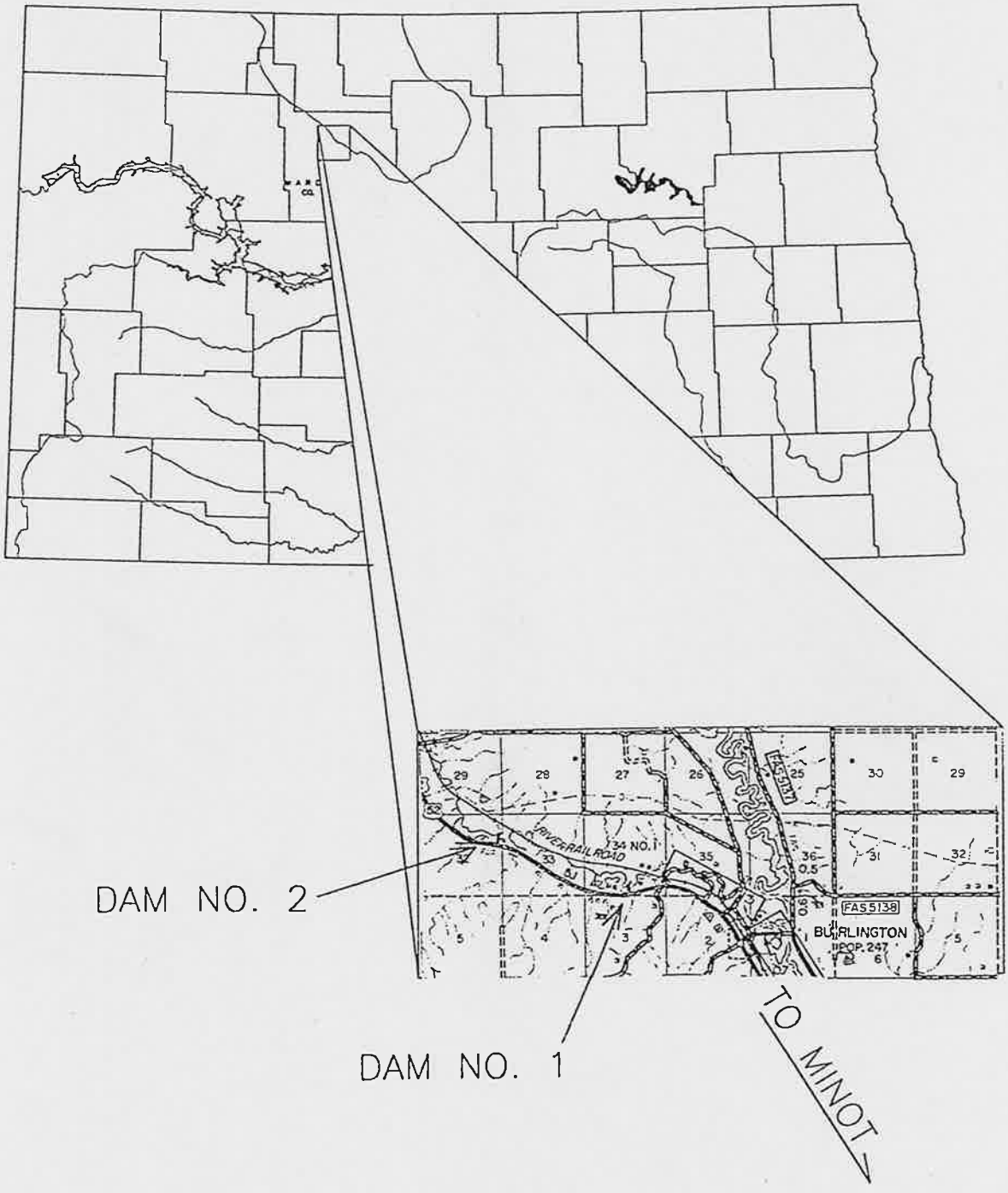
PRELIMINARY ENGINEERING REPORT

BURLINGTON DAMS
NO. 1 & NO. 2
SWC# 221
WARD COUNTY



NORTH DAKOTA
STATE WATER COMMISSION
DECEMBER 1999

PRELIMINARY ENGINEERING REPORT

Burlington Dams No. 1 and No. 2
SWC Project #221

North Dakota State Water Commission
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Bismarck, North Dakota 58501

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I. INTRODUCTION

Study Objectives

In August 1997, the North Dakota State Water Commission entered into an agreement with the Bank of North Dakota to conduct a feasibility study of Burlington dams. The purpose of the study was to determine the cost to modify the dams to bring the dams into compliance with current dam safety requirements, or the costs associated with breaching the dams. A copy of the agreement can be found in Appendix A.

Location

Burlington dams are located on the Des Lacs River, in Ward County of North Dakota. The Des Lacs River traverses Ward County from northwest to southeast, with flow in a southeasterly direction. The dams are located in western Ward County, immediately upstream of Burlington, North Dakota, near US Highway 52. Burlington Dam No. 1 is located approximately two miles northwest of Burlington and is located in Section 34, Township 156 North, Range 84 West. Burlington Dam No. 2 is located 3.5 miles upstream of Burlington, in Section 32, Township 156 North, Range 84 West (Figure 1).

Geology and Climate

The project area is located within the Missouri Escarpment District within the Central Lowland physiographic province. The Missouri Escarpment extends from the Des Lacs and Mouse River valleys to the eastern margin of the Missouri Couteau.

The surface of the escarpment, which is controlled in part by the underlying bedrock, is inclined rather steeply to the northeast. The northeast-facing escarpment is an abrupt feature along most of its length in Ward County and local relief may exceed 300 feet (Bluemle, 1989).

The area receives approximately 15 inches of precipitation annually, with the majority falling during the growing season, May through September. The area has an annual mean temperature of approximately 39 degrees Fahrenheit and experiences large annual, daily, and day-to-day temperature changes. Based on the annual precipitation and mean temperature, the climate is classified as semi-arid.

BURLINGTON DAMS
NO. 1 & NO. 2
SWC# 221
LOCATION MAP

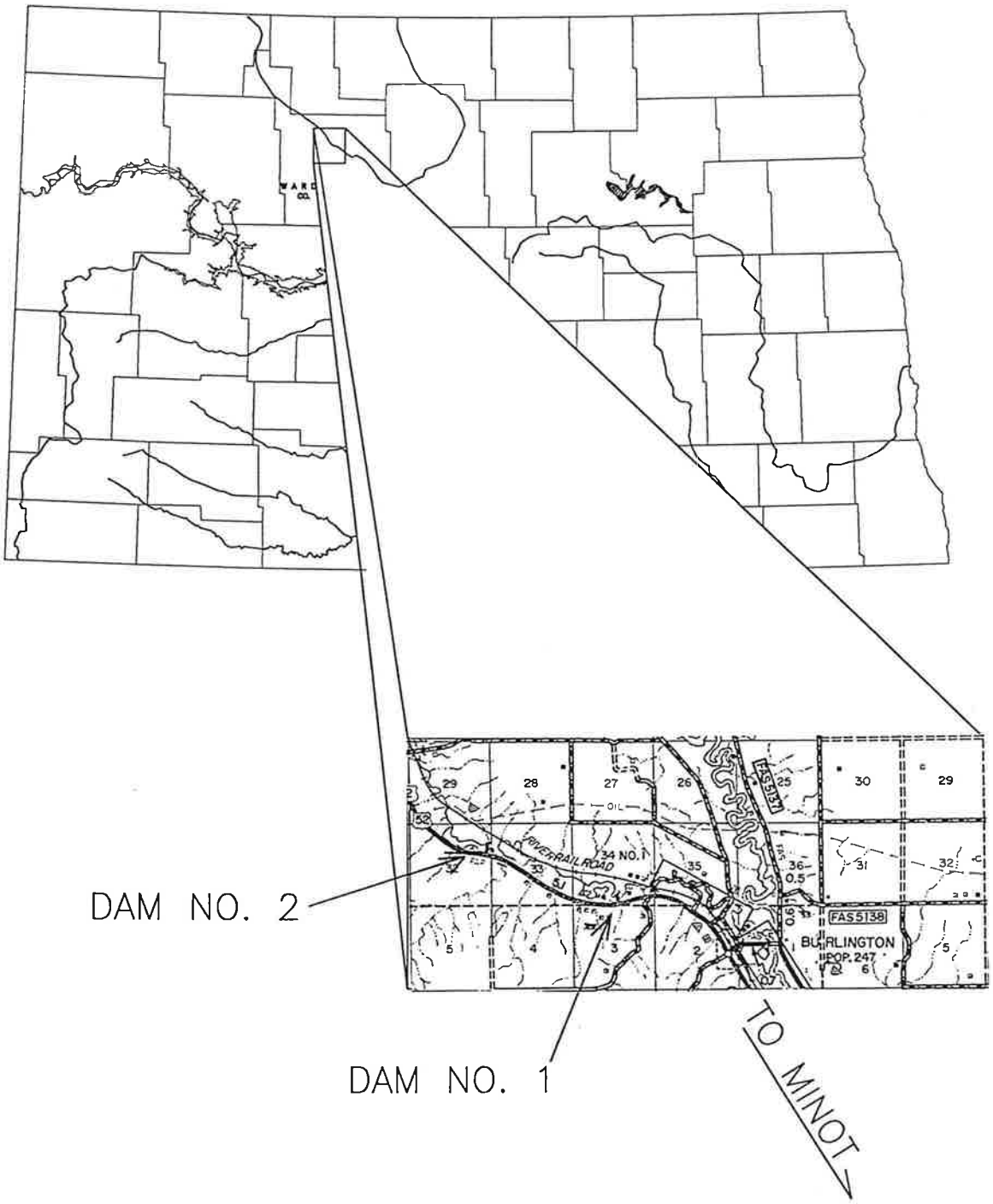


FIGURE 1

Project History

The dams are project features of the Burlington Project (Project). The Project was established as the first subsistence project to be undertaken in North Dakota under the Rural Rehabilitation Corporation (Corporation). The Corporation, besides carrying on rehabilitation work, was authorized to establish industrial community projects for the rehabilitation of groups in so-called "stranded communities".

Under the auspices of the Federal Emergency Relief Administration (FERA), each state established a Corporation in 1934. The concept of rehabilitation for people suffering from rural poverty came from the efforts of the federal government to rehabilitate disabled veterans of World War I so that they might learn new skills and become productive workers again. Each state sets up plans to improve conditions for farmers through loan programs or by removing settlers from submarginal lands and re-establishing them on better farmlands. Each state could also rehabilitate unemployed miners or factory workers in so-called "industrial community projects." The Corporations had the leeway to form a plan for each state and institute the plan under the guidance and direction of FERA. Each state would thus implement its own plan according to local conditions, but could spend money only with the approval of the national FERA administration.

The Burlington Dam Subsistence Homestead Project represented the first such effort in North Dakota and gained state approval in 1934. The Project followed the basic form of the earlier projects, namely, that unemployed workers would grow some of their own food on small plots of land and gain a decent house to live in. The dams were constructed to provide water for irrigating the individual land plots.

The Project consisted of thirty-five farming units on small plots of land, just eight to ten acres in size. The Project began with the hope that families would be able to purchase their home and land with money that they earned from truck-farming and coal mining. Each unit was to have a modest-sized house, a small barn, a chicken house, and a pig shed. (Hoffbeck, 1997).

The first dam, Burlington Dam No. 1, was completed as a work relief project in the spring of 1935. The construction of the irrigation canals, roads, and land leveling were also accomplished as a part of the construction. Burlington Dam No. 2 was completed in March,

1938. The completion of this dam assured an adequate water supply for irrigating.

The ownership of the Project was transferred from the federal government to the State of North Dakota in 1946, acting by and through the Industrial Commission. On, November 12, 1946, the Industrial Commission accepted a deed from the Secretary of Agriculture conveying the Project to the State and designated the Bank of North Dakota as its agent to manage, control, and supervise the real and personal property comprising the Project. A memo dated May 8, 1990, by Tom Tudor, Assistant Attorney General, is located in Appendix B. The memo goes into detail concerning the history of the Project and the transfer of the Project to the state.

II. BACKGROUND

Site Description

Burlington Dam No. 1

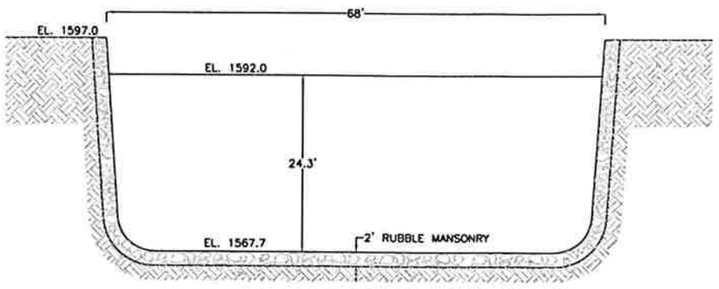
Burlington Dam No. 1 is approximately two miles upstream from the city of Burlington. The dam is a zoned rolled-earth fill embankment. The embankment trends north-south. The left and right abutments, looking downstream, are located to the north and south, respectively. The embankment has a length of approximately 1,100 feet and a top width of approximately 12 feet. The crest elevation is at approximately 1597 mean sea level (msl). The embankment rises approximately nine feet above the flood plain and is approximately 21 feet above the streambed elevation.

The principal spillway is a Winsor Bowl spillway with a crest elevation of 1592 msl. A Winsor Bowl spillway is a fixed weir structure that is semi-circular in plan view. There is a vertical drop of approximately 16 feet from the crest of the spillway down to the stream bed elevation. The crest of the spillway has a width of approximately 15 feet and a length of approximately 89 feet. The vertical face of the structure is constructed of rock masonry. Figure 2 shows a layout of the spillway.

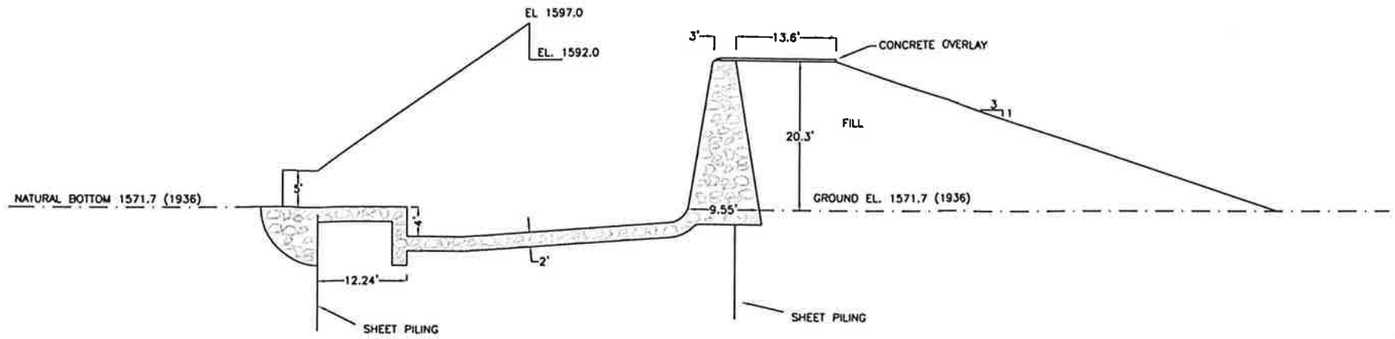
A gated release structure is located approximately half way between the abutments. The structure consists of three 4 feet x 4 feet cast iron gates. The gates are operated manually and can lower the water surface elevation approximately 5.5 feet below the crest elevation of the Winsor Bowl spillway.

An irrigation release structure is located near the right abutment. The structure consists of a 30-inch diameter concrete pipe which is controlled by a gate. The purpose of the structure was to provide water to the system of irrigation canals. At the present time the structure is inoperable.

The reservoir is approximately 38 acres at the crest elevation of 1592 msl and approximately 112 acres at the top of dam elevation of 1597 msl. The volume is 207 acre-feet and 567 acre-feet at the spillway crest and top of dam, respectively. The drainage area above the dam is approximately 629 square miles. Figure 3 is a topographical map of Dam Site Number 1.



SECTION A–A



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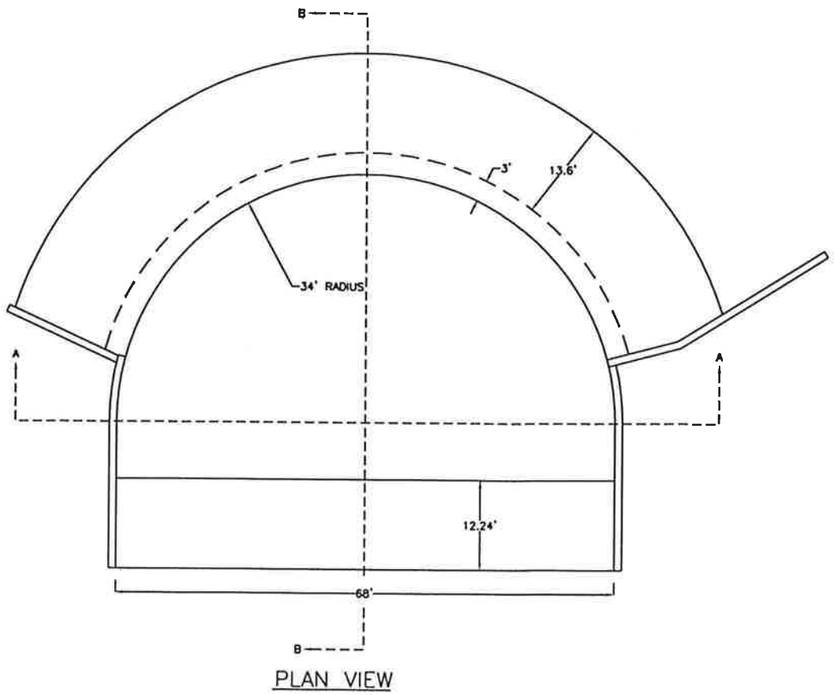


PLAN VIEW

10 0 10 30

Scale 1" = 10 ft

SHEET 1 of 2

NORTH DAKOTA STATE WATER COMMISSION
BISMARCK, NORTH DAKOTA

SWC Project No. 221

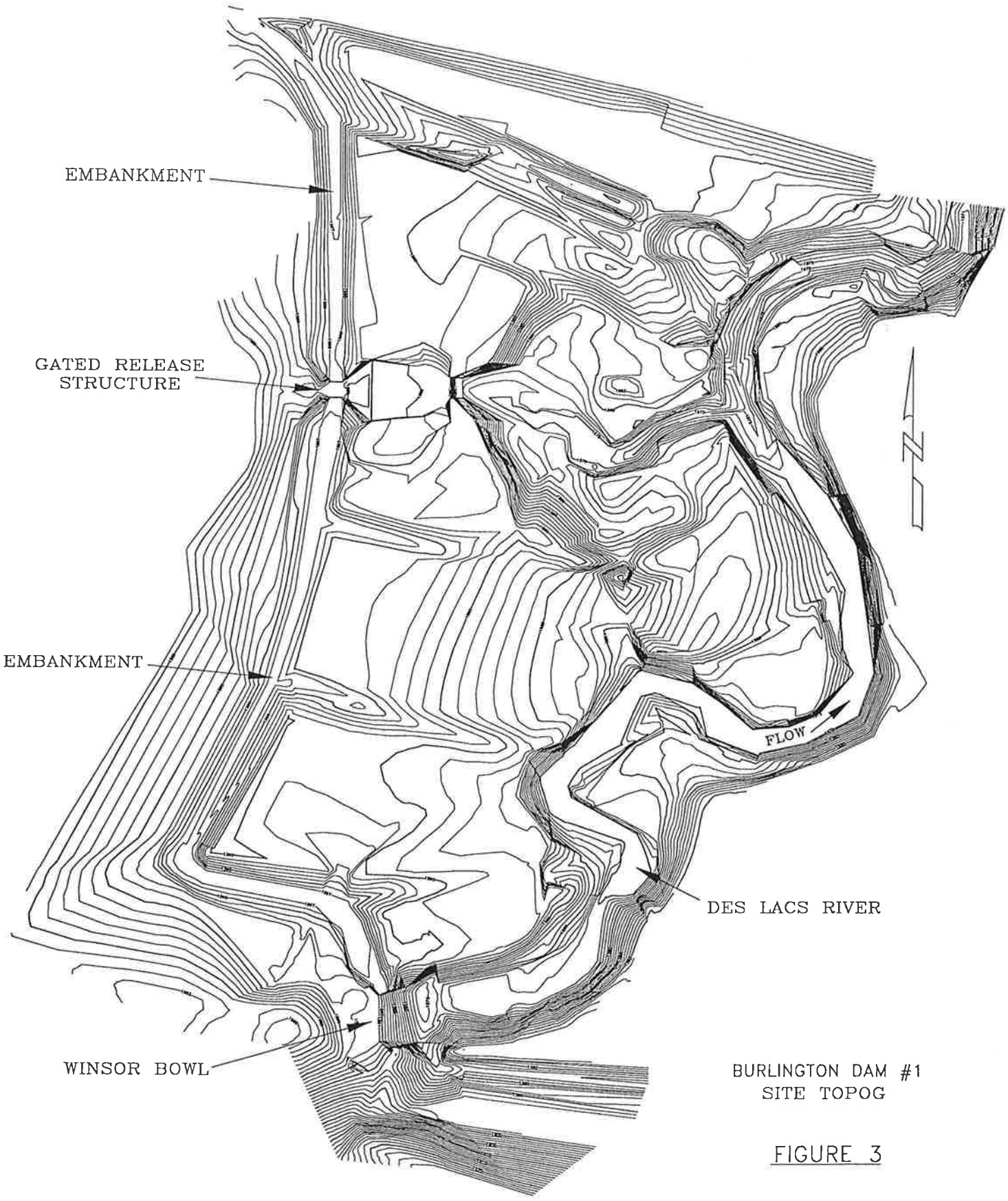
WINSOR SPILLWAY

BURLINGTON DAM No. 1

COUNTY: WARD	SCALE: 1"=10'	DATE: 11/16/94
SURVEYED:	CHECKED BY:	SUBMITTED BY:
DRAWN BY: Tom Engberg	DESIGNED BY:	APPROVED BY:
DRAWING # XXXX-XXXX		

NO.	DATE	DESCRIPTION	BY

FIGURE 2



BURLINGTON DAM #1
SITE TOPOG

FIGURE 3

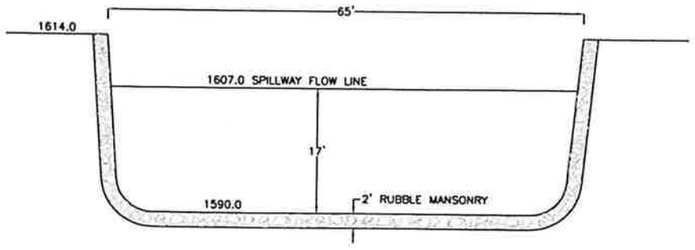
Burlington Dam No. 2

Burlington Dam No. 2 is located approximately 1.5 miles upstream of Burlington Dam No. 1. The dam is a zoned rolled-earth fill embankment, with a length of approximately 4,400 feet and a top width of approximately 10 feet. The embankment is L-shaped, with the embankment across the valley trending north-south, with the right abutment located to the south. The embankment extends across the main valley for a length of approximately 1,150 feet and then turns to the northwest and parallels the railroad embankment for a length of approximately 3,250 feet. The crest elevation of the embankment is approximately 1614 msl and a maximum height of 24 feet at the spillway. The embankment across the valley is approximately 11 feet high, with a downstream slope of 3:1 (horizontal to vertical) and an upstream slope of approximately 2:1.

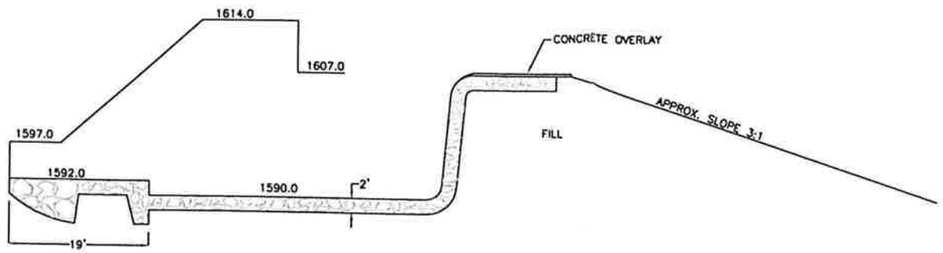
The principal spillway is identical to the configuration at Dam No. 1, namely, a Winsor Bowl spillway. The spillway has a crest elevation of approximately 1607 msl. The elevation of the training walls is at elevation 1614 msl, seven feet above the crest elevation of 1607 msl. There is a vertical drop of approximately 17 feet from the crest of the spillway down to the stream bed elevation. The crest of the spillway has a width of approximately 15 feet and a length of approximately 85 feet. The vertical face of the structure is constructed of rock masonry. Figure 4 shows the profile and plan view of the spillway.

A gated irrigation release structure is located near the right abutment. The structure consists of a gated 36-inch diameter concrete pipe. The purpose of the structure was to provide a means to transfer water to Dam No. 1 during drought years. The structure has fallen into disrepair and is no longer functional.

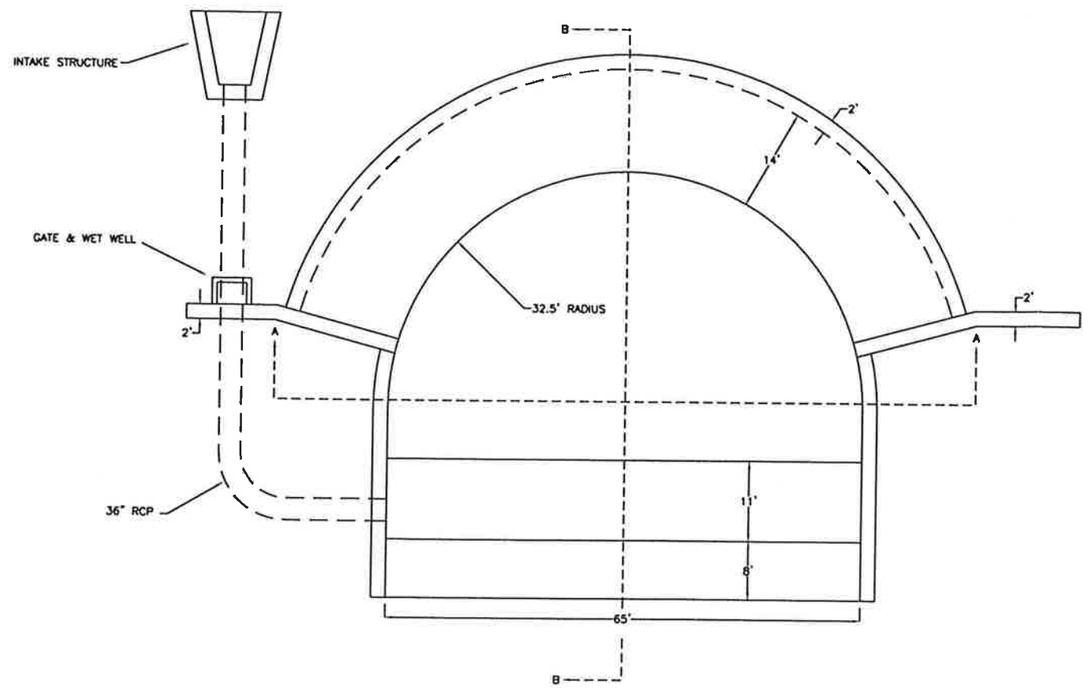
The reservoir is approximately 17 acres at the crest elevation of 1607 msl and approximately 88 acres at the top of dam elevation of 1614 msl. The volume is 92 acre-feet and 487 acre-feet at the spillway crest and top of dam, respectively. The drainage area above the dam is approximately 605 square miles. Figure 5 is a topographical map of dam site number 2.



SECTION A–A



SECTION B–B



PLAN VIEW

FIGURE 4

10 0 10 30

Scale 1" = 10 ft

SHEET 2 of 2

NORTH DAKOTA
STATE WATER COMMISSION
BISMARCK, NORTH DAKOTA

SWC Project No. 221

WINSOR SPILLWAY
BURLINGTON DAM No. 2

COUNTY: WARD	SCALE: 1"=10'	DATE: 10/30/98
SURVEYED:	CHECKED BY:	SUBMITTED BY:
DRAWN BY: Tom Engberg	DESIGNED BY:	APPROVED BY:

DRAWING # XXXX-XXXX

NO.	DATE	DESCRIPTION	BY

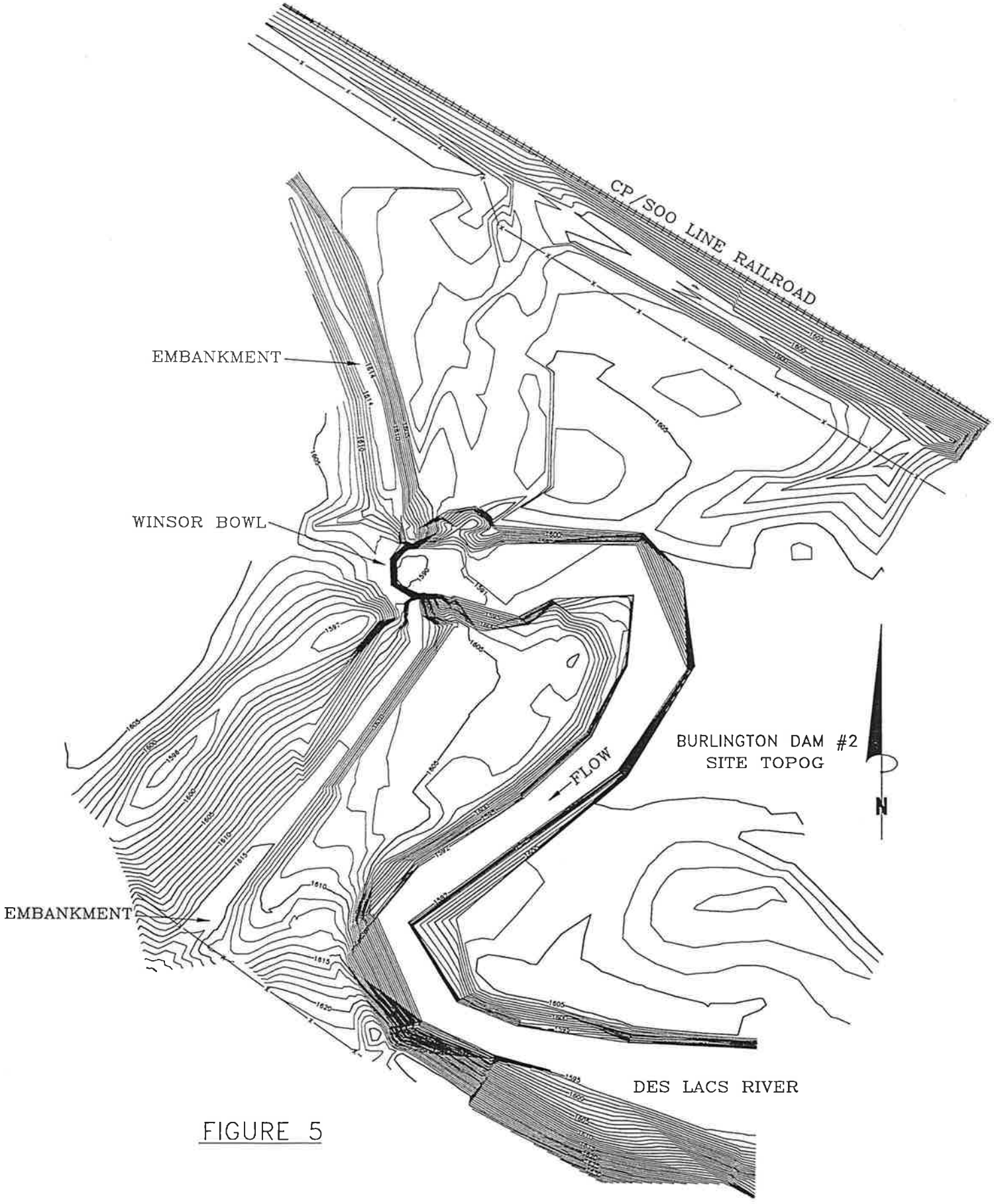

CP/SOO LINE RAILROAD
EMBANKMENT
WINSOR BOWL
BURLINGTON DAM #2
SITE TOPOG
FLOW
N
EMBANKMENT
DES LACS RIVER

FIGURE 5

Operation and Maintenance History

Minor repairs were performed at Burlington Dam 1 in the summer of 1957. The repair work consisted of the installation of a trash rack and the injection of grout at the drop structure located immediately downstream of the gated release structure. Repairs were also performed at Burlington Dam 2 in 1957. The repairs at Burlington Dam 2 involved the placement of concrete to the spillway and applying mortar to the structure.

A May 4, 1970, inspection of Burlington Dam 1 indicated the spring runoff had eroded a large area of the downstream face of the embankment. The erosion was located between the Winsor Bowl and the gated release structure. The area eroded started at the downstream toe and advanced towards the centerline of the embankment and was estimated at 40 to 50 feet across. Debris was also found at the inlet to the gate inlet structure.

A follow-up inspection indicated the presence of animal burrows. The animal burrows provided a flow path which initiated the partial failure of the embankment. Repairs were made to the embankment in late-summer 1970. The repairs consisted of backfilling the eroded area with suitable fill and removing the debris from the inlet of the gated release structure. Rock riprap was also placed at the inlet to the gated release structure.

Flood waters from the spring runoff in 1979 overtopped the embankment for approximately 30 hours, which resulted in erosion in the area of the gated release structure, erosion at the spillway structure, and erosion along portions of the embankment. The high flows also washed out a section of the Soo Line Railroad grade. The damage was considered minor and not a threat to the structure and repairs were made later that year.

Dam Classification

The Burlington Dams were classified as high hazard dams in 1979. The presence of homes located immediately downstream of the dams indicated a potential threat to personal property and life, resulting in the high hazard classification.

Dams in North Dakota are classified according to criteria found in "North Dakota Dam Design Handbook" (Moum, et al, 1985). The following criteria are used to classify dams for design purposes: 1) the height of the dam; and 2) the potential hazard to property or loss of life.

The first criteria used to classify dams is the height of the dam, as measured from the stream bed to the top of the embankment. Burlington Dam No. 1 has a height of 21 feet and Burlington Dam No. 2 has a height of approximately 24 feet. The following table lists the dam classifications based on the hazard category and embankment height.

TABLE 1 - DAM DESIGN CLASSIFICATION

DAM HEIGHT	HAZARD CATEGORIES		
	LOW	MEDIUM	HIGH
Less than 10	I	II	IV
10 to 24	II	III	IV
25 to 39	III	III	IV
40 to 55	III	IV	V
Over 55	III	IV	V

The dam hazard classification is the second criteria used in the design of dams and appurtenances. There are three types of hazard classifications: high, medium, and low.

High — Dams located upstream of developed and urban areas where failure may cause serious damage to homes, industrial and commercial buildings, and major public utilities. There is potential for the loss of more than a few lives if the dam fails.

Medium — Dams located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways, railroads, or cause interruption of minor public utilities. The potential for the loss of a few lives may be expected if the dam fails.

Low — Dams located in rural or agricultural areas where there is little possibility of further development, and if the dam fails, damage to agricultural land, township and county roads, and farm buildings other than residences may result. No loss of life is expected.

The 1979 dam classification was not based on an incremental hazard analysis, and the Commission believes the original high hazard classification for the Burlington Dams was overly conservative. Therefore, an important aspect of the feasibility study was to perform a dam breach analysis to more accurately determine the dam hazard classification, which is described in the following section.

III. HYDRAULIC ANALYSIS

Scope of Study

Burlington Dams No. 1 and 2 have relatively small storage capacities and relatively low embankments. Intuitively, it seems unlikely that they would cause a hazard to residents of the valley; however, questions of safety require a more careful assessment. This was addressed by an incremental hazard analysis.

The incremental hazard analysis for the Burlington dams was based on the question, "At what level of flood does the failure of the dams cause any incremental damage?" If the dams fail during a large flood damages may occur, but those attributable to the failure of the dams may be negligible compared to those caused by the flood itself. On the other hand, a large increment in flow or stage may result from failure of the dam during a lesser event, but that increment may not cause any damage. It would be pointless to spend large sums equipping the dams to pass large floods without failure when their failure during that flood would cause no incremental damage. They should, however, be constructed to survive conditions during which their failure would cause damages greater than those caused by the flood alone. In their current configuration, they may or may not be able to do that.

Method of Study

A study of this nature calls for a model which can meet the following requirements: 1) It must be capable of addressing the failure of two dams in sequence, 2) it must be capable of routing the unsteady flows resulting from dam failures, 3) it must be capable of routing hydrographs through the long, relatively small reservoirs of the two Burlington dams, 4) it must be capable of addressing tailwater effects presented by the confluence of the Des Lacs River with the Mouse river just below Burlington, and 5) it must be readily available for use, preferably in

the Public Domain, and ready for production use, rather than being configured as academic or research tools.

Two well-known models meet these requirements, the National Weather Service's DAMBRK and the Corps of Engineers' UNET. UNET was chosen because it was already available to the State Water Commission, which has a higher level of experience with it, and because the existing data required less manipulation with UNET.

In order to include the effects of backwater at Burlington in the model and to extend the model to a calibration point, the Mouse River was included in the model. This produces a simple network; the Des Lacs (including the two dams), the Mouse River above the confluence and the Mouse River below the confluence. Fortunately, there are USGS stream gages with long periods of record available for each of these branches. The gages at Des Lacs River at Foxholm (05116500 with a currently active record beginning in 1945) and the Souris (Mouse) River near Foxholm (05116000, with a currently active record beginning in October 1936) provide a wide range of hydrographs for upstream boundary conditions. The gage Souris (Mouse) River above Minot (05117500 with a currently active record beginning in May, 1903) produced information for downstream boundary conditions and hydrographs for calibration.

In addition to the boundary condition data, the model requires geometric information in the form of cross sections of the river and overbank areas and flow resistance information. This geometric information was available in large part from the flood plain management studies for the entire Mouse River in North Dakota and the Des Lacs River through Burlington, both of which were recently completed by the St. Paul District Corps of Engineers. Additional cross sections were required on the Des Lacs River from Burlington Dam No. 1 to Foxholm. These were obtained by the Water Commission's survey crew in the spring of 1998. The cross-sections on the Des Lacs are numbered based on the river miles downstream of Foxholm, ND. Figure 6 gives the location of the cross-sections used in the analysis.

Some minor crossings were not included in the model. The reservoirs were routed as channels rather than as level pools. This allows simulation of the flood wave as it passes through the reservoirs

After the input data were assembled, the model was calibrated to the 1979 flood. The 1979 event was selected to provide a recent large event. A number of channel modifications and

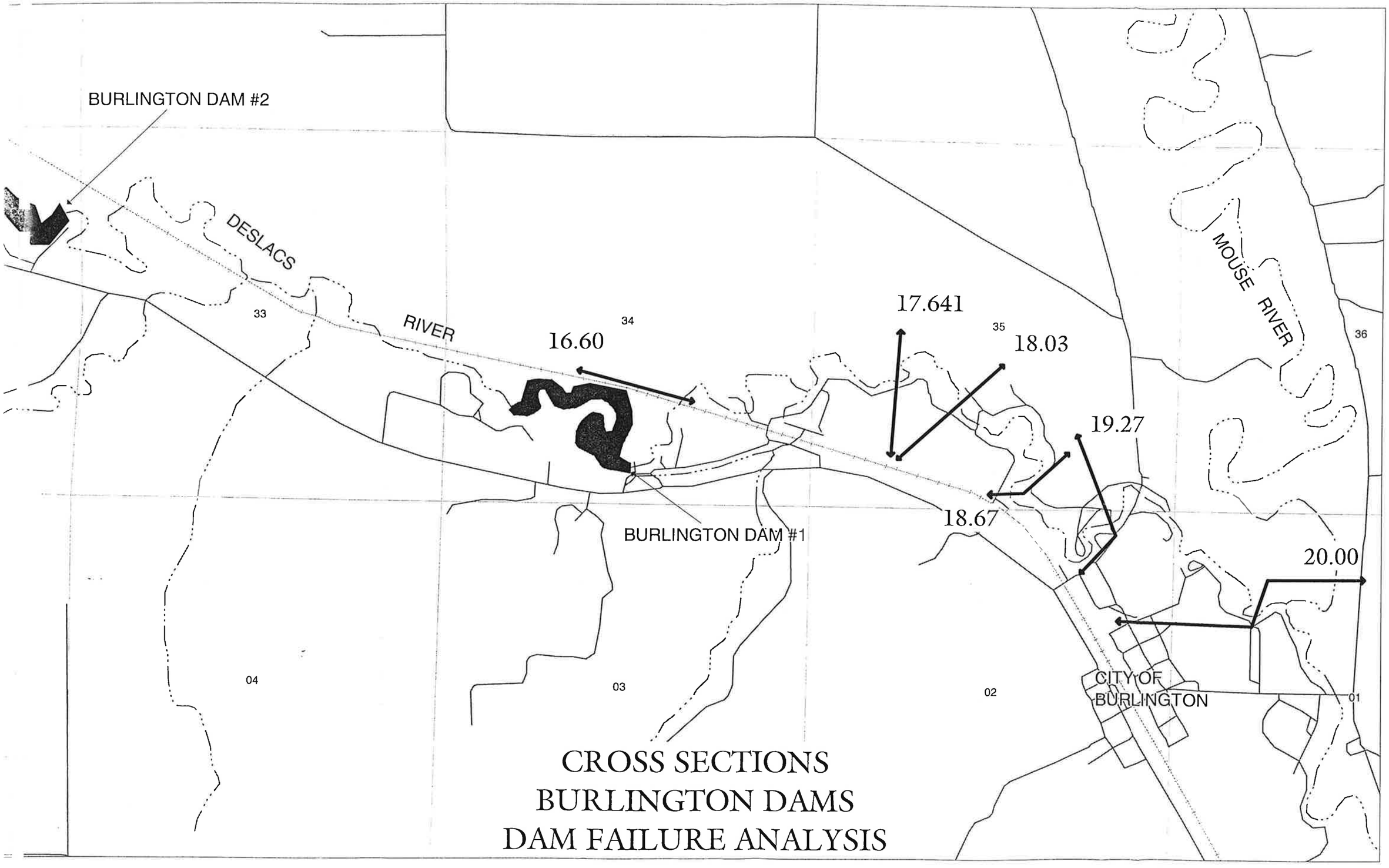

BURLINGTON DAM #2
DESLACS
RIVER
MOUSE RIVER
16.60
17.641
18.03
19.27
18.67
20.00
BURLINGTON DAM #1
CITY OF
BURLINGTON
33
34
35
36
04
03
02
01
CROSS SECTIONS
BURLINGTON DAMS
DAM FAILURE ANALYSIS

Figure 6

other works have been completed on the Mouse River, which are represented in the cross sectional data. It was important to calibrate to an event which included these modifications. The 1979 flood had a peak flow of 3,100 cubic feet per second at Foxholm, which approximates a 25 year event. Flow resistance values, effective flow limits, and local inflows were adjusted to reproduce the hydrograph at the Mouse River Above Minot gage.

Results

The first step in assessing the hazard presented by the Burlington dams is to evaluate the consequences of a sudden release of the reservoir contents without the complications of a simultaneous flood. This "blue-sky failure" was simulated by modeling piping failures of both dams during the 1994 spring runoff. This event was selected because it produced adequate flows (unsteady flow models fail when dry channel conditions occur) without exceeding bankfull capacity. Piping failures were simulated at both dams.

Piping failures were modeled by a leak forming through the dam embankment, at an elevation below the top of dam elevation. The leak causes the loss of embankment material which quickly grows into a large hole and eventually reaches the embankment top, through which the reservoir discharges.

Dam No. 2 was subjected to a piping failure beginning at elevation 1605.0 msl when the water reservoir elevation reached its maximum elevation 1608.6 msl. The piping failure removed embankment material and eroded downward to an elevation 1598.0 msl, and developed a bottom width of 20 feet within six hours. Dam No. 1 was set to fail by a piping failure to start at an elevation of 1589 msl when the reservoir reached a maximum elevation of 1593.5 msl. The failure caused erosion down to an elevation of 1589.0 msl with a final bottom width of 20 feet in a period of six hours. Both failures were set to begin when each reservoir reached its maximum stage. The maximum reservoir elevations represent points slightly below the crests of the rock masonry spillways.

The maximum stage increase from this event was 1.7 feet at cross section 7.49, between the railroad crossing and the city of Burlington. However, this increased stage is still within the channel banks. It therefore appears that there is no threat from the sudden release of the reservoir contents if there is no large flow event occurring.

The next step is to assess the consequences of a failure during a flood. This step evolves into a search for the flood during which the failure of the dams would make a significant difference.

The 1979 flood, to which the UNET model was calibrated, produced a peak flow of nearly 3700 cfs at Burlington. This event was used as a test case which approximates a 25-year peak flow of 3740 cfs at that point. An event approximating 50-year event (4440 cfs) was also simulated. The inflow hydrograph for this event was constructed by multiplying the 1979 hydrograph by a factor which produced about 4500 cfs at Burlington.

Separate analyses were performed in which each dam failed individually; however, the sequential failure of both dams, not surprisingly, turned out to be more severe. Therefore, only that scenario will be discussed here. The following six cross sections were selected to depict the consequences of a sequential failure of both dams during the 1979 flood and the 50-year flood: Number 16.60, on the downstream side of the railroad crossing just below Dam No. 1; No. 17.641, on the downstream side of the small bridge about one-half mile (measured along the channel) below No. 16.60; No. 18.03, about 2,000 feet below 17.641; No. 18.13, at the downstream side of the next bridge downstream; No. 18.67, about one-half mile below that bridge; No. 19.27, at the Old Settlers Park Dam, and No. 20 at the confluence with the Mouse River. The Table 2 displays the results of the simulations.

Table 2. Results of the Dam Break Analysis

Burlington Dams No. 1 and No. 2

	1979 Event (25-Year Event)			50-Year Event		
Cross Section	No Failure	Failure	Diff.	No Failure	Failure	Diff.
16.60 Flow (cfs)	3688	3813	125	4537	4599	62
16.60 Stage (ft-msl)	1587.55	1588.71	.16	1588.55	1588.63	.08
17.641 Flow (cfs)	3666	3795	129	4610	4670	60
17.641 Stage (ft-msl)	1583.35	1583.54	.19	1584.72	1584.7	.07
18.03 Flow (cfs)	3644	3761	72	4419	4417	--
18.03 Stage (ft-msl)	1581.56	1581.76	.20	1582.95	1583.0	.09
18.67 Flow (cfs)	3638	3754	116	4385	4436	51
18.67 Stage (ft-msl)	1577.96	1578.15	.19	1579.22	1579.3	.09
19.27 Flow (cfs)	3626	3743	117	4388	4429	41
19.27 Stage (ft-msl)	1572.51	1572.69	.18	1573.47	1573.63	.16
20 Flow (cfs)	3611	3726	115	4297	4329	32
20 Stage (ft-msl)	1568.85	1568.95	.7	1569.17	1570.08	.91

Discussion

The increase in stage caused by the failure of both dams over what would have occurred without the failures is less than 0.2 foot in the 1979 event and less than 0.1 foot in the 50-year flood. Flows increased by 4% or less for the 1979 event, and by slightly over 2% in the 50-year event. There is a point of local inflow near Section 17.461 whose effects can be seen by a slight increase in flows at that point. The analysis also indicates that below the Old Settlers Park Dam backwater conditions from the Mouse become highly significant. There are even cases in which the failure reduces stages by accelerating the peak discharge so it coincides with a lower part of the hydrograph on the Mouse.

Conclusion

Accuracy of 0.2 feet in peak flood stage and 4% in peak flood flows in a practical sense is unobtainable, so the actual values of the stages reported here is not significant. The differences calculated, however, represent a valid comparison between conditions which are identical except for the element of the dam failures. These differences, therefore, are a valid measure of the effects of the dam failures. They are amounts which would easily be overshadowed by random occurrences of any number of other conditions, such as ice, debris blockage, or backwater conditions. These consequences are therefore considered insignificant.

This conclusion should not be surprising. The top of the embankment of Dam No. 1 is, at most, seven feet above the surrounding natural ground. Discharge under this low head into a high tailwater will be limited, no matter how severe the failure conditions. Furthermore the pools, although extensive in area, are quite shallow comprising rather small storage (since the reservoir routing was done by channel routing rather than by level pool storage methods, an accurate measure of the reservoir storage capacity was not performed). The volume of water available to contribute to a significant flood is limited. Failure of the dams during non-flood conditions will not generate enough flow to fill the channel. Failure during a flood will not exacerbate flood damages to the extent that they can be attributed to the dam failures, rather than to other randomly occurring conditions. Therefore, Burlington Dam No. 1 and Burlington Dam No. 2 should be reclassified as "Low Hazard" dams.

IV. PRELIMINARY DESIGN

Based on the height of the dams, combined with the low hazard classification, both dams are considered class II dams for design purposes. A class II dam must have a spillway capable of passing a 25-year event within an acceptable range of velocity, i.e., velocity hydrograph, and the spillway must have the capacity to pass a 50-year event with adequate freeboard on the dams, i.e., freeboard hydrograph. These are guidelines established by the State Water Commission and can be found in the *"North Dakota Dam Design Handbook"*. The design requirements are established for new construction and when an existing dam is modified. The State Engineer has the authority to deviate from these guidelines on a case by case basis.

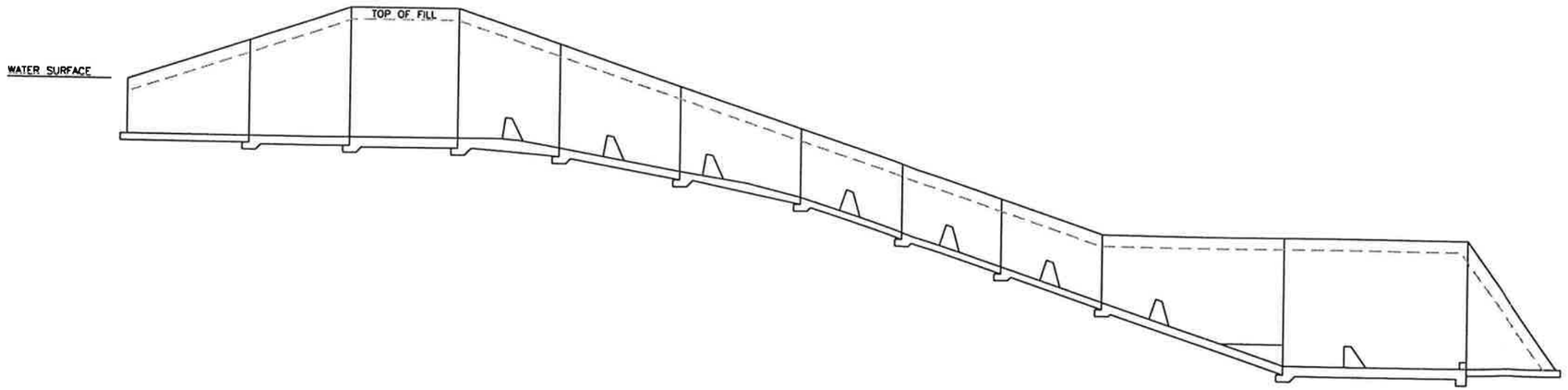
The flows for the 25-year event and the 50-year event are 3740 cfs and 4440 cfs, respectively. The weir at Burlington Dam 1 is at elevation 1592 msl, with a length of approximately 90 feet. The elevation of the crest of the embankment is at approximately 1597 msl. The maximum flow depth the structure can pass is approximately five feet, which results in a flow 3,320 cfs. Therefore, Burlington Dam 1 does not meet current design requirements for a class II dam. However, the dam breach analysis shows there is not a threat to downstream property or life in the event of a failure, meaning that a full replacement of the structure, or breaching the dam is not required.

The configuration of the spillway at Burlington Dam number No. 2 is identical to Dam 1, in that both are Windsor Bowl structures with weir lengths of 90 feet. The structure at Dam 2 differs in that the control elevation of the weir is at elevation 1607 msl and the top of the embankment is at 1614 msl. The maximum flow through the spillway at No. 2 is approximately seven feet, which results in a flow of approximately 5,500 cfs. Therefore, Burlington Dam No. 2 does meet the design requirement for a 25-year event. However, a flow depth of approximately six feet is required to pass a 50-year event, which does not leave adequate freeboard; this means Burlington Dam No. 2 does not meet the design requirements for a 50-year event. Again, as is the case for dam no. 1, the dam breach analysis shows there is not a threat to downstream property or life in the event of a failure of Burlington Dam No. 2, meaning a full replacement of the structure, or breaching the dam is not required.

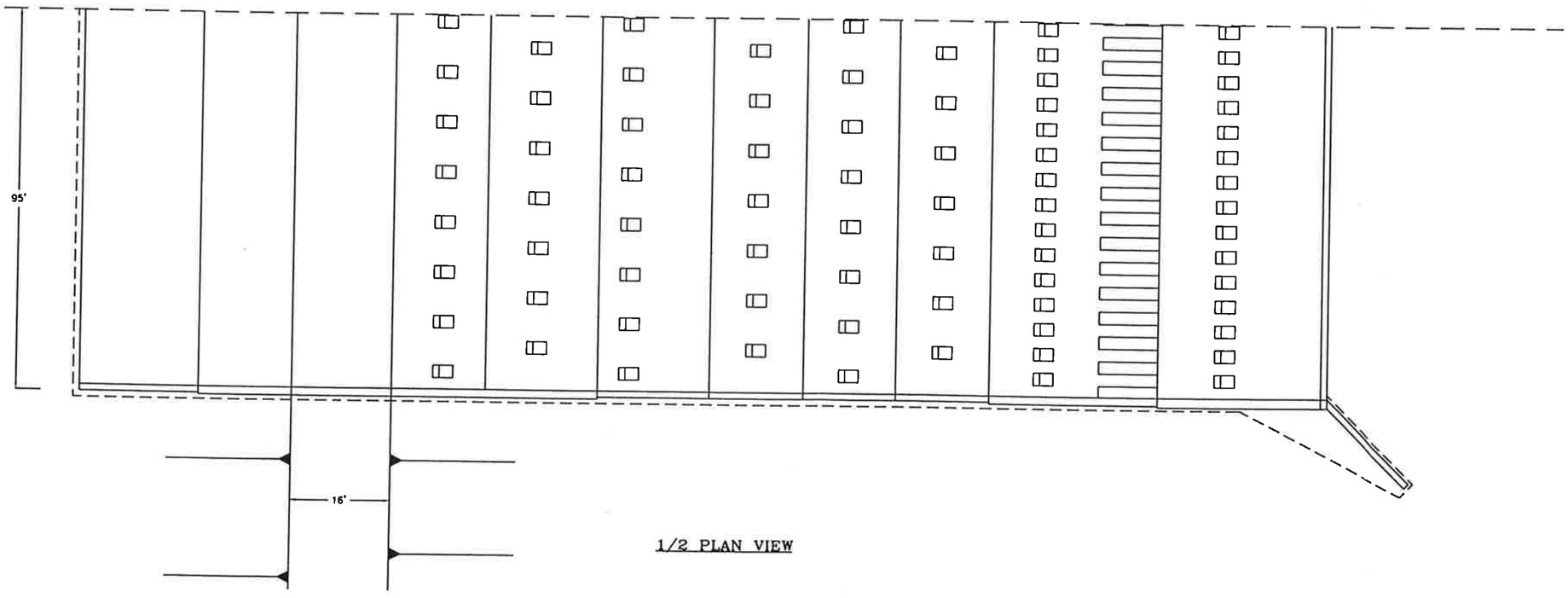
The hydraulic analysis indicates that a catastrophic failure of the dams does not pose a

threat to downstream property or life. Therefore, breaching the dams is not necessary and a cost estimate was not developed.

Major work at the structures is not called for at this time. Again the dam breach analysis indicates a failure of the dams do not pose a threat to downstream property and life, so the structures would not require major rehabilitation, unless requested by the dam owner. In the event the spillway(s) deteriorate to the point where a total replacement of the structure is required by the dam owner, a concrete chute spillway would be required. The chute spillway would be designed to pass a 50-year event without overtopping the embankment, thereby meeting the requirements for a class II dam. Figure 7 shows a typical cross-section and plan view of the structure. The estimated cost for such a structure at either, or both dams is $1,000,000. Table 3 provides a listing of the items used to generate the cost estimate.



ELEVATION VIEW



1/2 PLAN VIEW

FIGURE 7

NORTH DAKOTA
STATE WATER COMMISSION
BISMARCK, NORTH DAKOTA

SWC Project No. 221

BURLINGTON DAMS

CONCRETE CHUTE SPILLWAY
W/ENERGY DISSIPATORS

COUNTY: WARD	SCALE: NONE	DATE: 11/22/99
SURVEYED:	CHECKED BY:	SUBMITTED BY:
DRAWN BY: Tom Engberg	DESIGNED BY: RAS	APPROVED BY:
DRAWING 1		

Table 3. - Preliminary Cost Estimate for Chute Spillway Burlington Dams No. 1 and No. 2

Item No.	Item	Quantity	Units	Unit Cost	Total Cost
1.	Mobilization	1	LS	$20,000.00	$20,000.00
2.	Coffer Dam & Water Control	1	LS	$30,000.00	$30,000.00
3.	Structural Removal	1	LS	$20,000.00	$20,000.00
4.	Clearing and Grubbing	1	LS	$5,000.00	$5,000.00
5.	Topsoil Stripping & Spreading	10,000	SY	$0.25	$2,500.00
6.	Excavation	28,000	CY	$1.50	$42,000.00
7.	Sheet Piling	2,400	LF	$35.00	$84,000.00
8.	Concrete	1,900	CY	$200.00	$380,000.00
9.	Steel	213,000	LB	$0.55	$117,150.00
10.	Granular Fill	500	CY	$17.00	$8,500.00
11.	PVC Drain Pipe	2,000	LF	$5.00	$10,000.00
12.	Earthfill	7,500	CY	$2.00	$15,000.00
13.	Filter Fabric	333	SY	$3.00	$1,000.00
14.	Rock Rip Rap	500	CY	$30.00	$15,000.00
				Sub Total:	$750,150.00
				Contingencies	$83,300.00
				Engineering	$83,275.00
				Administration	$83,275.00
				Total:	$1,000,000.00

IV. SUMMARY AND RECOMMENDATIONS

Based on the results of the dam break analysis, the original high hazard classification assigned to the dams in 1979 was in error, when in fact, the analysis indicates the dams have a low hazard classification. Using the low hazard classification for each dam and the height of the dams, both dams are a Class II dam for design purposes. A Class II dam must be able to pass a 50-year event without overtopping the embankment. The hydraulic analysis indicates the spillways at both dams do not have the capacity to pass the 50-year event. However, since the analysis indicates there is no threat to downstream life in the event of a dam failure, it is not necessary to breach the dams, or rebuild the spillways to meet design requirements.

It is recommended to continue to monitor the structures at both dams and make repairs as necessary. If the spillways deteriorate to the point where a full replacement of one or both of the spillways is required, it is recommended a study be initiated to identify the most feasible replacement structure and provide detailed plans and specifications. Preliminary work indicates the most likely replacement spillway is a concrete chute, at an estimated cost of $1,000,000 per spillway.

APPENDIX A

Agreement - Investigation of Burlington Dams

SWC Project # 221
August 20, 1997

AGREEMENT

Investigation of Burlington Dams

I. PARTIES

This Agreement is between the North Dakota State Water Commission, hereinafter Commission, through its Secretary, David A. Sprynczynatyk, hereinafter Secretary; and the Bank of North Dakota, hereinafter Bank, through its Loan Workout Manager, Ray Zimmermann.

II. PROJECT, PURPOSE, AND LOCATION

The Bank has requested the Commission to conduct a field survey of Burlington Dams No. 1, located in S-34, T-156N, R-84W, and No. 2, located in S-32,T-156N, R-84W, to determine the cost of breaching the dams or of modifying them to comply with current dam safety standards. The Bank also requested the Commission to determine if the dams provide any flood control benefits.

The Commission will complete an investigation consisting of the following:

1. A topographic survey of both dams to identify construction quantities.
2. A preliminary design and an estimate of cost to breach the dams.
3. A preliminary design and an estimate of cost to renovate both dams to comply with current dam safety standards.
4. An assessment of the flood control benefits, if any, provided by the dams.

III. COSTS

The Bank agrees to pay the Commission a total of $3,000 to partially defray the cost of the investigation. The Bank shall make the payment to the Commission at the time of execution of this agreement.

IV. RIGHTS-OF-WAY

The Bank agrees to obtain written permission from any affected landowners for field investigations by the Commission.

V. INDEMNIFICATION

Each party, as state agencies, agrees to assume its own liability for any and all claims of any nature including all costs, expenses, and attorney's fees which may in any manner arise from or out of this Agreement.

VI. MERGER CLAUSE

This Agreement constitutes the entire Agreement between the parties. No waiver, consent, modification nor change of terms of this agreement shall bind either party unless is writing, signed by the parties, and attached hereto. Such waiver, consent, modification or change, if made, shall be effective only in the specific instance and for the specific purpose given. There are no understandings, agreements, or representations, oral or written, not specified herein regarding this agreement.

NORTH DAKOTA STATE WATER COMMISSION

By: Dale L. Frink Jr.

David A. Sprynczynatyk
Secretary

Date: 9-19-97

Bank of North Dakota

By: Ray Zimmermann

Ray Zimmermann
Loan Workout Manager

Date: 8-29-97

APPENDIX B

Judge A. M. Christianson/Burlington Project

MEMO

FROM: Tom Tudor, Assistant Attorney General

DATE: May 8, 1990

RE: Judge A. M. Christianson/Burlington Project

The purpose of this memo is to set out a brief documentary history of the Judge A.M. Christianson Project with respect to how it came into being, who has had control over it through the years and the present status of the remaining property.

The North Dakota Rural Rehabilitation Corporation, a nonprofit charitable corporation (the "Corporation"), was established by the filing of its articles of incorporated on October 25, 1934, in part, for the purpose of carrying out a program of relief and rehabilitation in North Dakota under the Federal Emergency Relief Administration. The primary purpose for which the Corporation was established was

> To rehabilitate individuals and families as self-sustaining human beings by enabling them to secure subsistence and gainful employment from the soil, from co-ordinate and affiliated industries and enterprises and activities and otherwise, in accordance with economic and social standards of good citizenship.

The Legislative Assembly of North Dakota, in 1935, authorized the state, its agencies and political subdivisions, to cooperate with and utilize the facilities of the Corporation to further and expedite the relief and rehabilitation activities of the Federal Emergency Relief Administration. The Legislative Assembly also accepted the offer set out in the articles of incorporation of the Corporation that, upon its dissolution, any funds or property it then held would be turned over to the state treasurer for appropriation by the Legislative Assembly for such public purposes as designated or placed in the general fund of the state as directed.

In 1937, following federal action which provided that federal funds could not be made available either to the Corporation or the state for carrying on the activities of the Corporation and that federal funds would be available only for direct expenditure by the Resettlement Administration of the United States Department of Agriculture, the Legislative Assembly, by joint resolution, authorized the Corporation to convey its property to the federal government so that the programs of the Corporation could be coordinated with those of the Resettlement Administration for relief and rural rehabilitation purposes in North Dakota. This conveyance was subject to the condition that any funds transferred or any funds realized from any of the property transferred to the Resettlement Administration would be held in trust, and that all of such property would be continually available as a revolving fund for rural rehabilitation purposes in North Dakota, and that if the federal government would cease to carry on a rural rehabilitation program in North Dakota, the remainder of any property

transferred by the Corporation to the federal government, together with all proceeds of such property, would be returned either to the Corporation, if still in existence, or to the state.

The United States Congress, in 1946, authorized and directed the Secretary of Agriculture to transfer to the State of North Dakota, acting by and through the Industrial Commission, the real and personal property known as the Burlington Farmstead and Coal Mine Project (the "Burlington Project"), which property had been transferred to the Secretary of Agriculture by the Corporation in 1937. Public Law 436, enacted June 24, 1946, provided

> That, upon the written consent of the majority of directors of North Dakota Rural Rehabilitation Corporation, the Secretary of Agriculture is hereby authorized and directed to transfer and to cause to be transferred forthwith to the State of North Dakota, acting by and through the Industrial Commission of North Dakota, all right, title, claim, and estate in and to all real and personal property in Ward County, North Dakota, known as the Burlington farmstead and coal-mine project, and which said properties were transferred by North Dakota Rehabilitation Corporation, in trust to the United States of America acting by and through the Secretary of Agriculture, by transfer agreement dated June 25, 1937, and which said properties have been subject to administration by the Secretary as trustee under such agreement. Such transfer by the Secretary of Agriculture shall be subject to any legal rights existing by virtue of any lease or other agreement by the Secretary, his successors or representatives as such trustee, to use such properties or any proceeds received therefrom wholly for rural rehabilitation.
>
> The transfer of the real and personal property under this Act is hereby found to be in the general interest of rural rehabilitation and particularly in the rehabilitation of disabled veterans of the United States, and dependent members of their families, resident in North Dakota, and shall not be deemed to impose any liability upon the Secretary of Agriculture with respect to his obligations under such agreement of transfer of June 25, 1937.

The Industrial Commission, by its resolution dated September 7, 1946, and with the unanimous consent of the directors of the Corporation, accepted the transfer of the Burlington Project by the Secretary of Agriculture. Included in the Burlington Project at that time were 35 farmsteads, of which the Industrial Commission indicated in its resolution of acceptance, the "larger number" could be made available for occupancy by veterans in need of housing. On November 12, 1946, the Commission, by its resolutions, accepted a deed from the Secretary of Agriculture conveying the Burlington Project to the state and designated the Bank of North Dakota as its agent to manage, control, and supervise the real and personal property comprising the Burlington Project.

On February 21, 1947, the Industrial Commission adopted a resolution requesting that the Burlington Project be removed from rent control under the Office of Rent Control, in which the Commission set out its policy with respect to the Burlington Project:

. . . .

WHEREAS, the transfer of said Burlington Farmstead properties was declared to be in the general interest of rural rehabilitation and particularly in the rehabilitation of disabled veterans of the United States and dependent members of their families, resident in North Dakota, and

WHEREAS, it is the declared purpose of the Industrial Commission to lease and sell as soon as possible said Burlington farmsteads to disabled veterans with a farm background, resident in North Dakota, whose disability is such that they can effectively use such farmsteads for the purpose for which they were intended,

. . . .

By resolution, in 1955, the Legislative Assembly provided that the Burlington Project was to be known in the future as the "Judge A. M. Christianson Project."

In an opinion to the Bank of North Dakota dated January 14, 1958, Attorney General Leslie R. Burgum stated, in part:

> Title to [the Judge A. M. Christianson Project] is in the State of North Dakota, and the State Industrial Commission is charged with the responsibility of supervising the use, management and sale of the property for rural rehabilitation and particularly for rehabilitation of disabled veterans of the United States and their dependents resident in North Dakota. I believe the stated purposes to be broad and flexible and that the State Industrial Commission has ample discretionary power to determine how the property shall be administered subject to any applicable statutory or constitutional provisions.
>
> Examination of the abstracts of title and inquiry of the employees of your Bank disclose that the portions of the Project real estate which have not been sold are presently owned by the State in fee subject only to the rights of the several tenants or renters presently in possession. I understand that the greater number of the individual tenants are in possession and are paying rent on a month to month basis, although there are a few who hold under leases for life. I understand that none of the tenants or renters holds a valid option contract on any of the property owned at the present time. Further, with the exception of the life tenancies, the property is rented subject to sale. It therefore is my opinion that, in the discretion of the Industrial Commission, portions of this real estate may be designated for sale and sold from time to time in form and manner as the Commission shall think best to further the general interest of the rural rehabilitation and the rehabilitation of disabled veterans of the United States and their dependents in North Dakota.
>
> . . . .
>
> From the information at hand I am further of the opinion that the obligations of the Industrial Commission with respect to this Project are intended to continue indefinitely. I therefore believe that the plan of management should be a permanent one, that the assets of the Project should be regarded and handled as property of a public trust

and that it would be appropriate at all times to apply business principles to the supervision and operation of the Project to the end that expenses and upkeep may be paid out of income and the property itself or its proceeds maintained unimpaired or increased. It seems to me clear that the safekeeping and growth of this Project in either its original form or as converted to other form by means of lawful land sales or otherwise, is and can be of substantial importance to rural rehabilitation work in this state.

However, in a later opinion to the Bank dated January 19, 1971, Attorney General Helgi Johanneson, after reviewing the history of the Judge A. M. Christianson Project, concluded:

> None of these documents spell out a permanent trust. The documents recognize certain purposes, and the transfer and acceptance are made with those purposes in mind. The documents also indicate, particularly the inception of the program and the federal act, that support to the project will be given and will be recognized so long as the government is able to support the program and that aid for the project or program is available.
>
> The abstracts of the property involved do not indicate that the transfers or grants were made with a trust condition attached, either temporary or perpetual. Nor are the lands or properties in question imposed with a perpetual trust by the laws and resolution relating to same.
>
> The title of the property is now in the state of North Dakota under the management, supervision and responsibility of the Industrial Commission (see opinion of Attorney General Leslie Burgum dated 1958) subject to certain interests of individuals who hold leases or its equivalent.
>
> After having considered all of the pertinent items, it is our opinion that the Legislature of this state is in a position to determine whether or not the needs and purposes for which the initial property was acquired have been accomplished and whether or not the need still exists. If the Legislature is of the opinion that the need no longer exists and that the property is no longer needed to accomplish the purpose for which the property was acquired and that it will be a burden to continue the program, it may enact legislation for the disposition of the property and determine the use of the proceeds received from such disposition.

Later that year (1971), the Legislative Assembly, by statute, transferred all property of the Judge A. M. Christianson project held by the Industrial Commission to the Bank of North Dakota, to be held by it as part of its general assets to be used for the benefit of the people of North Dakota. The act conveying the property also provided that the Bank "shall manage, operate, and supervise all properties transferred to it by this Act; shall have full power of sale with respect to same and respect to each and every item thereof; may enforce all rights of the owner by all lawful means in its own name without special power of attorney; and may make and execute all instruments of the lease or conveyance as agreements with respect to such assets may require, whether such agreements are made heretofore or hereafter."

In 1977, the Legislative Assembly, by statute, transferred all real property held or managed by the Bank to the Board of University and School Lands, which transfer included the real property held by the Bank as the Judge A. M. Christianson Project. Then, by enactment of a statute with an effective date of July 12, 1989, the Legislative Assembly conveyed to the Bank all real property which had been conveyed to the Board in 1977 and which was still held by the Board on July 12, 1989.

The Bank presently holds title to all property of the Judge A. M. Christianson project, and, presumably, the Bank still retains the authority to manage the property granted to it by the Legislative Assembly in 1971, which included a provision that the Bank's title to the property would be subject to all existing contracts, rights, easements, and encumbrances of record.

During the period from 1977 to 1989, when the Board of University and School Lands held title to property of the Judge A. M. Christianson Project, all income received by the Board from the sale, lease or management of such property was deposited in the lands and minerals trust as provided by N.D.C.C. §15-08.1-08. Also during this period, the Board did sell several tracts of this property containing residences when the original occupants of the residences were no longer occupying them.

There is not presently, nor are there any records of, a "trust fund" from which moneys have or may have been drawn for any purpose in connection with the Judge A. M. Christianson Project. For example, the $16,500 which Commissioner of Veterans Affairs, Milton W. Kane, refers to in his letter to the Bank dated April 24, 1990, as having been withdrawn from this "fund" in 1963 apparently was an appropriation in that amount from the Veterans' aid fund in the state treasury to the Veterans' aid commission. I am unable to locate or trace the $20,700 referred to by Commissioner Kane as having been drawn from the "fund" in 1965. However, in 1963, the Legislative Assembly appropriated $20,700 to the Bank for the purpose of defraying the expenses of the Judge A. M. Christianson Project from rents and other income of the Judge A. M. Christianson Project and of the Bank.

The present legal status of the real property consisting of the Judge A. M. Christianson Project is that the Bank, subject to existing leases (of which there are two) and contracts (of which there is one), is free to manage or dispose of the property in any manner it may determine to be proper.

pah

STATE OF NORTH DAKOTA

ATTORNEY GENERAL'S OPINION 86-12

Date issued: March 12, 1986

Requested by: Alfred A. Thompson,
Burleigh County Water Resource District

- QUESTIONS PRESENTED -

I.

Whether the responsibility for construction or reconstruction of a revetment lies with the water resource board or with the board of county commissioners.

II.

Whether a water resource board may finance a project to reconstruct a revetment work by special assessments.

ATTORNEY GENERAL'S OPINION

I.

It is my opinion that, the responsibility for construction or reconstruction of a revetment lies with either the water resource district of the board of county commissioners depending upon the circumstances of each case.

II.

It is further my opinion that a water resource district may finance a project to reconstruct a revetment work by special assessments.

ANALYSES

I.

A revetment is defined as a "facing, as of masonry, used to support an embankment." The American Heritage Dictionary, (New College Ed. 1981) at 1112. Such facings are used along the banks of streams and rivers to support the stream or river bank by protecting the bank from erosion. The legislature has placed the responsibility to construct revetment works on both the water resource district and the county commissioners.

A.

The water resource district's responsibility to construct revetment works arises under N.D.C.C. §§61-16.1-02(7) and 61-16.1-15. N.D.C.C. §61-16.1-15 authorizes a water resource district "either upon request or by its own motion, to acquire needed interest in property and provide for the cost of construction, alteration, repair, operation, and maintenance of a project. . . ." N.D.C.C. §61-16.1-15. A "project" is defined by statute as "any undertaking for water conservation, flood control, water supply, water delivery, erosion control and watershed improvement. . . ." N.D.C.C. §61-16.1-02(7) (emphasis supplied). Since the purpose of revetment works along a river bank is protection from bank erosion maintenance and construction of revetment works would be considered as an authorized water resource district project under N.D.C.C. §61-16.1-15.

In this case, the revetment works have been constructed by the United States Army Corps of Engineers (Corps), a federal agency. Reference has been made to N.D.C.C. §61-16.1-40. That statute provides that a water control device which has been constructed by a federal agency, but which is not maintained or operated by any federal agency, shall become the responsibility of the district where it is located. That statute further provides that the "district may take any action concerning this dam, dike, or other water control device it deems feasible or necessary." Thus, while a water resource district is the entity responsible for an abandoned federal water control device, the determination of what course of action to take is within the water resource board's discretion.

That discretion must be exercised in the public interest, however, and the public interest in each case will depend upon the facts. The board could therefore attempt to establish an assessment area for a project for revetment maintenance. It could make a determination that the public interest would be best served by removing the abandoned federal water control device. Finally, the board could take other actions regarding the water control device if those actions were in the public interest.

B.

The county commissioners are also authorized to construct and maintain revetment works. N.D.C.C. Ch. 61-19. This responsibility arises only if the commission is petitioned in writing by the owners of two-thirds of the land which will be benefited by the construction. N.D.C.C. §61-19-03. The petition must be accompanied by cash or a bond. Id.

In determining whether revetments should be constructed or maintained, the county commissioners must consider if "the construction is necessary for the welfare of the owners of the land sought to be protected and is for the public good. . . ." N.D.C.C. §61-19-04. If both those criteria are met, the commission "shall enter a resolution to that effect and shall appoint a competent engineer. . . ." Id.

The engineer reports his findings to the commission in the form of plans and specifications including the "probable cost" of the project. If owners of two-thirds of the land to be assessed object to further proceedings, the commission must discontinue those proceedings and has no responsibility to construct the revetment work. N.D.C.C. §61-19-06. If a sufficient number of landowners do not object, however, the commission must proceed and the project is eventually built.

Based upon the foregoing discussion, it is my opinion that either the water resource board of the county commissioners may be responsible for construction or reconstruction of a revetment work depending upon the facts of each case.

II.

As discussed above, a revetment work could be a water resource board project. N.D.C.C. §61-16.1-15 authorizes a water resource district to finance a "project with funds raised in whole or in part through special assessments. . . ." N.D.C.C. §61-16.1-15 (1985). It is, therefore, my opinion that a water resource board may finance reconstruction of a revetment work by special assessments.

- EFFECT -

This opinion is issued pursuant to N.D.C.C. §54-12-01. It governs the actions of public officials until such time as the question presented is decided by the courts.

Nicholas J. Spaeth
Attorney General

Assisted by: Rosellen Sand
Assistant Attorney General

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