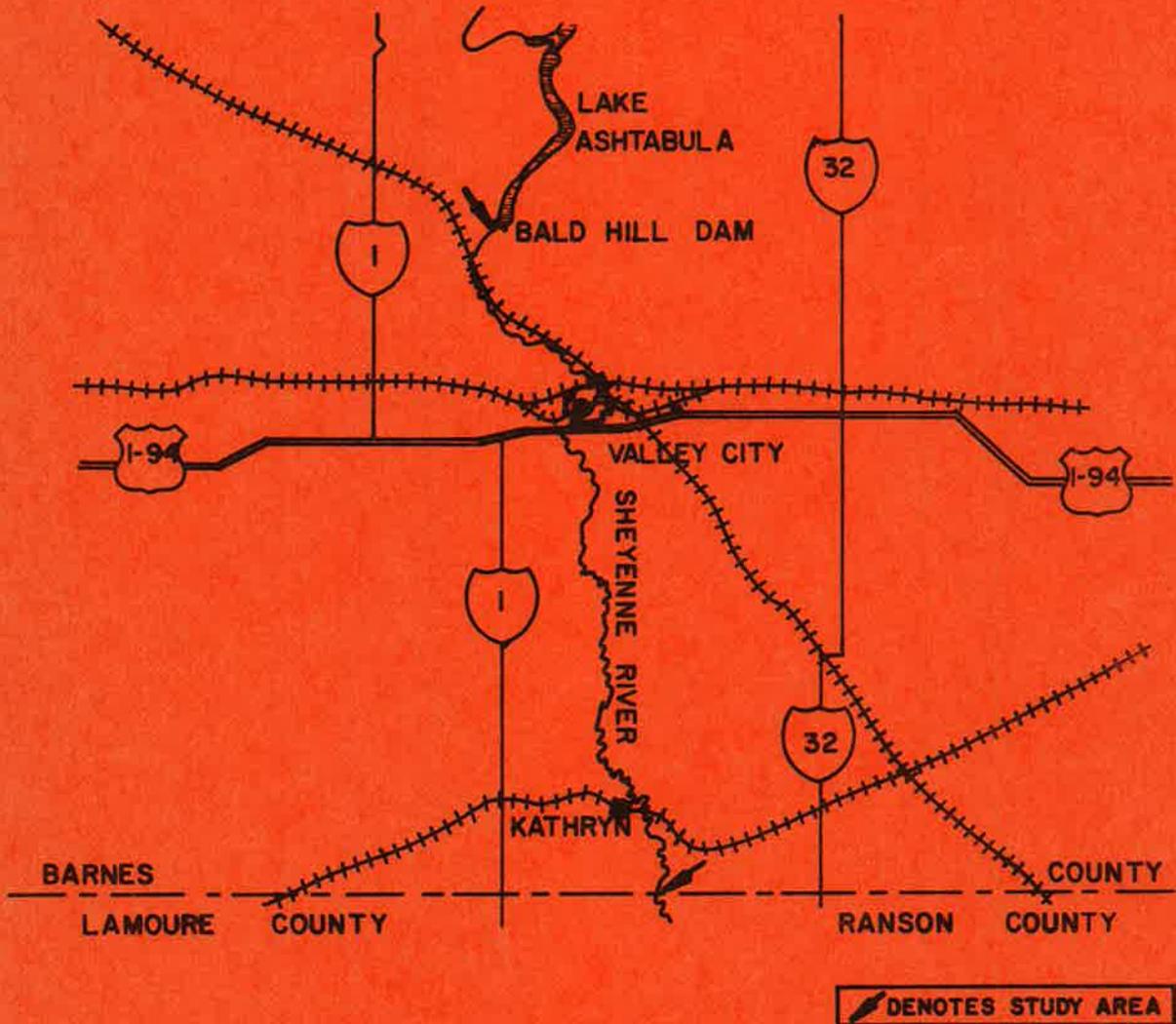


**PRELIMINARY ENGINEERING REPORT**  
**SHEYENNE RIVER SNAGGING & CLEARING REPORT**  
**BARNES COUNTY**

S.W.C. PROJECT NO. 568



**NORTH DAKOTA**  
**STATE WATER COMMISSION**  
**JUNE 1981**

PRELIMINARY ENGINEERING REPORT

SHEYENNE RIVER  
SNAGGING AND CLEARING PROJECT  
SWC PROJECT #568

July, 1981

North Dakota State Water Commission  
State Office Building  
900 East Boulevard  
Bismarck, North Dakota 58505

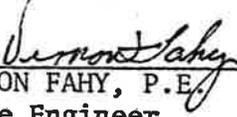
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VERNON FAHY, P.E.  
State Engineer

Prepared for the  
Barnes County Water Management Board

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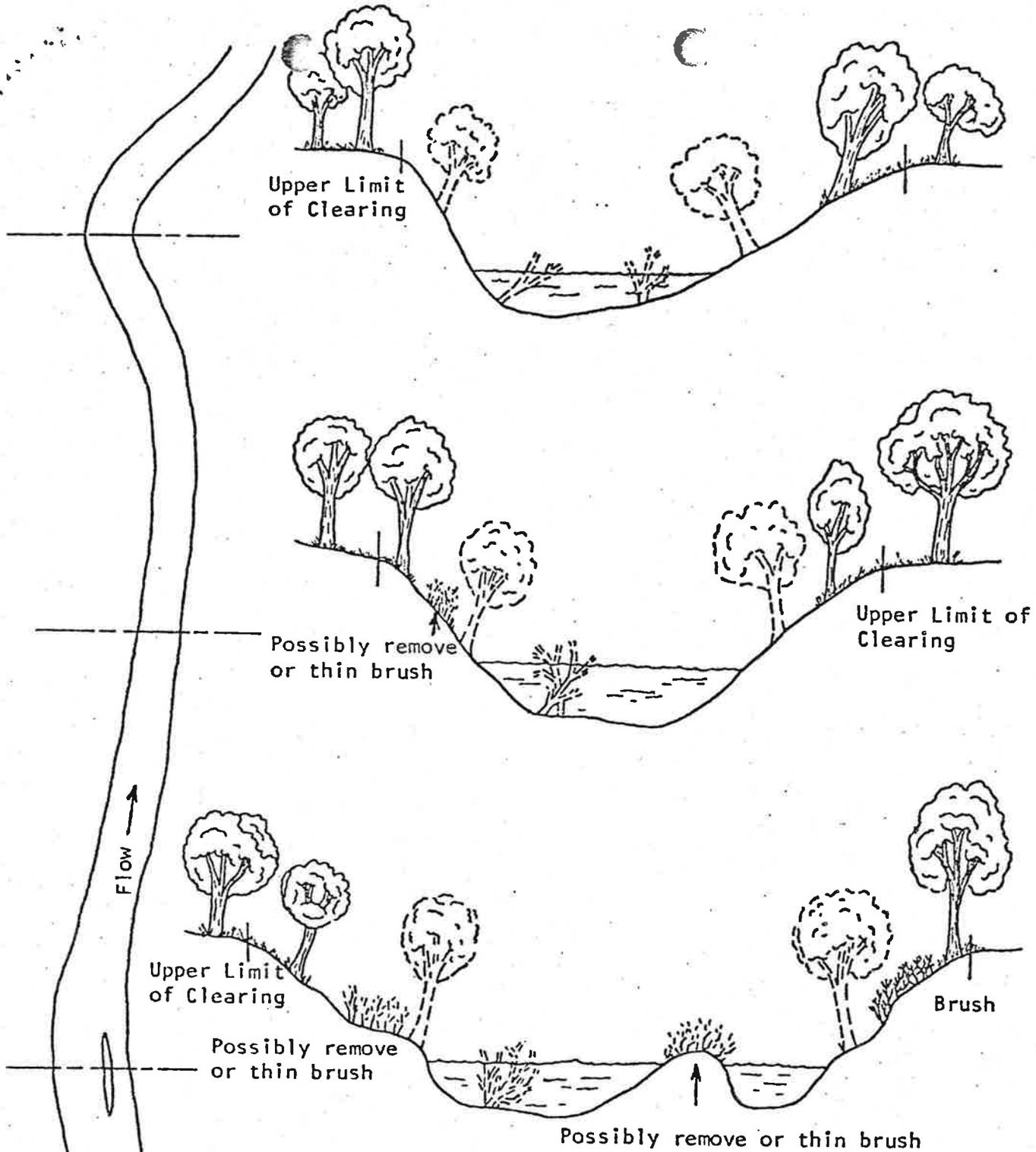
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## I. INTRODUCTION

In accordance with the January 29, 1981 preliminary investigation agreement with the Barnes County Water Management District, an inventory and cost estimate have been completed for a snagging and clearing project on a portion of the Sheyenne River. A schedule for snagging and clearing the debris out of the river channel has also been prepared, as requested by the above district. The purpose of this report is to present the findings of the investigation to all interested parties for consideration and future action.

For the purpose of this investigation, the scope of channel snagging and clearing consists of the removal and disposal of all fallen and standing trees, loose stumps and trunks, driftwood, and snags encountered within the primary channel between the upstream and downstream limits of the project as established in the next chapter of this report. Additional work items included in the snagging and clearing operation are the removal and disposal of fallen trees and driftwood which are lodged on the immediate bank slopes adjacent to the primary channel and the clearing and disposal of prominently leaning trees which overhang, and are in danger of falling into, the primary channel. Standing trees to be removed include all trees located within the wetted perimeter of the primary channel and standing trees whose root systems are exposed due to undermining. All vegetation which aids in reducing bank erosion and does not interfere with stream flow would remain intact. (See Figure 1)



Debris and leaning trees would be removed from the primary channel. In addition, some trees and brush would be removed that are on eroded banks or very low on the bank in the primary channel. The upper limit of clearing is the top of the primary bank.

EXTENT OF CLEARING AND SNAGGING TO BE DONE

FIGURE 1

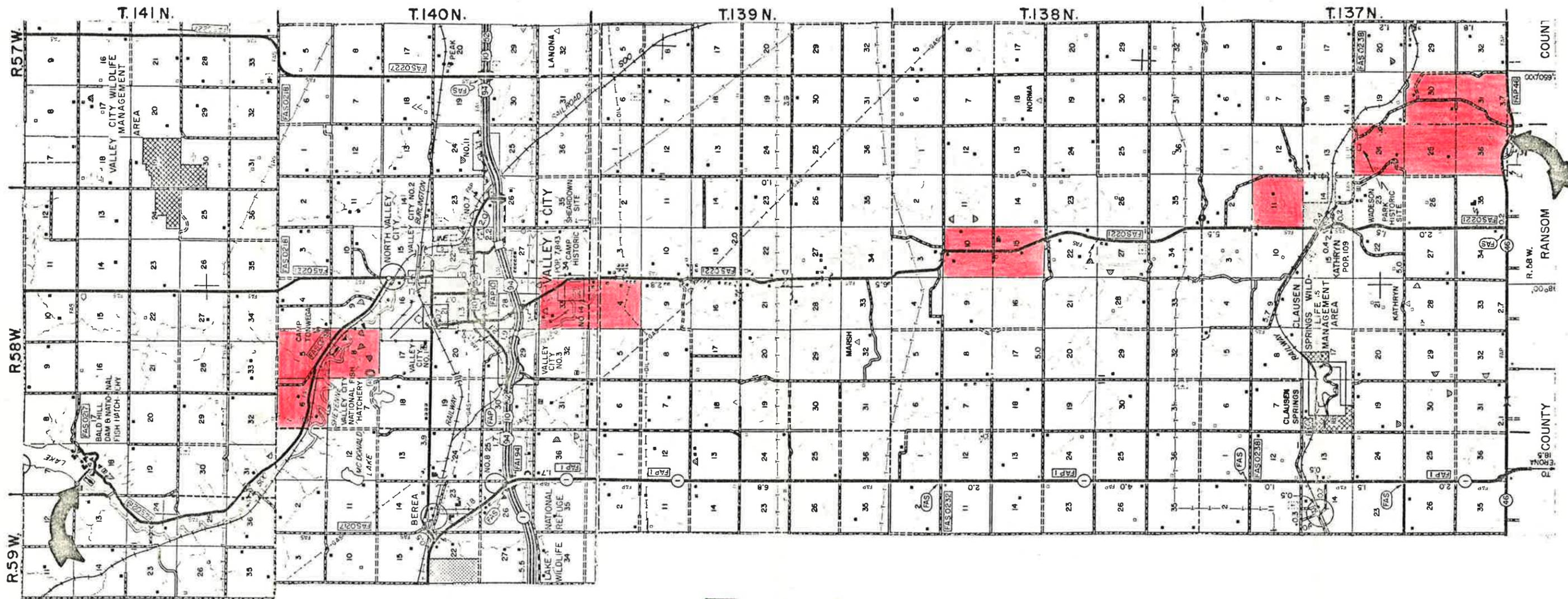
## II. DESCRIPTION OF PROJECT AREA

The State Water Commission investigated the portion of the Sheyenne River consisting of 63.7 miles of river channel starting at the Baldhill Dam located in Section 18, Township 141 North, Range 58 West. The study area extended southward through the City of Valley City, North Dakota, to the point where the channel intersects the Barnes County and Ransom County line. This is located at the common line between Section 36, Township 137 North, Range 58 West and Section 2, Township 136 North, Range 58 West.

The Sheyenne River carves a meandering course as it flows along the relatively flat valley floor. This deep, wide valley contains a large amount of trees, which line the river bank in many areas. The shallower portions of the river are good areas for vegetation to grow. A large amount of urban development, including Valley City, is located along the river within Barnes County. A number of rural dwellings and farms are also located along the river channel.

### III. DESCRIPTION OF INVESTIGATION

The entire study area was photographed with the use of an aerial mapping camera during February, 1981. These negatives were then viewed in order to determine the amount of standing trees and snags that were visible in each section. A crew of State Water Commission personnel conducted a field inventory, consisting of quantity estimates and photographs of typical channel conditions, on preselected sections of the river channel during the week of April 6 through 10, 1981. A variety of sections were chosen, ranging from those containing a sparse amount of trees to areas having a very dense tree cover. The number of snags and trees found by the field count was compared to the number from the photo count for each section inventoried. From this comparison a correlation coefficient was determined between the field count and the aerial photo count. To estimate the number of standing trees and debris for the inventory, the aerial photo count for each section was multiplied by the appropriate coefficient to account for trees that were not distinguishable on the aerial photos. The number of fallen trees and stumps for each section was estimated by using the quantities per mile that were field counted for a comparable section. The project cost estimate is based on the quantities of standing trees, debris, fallen trees, and stumps that were obtained in this inventory. Figure 2 is a map showing the reaches of the river that were surveyed in the field. The field records, ground-based photographs, and aerial photographs are available in the investigation file.



START STUDY  
BELOW BALDHILL DAM  
18-141-58

■ AREAS INVESTIGATED IN FIELD.  
REMAINING REACHES OF THE RIVER  
WERE INVESTIGATED FROM AERIAL  
PHOTOS USING THE SHADED AREAS  
AS REFERENCE SECTIONS.

END STUDY  
COUNTY LINE  
36-137-58

MAP OF STUDY AREA

#### IV. FIELD INVENTORY AND COST ESTIMATES

The results of the field inventory indicate that some reaches of the river channel contain a sufficient amount of snags and debris so as to impair streamflow in the channel. The project and its costs have been split into three phases according to the seriousness of the problem. Phase one includes reaches that should be snagged and cleared as soon as possible. Phase two reaches should be cleared within one to two years. The phase three reaches have a smaller amount of snags and debris at the present time. Some of these sections do contain a large amount of standing and fallen trees, but at present do not seem to impede the flow. These trees could cause more snags and debris to collect in the future. An occasional check should be made of the phase three reaches in order to locate new snags and debris that may accumulate. These reaches should be cleared as the funds become available, and as snags and debris gather and create problems. Tables 1, 2, and 3 summarize the estimated quantities of standing trees, fallen trees, stumps, and snags as calculated from the field inventory for each section. Tables 4, 5, and 6 contain cost estimates for each section and a total estimated cost for each phase, including contingency costs amounting to 30% of the construction costs. Contingency costs include variable and unforeseen costs such as increased costs for fuel and labor, accessibility to the project site, delays due to breakdown of equipment or landowner problems, administrative costs, etc.

The cost estimate for phase one was derived at by inflating the 1980 unit costs for a snagging and clearing project designed by the State Water Commission. An inflation factor of 10% was used to adjust to the 1981 costs. The cost estimate for phase two was derived at by adjusting the 1980 unit costs by 20% to allow for a 10% inflation rate from 1981 to 1982. These same unit costs were used for the phase three costs since it is not known when this work will be completed or if the board wants to do anything at all.

The cost of snagging and clearing a river channel is very difficult to estimate. The cost is dependent on the methods used for clearing the area, the climatic conditions, the amount of work available for contractors, and the cost of moving equipment from site to site. Due to these difficulties, a cost range is more appropriate than a specific amount for this type of project. The cost estimates from Tables 4, 5, and 6 represent the bottom of the range for each phase.

The conditions that the cost is dependent on can be estimated fairly closely for phase one because the clearing will be started as soon as possible. An additional 10% was added to the value from Table 4 in order to find the upper limit for this phase. The total cost range was determined to range from \$22,419 to \$24,661, which breaks down to a range of \$4,076 per mile to \$4,484 per mile.

Phase two and three reaches are not to be cleared for more than one year. The cost dependent conditions are ~~harder to predict~~ ~~this far~~ into the future. These two phases represent a large amount of river miles, which means that only a portion of each phase would be cleared during a specific time period. There is also a greater distance between problem areas than in phase one. For these reasons there will be a greater expense due to additional equipment movement. The amount of snagging and clearing required in these two phases may increase by the time that the work gets underway. The upper range limit for phase two and three was determined by adding 20% to the cost estimates from Tables 5 and 6. The range for the total cost estimate for phase two was \$66,908 to \$80,290 while phase three has a range from \$77,672 to \$93,206. These quantities break down to a range of \$2,624 per mile to \$3,149 per mile for phase two and \$2,375 per mile to \$2,850 per mile for phase three. Hopefully, the actual cost of each phase would lie closer to the bottom of the range, but it is possible that the cost could go as high or higher than the top of the range.

TABLE 1

Phase One - Estimated Quantities  
Recommended for Immediate Clearing

<u>Section</u>	<u>No. of Standing Trees</u>	<u>No. of Fallen Trees</u>	<u>No. of Stumps</u>	<u>No. of Snags</u>	<u>River Miles</u>
S33, T140N, R58W	396	205	64	27	3.0
S15, T138N, R58W	247	220	31	29	2.5
	<u>643</u>	<u>425</u>	<u>95</u>	<u>56</u>	<u>5.5</u>

TABLE 2

Phase Two - Estimated Quantities  
Recommended for Clearing Within One to Two Years

<u>Section</u>	<u>No. of Standing Trees</u>	<u>No. of Fallen Trees</u>	<u>No. of Stumps</u>	<u>No. of Snags</u>	<u>River Miles</u>
S 1, T140N, R59W	126	64	11	12	1.6
S29, T140N, R58W	150	54	17	18	0.8
S21, T139N, R58W	120	42	17	15	2.1
S28, T139N, R58W	291	81	18	12	2.3
S34, T139N, R58W	243	221	48	15	2.8
S10, T138N, R58W	216	143	30	15	1.8
S27, T138N, R58W	217	157	33	12	3.4
S11, T137N, R58W	192	130	31	14	3.7
S13, T137N, R58W	124	62	25	10	3.1
S24, T137N, R58W	27	42	16	+13	2.1
S30, T137N, R57W	66	62	18	+18	1.8
	<u>1,772</u>	<u>1,058</u>	<u>264</u>	<u>154</u>	<u>25.5</u>

+ Snags were pretty good size, large trees, almost crossed the river.

TABLE 3

Phase Three - Estimated Quantities  
Recommended For Clearing When Funds Will Allow

<u>Section</u>	<u>No. of Standing Trees</u>	<u>No. of Fallen Trees</u>	<u>No. of Stumps</u>	<u>No. of Snags</u>	<u>River Miles</u>
S18, T141N, R58W	16	12	5	4	0.6
S13, T141N, R59W	56	23	4	0	0.5
S24, T141N, R59W	84	34	29	4	1.3
S25, T141N, R59W	40	34	14	4	1.7
S36, T141N, R59W	18	23	20	0	0.9
S31, T141N, R58W	96	30	12	6	1.2
S 6, T140N, R58W	*158	51	19	3	2.0
S 5, T140N, R58W	*107	140	40	5	0.6
S 8, T140N, R58W	*108	78	38	2	1.1
S 9, T140N, R58W	78	41	6	0	0.9
S16, T140N, R58W	*156	63	10	0	1.4
S15, T140N, R58W	24	16	6	0	0.8
S22, T140N, R58W	40	36	14	2	1.8
S28, T140N, R58W	*150	95	15	8	2.1
S 4, T139N, R58W	60	23	20	1	0.9
S 3, T139N, R58W	78	16	13	6	0.6
S10, T139N, R58W	72	77	12	6	1.7
S16, T139N, R58W	93	76	13	9	1.9
S27, T139N, R58W	93	26	22	6	1.0
S 3, T138N, R58W	*174	126	27	3	1.6
S22, T138N, R58W	64	99	49	4	1.4
S34, T137N, R58W	46	75	30	2	3.0
S 3, T137N, R58W	*112	49	42	8	1.9
S31, T137N, R58W	27	27	4	0	0.6
S36, T137N, R58W	38	48	8	7	1.2
	<u>1988</u>	<u>1318</u>	<u>472</u>	<u>90</u>	<u>32.7</u>

\* Large number of trees but the channel is relatively clear.

TABLE 4

Phase One - Cost Estimate  
Recommended for Immediate Clearing

<u>Section</u>	<u>No. of Standing Trees @ \$17/each</u>	<u>Sub- Total</u>	<u>No. of Fallen Trees @ \$11/each</u>	<u>Sub- Total</u>	<u>No. of Stumps @ \$9/each</u>	<u>Sub- Total</u>	<u>No. of Snags @ \$14/each</u>	<u>Sub- Total</u>	<u>Total Per Section</u>
S33, T140N, R58W	396	\$ 6,732	205	\$2,255	64	\$576	27	\$378	\$ 9,941
S15, T138N, R58W	247	4,199	220	2,420	31	279	29	406	7,304
	<u>643</u>	<u>\$10,931</u>	<u>425</u>	<u>\$4,675</u>	<u>95</u>	<u>\$855</u>	<u>56</u>	<u>\$784</u>	<u>\$17,245</u>
Contingencies (30%)		$\$17,245 \times 0.30 = \$5,174$							<u>+\$ 5,174</u>
					Grand Total				<u>\$22,419</u>

TABLE 5

Phase Two - Cost Estimate  
Recommended for Clearing Within One to Two Years

Section	No. of Standing Trees @ \$19/each	Sub- Total	No. of Fallen Trees @ \$12/each	Sub- Total	No. of Stumps @ \$10/each	Sub- Total	No. of Snags @ \$16/each	Sub- Total	Total Per Section
S 1, T140N, R59W	126	\$ 2,394	64	\$ 768	11	\$ 110	12	\$ 192	\$ 3,464
S29, T140N, R58W	150	2,850	54	648	17	170	18	288	3,956
S21, T139N, R58W	120	2,280	42	504	17	170	15	240	3,194
S28, T139N, R58W	291	5,529	81	972	18	180	12	192	6,873
S34, T139N, R58W	243	4,617	221	2,652	48	480	15	240	7,989
S10, T138N, R58W	216	4,104	143	1,716	30	300	15	240	6,360
S27, T138N, R58W	217	4,123	157	1,884	33	330	12	192	6,529
S11, T137N, R58W	192	3,648	130	1,560	31	310	14	224	5,742
S13, T137N, R58W	124	2,356	62	744	25	250	10	160	3,510
S24, T137N, R58W	27	513	42	504	16	160	13	208	1,385
S30, T137N, R57W	66	1,254	62	744	18	180	18	288	2,466
	<u>1,772</u>	<u>\$33,668</u>	<u>1,058</u>	<u>\$12,696</u>	<u>264</u>	<u>\$2,640</u>	<u>154</u>	<u>\$2,464</u>	<u>\$51,468</u>
Contingencies (30%) $\$51,468 \times 0.30 = \$15,440$									<u>+\$15,440</u>
Grand Total									\$66,908

TABLE 6

Phase Three - Cost Estimate  
Recommended for When Funds Will Allow

<u>Section</u>	<u>No. of Standing Trees @ \$19/each</u>	<u>Sub- Total</u>	<u>No. of Fallen Trees @ \$12/each</u>	<u>Sub- Total</u>	<u>No. of Stumps @ \$10/each</u>	<u>Sub- Total</u>	<u>No. of Snags @ \$16/each</u>	<u>Sub- Total</u>	<u>Total Per Section</u>
S18, T141N, R58W	16	\$ 304	12	\$ 144	5	\$ 50	4	\$ 64	\$ 562
S13, T141N, R59W	56	1,064	23	276	4	40	0	0	1,380
S24, T141N, R59W	84	1,596	34	408	29	290	4	64	2,358
S25, T141N, R59W	40	760	34	408	14	140	4	64	1,372
S36, T141N, R59W	18	342	23	276	20	200	0	0	818
S31, T141N, R58W	96	1,824	30	360	12	120	6	96	2,400
S 6, T140N, R58W	158	3,002	51	612	19	190	3	48	3,852
S 5, T140N, R58W	107	2,033	140	1,680	40	400	5	80	4,193
S 8, T140N, R58W	108	2,052	78	936	38	380	2	32	3,400
S 9, T140N, R58W	78	1,482	41	492	6	60	0	0	2,034
S16, T140N, R58W	156	2,964	63	756	10	100	0	0	3,820
S15, T140N, R58W	24	456	16	192	6	60	0	0	708
S22, T140N, R58W	40	760	36	432	14	140	2	32	1,364
S28, T140N, R58W	150	2,850	95	1,140	15	150	8	128	4,268
S 4, T139N, R58W	60	1,140	23	276	20	200	1	16	1,632
S 3, T139N, R58W	78	1,482	16	192	13	130	6	96	1,900
S10, T139N, R58W	72	1,368	77	924	12	120	6	96	2,508
S16, T139N, R58W	93	1,767	76	912	13	130	9	144	2,953
S27, T139N, R58W	93	1,767	26	312	22	220	6	96	2,395
S 3, T138N, R58W	174	3,306	126	1,512	27	270	3	48	5,136
S22, T138N, R58W	64	1,216	99	1,188	49	490	4	64	2,958
S34, T137N, R58W	46	874	75	900	30	300	2	32	2,106
S 3, T137N, R58W	112	2,128	49	588	42	420	8	128	3,264
S31, T137N, R58W	27	513	27	324	4	40	0	0	877
S36, T137N, R58W	38	722	48	576	8	80	7	112	1,490
	<u>1,988</u>	<u>\$37,772</u>	<u>1,318</u>	<u>\$15,816</u>	<u>472</u>	<u>\$4,720</u>	<u>90</u>	<u>\$1,440</u>	<u>\$59,748</u>

Contingencies (30%) \$59,748 x 0.30 = \$17,924

+\$17,924

Grand Total

\$77,672

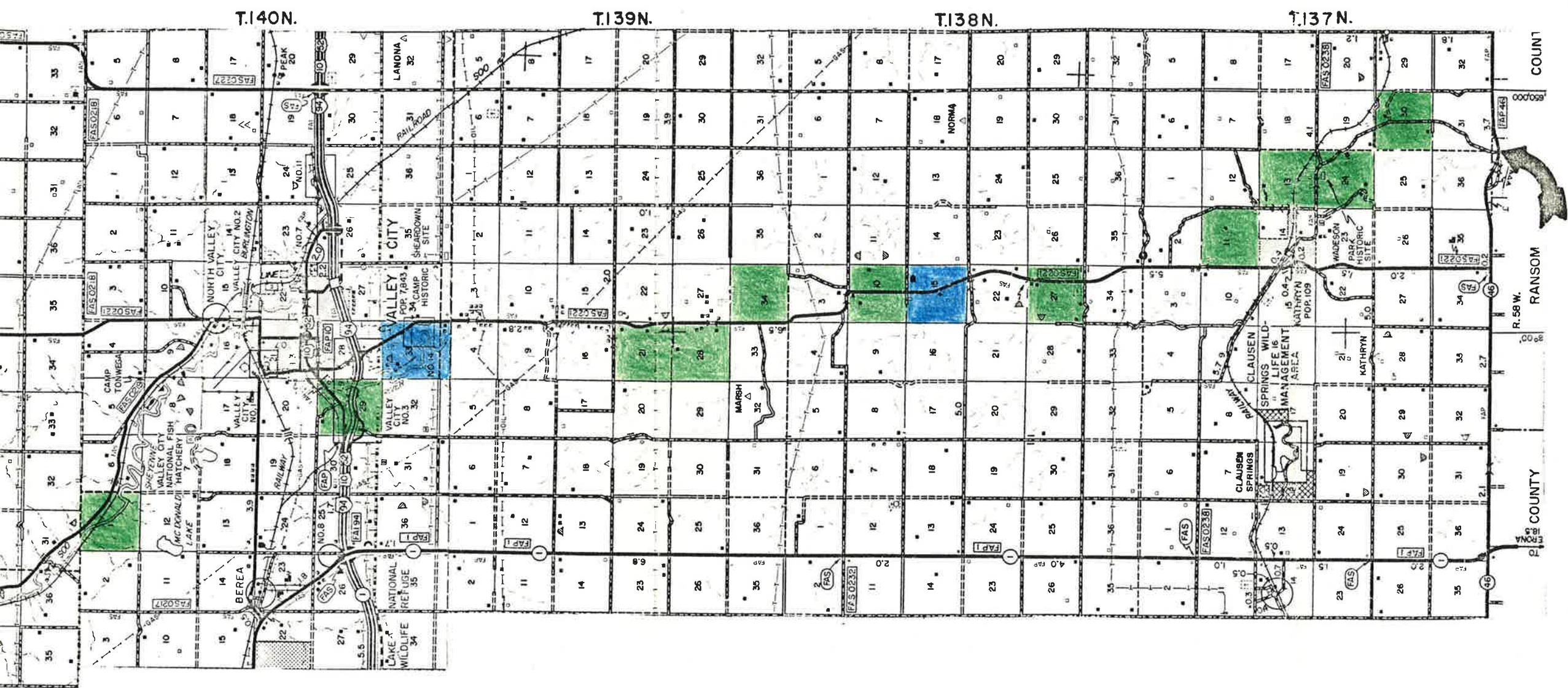
## V. CONCLUSIONS AND RECOMMENDATIONS

The results of the field inventory of the 63.7 mile segment on the Sheyenne River reveal many sections that have numerous obstructions to flow along both banks. Some sections should receive higher priority for snagging and clearing than others due to decreased channel capacity.

Phase one consists of Section 33, Township 140 North, Range 58 West and Section 15, Township 138 North, Range 58 West. It is recommended that these sections be snagged and cleared immediately. Both these sections, totaling 5.5 miles, contain a large quantity of trees, stumps, and debris. There is also a crossing with a culvert in Section 33 and a fence in Section 15 which should be removed. These two sections are located a short distance south of Valley City, North Dakota. If flow is hindered through these sections, the backwater could build up and threaten property within Valley City, or the subdivision just south of the city. This phase has a total cost ranging from \$22,419 to \$24,661. On a cost per mile basis the estimate yields a cost ranging from \$4,076 per mile to \$4,484 per mile.

There are eleven sections, consisting of 25.5 miles, that comprise phase two. It is recommended that these reaches be snagged and cleared within one to two years. These reaches also have a large amount of snags and trees which cause the backwater to build up, creating a greater potential to flood the adjacent fields. The total cost for this phase ranges from \$66,908 to \$80,290, which breaks down to a range of \$2,624 per mile to \$3,149 per mile. A map marking the areas included in phase one and two is shown in Figure 3.

Phase three consists of the remaining sections which do not impede the flow as much as the above mentioned sections even though some areas have more trees counted. The trees and snags that are now in these sections may cause more snags to occur in the near future. These areas should be cleared as funds are available if debris gathers in the trees and occasional snags. The



AREAS TO BE CLEARED IMMEDIATELY (PHASE 1)



AREAS TO BE CLEARED IN 1 TO 2 YEARS (PHASE 2)

END STUDY  
 COUNTY LINE  
 36-137-58

DAM

total cost for this phase is between \$77,672 and \$93,206 or ranging from \$2,375 per mile to \$2,850 per mile.

The usual policy of the State Water Commission is to provide technical or financial assistance amounting to 25% of the total cost of a snagging and clearing project. The technical assistance consists of providing any available equipment as well as supervision of project work. The Barnes County Water Management District should contact the State Water Commission about this cost sharing upon their decision to proceed with the project.

There should be no problem in allowing local residents to cut down the trees for firewood in the phase two and phase three reaches as long as arrangements are made to ensure that the proper trees are cut down. A problem with this type of program for snagging and clearing is that it is very difficult to supervise the activities of the many people who will be at the site during irregular hours. The phase one project should be cleared in one continuous operation to assure proper cleaning. Phase two and phase three areas could be improved by having people clear out problem trees before a clearing project is undertaken. This may decrease the amount of quantities but it is doubtful whether a good clearing can be obtained in this manner. Some type of project will be needed to clear the areas left by the residents and remove material they will most likely leave behind. Care must be taken that all cleared material is completely removed from the channel and the river banks. It is essential to remove all stumps remaining after cutting, as well as all snags and fallen trees that the residents do not collect for firewood.

APPENDIX A

Preliminary Investigation Agreement

A G R E E M E N T

Preliminary Investigation  
by the  
North Dakota State Water Commission

I. PARTIES

THIS AGREEMENT is between the Barnes County Water Management Board, hereinafter referred to as the Board, acting through its chairman, Howard McMillan; and the North Dakota State Water Commission, hereinafter referred to as the Commission, acting through the State Engineer, Vernon Fahy.

II. PROJECT, LOCATION AND PURPOSE

The Board has requested the Commission to investigate and determine the feasibility of a snagging and clearing project on the Sheyenne River. This investigation shall extend from Baldhill Dam to a point where the Sheyenne River crosses the Barnes-Ransom County Line. The purpose of the investigation is to determine the condition and adequacy of the river channel and prepare a cost estimate for the snagging and clearing operation.

III. PRELIMINARY INVESTIGATION

The parties agree that further information is necessary concerning the proposed project. Therefore, the Commission shall conduct a preliminary investigation consisting of the following:

1. Take aerial photographs of the channel described in Section II of this Agreement to inventory material that should be removed from the primary channel.
2. Inspect a few selected areas of the channel described in Section II of this Agreement with crews on the ground to inventory material that should be removed from the primary channel. This inspection will be used to check the accuracy of the aerial photography and adjust the inventory as necessary.
3. Prepare a detailed cost estimate for the project.

The inventory shall consist of only those items outlined herein. Field surveys and design work for the construction phase of this project shall not be included in this Agreement.

IV. DEPOSIT-REFUND

The Board shall deposit \$2,000 with the Commission to partially pay the costs of the investigation. Upon completion of the investigation outlined herein, upon receipt of a request from the Board to terminate the investigation, or upon a breach of this Agreement by any of the parties, the Commission shall provide the Board with a statement of all expenses incurred in the investigation and shall refund to the Board any unexpended deposit funds.

V. RIGHTS OF ENTRY

The Board agrees to obtain written permission from any affected landowner allowing the Commission to enter upon their property to conduct field surveys which are required for the investigation.

VI. INDEMNIFICATION

The Board hereby accepts responsibility for and holds the Commission free from all claims and damages to public and private properties, rights or persons arising out of this investigation. In the event a suit is initiated or judgment rendered against the Commission, the board shall indemnify it for any judgment arrived at or judgment satisfied.

VII. CHANGES TO AGREEMENT

Changes in any contractual provisions herein will not be effective or binding unless such changes are made in writing, signed by the parties, and attached hereto.

BARNES COUNTY WATER MANAGEMENT BOARD

NORTH DAKOTA STATE WATER COMMISSION

\_\_\_\_\_  
Howard McMillan

\_\_\_\_\_  
Vernon Fahy

Chairman

State Engineer

*signed 3/10/01*

*signed 2/13/01*

\_\_\_\_\_  
DATE

\_\_\_\_\_  
DATE

Distribution

- Board
- SWC Project #1344 (1)
- SWC Accountant (1)
- ✓SWC Investigation Engineer (1)