/A	6	6	24	24
FBH or Storm Rainfall Total (Inches)	N/A	19.36	19.36	23.57	23.57
FBH or Storm Rainfall Duration (Hours)	N/A	6	6	24	24
SDH Inflow Peak (CFS)	N/A	2052.7	2052.7	2324.2	2324.2
FBH or Storm Inflow Peak (CFS)	N/A	6346	6346	6557	6557
Initial Reservoir Elevation (Feet)	1272.03	1272.03	1272.03	1272.03	1272.03
Maximum WS SDH (Feet)	N/A	1292.48	1292.48	1292.86	1292.86
Maximum WS FBH or Storm (Feet)	N/A	1294.43	1294.43	1294.52	1294.52
Storage at Max. WS FBH or Storm (Acre-Ft)	N/A	1874.7	1874.7	1882.6	1882.6
Top Dam (Feet)	N/A	1294.43	1294.43	1294.52	1294.52
Storage, Top Dam (Acre-Ft)	N/A	1875	1875	1883	1883
PSH Drawdown WSE at 10-Days (Ft)	N/A	N/A	N/A	N/A	N/A
PS Crest (Feet)	1248.2	1248.2	1248.2	1248.2	1248.2
PS Number of Conduits	1	1	1	1	1
PS Conduit Diameter (Inches)	24	24	24	24	24
PS Conduit Area (Sq. Feet)	3.14	3.14	3.14	3.14	3.14
Storage, PS Crest (Acre-Ft)	75	75	75	75	75
PS Discharge at AS Crest (CFS)	84.8	84	84	84	84
PS Discharge for SDH (CFS)	N/A	85.5	85.5	85.8	85.8
PS Discharge FBH or Storm (CFS)	N/A	86.8	86.8	86.9	86.9
AS Crest (Feet)	1291.38	1290.2	1290.2	1290.2	1290.2
Storage, AS Crest (Acre-Ft)	1587.5	1512.7	1512.7	1512.7	1512.7
AS Width (Feet)	N/A	400	400	400	400
AS Exit Slope (%)	N/A	9.81	9.81	9.81	9.81
AS Ret. Curve Index	N/A	5.6	5.6	5.6	5.6
AS Veg. Cover Factor	N/A	0.75	0.75	0.75	0.75
AS Maintenance Code	N/A	1	3	1	3
AS Max. Head SDH (Feet)	N/A	2.29	2.29	2.66	2.66
AS Peak Discharge SDH/Storm (CFS)	N/A	1390.4	1390.4	2036.9	2036.9
AS Exit Velocity SDH or Storm (Ft/S)	N/A	6.44	6.44	8.07	8.07
AS Stress SDH or Storm (Lb./Sq.Ft.)	N/A	0.088	2.003	0.132	2.34
Hp FBH or Storm (Feet)	N/A	4.23	4.23	4.32	4.32
AS Peak Discharge FBH/Storm (CFS)	N/A	6214	6214	6468	6468
AS Integ. Dist. FBH or Storm (Feet)	N/A	469	257	318	126
Oe/B FBH or Storm (Acre-Ft/Ft)	N/A	12.3	12.3	16.3	16.3

SITES Summary Table Results - Veg D

	PSH	SDH & FBH 6HR Storm Condition 1	SDH & FBH 6HR Storm Condition 3	SDH & FBH 24HR Storm Condition 1	SDH & FBH 24HR Storm Condition 3
Watershed Runoff Curve Number	74	74	74	74	74
Total Watershed Drainage Area (Sq.Miles)	7.39	7.39	7.39	7.39	7.39
Watershed Time of Concentration (Hours)	13.8	13.8	13.8	13.8	13.8
SDH Rainfall Total (Inches)	N/A	8.17	8.17	10.31	10.31
SDH Rainfall Duration (Hours)	N/A	6	6	24	24
FBH or Storm Rainfall Total (Inches)	N/A	19.36	19.36	23.57	23.57
FBH or Storm Rainfall Duration (Hours)	N/A	6	6	24	24
SDH Inflow Peak (CFS)	N/A	2052.7	2052.7	2324.2	2324.2
FBH or Storm Inflow Peak (CFS)	N/A	6346	6346	6557	6557
Initial Reservoir Elevation (Feet)	1272.03	1272.03	1272.03	1272.03	1272.03
Maximum WS SDH (Feet)	N/A	1292.28	1292.28	1292.63	1292.63
Maximum WS FBH or Storm (Feet)	N/A	1294.2	1294.2	1294.28	1294.28
Storage at Max. WS FBH or Storm (Acre-Ft)	N/A	1854.5	1854.5	1861.5	1861.5
Top Dam (Feet)	N/A	1294.2	1294.2	1294.28	1294.28
Storage, Top Dam (Acre-Ft)	N/A	1855	1855	1862	1862
PSH Drawdown WSE at 10-Days (Ft)	N/A	N/A	N/A	N/A	N/A
PS Crest (Feet)	1248.2	1248.2	1248.2	1248.2	1248.2
PS Number of Conduits	1	1	1	1	1
PS Conduit Diameter (Inches)	24	24	24	24	24
PS Conduit Area (Sq. Feet)	3.14	3.14	3.14	3.14	3.14
Storage, PS Crest (Acre-Ft)	75	75	75	75	75
PS Discharge at AS Crest (CFS)	84.8	84	84	84	84
PS Discharge for SDH (CFS)	N/A	85.4	85.4	85.6	85.6
PS Discharge FBH or Storm (CFS)	N/A	86.7	86.7	86.7	86.7
AS Crest (Feet)	1291.38	1290.2	1290.2	1290.2	1290.2
Storage, AS Crest (Acre-Ft)	1587.5	1512.7	1512.7	1512.7	1512.7
AS Width (Feet)	N/A	400	400	400	400
AS Exit Slope (%)	N/A	9.81	9.81	9.81	9.81
AS Ret. Curve Index	N/A	4.44	4.44	4.44	4.44
AS Veg. Cover Factor	N/A	0.75	0.75	0.75	0.75
AS Maintenance Code	N/A	1	3	1	3
AS Max. Head SDH (Feet)	N/A	2.08	2.08	2.43	2.43
AS Peak Discharge SDH/Storm (CFS)	N/A	1399.8	1399.8	2056.1	2056.1
AS Exit Velocity SDH or Storm (Ft/S)	N/A	7.43	7.43	9.18	9.18
AS Stress SDH or Storm (Lb./Sq.Ft.)	N/A	0.123	1.748	0.177	2.077
Hp FBH or Storm (Feet)	N/A	4	4	4.08	4.08
AS Peak Discharge FBH/Storm (CFS)	N/A	6215	6215	6470	6470
AS Integ. Dist. FBH or Storm (Feet)	N/A	411	301	249	132
Oe/B FBH or Storm (Acre-Ft/Ft)	N/A	12.4	12.4	16.3	16.3

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 10:59:08

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5_5pt_6HR_VegC_Con1		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	1	6	6HR_SDH	
		0	0.026	0.806 0.974 1
ENDTABLE				
PDIRECT			8.17	19.36
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	5.6	.75 1 2
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	1	6	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

**** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8          UTR5_5pt_6HR_VegC_Con1      SUBW= 1
TIME 10:59:08          SITE = 1          PASS= 1    PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
      MATERIAL      PI  DENSITY      Kh      CLAY      RATE      DIAMETER
              lbs/CuFt              (Ft/H)/(lb/SqFt) inches
Alluvium      25.      92.      0.04      30.0      --      0.00600
TS_FILL       25.      92.      0.04      30.0      --      0.00600
GEN_FILL      25.      92.      0.04      30.0      --      0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -6HR_SDH

```

PRECIP. - Q-PS,1-DAY      Q-PS,10-DAY      P-SD      P-FB
          0.00          0.00          8.17      19.36

WSDATA -      CN      DA-SM      TC/L      -/H      QRF
          74.00      7.39      13.80      0.00      0.00

SITEDATA- PERM POOL      CREST PS      FP SED      VALLEY FL      378?
          1248.20      1248.20      1247.20      1232.60      NO

          BASEFLOW      INITIAL EL      EXTRA VOL      SITE TYPE
          0.00          0.00          0.00      DESIGN

PSDATA - NO. COND      COND L      DIA/W      -/H
          1.00      362.00      24.00      0.00

          PS N      KE      WEIR L      TW EL
          0.012      0.75      12.00      1228.20

          2ND STG      ORF H      ORF L      START AUX.
          1272.20      0.75      1.00      1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
          1290.20      0.00      0.00      0.00      0.00

AUX.Data - REF.NO.      RETARD. Ci      TIE STATION      INLET LENGTH
          41          0.00      1000.00      0

AUX.Data - INLET Ci      SIDE SLOPE      EXIT Ci      EXIT SLOPE      ACTUAL AUX?
          5.600      3.00      5.600      0.000      NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft          400.00      0.00      0.00      0.00      0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

6HR_SDH
 IDENTIFICATION NAME IS 1 GIVEN DURATION = 6.0 HRS

0.000	0.026	0.806	0.974	1.000
-------	-------	-------	-------	-------

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5_5pt_6HR_VegC_Con1 SUBW= 1
 TIME 10:59:08 SITE = 1 PASS= 1 PART= 2

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5_5pt_6HR_VegC_Con1 SUBW= 1
 TIME 10:59:08 SITE = 1 PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 6.00 HR	P= 8.17 IN	Q= 5.08 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2001.4 ACFT	

PEAK = 2052.7 CFS, AT 11.2 HRS.

**** WARNING - TR-60 REQUIRES AN INCREASE IN RAINFALL AMOUNT COMPATIBLE
 WITH INCREASE IN SDH OR FBH STORM DURATION WHEN TC EXCEEDS 6-HRS.

NRCS-FBH	D= 6.00 HR	P= 19.36 IN	Q= 15.70 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 6188.1 ACFT	

PEAK = 6346.0 CFS, AT 11.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	115.80	84.34	31.46	1545.91	0.00
15	1291.18	147.60	84.67	62.92	1589.01	0.00
16	1292.06	742.99	85.26	657.73	1666.59	0.00
17	1293.14	2611.17	85.98	2525.19	1761.41	0.00
18	1295.10	8189.82	87.27	8102.55	1933.50	0.00
19	1297.55	17344.21	88.85	17255.36	2141.75	0.00
20	1300.00	28941.17	90.41	28850.76	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	5.6	**	**	**	INLET
2	1000.	1400.	0.0	5.6	0.75	1	2.0	EXIT !
3	1400.	1600.	0.0	5.6	0.75	1	2.0	EXIT
4	1600.	1700.	4.9	5.6	0.75	1	2.0	EXIT
5	1700.	1800.	5.6	5.6	0.75	1	2.0	EXIT
6	1800.	1900.	4.4	5.6	0.75	1	2.0	EXIT
7	1900.	2000.	4.6	5.6	0.75	1	2.0	EXIT
8	2000.	2100.	5.1	5.6	0.75	1	2.0	EXIT
9	2100.	2200.	3.5	5.6	0.75	1	2.0	EXIT
10	2200.	2300.	0.6	5.6	0.75	1	2.0	EXIT
11	2300.	2400.	3.7	5.6	0.75	1	2.0	EXIT
12	2400.	2500.	8.1	5.6	0.75	1	2.0	EXIT
13	2500.	2672.	9.8	5.6	0.75	1	2.0	EXIT

+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.48	1703.8	0.0	2.29	191.1
PEAK - CFS		Q-PS	Q-AUX.	Q-TOT.		
DISCHARGE =		86.	1390.	1476.		
		CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc	
AUXILIARY		FT	FT/SEC	FT/FT	FT/FT	
SPILLWAY ---		0.72	4.80	0.037	0.176	

AUXILIARY SPILLWAY DURATION FLOW = 29.6 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.0 FT/SEC
EXIT SLOPE = 0.000 FT/FT

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

FLOW DEPTH = 3.2 FT

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 1390. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING'S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.048	1.05	0.05	0.001
3	1400.	1600.	0.05	0.048	1.30	0.08	0.002
4	1600.	1700.	4.94	0.048	5.24	2.04	0.055
5	1700.	1800.	5.59	0.048	5.43	2.22	0.059
6	1800.	1900.	4.41	0.048	5.06	1.88	0.050
7	1900.	2000.	4.62	0.048	5.13	1.94	0.052
8	2000.	2100.	5.09	0.048	5.28	2.08	0.056
9	2100.	2200.	3.50	0.048	4.72	1.60	0.043
10	2200.	2300.	0.59	0.048	2.76	0.46	0.012
11	2300.	2400.	3.72	0.048	4.80	1.67	0.045
12	2400.	2500.	8.09	0.048	6.08	2.88	0.077
13	2500.	2672.	9.81	0.048	6.44	3.29	0.088 max.

PLOT NRCS-SDH						1 IN = 500. CFS		EXIT SLOPE = 0.000							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	500.	1000.	1500.	2000.	2500.	3000.	3500.	
1.62	0	17	1272.0	555.7	0.0	0.00	.	I	I	I	I	I	I	I	
2.49	23	17	1272.0	555.7	0.0	0.00	.								
3.36	103	18	1272.2	559.0	0.0	0.00	. I								
4.24	241	21	1272.3	570.0	0.0	0.00	. I								
5.11	435	29	1272.7	592.5	0.0	0.00	. P	I							
5.98	696	61	1273.3	630.0	0.0	0.00	. P		I						
6.85	1028	73	1274.6	687.3	0.0	0.00	. P			I					
7.72	1379	74	1276.6	768.8	0.0	0.00	. P				I				
8.60	1679	76	1278.9	873.6	0.0	0.00	. P					I			
9.47	1896	78	1281.4	996.8	0.0	0.00	. P						I		
10.34	2014	80	1283.9	1132.0	0.0	0.00	. P							I	
11.21	2053	81	1286.4	1272.8	0.0	0.00	. P								X
12.08	2013	83	1288.6	1413.3	0.0	0.00	. P								I
12.96	1909	117	1290.7	1547.4	0.0	0.09*	. A								I
13.83	1769	637	1291.9	1652.8	0.0	0.58*	.		A						
14.70	1596	1408	1292.4	1700.4	0.0	1.02*	.			A	I				
15.57	1384	1476	1292.5	1703.8	0.0	1.05*	.				I X				
16.44	1162	1307	1292.4	1695.2	0.0	0.97*	.			I	A				
17.32	973	1108	1292.3	1685.1	0.0	0.87*	.			I	A				
18.19	819	932	1292.2	1676.2	0.0	0.77*	.			I	A				
19.06	692	785	1292.1	1668.7	0.0	0.68*	.			I	A				
19.93	588	702	1292.0	1661.3	0.0	0.62*	.			I	A				
20.80	504	635	1291.9	1652.5	0.0	0.57*	.			I	A				
21.68	429	562	1291.8	1643.0	0.0	0.52*	.			I	A				
22.55	364	490	1291.7	1633.7	0.0	0.46*	.			I	A				
23.42	309	423	1291.6	1625.0	0.0	0.41*	.			I	A				
24.29	263	364	1291.5	1617.2	0.0	0.35*	.			I	A				
25.16	224	312	1291.4	1610.4	0.0	0.30*	.			I	A				
26.04	190	266	1291.4	1604.5	0.0	0.25*	.			IA					
26.91	162	227	1291.3	1599.4	0.0	0.21*	.			I	A				
27.78	137	193	1291.2	1595.0	0.0	0.17*	.			IA					
28.65	116	164	1291.2	1591.2	0.0	0.13*	.			IA					
29.52	98	147	1291.2	1587.7	0.0	0.11*	.			IA					
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	500.	1000.	1500.	2000.	2500.	3000.	3500.	

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.43	1875.2	0.0	4.23	362.5
PEAK - CFS DISCHARGE =		Q-PS 87.	Q-AUX. 6214.	Q-TOT. 6301.		

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	1.95	7.86	0.013	0.034

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY

(The auxiliary spillway began flow at time = 6.8 hours
and peaked at time = 11.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 2% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 4% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 16.3 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 15.5 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 15.5 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 16.3 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 16.3 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 16.3 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 19.8 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 19.0 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 13.7 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.9 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.
and progressed upstream to station 1469.
The final height of the headcut was 47.8 ft.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

The headcut having the maximum final overfall height began at station 1700. and progressed upstream to station 1498. The final height of the headcut was 57.5 ft.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	39.2	12.3	469.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.3 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 6.4 FT

PLOT NRCS-FBH							1 IN = 1000. CFS							EXIT SLOPE = 0.000			
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I			
1.52	0	18	1272.1	557.6	0.0	0.00	.										
2.39	77	18	1272.1	557.6	0.0	0.00	.I										
3.26	335	21	1272.4	571.0	0.0	0.00	. I										
4.14	770	40	1272.9	608.7	0.0	0.00	.	I									
5.01	1376	73	1274.5	682.0	0.0	0.00	.P		I								
5.88	2197	75	1277.4	805.4	0.0	0.00	.P			I							
6.75	3234	78	1281.4	995.6	0.0	0.00	.P				I						
7.62	4316	81	1286.2	1261.9	0.0	0.00	.P					I					
8.50	5234	200	1291.3	1595.9	0.0	0.18*	. A						I				
9.37	5887	4613	1293.8	1823.2	0.0	2.00*	.						A				
10.24	6237	6174	1294.4	1871.3	0.0	2.30*	.							I			
11.11	6346	6301	1294.4	1875.2	0.0	2.32*	.								A	X	
11.98	6212	6277	1294.4	1874.5	0.0	2.32*	.									IA	
12.86	5881	6029	1294.3	1866.8	0.0	2.27*	.									IA	
13.73	5447	5636	1294.2	1854.7	0.0	2.20*	.								I A		
14.60	4906	5141	1294.0	1839.4	0.0	2.11*	.							I A			
15.47	4244	4531	1293.8	1820.6	0.0	1.98*	.								I A		
16.34	3560	3853	1293.6	1799.7	0.0	1.82*	.					I A					
17.22	2982	3226	1293.4	1780.4	0.0	1.66*	.				I A						
18.09	2512	2710	1293.2	1764.5	0.0	1.51*	.					I A					
18.96	2122	2361	1293.0	1748.7	0.0	1.39*	.						I A				
19.83	1806	2031	1292.8	1732.0	0.0	1.27*	.							I A			
20.70	1547	1737	1292.6	1717.0	0.0	1.16*	.								I A		
21.58	1317	1484	1292.5	1704.2	0.0	1.05*	.									I A	
22.45	1115	1262	1292.4	1692.9	0.0	0.95*	.										I A
23.32	948	1071	1292.3	1683.2	0.0	0.85*	.									I A	
24.19	807	910	1292.2	1675.1	0.0	0.75*	.									IA	
25.06	686	774	1292.1	1668.2	0.0	0.67*	.									IA	
25.94	583	699	1292.0	1660.8	0.0	0.62*	.									IA	
26.81	496	630	1291.9	1651.8	0.0	0.57*	.									IA	
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I			
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.			

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 1475.91 CFS at 14.69 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6300.51 CFS at 10.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

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

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:00:27

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	5	6	VegC_Con3_5pt	
		0	0.026 .806 .974	1
ENDTABLE				
PDIRECT			8.17	19.36
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	5.6 .75 3	1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006 30 92	.04
	11	29	.000078 73 92	0.0386
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	5	6	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8           UTR5          SUBW= 1
TIME 11:00:27          SITE = 1      PASS= 1    PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
MATERIAL    PI  DENSITY    Kh    CLAY    RATE    DIAMETER
      lbs/CuFt                (Ft/H)/(lb/SqFt) inches
Alluvium    25.    92.    0.04    30.0    --    0.00600
TS_FILL     29.    92.    0.04    73.0    --    0.00008
GEN_FILL    25.    92.    0.04    30.0    --    0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -VegC_Con3_5pt

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD    P-FB
      0.00    0.00    8.17    19.36

WSDATA -    CN    DA-SM    TC/L    -/H    QRF
      74.00    7.39    13.80    0.00    0.00

SITEDATA- PERM POOL    CREST PS    FP SED    VALLEY FL    378?
      1248.20    1248.20    1247.20    1232.60    NO

      BASEFLOW    INITIAL EL    EXTRA VOL    SITE TYPE
      0.00    0.00    0.00    DESIGN

PSDATA - NO. COND    COND L    DIA/W    -/H
      1.00    362.00    24.00    0.00

      PS N    KE    WEIR L    TW EL
      0.012    0.75    12.00    1228.20

      2ND STG    ORF H    ORF L    START AUX.
      1272.20    0.75    1.00    1272.03

ASCRESTS - AUX.1    AUX.2    AUX.3    AUX.4    AUX.5
      1290.20    0.00    0.00    0.00    0.00

AUX.Data - REF.NO.    RETARD. Ci    TIE STATION    INLET LENGTH
      41    0.00    1000.00    0

AUX.Data - INLET Ci    SIDE SLOPE    EXIT Ci    EXIT SLOPE    ACTUAL AUX?
      5.600    3.00    5.600    0.000    NO

BTM WIDTH - BW1    BW2    BW3    BW4    BW5
ft    400.00    0.00    0.00    0.00    0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```


NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

VegC_Con3_5pt
 IDENTIFICATION NAME IS 5 GIVEN DURATION = 6.0 HRS

0.000	0.026	0.806	0.974	1.000
-------	-------	-------	-------	-------

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:00:27 SITE = 1 PASS= 1 PART= 2

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:00:27 SITE = 1 PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 6.00 HR	P= 8.17 IN	Q= 5.08 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2001.4 ACFT	

PEAK = 2052.7 CFS, AT 11.2 HRS.

***** WARNING - TR-60 REQUIRES AN INCREASE IN RAINFALL AMOUNT COMPATIBLE
 WITH INCREASE IN SDH OR FBH STORM DURATION WHEN TC EXCEEDS 6-HRS.

NRCS-FBH	D= 6.00 HR	P= 19.36 IN	Q= 15.70 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 6188.1 ACFT	

PEAK = 6346.0 CFS, AT 11.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	115.80	84.34	31.46	1545.91	0.00
15	1291.18	147.60	84.67	62.92	1589.01	0.00
16	1292.06	742.99	85.26	657.73	1666.59	0.00
17	1293.14	2611.17	85.98	2525.19	1761.41	0.00
18	1295.10	8189.82	87.27	8102.55	1933.50	0.00
19	1297.55	17344.21	88.85	17255.36	2141.75	0.00
20	1300.00	28941.17	90.41	28850.76	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	5.6	**	**	**	INLET
2	1000.	1400.	0.0	5.6	0.75	3	1.0	EXIT !
3	1400.	1600.	0.0	5.6	0.75	3	1.0	EXIT
4	1600.	1700.	4.9	5.6	0.75	3	1.0	EXIT
5	1700.	1800.	5.6	5.6	0.75	3	1.0	EXIT
6	1800.	1900.	4.4	5.6	0.75	3	1.0	EXIT
7	1900.	2000.	4.6	5.6	0.75	3	1.0	EXIT
8	2000.	2100.	5.1	5.6	0.75	3	1.0	EXIT
9	2100.	2200.	3.5	5.6	0.75	3	1.0	EXIT
10	2200.	2300.	0.6	5.6	0.75	3	1.0	EXIT
11	2300.	2400.	3.7	5.6	0.75	3	1.0	EXIT
12	2400.	2500.	8.1	5.6	0.75	3	1.0	EXIT
13	2500.	2672.	9.8	5.6	0.75	3	1.0	EXIT

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.48	1703.8	0.0	2.29	191.1

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 86. 1390. 1476.

CRITICAL CRITICAL CRITICAL 25% OF Q
DEPTH VELOCITY SLOPE-Sc Sc
AUXILIARY FT FT/SEC FT/FT FT/FT
SPILLWAY --- 0.72 4.80 0.037 0.176

AUXILIARY SPILLWAY DURATION FLOW = 29.6 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.0 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 3.2 FT

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 1390. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING'S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.048	1.05	0.05	0.005
3	1400.	1600.	0.05	0.048	1.30	0.08	0.008
4	1600.	1700.	4.94	0.048	5.24	2.04	1.240
5	1700.	1800.	5.59	0.048	5.43	2.22	1.352
6	1800.	1900.	4.41	0.048	5.06	1.88	1.144
7	1900.	2000.	4.62	0.048	5.13	1.94	1.183
8	2000.	2100.	5.09	0.048	5.28	2.08	1.266
9	2100.	2200.	3.50	0.048	4.72	1.60	0.974
10	2200.	2300.	0.59	0.048	2.76	0.46	0.282
11	2300.	2400.	3.72	0.048	4.80	1.67	1.016
12	2400.	2500.	8.09	0.048	6.08	2.88	1.750
13	2500.	2672.	9.81	0.048	6.44	3.29	2.003 max.

PLOT NRCS-SDH							1 IN = 500. CFS		EXIT SLOPE = 0.000						
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I	I
1.62	0	17	1272.0	555.7	0.0	0.00	.	I	I	I	I	I	I	I	I
2.49	23	17	1272.0	555.7	0.0	0.00	.								
3.36	103	18	1272.2	559.0	0.0	0.00	. I								
4.24	241	21	1272.3	570.0	0.0	0.00	. I	I							
5.11	435	29	1272.7	592.5	0.0	0.00	.P	I							
5.98	696	61	1273.3	630.0	0.0	0.00	.P		I						
6.85	1028	73	1274.6	687.3	0.0	0.00	.P			I					
7.72	1379	74	1276.6	768.8	0.0	0.00	.P				I				
8.60	1679	76	1278.9	873.6	0.0	0.00	. P					I			
9.47	1896	78	1281.4	996.8	0.0	0.00	. P						I		
10.34	2014	80	1283.9	1132.0	0.0	0.00	. P							I	
11.21	2053	81	1286.4	1272.8	0.0	0.00	. P							X	
12.08	2013	83	1288.6	1413.3	0.0	0.00	. P							I	
12.96	1909	117	1290.7	1547.4	0.0	0.09*	. A							I	
13.83	1769	637	1291.9	1652.8	0.0	0.58*	.	A					I		
14.70	1596	1408	1292.4	1700.4	0.0	1.02*	.		A		I				
15.57	1384	1476	1292.5	1703.8	0.0	1.05*	.			I	X				
16.44	1162	1307	1292.4	1695.2	0.0	0.97*	.			I	A				
17.32	973	1108	1292.3	1685.1	0.0	0.87*	.			I	A				
18.19	819	932	1292.2	1676.2	0.0	0.77*	.			I	A				
19.06	692	785	1292.1	1668.7	0.0	0.68*	.			I	A				
19.93	588	702	1292.0	1661.3	0.0	0.62*	.			I	A				
20.80	504	635	1291.9	1652.5	0.0	0.57*	.			I	A				
21.68	429	562	1291.8	1643.0	0.0	0.52*	.			I	A				
22.55	364	490	1291.7	1633.7	0.0	0.46*	.			I	A				
23.42	309	423	1291.6	1625.0	0.0	0.41*	.			I	A				
24.29	263	364	1291.5	1617.2	0.0	0.35*	.			I	A				
25.16	224	312	1291.4	1610.4	0.0	0.30*	.			I	A				
26.04	190	266	1291.4	1604.5	0.0	0.25*	.			I	A				
26.91	162	227	1291.3	1599.4	0.0	0.21*	.			I	A				
27.78	137	193	1291.2	1595.0	0.0	0.17*	.			I	A				
28.65	116	164	1291.2	1591.2	0.0	0.13*	.			I	A				
29.52	98	147	1291.2	1587.7	0.0	0.11*	.			I	A				
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I	I
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.	

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.43	1875.2	0.0	4.23	362.5

PEAK - CFS DISCHARGE = Q-PS 87. Q-AUX. 6214. Q-TOT. 6301.

CRITICAL DEPTH CRITICAL VELOCITY CRITICAL SLOPE-Sc 25% OF Q Sc

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	1.95	7.86	0.013	0.034

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 6.8 hours
and peaked at time = 11.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 3% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 5% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 10.2 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.
and progressed upstream to station 1257.
The final height of the headcut was 57.5 ft.

The deepest headcut is also the furthest upstream.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

AUXILIARY
SPILLWAY --- DURATION
FLOW HRS 39.2
ATTACK OE/B ACFT/FT 12.3
DIST. FROM MOST U/S
HEADCUT TO U/S EDGE
AUX. CREST, FT 257.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.3 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 6.4 FT

PLOT NRCS-FBH							1 IN = 1000. CFS								EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.				
1.52	0	18	1272.1	557.6	0.0	0.00	.											
2.39	77	18	1272.1	557.6	0.0	0.00	.I											
3.26	335	21	1272.4	571.0	0.0	0.00	. I											
4.14	770	40	1272.9	608.7	0.0	0.00	.	I										
5.01	1376	73	1274.5	682.0	0.0	0.00	.P		I									
5.88	2197	75	1277.4	805.4	0.0	0.00	.P			I								
6.75	3234	78	1281.4	995.6	0.0	0.00	.P				I							
7.62	4316	81	1286.2	1261.9	0.0	0.00	.P					I						
8.50	5234	200	1291.3	1595.9	0.0	0.18*	. A						I					
9.37	5887	4613	1293.8	1823.2	0.0	2.00*	.					A		I				
10.24	6237	6174	1294.4	1871.3	0.0	2.30*	.							A				
11.11	6346	6301	1294.4	1875.2	0.0	2.32*	.							X				
11.98	6212	6277	1294.4	1874.5	0.0	2.32*	.							IA				
12.86	5881	6029	1294.3	1866.8	0.0	2.27*	.							IA				
13.73	5447	5636	1294.2	1854.7	0.0	2.20*	.						I A					
14.60	4906	5141	1294.0	1839.4	0.0	2.11*	.					I A						
15.47	4244	4531	1293.8	1820.6	0.0	1.98*	.				I A							
16.34	3560	3853	1293.6	1799.7	0.0	1.82*	.			I A								
17.22	2982	3226	1293.4	1780.4	0.0	1.66*	.				I A							
18.09	2512	2710	1293.2	1764.5	0.0	1.51*	.			I A								
18.96	2122	2361	1293.0	1748.7	0.0	1.39*	.				I A							
19.83	1806	2031	1292.8	1732.0	0.0	1.27*	.			I A								
20.70	1547	1737	1292.6	1717.0	0.0	1.16*	.				I A							
21.58	1317	1484	1292.5	1704.2	0.0	1.05*	.					I A						
22.45	1115	1262	1292.4	1692.9	0.0	0.95*	.				I A							
23.32	948	1071	1292.3	1683.2	0.0	0.85*	.					I A						
24.19	807	910	1292.2	1675.1	0.0	0.75*	.				IA							
25.06	686	774	1292.1	1668.2	0.0	0.67*	.					IA						
25.94	583	699	1292.0	1660.8	0.0	0.62*	.						IA					
26.81	496	630	1291.9	1651.8	0.0	0.57*	.				IA							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I				
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.				

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 1475.91 CFS at 14.69 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6300.51 CFS at 10.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

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

SITES.....COMPUTATIONS COMPLETE

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

SUMMARY TABLE 1

SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID			RUN DATE			RUN TIME		
-----			-----			-----		
1			02/05/2021			11:00:27		

>>>	SITE	SUBWS	SUBWS DA	CURVE	TC	TOTAL DA	TYPE	STRUC	<<<
	ID	ID	(SQ MI)	NO.	(HRS)	(SQ MI)	DESIGN	CLASS	
	-----	-----	-----	-----	-----	-----	-----	-----	
	1	1	7.39	74.	13.80	7.39	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)	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	1290.2	400.0	4.2	1294.4	0.	257.	2.3	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED
HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 15:03:34

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5_5pt_6HR_VegC_Con1		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	1	6	6HR_SDH	
		0	0.026	0.806 0.974 1
ENDTABLE				
PDIRECT			8.17	19.36
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	4.44	.75 1 1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	1	6	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8          UTR5_5pt_6HR_VegC_Con1      SUBW= 1
TIME 15:03:34          SITE = 1          PASS= 1    PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
MATERIAL      PI  DENSITY      Kh      CLAY      RATE      DIAMETER
      lbs/CuFt      (Ft/H)/(lb/SqFt)  inches
Alluvium      25.      92.      0.04      30.0      --      0.00600
TS_FILL       25.      92.      0.04      30.0      --      0.00600
GEN_FILL      25.      92.      0.04      30.0      --      0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -6HR_SDH

```

PRECIP. - Q-PS,1-DAY      Q-PS,10-DAY      P-SD      P-FB
      0.00      0.00      8.17      19.36

WSDATA -      CN      DA-SM      TC/L      -/H      QRF
      74.00      7.39      13.80      0.00      0.00

SITEDATA- PERM POOL      CREST PS      FP SED      VALLEY FL      378?
      1248.20      1248.20      1247.20      1232.60      NO

      BASEFLOW      INITIAL EL      EXTRA VOL      SITE TYPE
      0.00      0.00      0.00      DESIGN

PSDATA - NO. COND      COND L      DIA/W      -/H
      1.00      362.00      24.00      0.00

      PS N      KE      WEIR L      TW EL
      0.012      0.75      12.00      1228.20

      2ND STG      ORF H      ORF L      START AUX.
      1272.20      0.75      1.00      1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
      1290.20      0.00      0.00      0.00      0.00

AUX.Data - REF.NO.      RETARD. Ci      TIE STATION      INLET LENGTH
      41      0.00      1000.00      0

AUX.Data - INLET Ci      SIDE SLOPE      EXIT Ci      EXIT SLOPE      ACTUAL AUX?
      4.440      3.00      4.440      0.000      NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft      400.00      0.00      0.00      0.00      0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 2.50 2.50 10.0 0.0 0.00 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

6HR_SDH
 IDENTIFICATION NAME IS 1 GIVEN DURATION = 6.0 HRS
 0.000 0.026 0.806 0.974 1.000

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5_5pt_6HR_VegC_Con1 SUBW= 1
 TIME 15:03:34 SITE = 1 PASS= 1 PART= 2

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5_5pt_6HR_VegC_Con1 SUBW= 1
 TIME 15:03:34 SITE = 1 PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 6.00 HR	P= 8.17 IN	Q= 5.08 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2001.4 ACFT	

PEAK = 2052.7 CFS, AT 11.2 HRS.

**** WARNING - TR-60 REQUIRES AN INCREASE IN RAINFALL AMOUNT COMPATIBLE
 WITH INCREASE IN SDH OR FBH STORM DURATION WHEN TC EXCEEDS 6-HRS.

NRCS-FBH	D= 6.00 HR	P= 19.36 IN	Q= 15.70 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 6188.1 ACFT	

PEAK = 6346.0 CFS, AT 11.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	125.91	84.34	41.56	1545.91	0.00
15	1291.18	177.65	84.67	92.97	1589.01	0.00
16	1292.06	1063.58	85.26	978.32	1666.59	0.00
17	1293.14	3108.62	85.98	3022.64	1761.41	0.00
18	1295.10	9004.37	87.27	8917.10	1933.50	0.00
19	1297.55	18591.13	88.85	18502.28	2141.75	0.00
20	1300.00	30691.48	90.41	30601.07	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	4.4	**	**	**	INLET
2	1000.	1400.	0.0	4.4	0.75	1	1.0	EXIT !
3	1400.	1600.	0.0	4.4	0.75	1	1.0	EXIT
4	1600.	1700.	4.9	4.4	0.75	1	1.0	EXIT
5	1700.	1800.	5.6	4.4	0.75	1	1.0	EXIT
6	1800.	1900.	4.4	4.4	0.75	1	1.0	EXIT
7	1900.	2000.	4.6	4.4	0.75	1	1.0	EXIT
8	2000.	2100.	5.1	4.4	0.75	1	1.0	EXIT
9	2100.	2200.	3.5	4.4	0.75	1	1.0	EXIT
10	2200.	2300.	0.6	4.4	0.75	1	1.0	EXIT
11	2300.	2400.	3.7	4.4	0.75	1	1.0	EXIT
12	2400.	2500.	8.1	4.4	0.75	1	1.0	EXIT
13	2500.	2672.	9.8	4.4	0.75	1	1.0	EXIT

+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX. -HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.28	1686.1	0.0	2.08	173.4
PEAK - CFS DISCHARGE =		Q-PS 85.	Q-AUX. 1400.	Q-TOT. 1485.		
		CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc	
AUXILIARY SPILLWAY ---		FT	FT/SEC	FT/FT	FT/FT	
		0.72	4.81	0.023	0.085	

AUXILIARY SPILLWAY DURATION FLOW = 27.9 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.2 FT/SEC
EXIT SLOPE = 0.000 FT/FT

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

FLOW DEPTH = 2.8 FT

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 1400. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.038	1.21	0.04	0.002
3	1400.	1600.	0.05	0.038	1.50	0.07	0.003
4	1600.	1700.	4.94	0.038	6.04	1.78	0.076
5	1700.	1800.	5.59	0.038	6.27	1.94	0.083
6	1800.	1900.	4.41	0.038	5.84	1.64	0.070
7	1900.	2000.	4.62	0.038	5.92	1.70	0.072
8	2000.	2100.	5.09	0.038	6.10	1.82	0.078
9	2100.	2200.	3.50	0.038	5.45	1.40	0.060
10	2200.	2300.	0.59	0.038	3.19	0.40	0.017
11	2300.	2400.	3.72	0.038	5.55	1.46	0.062
12	2400.	2500.	8.09	0.038	7.01	2.51	0.107
13	2500.	2672.	9.81	0.038	7.43	2.87	0.123 max.

PLOT NRCS-SDH						1 IN = 500. CFS		EXIT SLOPE = 0.000							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	500.	1000.	1500.	2000.	2500.	3000.	3500.	
1.62	0	17	1272.0	555.7	0.0	0.00	.	I	I	I	I	I	I	I	
2.49	23	17	1272.0	555.7	0.0	0.00	.								
3.36	103	18	1272.2	559.0	0.0	0.00	. I								
4.24	241	21	1272.3	570.0	0.0	0.00	. I								
5.11	435	29	1272.7	592.5	0.0	0.00	. P	I							
5.98	696	61	1273.3	630.0	0.0	0.00	. P		I						
6.85	1028	73	1274.6	687.3	0.0	0.00	. P			I					
7.72	1379	74	1276.6	768.8	0.0	0.00	. P				I				
8.60	1679	76	1278.9	873.6	0.0	0.00	. P					I			
9.47	1896	78	1281.4	996.8	0.0	0.00	. P						I		
10.34	2014	80	1283.9	1132.0	0.0	0.00	. P							I	
11.21	2053	81	1286.4	1272.8	0.0	0.00	. P							X	
12.08	2013	83	1288.6	1413.3	0.0	0.00	. P							I	
12.96	1909	127	1290.7	1547.1	0.0	0.11*	. A							I	
13.83	1769	822	1291.8	1645.4	0.0	0.84*	.		A						
14.70	1596	1454	1292.3	1684.7	0.0	1.20*	.			A	I				
15.57	1384	1485	1292.3	1686.1	0.0	1.21*	.				I X				
16.44	1162	1300	1292.2	1677.5	0.0	1.12*	.			I	A				
17.32	973	1097	1292.1	1668.1	0.0	1.01*	.			I	A				
18.19	819	969	1292.0	1658.3	0.0	0.93*	.			I	A				
19.06	692	844	1291.8	1647.4	0.0	0.85*	.			I	A				
19.93	588	725	1291.7	1637.0	0.0	0.77*	.			I	A				
20.80	504	621	1291.6	1627.8	0.0	0.69*	.			I	A				
21.68	429	531	1291.5	1619.9	0.0	0.61*	.			I	A				
22.55	364	453	1291.5	1613.1	0.0	0.54*	.			I	A				
23.42	309	385	1291.4	1607.1	0.0	0.47*	.			I	A				
24.29	263	327	1291.3	1602.1	0.0	0.41*	.			I	A				
25.16	224	278	1291.3	1597.8	0.0	0.35*	.			I	A				
26.04	190	237	1291.2	1594.2	0.0	0.29*	.			IA					
26.91	162	201	1291.2	1591.1	0.0	0.24*	.			IA					
27.78	137	177	1291.2	1588.2	0.0	0.20*	.			IA					
28.65	116	173	1291.1	1584.7	0.0	0.20*	.			IA					
29.52	98	167	1291.1	1580.2	0.0	0.19*	.			IA					
30.40	84	161	1291.0	1574.9	0.0	0.18*	.			IA					
31.27	71	154	1291.0	1569.2	0.0	0.16*	. I	A							
32.14	61	147	1290.9	1563.1	0.0	0.15*	. I	A							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	500.	1000.	1500.	2000.	2500.	3000.	3500.	

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.20	1854.6	0.0	4.00	341.9

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.	
DISCHARGE =	87.	6215.	6302.	
	CRITICAL	CRITICAL	CRITICAL	25% OF Q
	DEPTH	VELOCITY	SLOPE-Sc	Sc
AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	1.95	7.86	0.010	0.021

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
 (The auxiliary spillway began flow at time = 6.8 hours
 and peaked at time = 11.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
 Surface unfailed: Stressed to 3% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
 Surface unfailed: Stressed to 5% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 14.6 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 13.7 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 13.7 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 14.6 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 14.6 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 14.6 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 16.3 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 15.5 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 12.9 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
 Vegetal cover failed and concentrated flow developed
 at time = 12.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

The most upstream headcut began at station 1600.
and progressed upstream to station 1411.
The final height of the headcut was 56.8 ft.

The headcut having the maximum final overfall height began
at station 1700. and progressed upstream to station 1430.
The final height of the headcut was 57.5 ft.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	38.4	12.4	411.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.6 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 5.8 FT

PLOT NRCS-FBH						1 IN = 1000. CFS	EXIT SLOPE = 0.000							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.
1.52	0	18	1272.1	557.6	0.0	0.00	I	I	I	I	I	I	I	I
2.39	77	18	1272.1	557.6	0.0	0.00	.I							
3.26	335	21	1272.4	571.0	0.0	0.00	. I							
4.14	770	40	1272.9	608.7	0.0	0.00	.	I						
5.01	1376	73	1274.5	682.0	0.0	0.00	.P		I					
5.88	2197	75	1277.4	805.4	0.0	0.00	.P			I				
6.75	3234	78	1281.4	995.6	0.0	0.00	.P				I			
7.62	4316	81	1286.2	1261.9	0.0	0.00	.P					I		
8.50	5234	240	1291.2	1594.5	0.0	0.30*	. A						I	
9.37	5887	4843	1293.7	1812.0	0.0	2.27*	.					A		I
10.24	6237	6190	1294.2	1851.3	0.0	2.54*	.							A
11.11	6346	6302	1294.2	1854.6	0.0	2.56*	.							X
11.98	6212	6276	1294.2	1853.9	0.0	2.56*	.							IA
12.86	5881	6022	1294.1	1846.5	0.0	2.51*	.							IA
13.73	5447	5627	1294.0	1834.9	0.0	2.44*	.						I A	
14.60	4906	5129	1293.8	1820.4	0.0	2.33*	.					I A		
15.47	4244	4517	1293.6	1802.5	0.0	2.20*	.						I A	
16.34	3560	3838	1293.4	1782.7	0.0	2.03*	.				I A			
17.22	2982	3212	1293.2	1764.4	0.0	1.85*	.			I A				
18.09	2512	2784	1293.0	1746.4	0.0	1.72*	.				I A			
18.96	2122	2375	1292.8	1727.4	0.0	1.58*	.			I A				
19.83	1806	2015	1292.6	1710.7	0.0	1.45*	.				I A			
20.70	1547	1719	1292.4	1697.0	0.0	1.32*	.			I A				
21.58	1317	1468	1292.3	1685.4	0.0	1.21*	.				I A			
22.45	1115	1248	1292.2	1675.1	0.0	1.09*	.					IA		
23.32	948	1060	1292.1	1666.3	0.0	0.99*	.						I A	
24.19	807	954	1292.0	1657.0	0.0	0.92*	.						I A	
25.06	686	833	1291.8	1646.4	0.0	0.84*	.						IA	
25.94	583	717	1291.7	1636.3	0.0	0.76*	.						IA	
26.81	496	613	1291.6	1627.2	0.0	0.68*	.						IA	
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 1485.21 CFS at 14.69 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6302.09 CFS at 10.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

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

SUMMARY TABLE 1 SITES VERSION 2005.1.8
----- DATED 01/01/2005

>>>	SITE	SUBWS	SUBWS DA	CURVE	TC	TOTAL DA	TYPE	STRUC	<<<
	ID	ID	(SQ MI)	NO.	(HRS)	(SQ MI)	DESIGN	CLASS	
	----	----	-----	-----	-----	-----	-----	-----	
	1	1	7.39	74.	13.80	7.39	TR60	C	

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	24.0	1290.2	400.0	4.0	1294.2	0.	411.	2.6	NRCS-FBH

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:02:10

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	6	6	VegD_Con3_5pt	
		0	.026 .806 .974	1
ENDTABLE				
PDIRECT			8.17	19.36
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	4.44 .75 3	1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006 30 92	.04
	11	29	.000078 73 92	0.0386
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	6	6	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8           UTR5          SUBW= 1
TIME 11:02:10          SITE = 1      PASS= 1  PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
      MATERIAL    PI  DENSITY      Kh      CLAY      RATE      DIAMETER
              lbs/CuFt              (Ft/H)/(lb/SqFt) inches
Alluvium      25.    92.    0.04    30.0    --    0.00600
TS_FILL      29.    92.    0.04    73.0    --    0.00008
GEN_FILL     25.    92.    0.04    30.0    --    0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -VegD_Con3_5pt

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD    P-FB
          0.00          0.00          8.17    19.36

WSDATA -   CN          DA-SM          TC/L          -/H          QRF
          74.00          7.39          13.80          0.00          0.00

SITEDATA- PERM POOL    CREST PS          FP SED          VALLEY FL          378?
          1248.20      1248.20          1247.20          1232.60          NO

          BASEFLOW      INITIAL EL    EXTRA VOL    SITE TYPE
          0.00          0.00          0.00          DESIGN

PSDATA - NO. COND      COND L          DIA/W          -/H
          1.00          362.00          24.00          0.00

          PS N          KE          WEIR L          TW EL
          0.012          0.75          12.00          1228.20

          2ND STG      ORF H          ORF L          START AUX.
          1272.20      0.75          1.00          1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
          1290.20      0.00          0.00          0.00          0.00

AUX.Data - REF.NO.    RETARD. Ci    TIE STATION    INLET LENGTH
          41          0.00          1000.00          0

AUX.Data - INLET Ci    SIDE SLOPE    EXIT Ci    EXIT SLOPE    ACTUAL AUX?
          4.440      3.00          4.440      0.000          NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft          400.00      0.00          0.00          0.00          0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

VegD_Con3_5pt
 IDENTIFICATION NAME IS 6 GIVEN DURATION = 6.0 HRS

0.000	0.026	0.806	0.974	1.000
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1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:02:10 SITE = 1 PASS= 1 PART= 2

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:02:10 SITE = 1 PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
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PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
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EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 6.00 HR	P= 8.17 IN	Q= 5.08 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2001.4 ACFT	

PEAK = 2052.7 CFS, AT 11.2 HRS.

***** WARNING - TR-60 REQUIRES AN INCREASE IN RAINFALL AMOUNT COMPATIBLE
 WITH INCREASE IN SDH OR FBH STORM DURATION WHEN TC EXCEEDS 6-HRS.

NRCS-FBH	D= 6.00 HR	P= 19.36 IN	Q= 15.70 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 6188.1 ACFT	

PEAK = 6346.0 CFS, AT 11.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	125.91	84.34	41.56	1545.91	0.00
15	1291.18	177.65	84.67	92.97	1589.01	0.00
16	1292.06	1063.58	85.26	978.32	1666.59	0.00
17	1293.14	3108.62	85.98	3022.64	1761.41	0.00
18	1295.10	9004.37	87.27	8917.10	1933.50	0.00
19	1297.55	18591.13	88.85	18502.28	2141.75	0.00
20	1300.00	30691.48	90.41	30601.07	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	4.4	**	**	**	INLET
2	1000.	1400.	0.0	4.4	0.75	3	1.0	EXIT !
3	1400.	1600.	0.0	4.4	0.75	3	1.0	EXIT
4	1600.	1700.	4.9	4.4	0.75	3	1.0	EXIT
5	1700.	1800.	5.6	4.4	0.75	3	1.0	EXIT
6	1800.	1900.	4.4	4.4	0.75	3	1.0	EXIT
7	1900.	2000.	4.6	4.4	0.75	3	1.0	EXIT
8	2000.	2100.	5.1	4.4	0.75	3	1.0	EXIT
9	2100.	2200.	3.5	4.4	0.75	3	1.0	EXIT
10	2200.	2300.	0.6	4.4	0.75	3	1.0	EXIT
11	2300.	2400.	3.7	4.4	0.75	3	1.0	EXIT
12	2400.	2500.	8.1	4.4	0.75	3	1.0	EXIT
13	2500.	2672.	9.8	4.4	0.75	3	1.0	EXIT

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.28	1686.1	0.0	2.08	173.4

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 85. 1400. 1485.

CRITICAL CRITICAL CRITICAL 25% OF Q
DEPTH VELOCITY SLOPE-Sc Sc
AUXILIARY FT FT/SEC FT/FT FT/FT
SPILLWAY --- 0.72 4.81 0.023 0.085

AUXILIARY SPILLWAY DURATION FLOW = 27.9 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.2 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 2.8 FT

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 1400. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING'S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.038	1.21	0.04	0.007
3	1400.	1600.	0.05	0.038	1.50	0.07	0.012
4	1600.	1700.	4.94	0.038	6.04	1.78	1.082
5	1700.	1800.	5.59	0.038	6.27	1.94	1.180
6	1800.	1900.	4.41	0.038	5.84	1.64	0.998
7	1900.	2000.	4.62	0.038	5.92	1.70	1.033
8	2000.	2100.	5.09	0.038	6.10	1.82	1.105
9	2100.	2200.	3.50	0.038	5.45	1.40	0.850
10	2200.	2300.	0.59	0.038	3.19	0.40	0.246
11	2300.	2400.	3.72	0.038	5.55	1.46	0.887
12	2400.	2500.	8.09	0.038	7.01	2.51	1.528
13	2500.	2672.	9.81	0.038	7.43	2.87	1.748 max.

PLOT NRCS-SDH							1 IN = 500. CFS							EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			
1.62	0	17	1272.0	555.7	0.0	0.00	.	I	I	I	I	I	I	I			
2.49	23	17	1272.0	555.7	0.0	0.00	.										
3.36	103	18	1272.2	559.0	0.0	0.00	. I										
4.24	241	21	1272.3	570.0	0.0	0.00	.	I									
5.11	435	29	1272.7	592.5	0.0	0.00	.P	I									
5.98	696	61	1273.3	630.0	0.0	0.00	.P		I								
6.85	1028	73	1274.6	687.3	0.0	0.00	.P			I							
7.72	1379	74	1276.6	768.8	0.0	0.00	.P				I						
8.60	1679	76	1278.9	873.6	0.0	0.00	. P					I					
9.47	1896	78	1281.4	996.8	0.0	0.00	. P						I				
10.34	2014	80	1283.9	1132.0	0.0	0.00	. P							I			
11.21	2053	81	1286.4	1272.8	0.0	0.00	. P							X			
12.08	2013	83	1288.6	1413.3	0.0	0.00	. P							I			
12.96	1909	127	1290.7	1547.1	0.0	0.11*	. A							I			
13.83	1769	822	1291.8	1645.4	0.0	0.84*	.		A					I			
14.70	1596	1454	1292.3	1684.7	0.0	1.20*	.			A	I						
15.57	1384	1485	1292.3	1686.1	0.0	1.21*	.				I X						
16.44	1162	1300	1292.2	1677.5	0.0	1.12*	.			I	A						
17.32	973	1097	1292.1	1668.1	0.0	1.01*	.			I	A						
18.19	819	969	1292.0	1658.3	0.0	0.93*	.			I	A						
19.06	692	844	1291.8	1647.4	0.0	0.85*	.			I	A						
19.93	588	725	1291.7	1637.0	0.0	0.77*	.			I	A						
20.80	504	621	1291.6	1627.8	0.0	0.69*	.			I	A						
21.68	429	531	1291.5	1619.9	0.0	0.61*	.			I	A						
22.55	364	453	1291.5	1613.1	0.0	0.54*	.			I	A						
23.42	309	385	1291.4	1607.1	0.0	0.47*	.			I	A						
24.29	263	327	1291.3	1602.1	0.0	0.41*	.			I	A						
25.16	224	278	1291.3	1597.8	0.0	0.35*	.			I	A						
26.04	190	237	1291.2	1594.2	0.0	0.29*	.			I	A						
26.91	162	201	1291.2	1591.1	0.0	0.24*	.			I	A						
27.78	137	177	1291.2	1588.2	0.0	0.20*	.			I	A						
28.65	116	173	1291.1	1584.7	0.0	0.20*	.			I	A						
29.52	98	167	1291.1	1580.2	0.0	0.19*	.			I	A						
30.40	84	161	1291.0	1574.9	0.0	0.18*	.			I	A						
31.27	71	154	1291.0	1569.2	0.0	0.16*	.I	A									
32.14	61	147	1290.9	1563.1	0.0	0.15*	.I	A									
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I			
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.20	1854.6	0.0	4.00	341.9
PEAK - CFS DISCHARGE =		Q-PS 87.	Q-AUX. 6215.	Q-TOT. 6302.		

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	1.95	7.86	0.010	0.021

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 6.8 hours
and peaked at time = 11.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 4% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 7% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.0 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.9 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 12.9 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 11.1 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 10.2 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.
and progressed upstream to station 1301.

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

The final height of the headcut was 57.5 ft.

The deepest headcut is also the furthest upstream.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	38.4	12.4	301.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.6 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 5.8 FT

PLOT NRCS-FBH							1 IN = 1000. CFS	EXIT SLOPE = 0.000							
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.	
1.52	0	18	1272.1	557.6	0.0	0.00	.	I	I	I	I	I	I	I	
2.39	77	18	1272.1	557.6	0.0	0.00	.I								
3.26	335	21	1272.4	571.0	0.0	0.00	. I								
4.14	770	40	1272.9	608.7	0.0	0.00	.	I							
5.01	1376	73	1274.5	682.0	0.0	0.00	.P		I						
5.88	2197	75	1277.4	805.4	0.0	0.00	.P			I					
6.75	3234	78	1281.4	995.6	0.0	0.00	.P				I				
7.62	4316	81	1286.2	1261.9	0.0	0.00	.P					I			
8.50	5234	240	1291.2	1594.5	0.0	0.30*	. A						I		
9.37	5887	4843	1293.7	1812.0	0.0	2.27*	.					A		I	
10.24	6237	6190	1294.2	1851.3	0.0	2.54*	.							A	
11.11	6346	6302	1294.2	1854.6	0.0	2.56*	.							X	
11.98	6212	6276	1294.2	1853.9	0.0	2.56*	.							IA	
12.86	5881	6022	1294.1	1846.5	0.0	2.51*	.							IA	
13.73	5447	5627	1294.0	1834.9	0.0	2.44*	.						I A		
14.60	4906	5129	1293.8	1820.4	0.0	2.33*	.						I A		
15.47	4244	4517	1293.6	1802.5	0.0	2.20*	.					I A			
16.34	3560	3838	1293.4	1782.7	0.0	2.03*	.				I A				
17.22	2982	3212	1293.2	1764.4	0.0	1.85*	.			I A					
18.09	2512	2784	1293.0	1746.4	0.0	1.72*	.				I A				
18.96	2122	2375	1292.8	1727.4	0.0	1.58*	.			I A					
19.83	1806	2015	1292.6	1710.7	0.0	1.45*	.			I A					
20.70	1547	1719	1292.4	1697.0	0.0	1.32*	.			I A					
21.58	1317	1468	1292.3	1685.4	0.0	1.21*	.			I A					
22.45	1115	1248	1292.2	1675.1	0.0	1.09*	.			IA					
23.32	948	1060	1292.1	1666.3	0.0	0.99*	.			I A					
24.19	807	954	1292.0	1657.0	0.0	0.92*	.			I A					
25.06	686	833	1291.8	1646.4	0.0	0.84*	.			IA					
25.94	583	717	1291.7	1636.3	0.0	0.76*	.			IA					
26.81	496	613	1291.6	1627.2	0.0	0.68*	.			IA					
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I	
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.	

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 1485.21 CFS at 14.69 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6302.09 CFS at 10.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

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

NRCS 6-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

SITES.....COMPUTATIONS COMPLETE

SUMMARY TABLE 1

SITES VERSION 2005.1.8
DATED 01/01/2005

WATERSHED ID	RUN DATE	RUN TIME
-----	-----	-----
1	02/05/2021	11:02:10

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1	1	7.39	74.	13.80	7.39	TR60	C	

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	1290.2	400.0	4.0	1294.2	0.	301.	2.6	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:03:19

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	5	24	NRCS5pt	
		0	.026	.806 .974 1
ENDTABLE				
PDIRECT			10.31	23.57
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	5.6	.75 1 1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	5	24	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:03:19 SITE = 1 PASS= 1 PART= 1

*****		MATERIAL PROPERTIES		*****		
MATERIAL	PI	DRY DENSITY lbs/CuFt	Kh	PERCENT CLAY	DETACH. RATE (Ft/H)/(lb/SqFt)	REP. DIAMETER inches
Alluvium	25.	92.	0.04	30.0	--	0.00600
TS_FILL	25.	92.	0.04	30.0	--	0.00600
GEN_FILL	25.	92.	0.04	30.0	--	0.00600

***** BASIC Data *****
 CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION AUX. -NRCS5pt

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	P-SD	P-FB	
0.00	0.00	10.31	23.57	
WSDATA - CN	DA-SM	TC/L	-/H	QRF
74.00	7.39	13.80	0.00	0.00
SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
1248.20	1248.20	1247.20	1232.60	NO
BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE	
0.00	0.00	0.00	DESIGN	
PSDATA - NO. COND	COND L	DIA/W	-/H	
1.00	362.00	24.00	0.00	
PS N	KE	WEIR L	TW EL	
0.012	0.75	12.00	1228.20	
2ND STG	ORF H	ORF L	START AUX.	
1272.20	0.75	1.00	1272.03	
ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
1290.20	0.00	0.00	0.00	0.00
AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH	
41	0.00	1000.00	0	
AUX.Data - INLET Ci	SIDE SLOPE	EXIT Ci	EXIT SLOPE	ACTUAL AUX?
5.600	3.00	5.600	0.000	NO
BTM WIDTH - BW1	BW2	BW3	BW4	BW5
ft 400.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

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

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

NRCS5pt
 IDENTIFICATION NAME IS 5 GIVEN DURATION = 24.0 HRS

0.000	0.026	0.806	0.974	1.000
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1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:03:19 SITE = 1 PASS= 1 PART= 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----

XEQ 02/05/2021	UTR5	WSID= 1
VER 2005.1.8	UTR5	SUBW= 1
TIME 11:03:19	SITE = 1	PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 24.00 HR	P= 10.31 IN	Q= 7.03 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2772.6 ACFT	

PEAK = 2324.2 CFS, AT 19.4 HRS.

NRCS-FBH	D= 24.00 HR	P= 23.57 IN	Q= 19.82 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 7812.4 ACFT	

PEAK = 6557.0 CFS, AT 19.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	115.80	84.34	31.46	1545.91	0.00
15	1291.18	147.60	84.67	62.92	1589.01	0.00
16	1292.06	742.99	85.26	657.73	1666.59	0.00
17	1293.14	2611.17	85.98	2525.19	1761.41	0.00
18	1295.10	8189.82	87.27	8102.55	1933.50	0.00
19	1297.55	17344.21	88.85	17255.36	2141.75	0.00
20	1300.00	28941.17	90.41	28850.76	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	5.6	**	**	**	INLET
2	1000.	1400.	0.0	5.6	0.75	1	1.0	EXIT !
3	1400.	1600.	0.0	5.6	0.75	1	1.0	EXIT
4	1600.	1700.	4.9	5.6	0.75	1	1.0	EXIT
5	1700.	1800.	5.6	5.6	0.75	1	1.0	EXIT
6	1800.	1900.	4.4	5.6	0.75	1	1.0	EXIT
7	1900.	2000.	4.6	5.6	0.75	1	1.0	EXIT
8	2000.	2100.	5.1	5.6	0.75	1	1.0	EXIT
9	2100.	2200.	3.5	5.6	0.75	1	1.0	EXIT
10	2200.	2300.	0.6	5.6	0.75	1	1.0	EXIT
11	2300.	2400.	3.7	5.6	0.75	1	1.0	EXIT
12	2400.	2500.	8.1	5.6	0.75	1	1.0	EXIT
13	2500.	2672.	9.8	5.6	0.75	1	1.0	EXIT

+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.86	1736.6	0.0	2.66	223.9

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 86. 2037. 2123.

CRITICAL CRITICAL CRITICAL 25% OF Q
DEPTH VELOCITY SLOPE-Sc Sc
AUXILIARY FT FT/SEC FT/FT FT/FT
SPILLWAY --- 0.93 5.45 0.027 0.108

AUXILIARY SPILLWAY DURATION FLOW = 34.0 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.3 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 3.8 FT

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 2037. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.043	1.31	0.06	0.002
3	1400.	1600.	0.05	0.043	1.62	0.10	0.003
4	1600.	1700.	4.94	0.042	6.56	2.38	0.081
5	1700.	1800.	5.59	0.042	6.81	2.60	0.089
6	1800.	1900.	4.41	0.042	6.34	2.20	0.075
7	1900.	2000.	4.62	0.042	6.43	2.27	0.078
8	2000.	2100.	5.09	0.042	6.62	2.43	0.083
9	2100.	2200.	3.50	0.042	5.91	1.87	0.064
10	2200.	2300.	0.59	0.042	3.45	0.54	0.018
11	2300.	2400.	3.72	0.042	6.02	1.95	0.067
12	2400.	2500.	8.09	0.042	7.61	3.36	0.115
13	2500.	2672.	9.81	0.042	8.07	3.84	0.132 max.

PLOT NRCS-SDH						1 IN = 500. CFS						EXIT SLOPE = 0.000					
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			
6.32	0	17	1272.0	555.4	0.0	0.00	I	I	I	I	I	I	I	I			
7.19	4	17	1272.0	555.4	0.0	0.00	.										
8.06	20	17	1272.0	555.4	0.0	0.00	.										
8.94	59	17	1272.1	556.1	0.0	0.00	.I										
9.81	132	18	1272.2	561.7	0.0	0.00	. I										
10.68	251	22	1272.4	574.0	0.0	0.00	. I										
11.55	430	32	1272.7	596.6	0.0	0.00	.P	I									
12.42	672	65	1273.4	632.8	0.0	0.00	.P		I								
13.30	958	73	1274.6	686.6	0.0	0.00	.P			I							
14.17	1267	74	1276.4	761.4	0.0	0.00	.P				I						
15.04	1573	76	1278.5	858.4	0.0	0.00	. P					I					
15.91	1851	77	1281.0	976.3	0.0	0.00	. P						I				
16.78	2073	79	1283.5	1112.0	0.0	0.00	. P							I			
17.66	2223	81	1286.2	1261.0	0.0	0.00	. P								I		
18.53	2305	83	1288.7	1418.3	0.0	0.00	. P									I	
19.40	2324	139	1291.0	1577.1	0.0	0.11*	. A									X	
20.27	2286	1260	1292.4	1692.8	0.0	0.94*	.			A						I	
21.14	2197	2075	1292.8	1734.2	0.0	1.29*	.						A		I		
22.02	2068	2123	1292.9	1736.6	0.0	1.31*	.							IX			
22.89	1913	2013	1292.8	1731.1	0.0	1.27*	.								I A		
23.76	1740	1858	1292.7	1723.2	0.0	1.21*	.										
24.63	1562	1687	1292.6	1714.5	0.0	1.14*	.								I A		
25.50	1393	1513	1292.5	1705.7	0.0	1.06*	.										
26.38	1240	1350	1292.4	1697.4	0.0	0.99*	.								I A		
27.25	1099	1200	1292.3	1689.8	0.0	0.91*	.										
28.12	968	1062	1292.2	1682.8	0.0	0.84*	.								I A		
28.99	847	933	1292.2	1676.3	0.0	0.77*	.										
29.86	735	815	1292.1	1670.3	0.0	0.70*	.								IA		
30.74	634	724	1292.0	1664.1	0.0	0.64*	.										
31.61	544	666	1291.9	1656.5	0.0	0.60*	.								IA		
32.48	468	596	1291.8	1647.5	0.0	0.55*	.								I A		
33.35	401	526	1291.7	1638.4	0.0	0.49*	.										
34.22	343	459	1291.6	1629.6	0.0	0.44*	.								I A		
35.10	292	398	1291.6	1621.6	0.0	0.38*	.										
35.97	248	343	1291.5	1614.4	0.0	0.33*	.								I A		
36.84	210	293	1291.4	1608.0	0.0	0.28*	.										
37.71	178	250	1291.3	1602.4	0.0	0.24*	.								IA		
38.58	152	213	1291.3	1597.6	0.0	0.19*	.										
39.46	129	182	1291.2	1593.5	0.0	0.15*	.								IA		
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I			
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.52	1883.1	0.0	4.32	370.4

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.	
DISCHARGE =	87.	6468.	6555.	
	CRITICAL	CRITICAL	CRITICAL	25% OF Q
	DEPTH	VELOCITY	SLOPE-Sc	Sc
AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	2.00	7.97	0.013	0.032

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 13.0 hours
and peaked at time = 19.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 3% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 5% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 22.6 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 21.7 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 21.7 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 22.6 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 21.7 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 21.7 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 24.3 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 23.5 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.0 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

The most upstream headcut began at station 1600.
and progressed upstream to station 1318.
The final height of the headcut was 57.5 ft.

The deepest headcut is also the furthest upstream.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	43.6	16.3	318.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.4 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 6.5 FT

PLOT NRCS-FBH						1 IN = 1000. CFS										EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.					
6.03	0	17	1272.0	555.4	0.0	0.00	.	I	I	I	I	I	I	I					
6.90	14	17	1272.0	555.4	0.0	0.00	.												
7.77	73	18	1272.1	557.2	0.0	0.00	.I												
8.65	203	20	1272.3	565.8	0.0	0.00	. I												
9.52	434	27	1272.6	587.1	0.0	0.00	. I												
10.39	800	59	1273.3	628.5	0.0	0.00	.P	I											
11.26	1336	73	1275.0	700.7	0.0	0.00	.P		I										
12.13	2044	75	1277.7	817.2	0.0	0.00	.P			I									
13.01	2868	78	1281.2	988.7	0.0	0.00	.P				I								
13.88	3736	81	1285.5	1221.0	0.0	0.00	.P					I							
14.75	4581	86	1290.2	1514.6	0.0	0.00	.A						I						
15.62	5341	2814	1293.2	1767.7	0.0	1.54*	.			A				I					
16.49	5944	5862	1294.3	1861.7	0.0	2.24*	.								I				
17.37	6340	6164	1294.4	1871.0	0.0	2.30*	.									A			
18.24	6539	6461	1294.5	1880.2	0.0	2.35*	.										AI		
19.11	6557	6555	1294.5	1883.1	0.0	2.36*	.											A	
19.98	6408	6477	1294.5	1880.7	0.0	2.35*	.											X	
20.85	6124	6250	1294.4	1873.7	0.0	2.31*	.											IA	
21.73	5736	5906	1294.3	1863.0	0.0	2.25*	.												
22.60	5291	5483	1294.1	1850.0	0.0	2.17*	.												
23.47	4804	5014	1294.0	1835.5	0.0	2.08*	.												
24.34	4305	4519	1293.8	1820.3	0.0	1.98*	.												
25.21	3827	4031	1293.6	1805.2	0.0	1.86*	.												
26.09	3396	3579	1293.5	1791.3	0.0	1.75*	.												
26.96	3006	3172	1293.3	1778.7	0.0	1.64*	.												
27.83	2645	2798	1293.2	1767.2	0.0	1.53*	.												
28.70	2314	2491	1293.1	1755.3	0.0	1.44*	.												
29.57	2012	2219	1292.9	1741.5	0.0	1.34*	.												
30.45	1736	1932	1292.7	1726.9	0.0	1.24*	.												
31.32	1490	1667	1292.6	1713.5	0.0	1.13*	.												
32.19	1279	1433	1292.5	1701.6	0.0	1.03*	.												
33.06	1098	1230	1292.3	1691.3	0.0	0.93*	.												
33.93	938	1054	1292.2	1682.4	0.0	0.84*	.												
34.81	800	900	1292.2	1674.6	0.0	0.75*	.												
35.68	681	767	1292.1	1667.8	0.0	0.67*	.												
36.55	577	696	1292.0	1660.4	0.0	0.62*	.												
37.42	489	625	1291.9	1651.3	0.0	0.57*	.												
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I	I	I	I	I	I
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.					

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 2122.65 CFS at 21.15 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6554.80 CFS at 18.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg C

1 STRUCTURE(S) ANALYZED.

2 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	02/05/2021	11:03:19

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	1	1	7.39	74.	13.80	7.39	TR60	C	

PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	1290.2	400.0	4.3	1294.5	0.	318.	2.4	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:06:31

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	7	24	NRCS5pt	
		0	.026	.806 .974 1
ENDTABLE				
PDIRECT			10.31	23.57
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	5.6	.75 3 1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	7	24	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

**** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8           UTR5          SUBW= 1
TIME 11:06:31          SITE = 1      PASS= 1    PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
      MATERIAL    PI  DENSITY      Kh      CLAY      RATE      DIAMETER
              lbs/CuFt              (Ft/H)/(lb/SqFt) inches
Alluvium      25.    92.    0.04    30.0      --    0.00600
TS_FILL      25.    92.    0.04    30.0      --    0.00600
GEN_FILL     25.    92.    0.04    30.0      --    0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -NRCS5pt

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD      P-FB
          0.00          0.00          10.31     23.57

WSDATA -   CN          DA-SM          TC/L      -/H      QRF
          74.00        7.39          13.80     0.00     0.00

SITEDATA- PERM POOL    CREST PS      FP SED      VALLEY FL    378?
          1248.20      1248.20      1247.20     1232.60     NO

          BASEFLOW      INITIAL EL    EXTRA VOL    SITE TYPE
          0.00          0.00          0.00         DESIGN

PSDATA - NO. COND      COND L      DIA/W      -/H
          1.00          362.00      24.00     0.00

          PS N          KE          WEIR L      TW EL
          0.012         0.75         12.00     1228.20

          2ND STG      ORF H          ORF L      START AUX.
          1272.20      0.75          1.00     1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
          1290.20      0.00          0.00     0.00     0.00

AUX.Data - REF.NO.      RETARD. Ci    TIE STATION    INLET LENGTH
          41           0.00         1000.00         0

AUX.Data - INLET Ci      SIDE SLOPE    EXIT Ci      EXIT SLOPE    ACTUAL AUX?
          5.600         3.00         5.600         0.000         NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft          400.00     0.00     0.00     0.00     0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```


NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

NRCS5pt
 IDENTIFICATION NAME IS 7 GIVEN DURATION = 24.0 HRS

0.000	0.026	0.806	0.974	1.000
-------	-------	-------	-------	-------

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:06:31 SITE = 1 PASS= 1 PART= 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----

XEQ 02/05/2021	UTR5	WSID= 1
VER 2005.1.8	UTR5	SUBW= 1
TIME 11:06:31	SITE = 1	PASS= 1
		PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 24.00 HR	P= 10.31 IN	Q= 7.03 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2772.6 ACFT	

PEAK = 2324.2 CFS, AT 19.4 HRS.

NRCS-FBH	D= 24.00 HR	P= 23.57 IN	Q= 19.82 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 7812.4 ACFT	

PEAK = 6557.0 CFS, AT 19.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	115.80	84.34	31.46	1545.91	0.00
15	1291.18	147.60	84.67	62.92	1589.01	0.00
16	1292.06	742.99	85.26	657.73	1666.59	0.00
17	1293.14	2611.17	85.98	2525.19	1761.41	0.00
18	1295.10	8189.82	87.27	8102.55	1933.50	0.00
19	1297.55	17344.21	88.85	17255.36	2141.75	0.00
20	1300.00	28941.17	90.41	28850.76	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	5.6	**	**	**	INLET
2	1000.	1400.	0.0	5.6	0.75	3	1.0	EXIT !
3	1400.	1600.	0.0	5.6	0.75	3	1.0	EXIT
4	1600.	1700.	4.9	5.6	0.75	3	1.0	EXIT
5	1700.	1800.	5.6	5.6	0.75	3	1.0	EXIT
6	1800.	1900.	4.4	5.6	0.75	3	1.0	EXIT
7	1900.	2000.	4.6	5.6	0.75	3	1.0	EXIT
8	2000.	2100.	5.1	5.6	0.75	3	1.0	EXIT
9	2100.	2200.	3.5	5.6	0.75	3	1.0	EXIT
10	2200.	2300.	0.6	5.6	0.75	3	1.0	EXIT
11	2300.	2400.	3.7	5.6	0.75	3	1.0	EXIT
12	2400.	2500.	8.1	5.6	0.75	3	1.0	EXIT
13	2500.	2672.	9.8	5.6	0.75	3	1.0	EXIT

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.86	1736.6	0.0	2.66	223.9

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 86. 2037. 2123.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT 0.93	FT/SEC 5.45	FT/FT 0.027	FT/FT 0.108

AUXILIARY SPILLWAY DURATION FLOW = 34.0 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.3 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 3.8 FT

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

Aux. Spillway Discharge = 2037. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.043	1.31	0.06	0.008
3	1400.	1600.	0.05	0.043	1.62	0.10	0.012
4	1600.	1700.	4.94	0.042	6.56	2.38	1.448
5	1700.	1800.	5.59	0.042	6.81	2.60	1.579
6	1800.	1900.	4.41	0.042	6.34	2.20	1.336
7	1900.	2000.	4.62	0.042	6.43	2.27	1.382
8	2000.	2100.	5.09	0.042	6.62	2.43	1.479
9	2100.	2200.	3.50	0.042	5.91	1.87	1.138
10	2200.	2300.	0.59	0.042	3.45	0.54	0.329
11	2300.	2400.	3.72	0.042	6.02	1.95	1.187
12	2400.	2500.	8.09	0.042	7.61	3.36	2.045
13	2500.	2672.	9.81	0.042	8.07	3.84	2.340 max.

PLOT NRCS-SDH							1 IN = 500. CFS							EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			
6.32	0	17	1272.0	555.4	0.0	0.00	.	I	I	I	I	I	I	I			
7.19	4	17	1272.0	555.4	0.0	0.00	.	.	.	.	.	.	.	.			
8.06	20	17	1272.0	555.4	0.0	0.00	.	.	.	.	.	.	.	.			
8.94	59	17	1272.1	556.1	0.0	0.00	.I	.	.	.	.	.	.	.			
9.81	132	18	1272.2	561.7	0.0	0.00	.	I	.	.	.	.	.	.			
10.68	251	22	1272.4	574.0	0.0	0.00	.	I	.	.	.	.	.	.			
11.55	430	32	1272.7	596.6	0.0	0.00	.P	.	I	.	.	.	.	.			
12.42	672	65	1273.4	632.8	0.0	0.00	.P	.	I	.	.	.	.	.			
13.30	958	73	1274.6	686.6	0.0	0.00	.P	.	I	.	.	.	.	.			
14.17	1267	74	1276.4	761.4	0.0	0.00	.P	.	I	.	.	.	.	.			
15.04	1573	76	1278.5	858.4	0.0	0.00	.P	.	I	.	.	.	.	.			
15.91	1851	77	1281.0	976.3	0.0	0.00	.P	.	I	.	.	.	.	.			
16.78	2073	79	1283.5	1112.0	0.0	0.00	.P	.	I	.	.	.	.	.			
17.66	2223	81	1286.2	1261.0	0.0	0.00	.P	.	I	.	.	.	.	.			
18.53	2305	83	1288.7	1418.3	0.0	0.00	.P	.	I	.	.	.	.	.			
19.40	2324	139	1291.0	1577.1	0.0	0.11*	.A	.	I	.	.	.	.	.			
20.27	2286	1260	1292.4	1692.8	0.0	0.94*	.	.	A	.	.	.	.	.			
21.14	2197	2075	1292.8	1734.2	0.0	1.29*	.	.	.	.	.	.	.	.			
22.02	2068	2123	1292.9	1736.6	0.0	1.31*	.	.	.	.	.	.	.	.			
22.89	1913	2013	1292.8	1731.1	0.0	1.27*	.	.	.	.	.	.	.	.			
23.76	1740	1858	1292.7	1723.2	0.0	1.21*	.	.	.	.	.	.	.	.			
24.63	1562	1687	1292.6	1714.5	0.0	1.14*	.	.	.	.	.	.	.	.			
25.50	1393	1513	1292.5	1705.7	0.0	1.06*	.	.	.	.	.	.	.	.			
26.38	1240	1350	1292.4	1697.4	0.0	0.99*	.	.	.	.	.	.	.	.			
27.25	1099	1200	1292.3	1689.8	0.0	0.91*	.	.	.	.	.	.	.	.			
28.12	968	1062	1292.2	1682.8	0.0	0.84*	.	.	.	.	.	.	.	.			
28.99	847	933	1292.2	1676.3	0.0	0.77*	.	.	.	.	.	.	.	.			
29.86	735	815	1292.1	1670.3	0.0	0.70*	.	.	.	.	.	.	.	.			
30.74	634	724	1292.0	1664.1	0.0	0.64*	.	.	.	.	.	.	.	.			
31.61	544	666	1291.9	1656.5	0.0	0.60*	.	.	.	.	.	.	.	.			
32.48	468	596	1291.8	1647.5	0.0	0.55*	.	.	.	.	.	.	.	.			
33.35	401	526	1291.7	1638.4	0.0	0.49*	.	.	.	.	.	.	.	.			
34.22	343	459	1291.6	1629.6	0.0	0.44*	.	.	.	.	.	.	.	.			
35.10	292	398	1291.6	1621.6	0.0	0.38*	.	.	.	.	.	.	.	.			
35.97	248	343	1291.5	1614.4	0.0	0.33*	.	.	.	.	.	.	.	.			
36.84	210	293	1291.4	1608.0	0.0	0.28*	.	.	.	.	.	.	.	.			
37.71	178	250	1291.3	1602.4	0.0	0.24*	.	.	.	.	.	.	.	.			
38.58	152	213	1291.3	1597.6	0.0	0.19*	.	.	.	.	.	.	.	.			
39.46	129	182	1291.2	1593.5	0.0	0.15*	.	.	.	.	.	.	.	.			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I			
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.			

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.52	1883.1	0.0	4.32	370.4
PEAK - CFS DISCHARGE =	Q-PS 87.	Q-AUX. 6468.	Q-TOT. 6555.			

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	2.00	7.97	0.013	0.032

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 13.0 hours
and peaked at time = 19.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 5% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 8% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.
and progressed upstream to station 1126.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg C

The final height of the headcut was 57.6 ft.

The deepest headcut is also the furthest upstream.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	43.6	16.3	126.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.4 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 6.5 FT

PLOT NRCS-FBH							1 IN = 1000. CFS								EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.				
6.03	0	17	1272.0	555.4	0.0	0.00	.	I	I	I	I	I	I	I				
6.90	14	17	1272.0	555.4	0.0	0.00	.											
7.77	73	18	1272.1	557.2	0.0	0.00	.I											
8.65	203	20	1272.3	565.8	0.0	0.00	. I											
9.52	434	27	1272.6	587.1	0.0	0.00	. I											
10.39	800	59	1273.3	628.5	0.0	0.00	.P	I										
11.26	1336	73	1275.0	700.7	0.0	0.00	.P		I									
12.13	2044	75	1277.7	817.2	0.0	0.00	.P			I								
13.01	2868	78	1281.2	988.7	0.0	0.00	.P				I							
13.88	3736	81	1285.5	1221.0	0.0	0.00	.P					I						
14.75	4581	86	1290.2	1514.6	0.0	0.00	.A						I					
15.62	5341	2814	1293.2	1767.7	0.0	1.54*	.			A				I				
16.49	5944	5862	1294.3	1861.7	0.0	2.24*	.							A				
17.37	6340	6164	1294.4	1871.0	0.0	2.30*	.							AI				
18.24	6539	6461	1294.5	1880.2	0.0	2.35*	.							A				
19.11	6557	6555	1294.5	1883.1	0.0	2.36*	.							X				
19.98	6408	6477	1294.5	1880.7	0.0	2.35*	.							IA				
20.85	6124	6250	1294.4	1873.7	0.0	2.31*	.							IA				
21.73	5736	5906	1294.3	1863.0	0.0	2.25*	.							I A				
22.60	5291	5483	1294.1	1850.0	0.0	2.17*	.							I A				
23.47	4804	5014	1294.0	1835.5	0.0	2.08*	.							I A				
24.34	4305	4519	1293.8	1820.3	0.0	1.98*	.							I A				
25.21	3827	4031	1293.6	1805.2	0.0	1.86*	.							I A				
26.09	3396	3579	1293.5	1791.3	0.0	1.75*	.							I A				
26.96	3006	3172	1293.3	1778.7	0.0	1.64*	.							I A				
27.83	2645	2798	1293.2	1767.2	0.0	1.53*	.							I A				
28.70	2314	2491	1293.1	1755.3	0.0	1.44*	.							I A				
29.57	2012	2219	1292.9	1741.5	0.0	1.34*	.							I A				
30.45	1736	1932	1292.7	1726.9	0.0	1.24*	.							I A				
31.32	1490	1667	1292.6	1713.5	0.0	1.13*	.							I A				
32.19	1279	1433	1292.5	1701.6	0.0	1.03*	.							IA				
33.06	1098	1230	1292.3	1691.3	0.0	0.93*	.							IA				
33.93	938	1054	1292.2	1682.4	0.0	0.84*	.							I A				
34.81	800	900	1292.2	1674.6	0.0	0.75*	.							IA				
35.68	681	767	1292.1	1667.8	0.0	0.67*	.							IA				
36.55	577	696	1292.0	1660.4	0.0	0.62*	.							IA				
37.42	489	625	1291.9	1651.3	0.0	0.57*	.							IA				
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I				
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.				

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 2122.65 CFS at 21.15 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6554.80 CFS at 18.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:05:07

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	6	24	NRCS5pt	
		0	.026	.806 .974 1
ENDTABLE				
PDIRECT			10.31	23.57
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	4.44	.75 1 1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	6	24	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

**** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8           UTR5          SUBW= 1
TIME 11:05:07          SITE = 1      PASS= 1  PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
      MATERIAL    PI  DENSITY      Kh      CLAY      RATE      DIAMETER
              lbs/CuFt              (Ft/H)/(lb/SqFt) inches
Alluvium      25.    92.    0.04    30.0      --    0.00600
TS_FILL      25.    92.    0.04    30.0      --    0.00600
GEN_FILL     25.    92.    0.04    30.0      --    0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -NRCS5pt

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD    P-FB
          0.00          0.00          10.31    23.57

WSDATA -   CN          DA-SM          TC/L          -/H          QRF
          74.00          7.39          13.80          0.00          0.00

SITEDATA- PERM POOL    CREST PS          FP SED          VALLEY FL          378?
          1248.20      1248.20          1247.20          1232.60          NO

          BASEFLOW      INITIAL EL    EXTRA VOL    SITE TYPE
          0.00          0.00          0.00          DESIGN

PSDATA - NO. COND      COND L          DIA/W          -/H
          1.00          362.00          24.00          0.00

          PS N          KE          WEIR L          TW EL
          0.012          0.75          12.00          1228.20

          2ND STG      ORF H          ORF L          START AUX.
          1272.20      0.75          1.00          1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
          1290.20      0.00          0.00          0.00          0.00

AUX.Data - REF.NO.    RETARD. Ci    TIE STATION    INLET LENGTH
          41          0.00          1000.00          0

AUX.Data - INLET Ci    SIDE SLOPE    EXIT Ci      EXIT SLOPE    ACTUAL AUX?
          4.440          3.00          4.440          0.000          NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft          400.00      0.00          0.00          0.00          0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
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NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

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 WIDTHS, ft HEIGHTS, ft
 U/S D/S ft ft ft U/S D/S U/S D/S
 2.50 2.50 10.0 0.0 0.00 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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

NRCS5pt
 IDENTIFICATION NAME IS 6 GIVEN DURATION = 24.0 HRS

0.000	0.026	0.806	0.974	1.000
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1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:05:07 SITE = 1 PASS= 1 PART= 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----
 XEQ 02/05/2021 UTR5 WSID= 1
 VER 2005.1.8 UTR5 SUBW= 1
 TIME 11:05:07 SITE = 1 PASS= 1 PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
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PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
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EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 24.00 HR	P= 10.31 IN	Q= 7.03 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2772.6 ACFT	

PEAK = 2324.2 CFS, AT 19.4 HRS.

NRCS-FBH	D= 24.00 HR	P= 23.57 IN	Q= 19.82 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 7812.4 ACFT	

PEAK = 6557.0 CFS, AT 19.1 HRS.

 RATING TABLE DEVELOPED, SITE = 1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	125.91	84.34	41.56	1545.91	0.00
15	1291.18	177.65	84.67	92.97	1589.01	0.00
16	1292.06	1063.58	85.26	978.32	1666.59	0.00
17	1293.14	3108.62	85.98	3022.64	1761.41	0.00
18	1295.10	9004.37	87.27	8917.10	1933.50	0.00
19	1297.55	18591.13	88.85	18502.28	2141.75	0.00
20	1300.00	30691.48	90.41	30601.07	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	4.4	**	**	**	INLET
2	1000.	1400.	0.0	4.4	0.75	1	1.0	EXIT !
3	1400.	1600.	0.0	4.4	0.75	1	1.0	EXIT
4	1600.	1700.	4.9	4.4	0.75	1	1.0	EXIT
5	1700.	1800.	5.6	4.4	0.75	1	1.0	EXIT
6	1800.	1900.	4.4	4.4	0.75	1	1.0	EXIT
7	1900.	2000.	4.6	4.4	0.75	1	1.0	EXIT
8	2000.	2100.	5.1	4.4	0.75	1	1.0	EXIT
9	2100.	2200.	3.5	4.4	0.75	1	1.0	EXIT
10	2200.	2300.	0.6	4.4	0.75	1	1.0	EXIT
11	2300.	2400.	3.7	4.4	0.75	1	1.0	EXIT
12	2400.	2500.	8.1	4.4	0.75	1	1.0	EXIT
13	2500.	2672.	9.8	4.4	0.75	1	1.0	EXIT

+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.63	1716.6	0.0	2.43	203.9

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 86. 2056. 2142.

CRITICAL CRITICAL CRITICAL 25% OF Q
DEPTH VELOCITY SLOPE-Sc Sc
AUXILIARY FT FT/SEC FT/FT FT/FT
SPILLWAY --- 0.93 5.47 0.018 0.057

AUXILIARY SPILLWAY DURATION FLOW = 33.1 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.5 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 3.4 FT

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 2056. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.035	1.50	0.05	0.003
3	1400.	1600.	0.05	0.035	1.85	0.08	0.004
4	1600.	1700.	4.94	0.034	7.47	2.11	0.110
5	1700.	1800.	5.59	0.034	7.75	2.30	0.119
6	1800.	1900.	4.41	0.034	7.21	1.95	0.101
7	1900.	2000.	4.62	0.034	7.32	2.02	0.105
8	2000.	2100.	5.09	0.034	7.53	2.16	0.112
9	2100.	2200.	3.50	0.034	6.73	1.66	0.086
10	2200.	2300.	0.59	0.034	3.93	0.48	0.025
11	2300.	2400.	3.72	0.034	6.85	1.73	0.090
12	2400.	2500.	8.09	0.034	8.66	2.98	0.155
13	2500.	2672.	9.81	0.034	9.18	3.41	0.177 max.

PLOT NRCS-SDH						1 IN = 500. CFS						EXIT SLOPE = 0.000			
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	500.	1000.	1500.	2000.	2500.	3000.	3500.	
6.32	0	17	1272.0	555.4	0.0	0.00	.	I	I	I	I	I	I	I	
7.19	4	17	1272.0	555.4	0.0	0.00	.								
8.06	20	17	1272.0	555.4	0.0	0.00	.								
8.94	59	17	1272.1	556.1	0.0	0.00	.I								
9.81	132	18	1272.2	561.7	0.0	0.00	. I								
10.68	251	22	1272.4	574.0	0.0	0.00	. I								
11.55	430	32	1272.7	596.6	0.0	0.00	.P	I							
12.42	672	65	1273.4	632.8	0.0	0.00	.P		I						
13.30	958	73	1274.6	686.6	0.0	0.00	.P			I					
14.17	1267	74	1276.4	761.4	0.0	0.00	.P				I				
15.04	1573	76	1278.5	858.4	0.0	0.00	. P					I			
15.91	1851	77	1281.0	976.3	0.0	0.00	. P						I		
16.78	2073	79	1283.5	1112.0	0.0	0.00	. P							I	
17.66	2223	81	1286.2	1261.0	0.0	0.00	. P								I
18.53	2305	83	1288.7	1418.3	0.0	0.00	. P								I
19.40	2324	162	1291.0	1576.3	0.0	0.18*	. A								X
20.27	2286	1447	1292.3	1684.4	0.0	1.19*	.			A					I
21.14	2197	2142	1292.6	1716.6	0.0	1.50*	.								XI
22.02	2068	2134	1292.6	1716.2	0.0	1.49*	.								I A
22.89	1913	2009	1292.6	1710.4	0.0	1.44*	.								I A
23.76	1740	1850	1292.5	1703.0	0.0	1.38*	.								I A
24.63	1562	1676	1292.4	1695.0	0.0	1.30*	.								I A
25.50	1393	1503	1292.3	1687.0	0.0	1.22*	.								I A
26.38	1240	1340	1292.2	1679.4	0.0	1.14*	.								I A
27.25	1099	1191	1292.1	1672.5	0.0	1.06*	.								I A
28.12	968	1057	1292.1	1666.0	0.0	0.98*	.								I A
28.99	847	970	1292.0	1658.4	0.0	0.93*	.								I A
29.86	735	865	1291.9	1649.2	0.0	0.86*	.								I A
30.74	634	760	1291.8	1640.0	0.0	0.79*	.								I A
31.61	544	660	1291.7	1631.3	0.0	0.72*	.								I A
32.48	468	570	1291.6	1623.4	0.0	0.64*	.								I A
33.35	401	491	1291.5	1616.5	0.0	0.58*	.								I A
34.22	343	422	1291.4	1610.4	0.0	0.51*	.								IA
35.10	292	361	1291.4	1605.1	0.0	0.45*	.								IA
35.97	248	308	1291.3	1600.4	0.0	0.38*	.								IA
36.84	210	262	1291.3	1596.4	0.0	0.33*	.								IA
37.71	178	223	1291.2	1592.9	0.0	0.27*	.								A
38.58	152	189	1291.2	1590.0	0.0	0.22*	.								IA
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I	I
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.	

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.28	1862.0	0.0	4.08	349.4

PEAK - CFS Q-PS Q-AUX. Q-TOT.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

DISCHARGE	=	87.	6470.	6556.
		CRITICAL	CRITICAL	CRITICAL
		DEPTH	VELOCITY	SLOPE-Sc
AUXILIARY		FT	FT/SEC	25% OF Q
SPILLWAY ---		2.00	7.97	Sc
			0.009	FT/FT
				0.021

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 13.0 hours
and peaked at time = 19.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 4% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 7% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.9 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.0 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.0 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.9 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.9 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 20.9 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 22.6 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 21.7 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 19.1 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 19.1 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

and progressed upstream to station 1249.
The final height of the headcut was 57.5 ft.

The deepest headcut is also the furthest upstream.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	41.9	16.3	249.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.6 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 5.9 FT

PLOT NRCS-FBH						1 IN =	1000. CFS					EXIT SLOPE = 0.000				
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.		
6.03	0	17	1272.0	555.4	0.0	0.00	I	I	I	I	I	I	I	I		
6.90	14	17	1272.0	555.4	0.0	0.00	.									
7.77	73	18	1272.1	557.2	0.0	0.00	.I									
8.65	203	20	1272.3	565.8	0.0	0.00	. I									
9.52	434	27	1272.6	587.1	0.0	0.00	. I	I								
10.39	800	59	1273.3	628.5	0.0	0.00	.P	I								
11.26	1336	73	1275.0	700.7	0.0	0.00	.P		I							
12.13	2044	75	1277.7	817.2	0.0	0.00	.P			I						
13.01	2868	78	1281.2	988.7	0.0	0.00	.P				I					
13.88	3736	81	1285.5	1221.0	0.0	0.00	.P					I				
14.75	4581	86	1290.2	1514.6	0.0	0.00	.A						I			
15.62	5341	3055	1293.1	1758.9	0.0	1.81*	.			A				I		
16.49	5944	5900	1294.1	1842.9	0.0	2.49*	.							I		
17.37	6340	6167	1294.2	1850.7	0.0	2.54*	.							A		
18.24	6539	6468	1294.3	1859.5	0.0	2.59*	.							AI		
19.11	6557	6556	1294.3	1862.0	0.0	2.61*	.							A		
19.98	6408	6475	1294.3	1859.7	0.0	2.60*	.							X		
20.85	6124	6244	1294.2	1852.9	0.0	2.55*	.							IA		
21.73	5736	5897	1294.1	1842.8	0.0	2.49*	.							IA		
22.60	5291	5473	1293.9	1830.4	0.0	2.40*	.							I A		
23.47	4804	5003	1293.8	1816.7	0.0	2.31*	.							I A		
24.34	4305	4508	1293.6	1802.2	0.0	2.19*	.							I A		
25.21	3827	4020	1293.4	1788.0	0.0	2.08*	.							I A		
26.09	3396	3569	1293.3	1774.8	0.0	1.96*	.							I A		
26.96	3006	3162	1293.2	1763.0	0.0	1.84*	.							I A		
27.83	2645	2856	1293.0	1749.7	0.0	1.75*	.							I A		
28.70	2314	2527	1292.8	1734.4	0.0	1.64*	.							I A		
29.57	2012	2209	1292.7	1719.7	0.0	1.52*	.							I A		
30.45	1736	1916	1292.5	1706.1	0.0	1.41*	.							I A		
31.32	1490	1651	1292.4	1693.8	0.0	1.29*	.							I A		
32.19	1279	1418	1292.2	1683.0	0.0	1.18*	.							IA		
33.06	1098	1217	1292.1	1673.7	0.0	1.08*	.							IA		
33.93	938	1050	1292.0	1665.4	0.0	0.98*	.							IA		
34.81	800	944	1291.9	1656.2	0.0	0.92*	.							IA		
35.68	681	825	1291.8	1645.7	0.0	0.84*	.							IA		
36.55	577	711	1291.7	1635.7	0.0	0.76*	.							IA		
37.42	489	607	1291.6	1626.6	0.0	0.68*	.							IA		
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I		
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.		

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 2141.78 CFS at 20.28 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6556.43 CFS at 18.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 1 & Veg D

2 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			02/05/2021			11:05:07			
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	1	1	7.39	74.	13.80	7.39	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
	-----	-----	-----	-----	-----	-----	-----	-----	-----
	1	24.0	1290.2	400.0	4.1	1294.3	0.	249.	2.6 NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

SITES XEQ 02/05/2021 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
 VER 2005.1.8 (USER MANUAL - DATED DECEMBER 2005)
 TIME 11:07:34

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

SITES	01/01/20051	UTR5	7.39	C2
SAVMOV	0 101			
SAVMOV	101 1			1
STRUCTURE	1	UTR5		
		1228.2	0.0	
		1231.2	0.4	
		1236.2	4.7	
		1241.2	17.9	
		1246.2	45.6	
		1246.7	62.0	
		1250	90.0	
		1252.5	119.1	
		1256.6	177.0	
		1261.1	263.4	
		1265.2	360.9	
		1268.7	466.2	
		1272.2	560.0	
		1273	617.3	
		1277.7	817.3	
		1281.8	1015.5	
		1286.1	1253.2	
		1290.6	1538.0	
		1295	1925.0	
		1300	2350	
ENDTABLE				
WSDATA	5C 1	74	7.39	13.8
BASEFLOW		0		
RAINTABLE	6	24	NRCS5pt	
		0	.026	.806 .974 1
ENDTABLE				
PDIRECT			10.31	23.57
POOLDATA	ELEV	1248.2	1248.2	1247.2 1220 1232.6 TC
PSINLET	ELEV	.75	12	1272.2 .75 1
PSDATA	1	362	24	.012 1228.2
ASSPRFL	41	0.5	UTR5	
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
ASSURFACE	41	2800	.006	
	800	2800	4.44	.75 3 1
ENDTABLE				
ASDATA	41		3	1
BTMWIDTH	FEET	400		
ASMATERIAL	11	1		
	1	25	.006	30 92 .04
	11	25	.006	30 92 .04
ENDTABLE				
ASCOORD	1	Alluvium N		
	800	1290.118751000	1290.2 1200	1290.15
	1400	1290.1 1600	1290 1700	1285.05625
	1800	1279.4625 1900	1275.056252000	1270.43125
	2100	1265.3375 2200	1261.8375 2300	1261.24375
	2400	1257.525 2500	1249.431252800	1220
ENDTABLE				
GRAPHICS	I			
GO,DESIGN	LCP	6	24	1272.03
SAVMOV	2 101 1		1	
ENDJOB				

***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 1290.20
 FROM THE ASSPRFL RECORDS.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

```

1SITES -----
XEQ 02/05/2021          UTR5          WSID= 1
VER 2005.1.8           UTR5          SUBW= 1
TIME 11:07:34          SITE = 1      PASS= 1  PART= 1
  
```

```

***** MATERIAL PROPERTIES *****
      DRY          PERCENT          DETACH.          REP.
      MATERIAL    PI  DENSITY      Kh      CLAY      RATE      DIAMETER
              lbs/CuFt              (Ft/H)/(lb/SqFt) inches
Alluvium      25.    92.    0.04    30.0      --    0.00600
TS_FILL       25.    92.    0.04    30.0      --    0.00600
GEN_FILL      25.    92.    0.04    30.0      --    0.00600
  
```

```

***** BASIC Data *****
CLIMATE AREA - NOT DEFINED          DESIGN CLASS  C
  
```

STORM DISTRIBUTION AUX. -NRCS5pt

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD    P-FB
          0.00          0.00          10.31    23.57

WSDATA -   CN          DA-SM          TC/L          -/H          QRF
          74.00          7.39          13.80          0.00          0.00

SITEDATA- PERM POOL    CREST PS          FP SED          VALLEY FL          378?
          1248.20      1248.20          1247.20          1232.60          NO

          BASEFLOW      INITIAL EL      EXTRA VOL      SITE TYPE
          0.00          0.00          0.00          DESIGN

PSDATA - NO. COND      COND L          DIA/W          -/H
          1.00          362.00          24.00          0.00

          PS N          KE          WEIR L          TW EL
          0.012          0.75          12.00          1228.20

          2ND STG      ORF H          ORF L          START AUX.
          1272.20      0.75          1.00          1272.03

ASCRESTS - AUX.1      AUX.2      AUX.3      AUX.4      AUX.5
          1290.20      0.00          0.00          0.00          0.00

AUX.Data - REF.NO.      RETARD. Ci      TIE STATION      INLET LENGTH
          41          0.00          1000.00          0

AUX.Data - INLET Ci      SIDE SLOPE      EXIT Ci      EXIT SLOPE      ACTUAL AUX?
          4.440          3.00          4.440          0.000          NO

BTM WIDTH - BW1      BW2      BW3      BW4      BW5
ft          400.00      0.00          0.00          0.00          0.00
  
```

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

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
  
```

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

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 WIDTHS, ft HEIGHTS, ft
U/S D/S ft ft ft U/S D/S U/S D/S
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				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

800.	1290.12
1000.	1290.20
1200.	1290.15
1400.	1290.10
1600.	1290.00
1700.	1285.06
1800.	1279.46
1900.	1275.06
2000.	1270.43
2100.	1265.34
2200.	1261.84
2300.	1261.24
2400.	1257.53
2500.	1249.43
2672.	1232.60

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				

NRCS5pt
IDENTIFICATION NAME IS 6 GIVEN DURATION = 24.0 HRS

0.000	0.026	0.806	0.974	1.000
-------	-------	-------	-------	-------

1SITES -----
XEQ 02/05/2021 UTR5 WSID= 1
VER 2005.1.8 UTR5 SUBW= 1
TIME 11:07:34 SITE = 1 PASS= 1 PART= 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

PERM POOL	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
CREST PS	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
SED ACCUM	1248.20 FT	74.7 ACFT	0.00 AC	15.8 CFS
2ND STAGE	1272.20 FT	560.0 ACFT	0.00 AC	90.4 CFS
START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1282.32	78.49	78.49	0.00	1044.16	0.00
12	1291.16	84.66	84.66	0.00	1587.18	0.00
13	1300.00	90.41	90.41	0.00	2349.99	0.00

1SITES -----

XEQ 02/05/2021	UTR5	WSID= 1
VER 2005.1.8	UTR5	SUBW= 1
TIME 11:07:34	SITE = 1	PASS= 1
		PART= 3

AUX. CREST	1290.20 FT	1512.7 ACFT	0.00 AC	83.8 CFS
------------	------------	-------------	---------	----------

PS STORAGE 1438.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV	1272.03 FT	555.4 ACFT	0.00 AC	17.5 CFS
------------	------------	------------	---------	----------

EFFECTIVE HEIGHT(H)= 70.2 FEET, PRODUCT= 106190. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH	D= 24.00 HR	P= 10.31 IN	Q= 7.03 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 2772.6 ACFT	

PEAK = 2324.2 CFS, AT 19.4 HRS.

NRCS-FBH	D= 24.00 HR	P= 23.57 IN	Q= 19.82 IN	DA= 7.39 SM
	TC= 13.80 HR	CN= 74.00	VOL= 7812.4 ACFT	

PEAK = 6557.0 CFS, AT 19.1 HRS.

RATING TABLE DEVELOPED, SITE = 1 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	1248.20	0.00	0.00	0.00	74.73	0.00
2	1248.35	0.17	0.17	0.00	75.96	0.00
3	1248.49	0.49	0.49	0.00	77.20	0.00
TRANSITION TO ORIFICE FLOW, ELEV = 1248.64 FT						
4	1248.64	0.89	0.89	0.00	78.43	0.00
5	1256.49	10.15	10.15	0.00	175.46	0.00
6	1264.35	14.33	14.33	0.00	340.58	0.00
7	1272.20	17.54	17.54	0.00	560.00	0.00
8	1272.63	28.04	28.04	0.00	590.50	0.00
9	1273.05	47.10	47.10	0.00	619.50	0.00
FULL CONDUIT FLOW, ELEV = 1273.48 FT						
10	1273.48	71.74	71.74	0.00	637.63	0.00
11	1279.05	76.09	76.09	0.00	882.65	0.00
12	1284.63	80.15	80.15	0.00	1171.72	0.00
13	1290.20	84.01	84.01	0.00	1512.69	0.00
14	1290.69	125.91	84.34	41.56	1545.91	0.00
15	1291.18	177.65	84.67	92.97	1589.01	0.00
16	1292.06	1063.58	85.26	978.32	1666.59	0.00
17	1293.14	3108.62	85.98	3022.64	1761.41	0.00
18	1295.10	9004.37	87.27	8917.10	1933.50	0.00
19	1297.55	18591.13	88.85	18502.28	2141.75	0.00
20	1300.00	30691.48	90.41	30601.07	2350.00	0.00

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX	VEGETAL COVER FACTOR	MAINT. CODE	ROOTING DEPTH (ft)	REACH LOCATION *
1	800.	1000.	0.0	4.4	**	**	**	INLET
2	1000.	1400.	0.0	4.4	0.75	3	1.0	EXIT !
3	1400.	1600.	0.0	4.4	0.75	3	1.0	EXIT
4	1600.	1700.	4.9	4.4	0.75	3	1.0	EXIT
5	1700.	1800.	5.6	4.4	0.75	3	1.0	EXIT
6	1800.	1900.	4.4	4.4	0.75	3	1.0	EXIT
7	1900.	2000.	4.6	4.4	0.75	3	1.0	EXIT
8	2000.	2100.	5.1	4.4	0.75	3	1.0	EXIT
9	2100.	2200.	3.5	4.4	0.75	3	1.0	EXIT
10	2200.	2300.	0.6	4.4	0.75	3	1.0	EXIT
11	2300.	2400.	3.7	4.4	0.75	3	1.0	EXIT
12	2400.	2500.	8.1	4.4	0.75	3	1.0	EXIT
13	2500.	2672.	9.8	4.4	0.75	3	1.0	EXIT

* Upper case indicates a reach of constructed spillway channel.

** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.

! Reach 2 used in computing exit channel velocities.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	400.0	1292.63	1716.6	0.0	2.43	203.9

PEAK - CFS DISCHARGE =	Q-PS 86.	Q-AUX. 2056.	Q-TOT. 2142.
AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT
	0.93	5.47	0.018
			25% OF Q Sc FT/FT
			0.057

AUXILIARY SPILLWAY DURATION FLOW = 33.1 HOURS

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 1.5 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 3.4 FT

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

Aux. Spillway Discharge = 2056. cfs; Bottom Width = 400. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2
2	1000.	1400.	0.02	0.035	1.50	0.05	0.010
3	1400.	1600.	0.05	0.035	1.85	0.08	0.017
4	1600.	1700.	4.94	0.034	7.47	2.11	1.286
5	1700.	1800.	5.59	0.034	7.75	2.30	1.402
6	1800.	1900.	4.41	0.034	7.21	1.95	1.186
7	1900.	2000.	4.62	0.034	7.32	2.02	1.227
8	2000.	2100.	5.09	0.034	7.53	2.16	1.313
9	2100.	2200.	3.50	0.034	6.73	1.66	1.010
10	2200.	2300.	0.59	0.034	3.93	0.48	0.292
11	2300.	2400.	3.72	0.034	6.85	1.73	1.053
12	2400.	2500.	8.09	0.034	8.66	2.98	1.815
13	2500.	2672.	9.81	0.034	9.18	3.41	2.077 max.

PLOT NRCS-SDH						1 IN = 500. CFS		EXIT SLOPE = 0.000						
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	500.	1000.	1500.	2000.	2500.	3000.	3500.
6.32	0	17	1272.0	555.4	0.0	0.00	I	I	I	I	I	I	I	I
7.19	4	17	1272.0	555.4	0.0	0.00	.							
8.06	20	17	1272.0	555.4	0.0	0.00	.							
8.94	59	17	1272.1	556.1	0.0	0.00	.I							
9.81	132	18	1272.2	561.7	0.0	0.00	.	I						
10.68	251	22	1272.4	574.0	0.0	0.00	.	I						
11.55	430	32	1272.7	596.6	0.0	0.00	.P		I					
12.42	672	65	1273.4	632.8	0.0	0.00	.P		I					
13.30	958	73	1274.6	686.6	0.0	0.00	.P			I				
14.17	1267	74	1276.4	761.4	0.0	0.00	.P				I			
15.04	1573	76	1278.5	858.4	0.0	0.00	.	P				I		
15.91	1851	77	1281.0	976.3	0.0	0.00	.	P					I	
16.78	2073	79	1283.5	1112.0	0.0	0.00	.	P					I	
17.66	2223	81	1286.2	1261.0	0.0	0.00	.	P						I
18.53	2305	83	1288.7	1418.3	0.0	0.00	.	P						I
19.40	2324	162	1291.0	1576.3	0.0	0.18*	.	A						X
20.27	2286	1447	1292.3	1684.4	0.0	1.19*	.			A				I
21.14	2197	2142	1292.6	1716.6	0.0	1.50*	.							XI
22.02	2068	2134	1292.6	1716.2	0.0	1.49*	.						I	A
22.89	1913	2009	1292.6	1710.4	0.0	1.44*	.					I	A	
23.76	1740	1850	1292.5	1703.0	0.0	1.38*	.					I	A	
24.63	1562	1676	1292.4	1695.0	0.0	1.30*	.						I	A
25.50	1393	1503	1292.3	1687.0	0.0	1.22*	.				I	A		
26.38	1240	1340	1292.2	1679.4	0.0	1.14*	.					I	A	
27.25	1099	1191	1292.1	1672.5	0.0	1.06*	.				I	A		
28.12	968	1057	1292.1	1666.0	0.0	0.98*	.					I	A	
28.99	847	970	1292.0	1658.4	0.0	0.93*	.						I	A
29.86	735	865	1291.9	1649.2	0.0	0.86*	.							I
30.74	634	760	1291.8	1640.0	0.0	0.79*	.							I
31.61	544	660	1291.7	1631.3	0.0	0.72*	.							I
32.48	468	570	1291.6	1623.4	0.0	0.64*	.							I
33.35	401	491	1291.5	1616.5	0.0	0.58*	.							I
34.22	343	422	1291.4	1610.4	0.0	0.51*	.							I
35.10	292	361	1291.4	1605.1	0.0	0.45*	.							I
35.97	248	308	1291.3	1600.4	0.0	0.38*	.							I
36.84	210	262	1291.3	1596.4	0.0	0.33*	.							I
37.71	178	223	1291.2	1592.9	0.0	0.27*	.							I
38.58	152	189	1291.2	1590.0	0.0	0.22*	.							I
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I
							0.	500.	1000.	1500.	2000.	2500.	3000.	3500.
END NRCS-SDH			PLOT											

END NRCS-SDH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-FBH	400.0	1294.28	1862.0	0.0	4.08	349.4
PEAK - CFS DISCHARGE =		Q-PS 87.	Q-AUX. 6470.	Q-TOT. 6556.		

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	2.00	7.97	0.009	0.021

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 13.0 hours
and peaked at time = 19.1 hours.)

REACH 2: FROM STATION 1000. TO 1400. ON 0.0% SLOPE.
Surface unfailed: Stressed to 6% of allowable.

REACH 3: FROM STATION 1400. TO 1600. ON 0.0% SLOPE.
Surface unfailed: Stressed to 10% of allowable.

REACH 4: FROM STATION 1600. TO 1700. ON 4.9% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 5: FROM STATION 1700. TO 1800. ON 5.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 6: FROM STATION 1800. TO 1900. ON 4.4% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 7: FROM STATION 1900. TO 2000. ON 4.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 8: FROM STATION 2000. TO 2100. ON 5.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 9: FROM STATION 2100. TO 2200. ON 3.5% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 10: FROM STATION 2200. TO 2300. ON 0.6% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 19.1 hours.

REACH 11: FROM STATION 2300. TO 2400. ON 3.7% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 18.2 hours.

REACH 12: FROM STATION 2400. TO 2500. ON 8.1% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

REACH 13: FROM STATION 2500. TO 2672. ON 9.8% SLOPE.
Vegetal cover failed and concentrated flow developed
at time = 17.4 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 1600.
and progressed upstream to station 1132.
The final height of the headcut was 57.6 ft.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

The deepest headcut is also the furthest upstream.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY ---	41.9	16.3	132.

EXIT CHANNEL FLOW SUBCRITICAL: MAX VELOCITY= 2.6 FT/SEC
EXIT SLOPE = 0.000 FT/FT
FLOW DEPTH = 5.9 FT

PLOT NRCS-FBH							1 IN = 1000. CFS							EXIT SLOPE = 0.000						
Time	Qin	Qout	Elev	Vol	Area	ExtVel	0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.						
6.03	0	17	1272.0	555.4	0.0	0.00	.	I	I	I	I	I	I	I						
6.90	14	17	1272.0	555.4	0.0	0.00	.													
7.77	73	18	1272.1	557.2	0.0	0.00	.I													
8.65	203	20	1272.3	565.8	0.0	0.00	. I													
9.52	434	27	1272.6	587.1	0.0	0.00	. I													
10.39	800	59	1273.3	628.5	0.0	0.00	.P	I												
11.26	1336	73	1275.0	700.7	0.0	0.00	.P		I											
12.13	2044	75	1277.7	817.2	0.0	0.00	.P			I										
13.01	2868	78	1281.2	988.7	0.0	0.00	.P				I									
13.88	3736	81	1285.5	1221.0	0.0	0.00	.P					I								
14.75	4581	86	1290.2	1514.6	0.0	0.00	.A						I							
15.62	5341	3055	1293.1	1758.9	0.0	1.81*	.			A				I						
16.49	5944	5900	1294.1	1842.9	0.0	2.49*	.							A						
17.37	6340	6167	1294.2	1850.7	0.0	2.54*	.							AI						
18.24	6539	6468	1294.3	1859.5	0.0	2.59*	.							A						
19.11	6557	6556	1294.3	1862.0	0.0	2.61*	.							X						
19.98	6408	6475	1294.3	1859.7	0.0	2.60*	.							IA						
20.85	6124	6244	1294.2	1852.9	0.0	2.55*	.							IA						
21.73	5736	5897	1294.1	1842.8	0.0	2.49*	.							I A						
22.60	5291	5473	1293.9	1830.4	0.0	2.40*	.							I A						
23.47	4804	5003	1293.8	1816.7	0.0	2.31*	.							I A						
24.34	4305	4508	1293.6	1802.2	0.0	2.19*	.							I A						
25.21	3827	4020	1293.4	1788.0	0.0	2.08*	.							I A						
26.09	3396	3569	1293.3	1774.8	0.0	1.96*	.							I A						
26.96	3006	3162	1293.2	1763.0	0.0	1.84*	.							I A						
27.83	2645	2856	1293.0	1749.7	0.0	1.75*	.							I A						
28.70	2314	2527	1292.8	1734.4	0.0	1.64*	.							I A						
29.57	2012	2209	1292.7	1719.7	0.0	1.52*	.							I A						
30.45	1736	1916	1292.5	1706.1	0.0	1.41*	.							I A						
31.32	1490	1651	1292.4	1693.8	0.0	1.29*	.							I A						
32.19	1279	1418	1292.2	1683.0	0.0	1.18*	.							IA						
33.06	1098	1217	1292.1	1673.7	0.0	1.08*	.							IA						
33.93	938	1050	1292.0	1665.4	0.0	0.98*	.							IA						
34.81	800	944	1291.9	1656.2	0.0	0.92*	.							IA						
35.68	681	825	1291.8	1645.7	0.0	0.84*	.							IA						
36.55	577	711	1291.7	1635.7	0.0	0.76*	.							IA						
37.42	489	607	1291.6	1626.6	0.0	0.68*	.							IA						
Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I	I	I	I						
							0.	1000.	2000.	3000.	4000.	5000.	6000.	7000.						

END NRCS-FBH PLOT

***** MESSAGE - ASKTERISK NEXT TO EXIT VELOCITY MEANS SUBCRITICAL FLOW.

Inflow Hyd 1 SDH-Peak = 2141.78 CFS at 20.28 hrs., Location Point

Inflow Hyd 1 FBH-Peak = 6556.43 CFS at 18.24 hrs., Location Point
HYDOUT 1 1

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

1 UTR5

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

NRCS 24-hour Storm SDH and FBH Criteria for Top of Dam Evaluation – Maintenance Code 3 & Veg D

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	02/05/2021							11:07:34	
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	1	1	7.39	74.	13.80	7.39	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	1290.2	400.0	4.1	1294.3	0.	132.	2.6	NRCS-FBH

* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.



Appendix E
Wave Analysis

UTR5 --Wave Height Analysis

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

Top of Dam	1295.0 Ft
------------	-----------

WSE at ASH 1292.6 Ft

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

α (°)	$\cos \alpha$	Trial 1	
		Distance (ft)	Distance $\times$ $\cos \alpha$
42	0.743	217	161.26
36	0.809	227	183.65
30	0.866	248	214.77
24	0.914	369	337.10
18	0.951	1038	987.20
12	0.978	1063	1039.77
6	0.995	2588	2573.82
0	1.000	3373	3373.00
6	0.995	2937	2920.91
12	0.978	1911	1869.24
18	0.951	1542	1466.53
24	0.914	1514	1383.11
30	0.866	1420	1229.76
36	0.809	880	711.93
42	0.743	804	597.49

$$\Sigma \cos \alpha$$

13.511

$\Sigma \text{Distance} \times \cos \alpha$
19049.54

EFFECTIVE FETCH LENGTH:

1409.94 ft

0.27 mi

V_L 80 mph

$$V_w/V_L \quad 1.23$$

V w 98.4 mph

H s 1.6164 ft

α (°)	$\cos \alpha$	Trial 2	
		Distance (ft)	Distance $\times$ $\cos \alpha$
42	0.743	425	315.84
36	0.809	513	415.03
30	0.866	1133	981.21
24	0.914	1190	1087.12
18	0.951	1206	1146.97
12	0.978	1718	1680.46
6	0.995	2754	2738.91
0	1.000	3945	3945.00
6	0.995	2058	2046.73
12	0.978	1576	1541.56
18	0.951	1584	1506.47
24	0.914	842	769.21
30	0.866	809	700.61
36	0.809	835	675.53
42	0.743	849	630.93

13.511

20181.57

EFFECTIVE FETCH LENGTH:

1493.72

0.28

V_L 80 mph

V_w/V_L 1.2

V_w 96 mph

H_s 1.61795 ft

α (°)	$\cos \alpha$	Trial 3	
		Distance (ft)	Distance $\times$ $\cos \alpha$
42	0.743	714	530.61
36	0.809	1276	1032.31
30	0.866	1326	1148.35
24	0.914	1384	1264.35
18	0.951	1802	1713.80
12	0.978	2858	2795.55
6	0.995	3560	3540.50
0	1.000	2381	2381.00
6	0.995	1623	1614.11
12	0.978	870	850.99
18	0.951	847	805.54
24	0.914	850	776.51
30	0.866	817	707.54
36	0.809	754	610.00
42	0.743	662	491.96

13.511

20263.11

EFFECTIVE FETCH LENGTH:

1499.76

0.28

V_L 80 mph

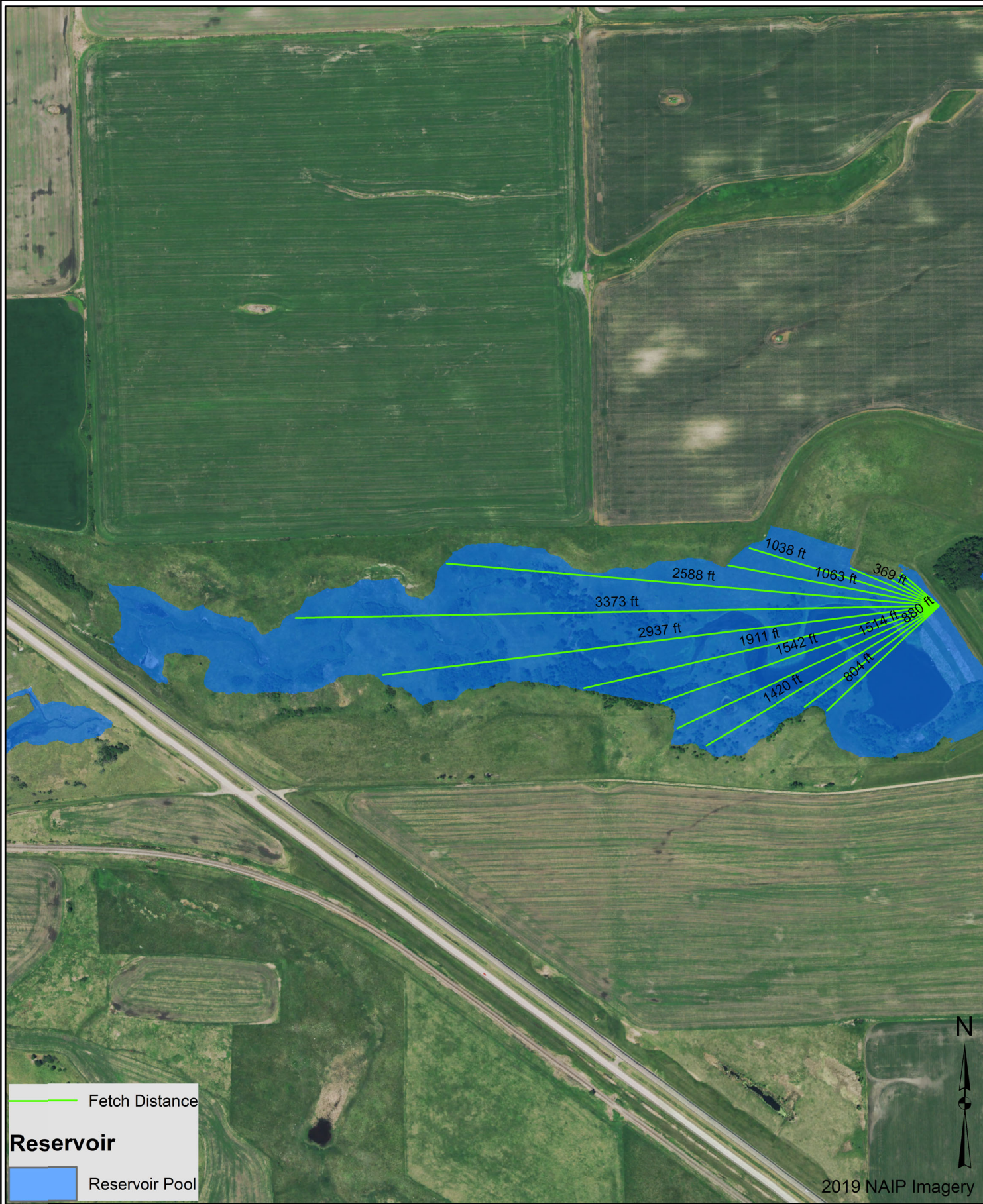
V_w/V_L 1.22

V_w 97.6 mph

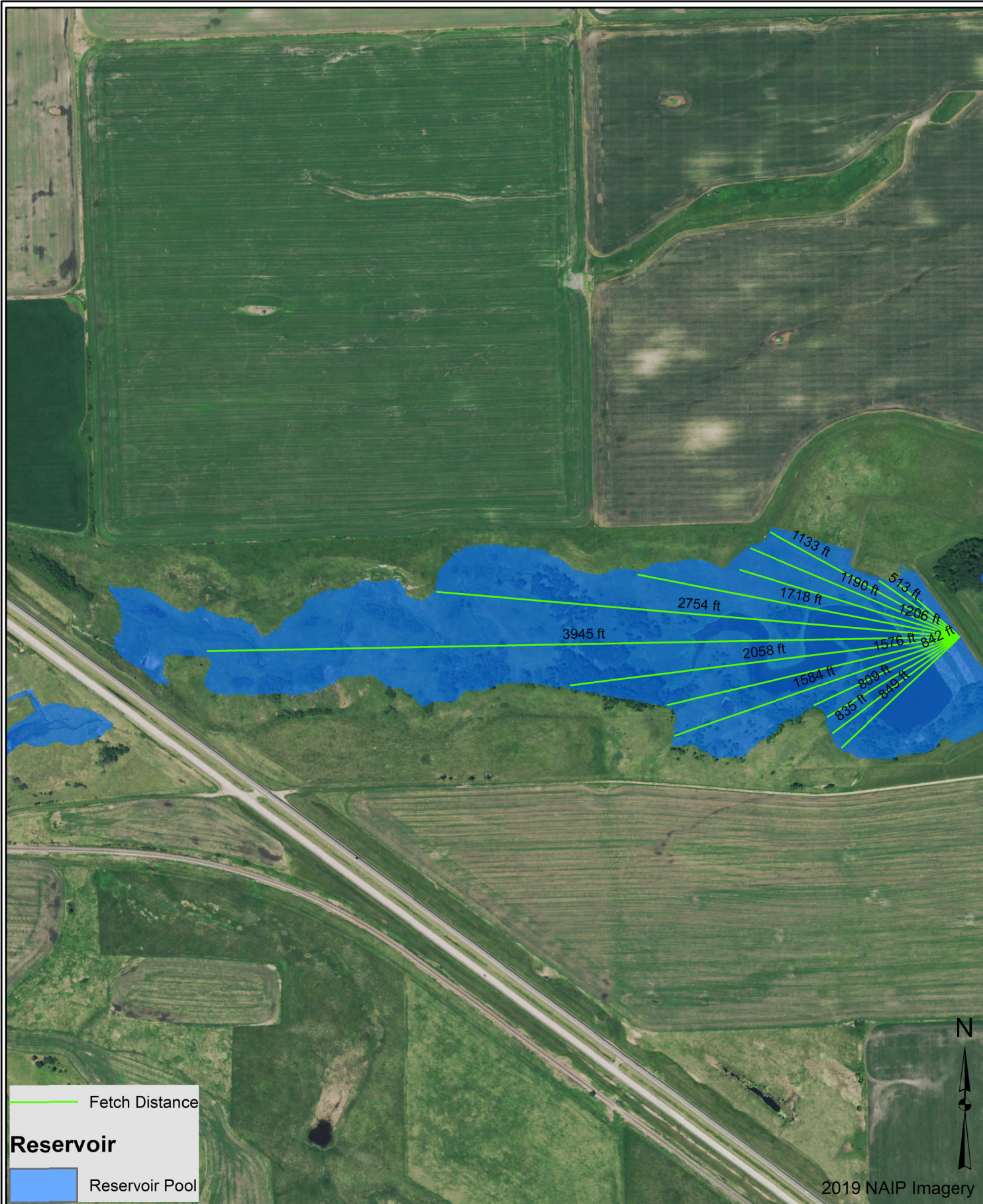
H_s 1.64967 ft

Summary of Results:

	Maximum Wave Height (Ft)
Trial 1	1.62
Trial 2	1.62
Trial 3	1.65



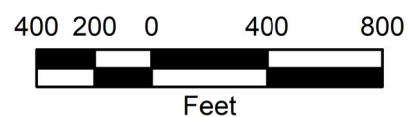
 United States Department of Agriculture	Fetch Length Map Fetch Length Grand Forks, ND Section 11, T-152N, R-56W	400 200 0 400 800  Feet
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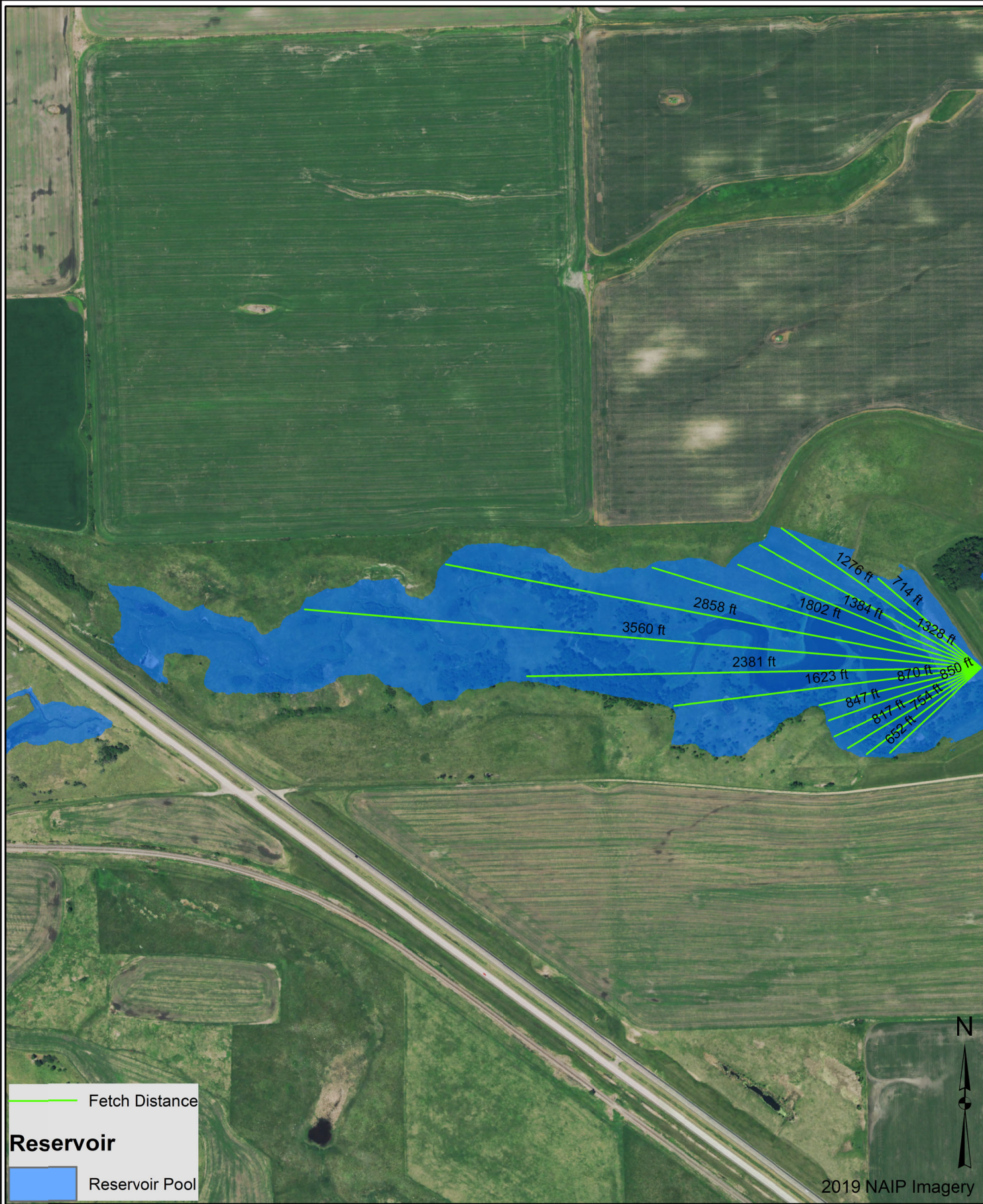


United States
Department of
Agriculture

Fetch Length Map

Fetch Length
Grand Forks, ND
Section 11, T-152N, R-56W





 United States Department of Agriculture	Fetch Length Map Fetch Length Grand Forks, ND Section 11, T-152N, R-56W	400 200 0 400 800  Feet
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Appendix F
Auxiliary Spillway Stability

AH667/TR-60 Auxiliary Spillway 6-hr SDH Stability Analysis from SITES

Project Data	Date: Feb 5, 2021	Checked By: _____
	Designer: BRM	
	Project: 1 X 400' wide AS	
	County: Grand Forks	Check Date: _____
	State: ND	

Topsoil Properties	CL	Dominant Textural Soil Class of Aux Spwy Topsoil
	25	Plasticity Index of Aux Spwy Topsoil (for CH, CL, GC, GM, MH, ML, OH, OL, SC, SM)
	0.200 in	
	92 pcf	Dry Density of Topsoil (lbs/ft ³)
	2.65	Specific Gravity of Topsoil, G _s

Vegetation C Aux Spwy Retardance Class (A-E) or Retardance Curve Index (2.88-10)

AS Flow Frequency 1.0% Auxiliary spillway anticipated average use (see TR-60 2nd ed., pg 7-3)

SITES 6-hr SDH values see *Erosionally Effective Stress For Stability Analysis of Aux Exit Channel* tbl
 3.29 psf Total Stress, from SITES 6-hr SDH (psf)
 0.088 psf Soil Effective Stress, from SITES 6-hr SDH (psf)

Soil Stress Analysis

Soil	Plasticity Index PI or D ₇₅	Allowable Effective Stress τ _{ab}	Void Ratio e	Void Ratio Correction C _e	= τ _{ab} * (C _e) ² τ _a	TR-60 AS Use Freq Multiplier	AH 667 Adjusted Allowable Stress τ _a	SITES 6-hr SDH Soil Effective Stress
CL	PI=25	0.076 psf	0.80	1.025	0.080 psf	1.5	0.120 psf	0.088 psf

Soil is stable. SITES 6-hr SDH actual effective stress less than adjusted AH 667 allowable effective soil stress.

Vegetal Stress Analysis

C _i - Retardance curve index AH 667 Table 3.2	AH 667 Allowable vegetal stress (AH 667 Eqn 1.17) τ _{va} = C _i * 0.75	SITES 6-hr SDH Vegetal Stress τ _{veg} = τ _{tot} - τ _{eff}
5.6	4.20 psf	3.20 psf

Vegetation is stable. SITES 6-hr SDH actual vegetal stress less than allowable AH 667 vegetal stress.

Overall Stability

Acceptable Design. Soil and vegetation predicted to be stable.

Version: 2.7 2/17/2010

Notes: This spreadsheet facilitates the USDA-NRCS TR-60 2nd edition stability analysis for earthen/vegetated auxiliary spillways with SITES software output.
 Users enter project data, auxiliary spillway topsoil data, vegetation, auxiliary spillway flow frequency, and SITES 6-hr SDH stress values. Depending on the soil, either PI or D₇₅ input is needed.
 The allowable vegetal and effective soil stresses are computed using USDA-ARS Ag Handbook 667 "Stability Design of Grass-Lined Open Channels". The design SITES stresses are compared to the AH 667 stresses (as modified by TR-60). An appropriate design has equal or lower design stresses than allowable stresses.

AH667/TR-60 Auxiliary Spillway 6-hr SDH Stability Analysis from SITES

Project Data	Date: Feb 5, 2021	Checked By: _____
	Designer: BRM	
	Project: 1 X 400' wide AS	
	County: Grand Forks	Check Date: _____
	State: ND	

Topsoil Properties	CL	Dominant Textural Soil Class of Aux Spwy Topsoil
	25	Plasticity Index of Aux Spwy Topsoil (for CH, CL, GC, GM, MH, ML, OH, OL, SC, SM)
	0.200 in	
	92 pcf	Dry Density of Topsoil (lbs/ft ³)
	2.65	Specific Gravity of Topsoil, G _s

Vegetation Earth-unvegetated Aux Spwy Retardance Class (A-E) or Retardance Curve Index (2.88-10)

AS Flow Frequency 1.0% Auxiliary spillway anticipated average use (see TR-60 2nd ed., pg 7-3)

SITES 6-hr SDH values see *Erosionally Effective Stress For Stability Analysis of Aux Exit Channel* tbl
 3.29 psf Total Stress, from SITES 6-hr SDH (psf)
 2.003 psf Soil Effective Stress, from SITES 6-hr SDH (psf)

Soil Stress Analysis

Soil	Plasticity Index PI or D ₇₅	Allowable Effective Stress τ_{ab}	Void Ratio e	Void Ratio Correction C _e	$= \tau_{ab} * (C_e)^2$ τ_a	TR-60 AS Use Freq Multiplier	AH 667 Adjusted Allowable Stress τ_a	SITES 6-hr SDH Soil Effective Stress
CL	PI=25	0.076 psf	0.80	1.025	0.080 psf	1.5	0.120 psf	2.003 psf

Soil erodes--effective soil stress exceeds adjusted allowable soil stress!! Consider widening and/or raising the auxiliary spillway or selecting a higher plasticity topsoil.

Vegetal Stress Analysis

C _i - Retardance curve index AH 667 Table 3.2	AH 667 Allowable vegetal stress (AH 667 Eqn 1.17) $\tau_{va} = C_i * 0.75$	SITES 6-hr SDH Vegetal Stress $\tau_{veg} = \tau_{tot} - \tau_{eff}$
Earth-unvegetated	NA	NA

Earth-unvegetated. No vegetal stress.

Version: **2.7** 2/17/2010

Notes: This spreadsheet facilitates the USDA-NRCS TR-60 2nd edition stability analysis for earthen/vegetated auxiliary spillways with SITES software output.
 Users enter project data, auxiliary spillway topsoil data, vegetation, auxiliary spillway flow frequency, and SITES 6-hr SDH stress values. Depending on the soil, either PI or D₇₅ input is needed.
 The allowable vegetal and effective soil stresses are computed using USDA-ARS Ag Handbook 667 "Stability Design of Grass-Lined Open Channels". The design SITES stresses are compared to the AH 667 stresses (as modified by TR-60). An appropriate design has equal or lower design stresses than allowable stresses.

AH667/TR-60 Auxiliary Spillway 6-hr SDH Stability Analysis from SITES

Project Data	Date: Feb 5, 2021	Checked By: _____
	Designer: BRM	
	Project: 1 X 400' wide AS	
	County: Grand Forks	Check Date: _____
	State: ND	

Topsoil Properties	CL	Dominant Textural Soil Class of Aux Spwy Topsoil
	25	Plasticity Index of Aux Spwy Topsoil (for CH, CL, GC, GM, MH, ML, OH, OL, SC, SM)
	0.200 in	
	92 pcf	Dry Density of Topsoil (lbs/ft ³)
	2.65	Specific Gravity of Topsoil, G _s

Vegetation D Aux Spwy Retardance Class (A-E) or Retardance Curve Index (2.88-10)

AS Flow Frequency 1.0% Auxiliary spillway anticipated average use (see TR-60 2nd ed., pg 7-3)

SITES 6-hr SDH values see *Erosionally Effective Stress For Stability Analysis of Aux Exit Channel* tbl
 2.87 psf Total Stress, from SITES 6-hr SDH (psf)
 0.123 psf Soil Effective Stress, from SITES 6-hr SDH (psf)

Soil Stress Analysis

Soil	Plasticity Index PI or D ₇₅	Allowable Effective Stress τ_{ab}	Void Ratio e	Void Ratio Correction C _e	$= \tau_{ab} * (C_e)^2$ τ_a	TR-60 AS Use Freq Multiplier	AH 667 Adjusted Allowable Stress τ_a	SITES 6-hr SDH Soil Effective Stress
CL	PI=25	0.076 psf	0.80	1.025	0.080 psf	1.5	0.120 psf	0.123 psf

Soil erodes--effective soil stress exceeds adjusted allowable soil stress!! Consider widening and/or raising the auxiliary spillway or selecting a higher plasticity topsoil.

Vegetal Stress Analysis

C _i - Retardance curve index AH 667 Table 3.2	AH 667 Allowable vegetal stress (AH 667 Eqn 1.17) $\tau_{va} = C_i * 0.75$	SITES 6-hr SDH Vegetal Stress $\tau_{veg} = \tau_{tot} - \tau_{eff}$
4.44	3.33 psf	2.75 psf

Vegetation is stable. SITES 6-hr SDH actual vegetal stress less than allowable AH 667 vegetal stress.

Overall Stability

Unacceptable design. Soil and/or vegetation predicted to erode.

Version: 2.7 2/17/2010

Notes: This spreadsheet facilitates the USDA-NRCS TR-60 2nd edition stability analysis for earthen/vegetated auxiliary spillways with SITES software output.
 Users enter project data, auxiliary spillway topsoil data, vegetation, auxiliary spillway flow frequency, and SITES 6-hr SDH stress values. Depending on the soil, either PI or D₇₅ input is needed.
 The allowable vegetal and effective soil stresses are computed using USDA-ARS Ag Handbook 667 "Stability Design of Grass-Lined Open Channels". The design SITES stresses are compared to the AH 667 stresses (as modified by TR-60). An appropriate design has equal or lower design stresses than allowable stresses.

AH667/TR-60 Auxiliary Spillway 6-hr SDH Stability Analysis from SITES

Project Data	Date: Feb 5, 2021	Checked By: _____
	Designer: BRM	
	Project: 1 X 400' wide AS	
	County: Grand Forks	Check Date: _____
	State: ND	

Topsoil Properties	CL	Dominant Textural Soil Class of Aux Spwy Topsoil
	25	Plasticity Index of Aux Spwy Topsoil (for CH, CL, GC, GM, MH, ML, OH, OL, SC, SM)
	0.200 in	
	92 pcf	Dry Density of Topsoil (lbs/ft ³)
	2.65	Specific Gravity of Topsoil, G _s

Vegetation Earth-unvegetated Aux Spwy Retardance Class (A-E) or Retardance Curve Index (2.88-10)

AS Flow Frequency 1.0% Auxiliary spillway anticipated average use (see TR-60 2nd ed., pg 7-3)

SITES 6-hr SDH values see *Erosionally Effective Stress For Stability Analysis of Aux Exit Channel* tbl
 2.87 psf Total Stress, from SITES 6-hr SDH (psf)
 1.748 psf Soil Effective Stress, from SITES 6-hr SDH (psf)

Soil Stress Analysis

Soil	Plasticity Index PI or D ₇₅	Allowable Effective Stress τ _{ab}	Void Ratio e	Void Ratio Correction C _e	= τ _{ab} * (C _e) ² τ _a	TR-60 AS Use Freq Multiplier	AH 667 Adjusted Allowable Stress τ _a	SITES 6-hr SDH Soil Effective Stress
CL	PI=25	0.076 psf	0.80	1.025	0.080 psf	1.5	0.120 psf	1.748 psf

Soil erodes--effective soil stress exceeds adjusted allowable soil stress!! Consider widening and/or raising the auxiliary spillway or selecting a higher plasticity topsoil.

Vegetal Stress Analysis

C _i - Retardance curve index AH 667 Table 3.2	AH 667 Allowable vegetal stress (AH 667 Eqn 1.17) τ _{va} = C _i * 0.75	SITES 6-hr SDH Vegetal Stress τ _{veg} = τ _{tot} - τ _{eff}
Earth-unvegetated	NA	NA

Earth-unvegetated. No vegetal stress.

Version: **2.7** 2/17/2010

Notes: This spreadsheet facilitates the USDA-NRCS TR-60 2nd edition stability analysis for earthen/vegetated auxiliary spillways with SITES software output.
 Users enter project data, auxiliary spillway topsoil data, vegetation, auxiliary spillway flow frequency, and SITES 6-hr SDH stress values. Depending on the soil, either PI or D75 input is needed.
 The allowable vegetal and effective soil stresses are computed using USDA-ARS Ag Handbook 667 "Stability Design of Grass-Lined Open Channels". The design SITES stresses are compared to the AH 667 stresses (as modified by TR-60). An appropriate design has equal or lower design stresses than allowable stresses.

UTR 5 Dam
Erodibility Index (Kh) Calculations

2/1/2021

Calc By: BRM
Checked By:

The headcut erodibility index (K_h) designates the measure of the resistance of earth material to erosion. The K_h value is a key component in the analysis of earthen spillways. The value can be attained through the application of guidelines presented in the NRCS National Engineering Handbook (NEH), Part 628 Dams, Chapter 52 Field Procedures Guide for the Engineering Handbook (NEH), Part 628 Dams, Chapter 52 Field Procedures Guide for the Engineering Handbook (NEH), Part 628 Dams, Chapter 52 Field Procedures Guide for the presented below.

$$K_h = M_s \cdot K_b \cdot K_d \cdot J_s$$

M_s = Material strength number of the earth material

K_b = Block or particle size number

K_d = Discontinuity or interparticle and shear strength number

J_s = Relative ground structure number

Material Properties of Auxiliary Spillway Soil:

Unified Soil Classification = CL (lean Clay)

Plasticity Index (PI) = 25

Liquid Limit (LL) = 46

Percent Clay = 30%

M_s -

The soil material is considered a cohesive soil, having a plasticity index (PI) greater than 10. Hence table 52-3 from NEH, Part 628, Chapter 52 for determining the M_s value.

The M_s value is an assessment of the material strength, using three available criteria for selection: Field identification tests (hand test), Blow count (SPT), and Unconfined compressive strength (UCS).

Test results were not found which showed blow count or unconfined compressive strength. A field identification test was used to determine the M_s . The field identification test method utilizes a qualitative determination of the consistency of the soil through handling characteristics, such as penetration by hand tools, how the soil handles in the hand, etc. This qualitative determination is then tied to a level of soil consistency which is tied to a typical quantitative values of unconfined compressive strength and associated M_s value.

The soil consistency was found to be stiff, which corresponds to a range of M_s values from 0.10 - 0.20. A value of 0.10 was chosen which denotes a more conservative soil strength within the stiff consistency.

$$M_s = 0.1$$

UTR 5 Dam
Erodibility Index (Kh) Calculations

Calc By: BRM
Checked By:

2/1/2021

K_b -

The term K_b represents the mean size of individual material units as determined by the spacing of discontinuities in a rock mass, or it is a function of particle diameter of cohesionless granular soils, including detritus and boulder formations. Since this soil does not act as a rock material the value of 1.0 is used.

$$K_b = 1.0$$

K_d -

The term K_d defines the interparticle bond shear strength of the soil by considering the expected minimum residual friction angle of the soil (ϕ'_r) estimated by a relationship between the liquid limit (LL) and the clay content of the soil.

$$LL = 46$$

$$\phi'_r = 329.56 * (LL)^{-0.71}$$

$$\phi'_r = 21.7459^\circ$$

<----- equation used for soil with clay content
between 25 and 45 percent.

$$K_d = \tan(\phi'_r) = 0.399$$

J_s -

The relative ground structure number (J_s) represents the orientation of the effective dip of the least favorable discontinuity with respect to spillway flow. The number takes into account the effect of the relative shape of the material units (as determined by joint set spacings) or the ease with which the spillway flow penetrates the ground and dislodges individual material particles. Soil material is considered intact (without structure), in which case $J_s=1.0$.

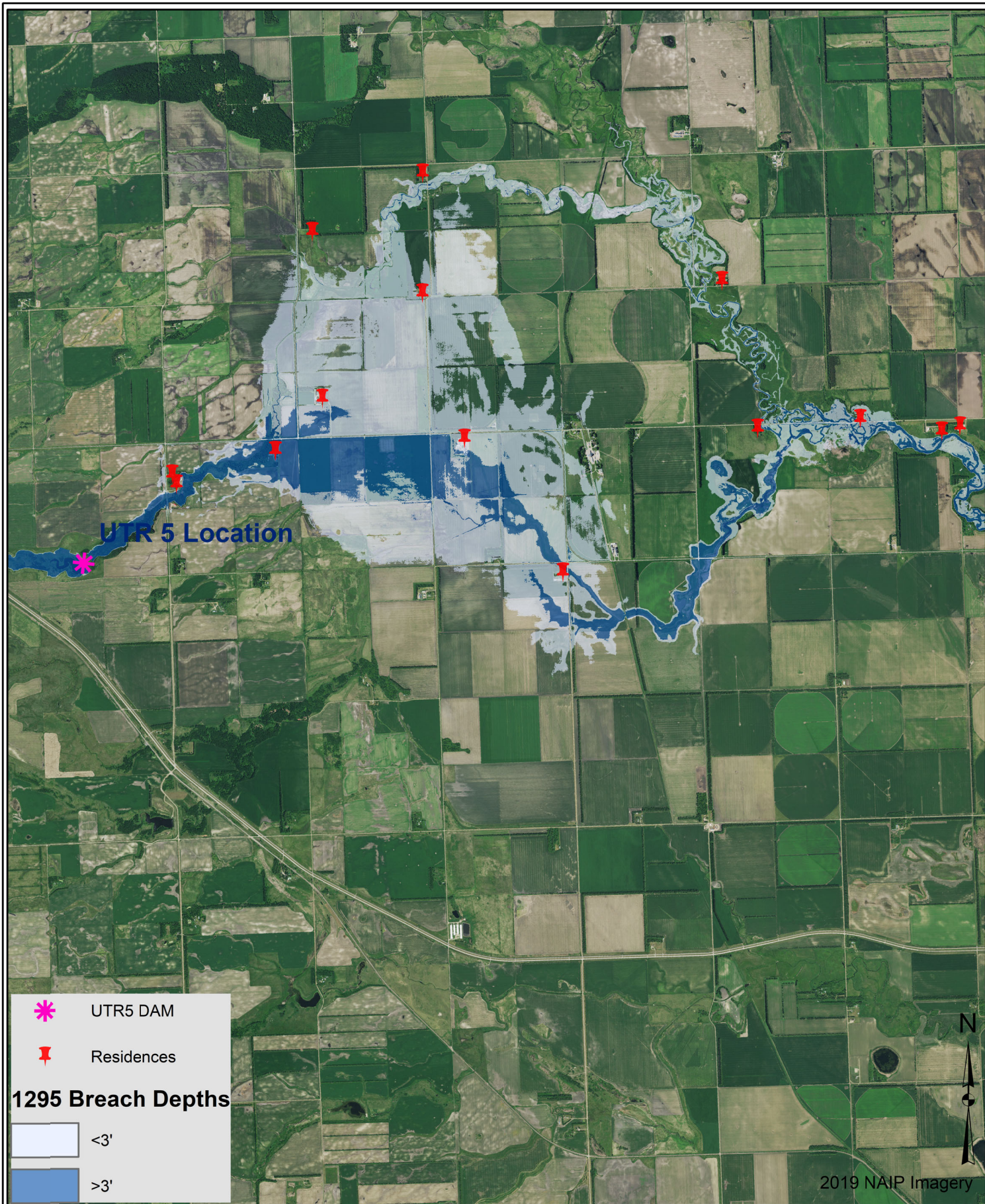
$$J_s = 1.0$$

$$K_h = (M_s)(K_b)(K_d)(J_s) = 0.04$$

$$K_h = (0.1)(1)(0.4)(1) = 0.04$$



Appendix G
Dam Failure Inundation Mapping



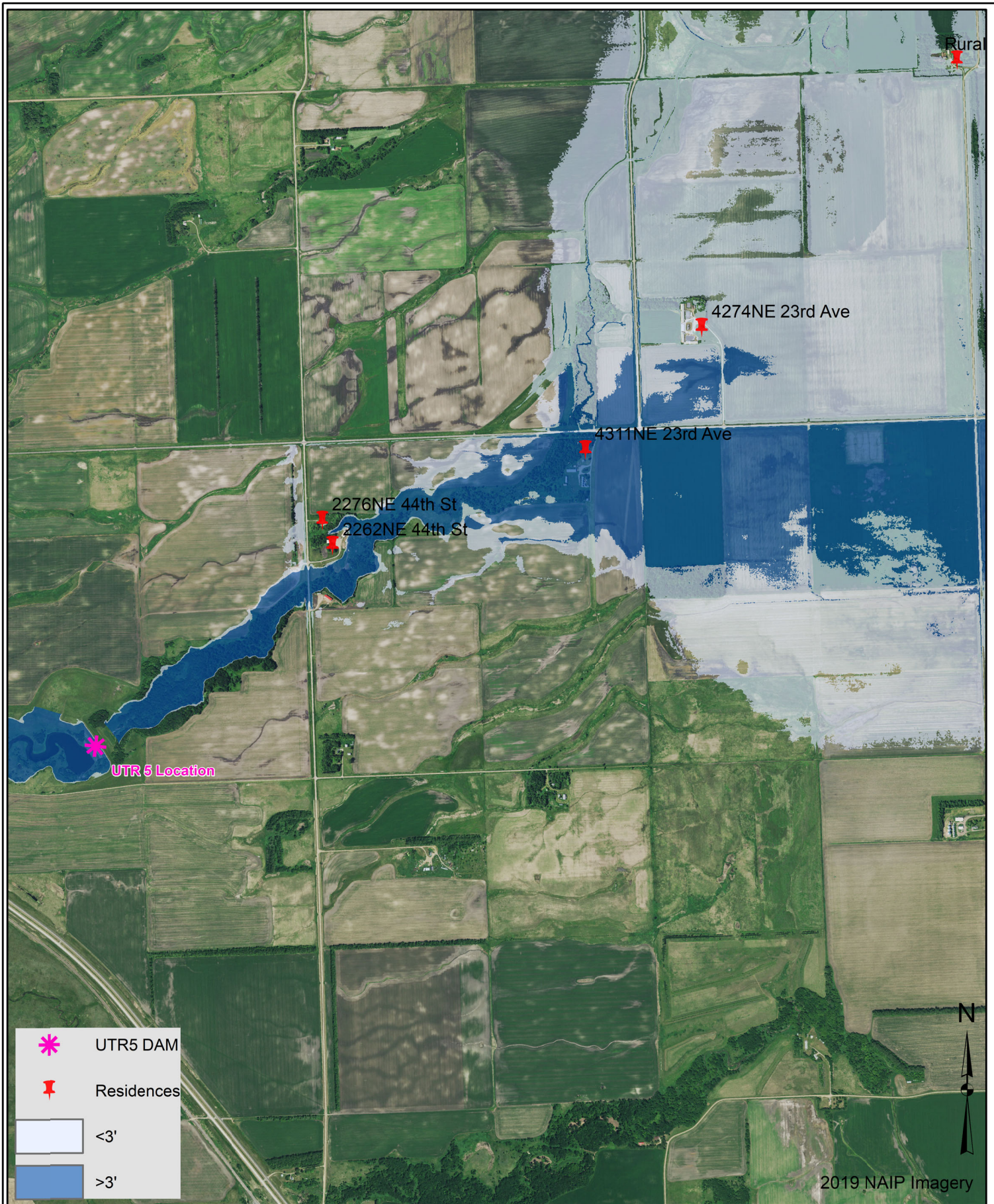
United States
Department of
Agriculture

Inundation Map

Overview-Depth

Grand Forks, ND
Section 11, T-152N, R-56W



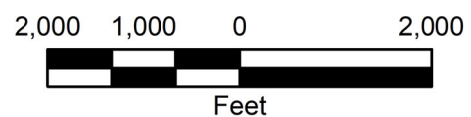


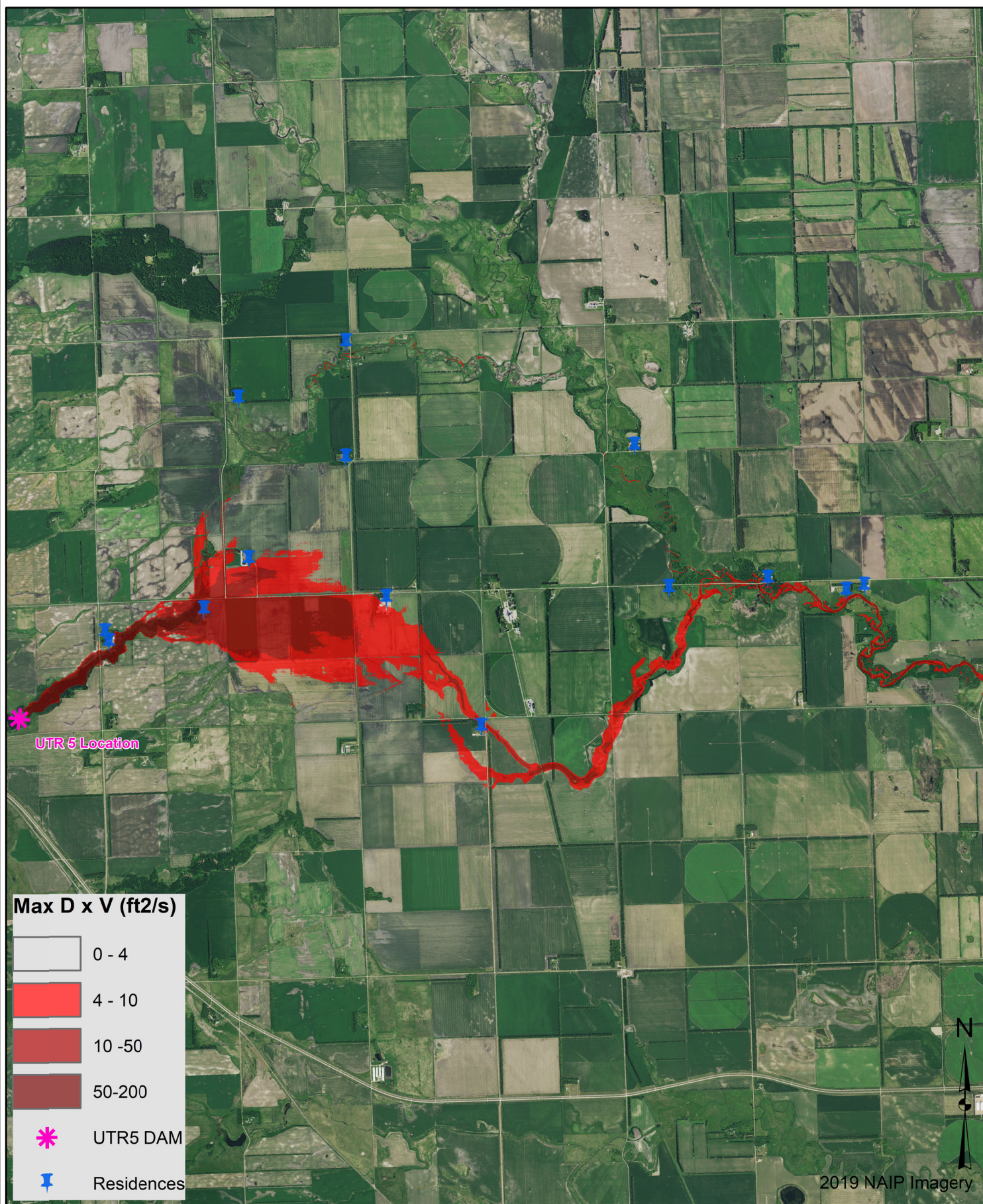
United States
Department of
Agriculture

Inundation Map

Directly Downstream-Depth

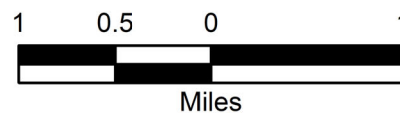
Grand Forks, ND
Section 11, T-152N, R-56W

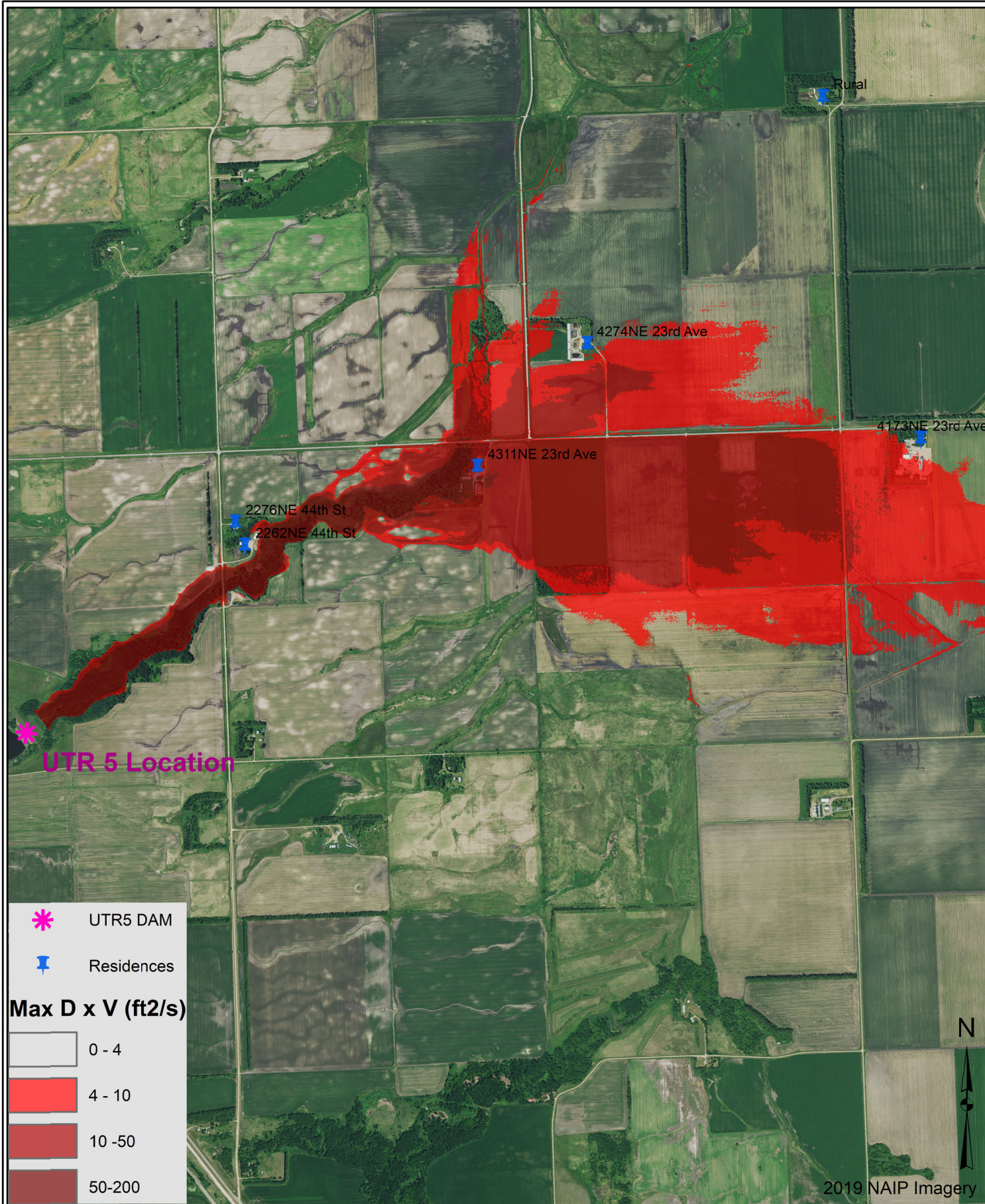




United States
Department of
Agriculture

Max (D)x(V)
Overview - Depth x Velocity
Grand Forks, ND
Section 11, T-152N, R-56W





 UTR5 DAM

 Residences

Max D x V (ft2/s)

	0 - 4
	4 - 10
	10 -50
	50-200



Appendix H
Failure and Risk Index Spreadsheets

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE						
STATE	North Dakota		BY	Brian Mager	DATE	1/6/20
DAM	UTR5		CHECKED BY		DATE	
YEAR BUILT	1975	DESIGN HAZARD CLASS	H	DRAINAGE AREA	7.39	mi ²
WORK PLAN DATE		CURRENT HAZARD CLASS	H	DAM HEIGHT	73	ft
sht 1 of 3	STATIC FAILURE SCENARIO (ver. 2013-01)				NID ID	ND00388
Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<2.0 Ft	>=2.0 Ft.				
Mobile Homes	1	0	1	3	0	
Seasonal Use RV's	0	0		2		
Other	0	0				
Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<1.0 Ft	>=1.0 Ft.				
Homes	0	1	1	3	3	
Seasonal Use Homes and Cabins	0	0		1.5		
Duplexes	0	0		5		
Apartments	0	0				
Commercial Buildings	2	0	2		0	
Schools (In Use)	0	0				
Schools (Not in Use)	0	0				
Hospitals	0	0				
Other						
Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Road Overflow Depth		Total			
	<1.0 Ft	>=1.0 Ft.				
Main Local Roads and Minor State Highways						
County Road 16		1	1	2	2	
Name(s) (if applicable)				2		
Major State and Minor Federal Highways						
Highway Name(s) or Number(s)				4		
Highway Name(s) or Number(s)				4		
Major Federal and Interstate Highways						
Highway Name(s) or Number(s)				8		
Highway Name(s) or Number(s)				8		
Railroads						
UPSF Freight Traffic Only				3		
Passenger Traffic				20		
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					5	

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE						
STATE	North Dakota		BY	Brian Mager	DATE	1/6/20
DAM	UTR5		CHECKED BY		DATE	
YEAR BUILT	1975	DESIGN HAZARD CLASS	H	DRAINAGE AREA	7.39	mi ²
WORK PLAN DATE		CURRENT HAZARD CLASS	H	DAM HEIGHT	73	ft
sht 2 of 3	HYDROLOGIC FAILURE SCENARIO (ver. 2013-01)				NID ID	ND00388
Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<2.0 Ft	>=2.0 Ft.				
Mobile Homes	1		1	3	0	
Seasonal Use RV's				2		
Other						
Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<1.0 Ft	>=1.0 Ft.				
Homes		1	1	3	3	
Seasonal Use Homes and Cabins				1.5		
Duplexes				5		
Apartments						
Commercial Buildings	2		2		0	
Schools (In Use)						
Schools (Not in Use)						
Hospitals						
Other						
Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Road Overflow Depth		Total			
	<1.0 Ft	>=1.0 Ft.				
Main Local Roads and Minor State Highways						
County Road 16		1	1	2	2	
Name(s) (if applicable)				2		
Major State and Minor Federal Highways						
Highway Name(s) or Number(s)				4		
Highway Name(s) or Number(s)				4		
Major Federal and Interstate Highways						
Highway Name(s) or Number(s)				8		
Highway Name(s) or Number(s)				8		
Railroads						
UPSF Freight Traffic Only				3		
Passenger Traffic				20		
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					5	

COMPUTATION OF POPULATION AT RISK (PAR) DURING DAM FAILURE						
STATE	North Dakota		BY	Brian Mager	DATE	1/6/20
DAM	UTR5		CHECKED BY		DATE	
YEAR BUILT	1975	DESIGN HAZARD CLASS	H	DRAINAGE AREA	7.39	mi ²
WORK PLAN DATE		CURRENT HAZARD CLASS	H	DAM HEIGHT	73	ft
sht 3 of 3	SEISMIC FAILURE SCENARIO (ver. 2013-01)				NID ID	ND00388
Structures (Elevated) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<2.0 Ft	>=2.0 Ft.				
Mobile Homes	0			3		
Seasonal Use RV's				2		
Other						
Structures (With Foundations) Impacted by Potential Breach	Number of Structures			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Inundation Depth Above Natural Ground		Total			
	<1.0 Ft	>=1.0 Ft.				
Homes		0		3		
Seasonal Use Homes and Cabins				1.5		
Duplexes				5		
Apartments						
Commercial Buildings	0					
Schools (In Use)						
Schools (Not in Use)						
Hospitals						
Other						
Highways and Railroads	Number of Roads, Highways and Railways			PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR	
	Road Overflow Depth		Total			
	<1.0 Ft	>=1.0 Ft.				
Main Local Roads and Minor State Highways						
County Road 16		0		2		
Name(s) (if applicable)				2		
Major State and Minor Federal Highways						
Highway Name(s) or Number(s)				4		
Highway Name(s) or Number(s)				4		
Major Federal and Interstate Highways						
Highway Name(s) or Number(s)				8		
Highway Name(s) or Number(s)				8		
Railroads						
UPSF Freight Traffic Only				3		
Passenger Traffic				20		
TOTAL NUMBER OF PEOPLE AT RISK (PAR)					0	

EVALUATION OF POTENTIAL REHABILITATION PROJECTS										
STATE	ND	DAM	UTR 5			BY	NMR	DATE	11/24/2020	
YEAR BUILT		1975	DESIGN HAZARD CLASS		H	DRAINAGE AREA		7.39	mi ²	
WORK PLAN DATE		1975	CURRENT HAZARD CLASS		H	DAM HEIGHT		70	ft	
sht 1 of 5	CONSEQUENCES OF DAM FAILURE (ver. 2013-02)						NID ID	ND00388		
POTENTIAL DAM FAILURE:										
Total Failure Index								192	A	
POTENTIAL LOSS OF LIFE:										
Maximum Population-at-Risk [PAR]								(number)	5	B
Total Risk Index								38	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		N/A				(H,M,L,-)			D	
Number of homes, businesses, major buildings						(number)	1		E	
POTENTIAL LIFELINE DISRUPTION:										
Water supply, identify community disrupted by dam failure, and estimate number/amount										
Municipal sole source		N/A		Users	(number)				F	
Supplemental source		N/A		Users	(number)				G	
Irrigation water				Storage	(Ac-Ft)				H	
POTENTIAL INFRASTRUCTURE DISRUPTION:										
Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number										
Major/Interstate		N/A		Roads	(number)				I	
Secondary/County		County Road 16		Roads	(number)	1			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		N/A		(H,M,L,-)					K	
Sensitive riparian areas		N/A		(H,M,L,-)					L	
Contaminated reservoir sediment		N/A		(H,M,L,-)					M	
Wetland and wildlife habitat		Loss of Reservoir		(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		N/A		(H,M,L,-)					P	
Historic preservation issues		N/A		(H,M,L,-)					Q	
Socially disadvantaged community		N/A		(H,M,L,-)					R	
POTENTIAL ADVERSE ECONOMIC IMPACTS:										
Average annual benefits attributed to this dam, updated workplan value								(\$)		S
Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D)								(I,NC,D)		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)	N	V
State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank)								(H,M,L,-)	H	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	UTR 5	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/rbpsi/documentation.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

5

A

Estimate PAR for hydrologic loading failure; typically assume water at or above invert of the lowest open channel auxiliary spillway

5

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 (ft²/sec)

DV = (breach discharge - bank full discharge) / 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

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	99,900	30	1300	77	7	Vague
Hydrologic	99,900	30	1300	77	7	Vague
Seismic	1,250	30	250	5	18	Vague

For DV ≥ 50	T ≤ 60	U = vague	FR = 0.04
	T > 60		FR = 0.03
For DV < 50	T ≤ 60	U = vague	FR = 0.007
	T > 60		FR = 0.0003

Estimate FR for static loading failure scenario

0.04

D

Estimate FR for hydrologic loading failure scenario

0.04

E

Estimate FR for seismic loading failure scenario

0.007

F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static Hydrologic Seismic	1	80	80	0.04	5	16
	*	*	112	0.04	5	22
	0.00	#DIV/0!	0	0.007	0	0
TOTAL=			192	TOTAL=		38

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	ND	DAM	UTR 5	BY	NMR	DATE	11/24/2020
sht 3 of 5	STATIC FAILURE INDEX						ver 2013-02
PRINCIPAL SPILLWAY SYSTEM (60 points max):				(total points)	40		A
Downstream filter or filter zone around conduit (yes=0 or no=10)					10		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)					10		E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)					10		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)	10		I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)					94		J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)					10		K
SEEPAGE AND DEFORMATION (85 points max):				(total points)	18		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)					6		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)					6		S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)					6		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)	4		AE
Filters for core or foundation or incompatibility between zones (no=4 or yes=0)					0		AF
Embankment or foundation drainage system (yes=0 or no=4)					0		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)					4		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					80		AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	ND	DAM	UTR 5	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)						21.3	A	
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings								
100 year, 6hr rainfall [P100] (inches)						4.2	B	
Probable Maximum Precipitation [PMP] (inches)						19.4	C	
if Pfb <= P100 = 4.20 enter 40								
if Pfb = P100+0.2(PMP-P100) = 7.23 enter 25								
if Pfb = P100+0.4(PMP-P100) = 10.26 enter 15								
if Pfb = P100+0.6(PMP-P100) = 13.30 enter 7								
if Pfb = P100+0.8(PMP-P100) = 16.33 enter 3								
if Pfb => PMP = 19.36 enter 1								
Enter interpolated value						1	D	
HYDROLOGIC UNCERTAINTY:								
Drainage Area [DA] (square miles)						7.39	E	
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2						1.5	F	
PIPE SPILLWAY PLUGGING:								
Pipe Diameter [D] (inches)						24	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						0.9	I	
EARTH SPILLWAY FLOW:								
Earth spillway flow depth [Des] from top of dam to spillway crest (feet)(10' max)						10.0	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						0.8	L	
http://www.pswcrf.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						2	N	
Vegetal Cover Factor [Cf], see SITES or AH667						0.9	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)						4	Q	
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)						112	R	
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300						112	S	

EVALUATION OF POTENTIAL REHABILITATION PROJECTS							
STATE	ND	DAM	UTR 5	BY	NMR	DATE	11/24/2020
sht 5 of 5	SEISMIC FAILURE INDEX						ver 2013-02
SEISMIC LOADING:							
Latitude (degrees.decimal)						47.992	A
Longitude (degrees.decimal)						-97.789	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)						2.00	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)						70	F
Freeboard - Elevation difference from top of dam to assumed pool surface (ft)						46.8	G
Freeboard percent of dam height (%)						67	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							