NORTH DAKOTA
STATE PLANNING BOARD

SUMMARY REPORT

OF

A PLAN OF WATER CONSERVATION

FOR

NORTH DAKOTA

VOLUME I

RED RIVER OF THE NORTH DRAINAGE BASIN
DAKOTA WILD RICE RIVER SHEYENNE RIVER
LOWER RED RIVER AREA

JANUARY 1, 1937

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Irvin Lavine, Director
Charles F. Hobbs, Assistant
Oscar Becker, Assistant

ENGINEERING	GEOLOGY & GEOGRAPHY	DRAFTSMEN	ECONOMICS
Charles F. Hobbs	Fredric Voedisch	Oscar Anderson	Leibel Bergman
Oscar Becker	Frank Foley	Merril Grady	Eliz. Goodnow
E.J. Thomas	Sverre Scheldrup	Kenneth Joslin	Harry Anderson
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U.S. Biological Survey
Soil Conservation Service
North Dakota State Geological Survey
Agricultural Dept., N. Dak. Agric. College
State Department of Health
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National Resources Committee
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North Dakota County Planning Boards

1/ The Cooperating Agencies are not responsible for the opinions, conclusions, or recommendations of the State Planning Board as expressed in this report.

"PLANNING for the use and control of water is planning for most of the basic functions of the life of the Nation. We cannot plan intelligently for water unless we consider the relevant problems of the land. We cannot plan intelligently for water and land together unless we plan in terms of collective interests. We are but tenants and transients on the earth; we should hand down our heritage unimpaired—yea; enriched—to those who come after us."[1]

[1] National Resources Board Report, December 1, 1934.

LETTER OF TRANSMITTAL

The Honorable William Langer, Governor
The Honorable Members of the Twenty-Fifth Legislative Assembly
State of North Dakota
Bismarck, North Dakota

Gentlemen:-

The State Planning Board has the pleasure of transmitting herewith a summary report of a "Plan for Water Conservation for North Dakota." For ease in assembly, the state report has been bound into five separate volumes according to certain natural watershed areas. This summary report is supported by a main report which includes the factual material upon which were based the recommendations embodied in the summary report and which can be referred to in the office of the State Planning Board. It is planned to have copies of the main report available also in the office of the Governor.

The State of North Dakota extends over an area in excess of 70,000 square miles. The physical characteristics vary from the eastern to the western part of the State as does also the population density and other factors that are of importance in analyzing water needs. In carrying out the present study, therefore, the State was sub-divided according to thirteen major watershed areas as follows:

Volume I	Wild Rice, Sheyenne and Lower Red Rivers.
Volume II	James River.
Volume III	Souris River and Devils Lake Basin.
Volume IV	Missouri River and Minor Tributaries.
Volume V	Slope Area; Knife, Heart, Cannonball, Grand, Little Missouri and Yellowstone Rivers.

This division made possible a rather careful analysis of the water problems of each area of the State. The accompanying reports summarize the analyses so made and include a listing of the projects that are proposed as solutions to these problems. The projects are listed according to priority ranking.

The need for a program which aims to utilize to the greatest advantage the waters of the State that are naturally available needs no lengthy discourse. During a relatively short period of time, this state has witnessed both years of over abundance of rain and years of extreme deficiency. The program that is proposed herewith attempts to minimize the shortcomings of such conditions.

The Planning Board staff has engaged in the present study for over a year. Due to limitations of funds it was impossible to engage engineering skill to conduct the necessary field surveys of the many projects submitted in this report. These field surveys will have to be carried out before final determination can be made as to the feasibility of many of these projects. Every effort should be made to complete this work as soon as possible.

The study was further handicapped by the lack of detailed topographic maps of the State and stream flow data for many of the major tributary streams. These data are essential for proper guidance in developing the full use of the water resources of an area. The United States Geological Survey has called attention to an arrangement whereby the State could enter into a cooperative program with the Geological Survey for carrying on such work by making available funds to be matched by the Federal Government.

Although advances have been made in conserving the waters of the State through dam construction work by federal agencies and to a lesser extent by State and local agencies, the accompanying reports show that this work is far from complete. Major construction work for stream flow regulation, pollution abatement, irrigation and other allied uses have not, in the main, been undertaken during these programs because of regulations beyond local control.

As of January 1, 1937, there were in existence in this State about 800 dams and reservoirs that were capable of storing approximately 390,000 acre feet of water. These structures were built at a cost of around $4,750,000.

The proposed program calls for additional water conservation work to store an additional 3,225,000 acre feet of water at a cost of approximately $47,500,000 as follows:

Slope Area	$6,308,400
Souris River-Devils Lake Areas (Including Diversion from Missouri River)	31,311,400
James River	633,200
Main Stem Missouri	6,329,465
Red River of the North	2,905,200

Included in this program are reservoirs of sufficient capacity to provide water for the irrigation of approximately 250,000 acres of land in the western part of the State.

In addition, the program lists a total of $3,174,000 that should be expended for municipal water works for needed improvements and new construction. The study showed further that projects totalling $4,860,000 will be needed for necessary sewage treatment works by the municipalities of this State.

In prosecution of a program such as proposed here, careful consideration must be given to several important factors among which are the degree of federal, state and local responsibility. It is probable that federal participation in water conservation programs will be continued. In such event, it is essential that some agency of the state be empowered to act in behalf of the state in a cooperative program with the Federal Government.

Respectfully submitted,

NORTH DAKOTA STATE PLANNING BOARD

M. O. Ryan, Executive Director

SUMMARY REPORT
OF
A WATER CONSERVATION PROGRAM FOR NORTH DAKOTA

Foreward

The Rivers — Three major rivers, the Red River of the North, the Souris River, and the Missouri River serve as the main arteries in carrying away such water as reach these, either directly or through their many tributaries. The available stream gauging records show that the rivers and streams of the State handle an average of 24,068,000 acre feet of water annually. This total, of course, was much greater during the abnormally wet year of 1917 and much less during the abnormally dry year of 1936. Of this average annual run-off, 1,862,000 acre feet, or 7.7 per cent, originate within the boundaries of the State and the remaining 22,206,000, or 92.3 per cent, reach here from adjoining areas, as Minnesota, Canada and Montana.

Precipitation — The average rainfall over the entire State for the period 1916-1935 inclusive was 15.92 inches and that during the period of May through September was 11.10 inches. The extent of the variation in rainfall is made evident from the average of 20.16 inches for the annual and 13.43 inches for the May-September precipitation that was had in the drainage basin of the Dakota Wild Rice River in the southeastern part of the State and the 14.10 inches and 9.51 inches respectively in the drainage basin of the Yellowstone River in McKenzie County in the western part of the State.

Eastern North Dakota — The eastern part of North Dakota, or that part drained by the Red River of the North and its tributaries is not only blessed with a very fertile soil but also with a relatively heavy rainfall and medium run-off. The average annual precipitation for this area is 18.13 inches and that during May-September is 12.35 inches. The average annual run-off over the 27,740 square miles of area is 0.46 of an inch or 681,000 acre feet.

Central North Dakota — The central part of the State, or those areas drained by the Souris River in North Dakota, by the Missouri River to the north and east of its channel and by small tributary streams on the west side of the Missouri River is characterized by a medium rainfall. The average annual rainfall in this area is 14.40 inches and that during May-September is 10.48 inches. The average annual run-off over the 25,846 square miles of area is 0.26 inches or 365,000 acre feet.

Western North Dakota

The western or Missouri Slope Area of the State is characterized by a low annual precipitation and high run-off. The average annual precipitation here is 14.59 inches and that during May-September is but 9.97 inches. Because of the rough terrain the run-off is high in proportion to the precipitation. There is an average annual run-off of 0.93 inches over the 16,597 square miles of area. This amounts to 813,000 acre feet of water.

These data are summarized as follows:

RUN-OFF AND PRECIPITATION DATA
NORTH DAKOTA

Basin	Area in Sq. Miles	Average Precipitation 1916-1935 incl. Annual Inches	Average Precipitation 1916-1935 incl. May-Sept. Inches	Annual Average Run-off North Dakota Inches	Annual Average Run-off North Dakota Acre feet	Annual Total Acre Feet Transported (Average)
Lower Red River	7,329	18.50	12.34	0.81	318,000	2,320,000
Sheyenne	7,309	18.77	13.24	0.42	164,000	
Dakota Wild Rice	1,658	20.16	13.43	0.60	53,000	71,000
Upper Red River	345	20.13	13.43	0.20	4,000	
Devils & Stump Lakes	3,816	16.50	11.68	0.23	48,000	
Souris	8,804	14.60	10.19	0.21	94,000	184,000
James	7,199	18.41	12.51	0.24	94,000	
Knife	2,645	14.54	10.32	0.82	116,000	
Heart	3,133	14.83	9.98	0.86	143,000	
Cannonball	4,513	14.87	9.96	0.55	133,000	135,000
Grand	937	14.32	9.93	0.57	28,000	
Little Missouri	4,635	14.40	9.86	1.40	348,000	710,000
Yellowstone	718	14.10	9.51	1.25	48,000	10,500,000
Main Stem Missouri	17,036	14.30	10.63	0.30	271,000	21,000,000

Variations in Run-off

Average run-off data do not indicate the actual conditions from year to year or from month to month. Thus, the flow of the Red River at Grand Forks during the past thirty-three years has varied from a maximum of 32,920 cubic feet per second in April 1904 to a minimum of 16 cubic feet per second in September, 1934. The total volume of water transported for the months of maximum and minimum flow was 17,954,379 and 12,728 acre feet respectively. The monthly volume transported by the James River for the period of available record has varied from a maximum of 16,200 acre feet during March, 1930 to zero during October, 1934 and several times since.

Similarily, the Souris River had a maximum flow of 12,000 cubic feet per second on April 20, 1904 and the flow has frequently dropped to zero in recent years. The total volume transported by the Souris River during any one month since 1904 has varied from a maximum of 1 4 0,793 acre feet in May, 1927 to 61.5 acre feet in January, 1932. The flow in the Little Missouri River has varied from a maximum of 21,000 cubic feet per second in July, 1935 to zero flow several times. The monthly volume of water transported has varied from 3,978,247 acre feet in March, 1929 to 178 acre feet in September, 1934. The other streams of the State have exhibited similar characteristics.

Control by Man

Although man cannot control precipitation, modern engineering has made it possible for him to control to a considerable degree the run-off to the streams. Thus, it should be possible through proper control works to obtain conditions on the rivers of the State that approach more closely the average condition of flow. The benefits that would follow are quite clear. Control of stream flow, therefore, becomes one of the major problems in the development of a water program.

Other problems follow in natural sequence. The storage of water, strategetically located and in sufficient quantities to be of service by municipalities, by farmers, by industries and others must be studied in light of availability and need if proper use is to be designed.

Water for Human Use

In the development of a program of water utilization, the need for human use must be given priority. In an agricultural state such as North Dakota this problem becomes one of not only providing adequate supplies for such municipal needs as domestic and industrial consumption and pollution abatement but also the providing of adequate rural supplies. Since wells serve as the major source of supply for the rural inhabitants of the State, the program must include the necessary work of rehabilitating old wells and developing new sources where present supplies are found not suitable for human use.

The State Sanitary Engineering Department of the Department of Health has made a survey of existing municipal water works and sewage treatment plants which was used to develop a program of needed construction. The program recommended by this Department has been included as part of the proposed program. Also included is a program of needed construction work for municipal and private supplies that are obtained from underground sources. This latter program was based on a survey made by the North Dakota Geological Survey. The need for immediate attention to the problem of locating new sources of supply for certain areas of the State is evident from the data that accompanies this report.

Flood Hazards

Although flood hazards, with possible loss of life and property, have not been extreme in this State, a detailed water plan must take into account the possibilities of floods and should attempt to minimize this danger through proper control works. The proposed plan calls for the construction of certain works which would minimize this danger should floods occur to the same degree as indicated by available records.

Agricultural Use of Water

Second only in importance in this State to the problem of providing adequate supplies of suitable water for human use is that of developing a water program which can be of maximum use to agriculture. This involves the providing of stored quantities of water that are easily accessible for stock-watering throughout the State; and in western North Dakota, the additional use for irrigation. The proposed program has taken due consideration of these requirements.

Small Dams

In the establishment of certain principles with regard to the building of reservoirs, especially for stock-water and recreation use, depth has been considered as one of the very important factors in the choice of a good site for a reservoir. Experience has shown that the amount of water used by livestock is usually very small as compared with the amount lost through evaporation. In North Dakota the average evaporation loss from surfaces of standing water is about three feet per year, of which about two-thirds occur in the five months between May and October. Furthermore, leakage and seepage may increase this loss considerably. To be effective, therefore, it is necessary that the reservoir be deep enough and have a sufficient drainage area that it will not go dry in periods when this water is needed most.

The standards used by the North Dakota State Planning Board in determining the effectiveness of a reservoir are based on minimum drainage area and storage depth. For each case the estimated inflow was balanced against the reservoir evaporation. Those for wich the inflow exceeded the evaporation in minimum years of precipitation were rated as excellent (E) and given preference for construction; those for which the inflow equals the evaporation in years of one-half average run-off were classed as good (G) and given a second rating; those having equal inflow and evaporation in average years were classed as fair and given a third rating. Those for which evaporation exceeds inflow in average years were not recommended for construction.

In the treatment of the major streams of the State, that is, those that are used to transport the principal water supply from the effective storage areas to the cities, the plan discourages the construction of small channel dams, and in place, recommends the necessary works for the control of stream flow. This, however, does not apply to other streams of the State.

Grouping of Projects

Proposed projects have been divided into three groups, classes "A", "B", and "C". Class "A" projects are those projects ready for immediate undertaking and which should be completed at the earliest possible date.

Class "B" projects are those needed immediately but which require surveys before being ready for construction. The needed surveys for Class "B" projects are listed as Class "A" projects. Class "C" projects are needed projects but their construction, in most cases, can be deferred until the completion of Class "A" and Class "B" projects. Due to the drought of 1936, it would probably be desirable to construct many of the projects listed in Class "C" in the near future for work relief purposes. Many of these projects are similar to those in the present W.P.A. program.

CHAPTER 1

WILD RICE SUB-BASIN

CHAPTER I

THE DAKOTA WILD RICE SUB-BASIN

GENERAL

The Dakota Wild Rice River rises in the south central part of Sargent County. In its winding course through the county it is joined by a number of tributaries several of which have their sources in the Sisseton Hills of South Dakota. Shortly after the river leaves Sargent County and enters Richland County, it decends to the Red River Valley and flows across the county in a serpentine course. In the eastern part of Richland County the river turns northward and enters the latter near Wild Rice in Cass County. The total area considered in this report, which also includes the area drained by the Bois de Sioux River in North Dakota, is 2003 square miles.

POPULATION

The population of the Dakota Wild Rice Sub-basin is predominently rural. As determined from the 1930 census the total population of the Basin was 27,718. The largest city was Wahpeton, the only urban center, with a population of 3,176. There are but two incorporated towns on the Wild Rice River, Cayuga with a population of 219 and Great Bend with a population of 169. The population directly served by the river is probably not in excess of 1000.

Much of the Sub-basin comprises one of the best farming areas in the state, but some parts, particularily in the west portion, are composed largely or marginal land. In the peak month of W.P.A. employment, 474 persons were employed on work projects in or near cities and villages and 1,302 persons were employed on rural projects making a total of 1,776 persons employed in October, 1936.

Because of the small population served directly by the Dakota Wild Rice River the problem is not a problem of merely providing water for human consumption along the river but is one of providing an adequate and satisfactory water supply to the entire Sub-basin.

WATER QUALITY SUB-SURFACE

The providing of water of satisfactory quality is of particular importance because practically all of the present supplies of water contain fluorides to an extent which makes it detrimental to the teeth of those using it. This is particularily true of water from the deep wells and is, to a lesser extent, true of that from shallow wells. The water from some tubular wells, however, shows a complete absence of fluorides. This would indicate that surveys should be made to determine the possibility of obtaining supplies from such wells for those communities now using water with a high fluoride content. Water from shallow wells in

the Sheyenne Delta area is of good quality.

Since there are no urban centers along the Wild Rice River there is little necessity for maintaining a flow for the benefit of the downstream areas. A comprehensive water plan should include the construction of storage reservoirs for the conserving of the run-off for use of the entire population for recreational purpose and for the maintenance and propagation of wild life. The maximum storage should be created that can be maintained nearly full of water during a series of dry years. Most reservoirs which would become dry during such a period would be of little practical use.

It is proposed that a limited number of small channel dams built on the Wild Rice River and tributary streams immediately adjacent to the towns located along its banks. The reservoirs so created would be used as recreational centers for these towns and the surrounding areas. Furthermore, if a survey shows a satisfactory sub-surface source of water cannot be found, the towns near such reservoirs could obtain a surface supply which would be of good quality when treated in a small plant including filtration and chlorination.

An alternate source of water for these towns would be the installation of small distillation plants. It is recommended that a detailed survey of all possible sources of water be made for those towns in the Sub-basin which at present are using water of unsatisfactory quality. If it is found that a satisfactory sub-surface source is not available and that the town is located too far from the Wild Rice to make use of a surface supply, it is recommended that distillation be considered as being the only possible method of securing water of satisfactory quality. Advances in the design of stills with consequent increased efficiency and capacity make this method of securing satisfactory water economically possible when other sources fail.

DRAINAGE

Approximately 150 miles of drainage ditches have been constructed in the Wild Rice Sub-basin and about six miles immediately adjacent thereto along the Bois de Sioux River. Some of these ditches drain land that is of much agricultural value, but during recent years, due to the growth of weeds and the collection of dust, these ditches have become partially filled and have lost much of their value. It is proposed to clear and rehabilitate these drainage ditches in areas of good agricultural land. Other drainage ditches have drained land that proved to be of little value as agricultural land. It is proposed that, where practicable, these ditches be blocked and control gates be installed for the reflooding of old lakes and marshes and returning them to their natural state as a wild game haven. The U. S. Biological

Survey is engaged in building dams to reflood a number of these old lakes and marshes in Sargent County. Computations show that it will require the drainage from all areas above the Biological Survey projects to maintain the level in these during average dry years. Therefore, no additional reservoirs are proposed in the area.

FLOODS

The river frequently over flows its banks in Richland and Cass Counties during spring run-off. It is proposed to construct a ditch simultaneously with the construction of the Baldhill reservoir on the Sheyenne River for diverting part of the flood flow of the Dakota Wild Rice River to the Sheyenne and thus reduce the flood plane at Fargo.

STREAM FLOW REGULATION

There is no possibility of impounding flood waters economically on the Dakota Wild Rice River, nor is there a necessity along the river itself for stream flow regulation because of the rural character of the adjacent area.

CHANNEL DAMS AND RESTORATION OF LAKES

The best utilization of the surface waters of the Sub-basin would be provided by the construction of a few carefully selected small channel dams on the Wild Rice River and adjoining coulees and by the refilling of old lake beds where it is practicable to do so.

USES OF RESERVOIRS

This would provide a number of reservoirs for the area. The larger projects would make excellent migratory waterfowl refuges and recreational centers. Fish could probably be planted in a number of the reservoirs. The smaller reservoirs would be used for recreational centers and for stock watering purposes and would provide possible sources of water supply for nearby towns if surveys showed other satisfactory supplies to be non-existant.

BIOLOGICAL SURVEY PROJECTS

There has been only one body of water maintained in Sargent County during the recent drought period. Silver Lake was filled by placing a channel dam in the Wild Rice River below the outlet to the old lake bed thus backing the impounded water into it. This lake has been made used in recent years as a recreational center for the surrounding territory. It has also served as a migratory waterfowl refuge. The U. S. Bureau of Biological Survey is at present engaged in the construction of dams and ditches to refill Cloud's Lake, White Lake, and Lake Tewaukon and to create a marsh area between Lake Tewaukon and White Lake. These lakes in addition to being excellent migratory waterfowl refuges will be used extensively for recreational purposes.

SARGENT COUNTY

There are a large number of lake beds in the morainic hills of Sargent County. These have been dry during recent years because of the small drainage area directly tributary to each.

Each average year the Wild RiceRiver carries off approximately 31,000 acre feet of water from Sargent County. A number of these dry lake beds are so situated that each can easily be filled by constructing a small channel dam in the Wild Rice River below the outlet to the lake and allowing the reservoir so created to back up and fill the lake. The U. S. Biological Survey is engaged in the development of such projects in this area.

LOWER WILD RICE

In the area down stream from Sargent County the average annual run-off is approximately 40,000 acre feet. It would alleviate the water problem greatly if some of this run-off were conserved in the Wild Rice River.

PRESENT DEVELOPMENT

Only Hankinson and Lidgerwood in the Dakota Wild Rice Drainage area at present have water supply and sewage disposal systems. The Lidgerwood water supply, however, is unsatisfactory because of the presence of an excessive amount of fluorides in the water. There are approximately 150 miles of installed drainage ditches in the Sub-basin proper and six miles adjacent thereto along the Bois de Sioux River. Many of these are inoperative, however. There are at present several channel dams on the Wild Rice River. There is also a dam located at the outlet to Lake Elsie south of Hankinson and one on the Wild Rice River in Sargent County which maintains Silver Lake. Existing reservoirs are listed in Table A and are shown on Plate II.

PROPOSED PROGRAM

It is proposed:

1. That necessary surveys be made to determine the possibility of replacing or supplementing present water supplies for farms, towns, and cities where the present supply is inadequate or the quality is unsatisfactory. This survey should include a complete fluoride survey of the area. It is proposed as a result of such surveys that inhabitants be instructed as to how they can best secure a satisfactory supply of water. Individual town and village surveys are listed in Table B and a general Sub-basin survey is listed in Table D.

2. That all unsatisfactory municipal water supplies be replaced by satisfactory supplies at the earliest opportunity. A list of needed improvements for water supplies in the Sub-basin is given in Table B and are shown on Plate I.

3. That all towns and cities not having water or sewage systems be so equipped where it is economically feasible to do so. A list of needed improvements is given in Tables B and C and are shown on Plate I.

4. That exiting drainage ditches in regions of good

agricultural land be cleared and rehabilitated but those in regions of unproductive land be used to fill other marshes or blocked to refill the marshes which they now drain. In either case the object would be to provide migratory waterfowl refuges. The recommended project covering this work is found in Table D.

5. That a floodway be constructed from the Wild Rice River to the Sheyenne River simultaneously with the construction of the Baldhill dam on the Sheyenne River. This floodway would lower the flood plane at Fargo and would not create a flood hazard on the Sheyenne because of the protection given by the Baldhill Reservoir. The recommended project covering this work is found in Table D and is shown on Plate II.

6. That a number of small channel dams be constructed on the Wild Rice River below Lake Tewaukon to provide recreation and stock watering for the area and, in the event of necessity, a possible water supply for several towns in the Sub-basin. A list of such projects is found in Table D and these are shown on Plate II. All dams constructed hereafter in the Sub-basin should be provided with outlet gates for releasing the water stored when a great need arises for it downstream or when it becomes so polluted that it is a definite health hazard to the community. Many existing dams should also be provided with outlet gates.

RUN-OFF

A study was made of run-off, evaporation, and storage in the various reservoirs in the Sub-basin. Annual run-off was deduced from data taken on the Red River at Grand Forks, from records of stream flow for several years, and from comparative run-off data of the streams tributary to the Red River as furnished by Dean E. F. Chandler of the University of North Dakota. The average annual run-off for the Wild Rice River Basin was found to be 32.6 acre feet per square mile.

An attempt was made to use a direct proportion for change in run-off from average to dry years in the area above Grand Forks to obtain the corresponding run-off for the Wild Rice Sub-basin. It was found, however that this gave a run-off much larger during dry years than the actual recorded run-off showed. This would indicate that a much greater portion of the water flowing past Grand Forks comes from the rivers of Minnesota during dry years than during years of average precipitation.

The actual recorded run-off for the year 1933 was used in estimating the run-off from the Wild Rice Basin during an average dry year. This was 3,500 acre feet or approximately 1.6 acre feet per square mile.

NET EVAPORATION

An average annual evaporation from water surface of 31.63 inches was assumed in the computations. This was the figure arrived at by Dean Chandler after observations of evaporation from the surface of a shallow lake near Grand Forks over a ten year period (1904-1915). During the drought period (1929-1934) the average annual precipitation in the Wild Rice Basin was approximately 16 inches. Therefore, a net annual evaporation of 15.63 inches, or roughly 16 inches took place during this period from water surfaces. A net evaporation of 16 inches was used in the computation.

LAKE TEWAUKON DRAINAGE AREA

A study was made of the run-off, evaporation, and storage in the various reservoirs in the area above the Lake Tewaukon outlet with the view of proposing additional projects in the area as recommended by the Sargent County Planning Board. It was found, however, that the run-off from the total area during an average dry year would not quite maintain the evaporation in the Biological Survey projects and Silver Lake. It is probable that during a series of dry years all lakes and marshes, with the exception of Cloud's Lake and Lake Tewaukon, would remain full; Cloud's Lake would decrease slightly; and Lake Tewaukon would lower considerably. Any additional storage created in the area would greatly decrease the value of these, both for recreation and as migratory waterfowl refuges.

The area tributary to Storm Lake with the installation of the Biological Survey dam in the drainage ditch and the diversion ditch to the lake will be sufficient during average years to maintain the lake full, but during a dry period its level will lower considerably. If the dike between Storm Lake and Fangsrude Lake were eliminated, it is probable that during average years Fangsrude Lake would fill up but during the dry periods it would go completely dry. The cost of buying the land to permit the flooding of Fangsrude Lake makes such a project uneconomical.

CHANNEL DAMS

Several channel dams in the Wild Rice River in Sargent County in the area below Lake Tewaukon are desirable. A suggested site in section 2-131-53 where the river runs through a heavily wooded area would make an ideal park site. A larger reservoir could be created by a dam at the section line between sections 29 and 20-131-53. A dam 20 to 25 feet high would create a reservoir extending back for a mile or more between high banks. This project would also be good fishing within a few years. The water would be fresh constantly, and the ice would never freeze to the bottom, and consequently fish would survive very well. Estimates for this project are 15 acres and 150 acre feet capacity. Two additional dams in the area between the former two dams are recommended to provide the surrounding territory with conveniently stored water.

EXISTING DAMS OF LOWER WILD RICE BASIN

There are at present several dams in the Wild Rice River in Richland and Cass Counties. There is also a dam at the outlet to Lake Elsie south of Hankinson. This is a spring fed lake of considerable depth and serves as a recreational center for a large area. The sandy bottom in this lake has become covered by slimy silt which makes bathing less pleasant. It is proposed that this silt immediately adjacent to the bathing beach be removed.

PROPOSED C. C. C. DAM

It is proposed that a dam be constructed by the C. C. C. in Cass County, Sec. 2, T. 137 N., R. 49 W. This dam would have a storage capacity of 345 acre feet. It would be available to the surrounding area for recreational purposes and in the event of necessity could serve the town of Hickson as a source of water supply. Approximately 300 additional acre feet of storage is desirable in the area between Sargent County and the mouth of the Wild Rice River. Five dams could be built in this area on the Wild Rice. Locations have been spotted for some of these dams, but no surveys have been made. A number of these dams, as listed in Table D, would be near to or at small towns and would be of great recreational value. If surveys show all other water in the vicinity of these towns to contain fluorides to an amount beyond the safe limit, each of these communities could go to its reservoir and secure a plentiful supply of water by merely installing a small pipe line and treating plant. This would probably be more economical than installing a distillation plant which would be the only alternative since at present it is not commercially possible to remove fluorides in any other manner.

TABLE OF EXISTING DAMS

The dams existing and under construction in the Wild Rice River Sub-basin listed in Table A and are shown on Plate II. These are listed in the order of their usefulness and the percentage of time that they are filled to capacity.

Wild Rice Sub-basin Projects. These projects involve:

1. The survey of possible water supplies in the Sub-basin with a view to replacing present inadequate supplies with supplies more adequate and of satisfactory quality.

2. The improvement of sewage disposal facilities for towns along the Wild Rice River and tributary streams.

3. The improvement of drainage facilities in the Sub-basin.

4. The improvement of water storage facilities along the Wild RiceRiver.

The projects will not appreciably change the flood status

along the Wild Rice River but will assist in the lowering of the flood plane at Fargo.

STREAM GAGING AND WEATHER OBSERVATION FACILITIES

Proposed stream gaging stations are listed in Table E and these together with present facilities for stream gaging and weather recording are shown on Plate III. It is strongly urged that adequate facilities be established and maintained for the recording of stream flow and weather data for use in future planning.

TABLE A

EXISTING RESERVOIRS

WILD RICE RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Lege
1.	Cass	24	138	49	175	$10,500	III	E	Dam--Wild Rice River.	*
2.	Sargent	36	130	54 LTL	7,000	6,500	III,VII	G	Dam--Outlet to Lake Tewaukon.	*****
3.	Sargent	9	132	54	1,500	5,400	VII	F	Diversion Ditch--Drain No. 11 to Storm Lake.	*****
4.	Sargent	33	130	55	450	5,000	III,VII	E	Dam--Wild Rice River below outlet to Silver Lake.	*****
5.	Sargent	35	130	54 LTL	1,850		VII	G	North Marsh Area and White Lake. Part of Lake Tewaukan Project.	*****
6.	Sargent	33	130	54 LTL	600	900	VII	G	Dam--Outlet to Cloud's Lake.	*****
7.	Sargent		130	54	20	1,200	III,V	E	Dam--Wild Rice River. Near Cayuga.	**
8.	Sargent	20/29	131	53	150	9,000	III	E	Dam--Wild Rice River.	**
9.	Sargent	21	131	53	20	1,200	IV	E	Dam--Wild Rice River.	**
10.	Richland	23	131	49	60	5,200	III	E	Dam--Wild Rice River. Near Great Bend.	***
11.	Richland	35	133	48	60	5,200	III	E	Dam--Wild Rice River. Near Dwight.	***
12.	Richland	34	130	50	4,480	5,000	III	G	Dam--Outlet to Lake Elsie. Lake Elsie is spring fed.	******
13.	Richland	21	131	50	60	6,000	III,V	E	Dam--Wild Rice River near Mantador.	**
14.	Richland	12	134	49	60	6,000	III,V	E	Dam--Wild Rice River. Near Galchutt.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

WILD RICE RIVER SUB-BASIN

No.	County	Sec	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Lege
15.	Richland	34	136	49	60	$ 6,000	III,V	E	Dam--Wild Rice River. Near Christine.	**
16.	Richland	6	132	49	60	6,000	III,V	G	Dam--Creek. Near Mooreton.	**
17.	Richland	3	132	48	60	6,000	IV	G	Dam--Wild Rice River.	**
18.	Richland	30	132	51	15	1,000	III,V	G	Dam--Wild Rice River. South of Wyndmere.	**
TOTAL EXISTING RESERVOIRS:					16,680	$86,100				

LEGEND:

*	Constructed by CCC
**	Constructed by FERA and WPA
***	Constructed by Individuals
*****	Constructed by U. S. Biological Survey
********	State Game and Fish Department

USE:

III	Recreation
IV	Stock Watering and Water Conservation
V	Municipal Water Supply
VII	Waterfowl Refuge

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

WILD RICE RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estir
1.	Barney	150	High Fluoride Content	Survey and 1 well	100	600			$ 7(
2.	Brampton	68	High Fluoride Content	Survey and 1 well	100	600			7(
3.	Cogswell	425	Needs water system. High Fluoride Content.	Survey and 2 wells. Water distribution system.	100	1,200	10,000	20,000	31,3(
4.	Christine	200	Poor Quality.	Survey and 1 well.	100	600			7(
5.	Cayuga	219	High Fluoride Content	Survey and 1 well.	100	600			7(
6.	Colfax	100	High Fluoride Content	Survey and 1 well	100	600			7(
7.	Delamere	225	High Fluoride Content	Survey and 1 well.	100	600			7(
8.	Dwight	104	Inadequate for fire protection.	Survey and 1 well.	100	600			7(
9.	Abercrombie	242	Danger of pollution. High Fluoride Content.	New pumping equipment and construction. Survey and 1 well.	100	600		2,000	2,7(
10.	Forman	386	High Fluoride C ntent	Survey and 1 well.	100	1,200			1,3(
11.	Great Bend	169	High Fluoride Content	Survey and 1 well.	100	600			7(
12.	Gwinner	350	High Fluoride Content	Survey and 1 well.	100	1,200			1,3(
13.	Havana	270	High Fluoride Content	Survey and 1 well.	100	600			7(

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

WILD RICE RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estim
14.	Lidgerwood	1,089	Danger of pollution. High Fluoride Content.	Survey and 4 wells. Bring outlet of artesian well out of the pit.	100	2,400		200	2,700
15.	McLeod	400	Inadequate for fire protection.	Survey and 1 well	100	600			700
16.	Milnor	564	Needs Water System. High Fluoride Content.	Water distribution system. Survey and 2 wells.	100	1,200	10,000	25,000	36,300
17.	Mooreton	147	High Fluoride Content	Survey and 1 well	100	600			70(
18.	Rutland	264	High Fluoride Content	Survey and 1 well	100	600			70(
19.	Wallcott	250	High Fluoride Content	Survey and 1 well	100	600			70(
20.	Wahpeton	3,176	High Fluoride Content Danger of pollution.	Change from present well to river supply. Install a treatment plant and new pumps.			40,000	8,000	48,000
21.	Wyndmere	521	High Fluoride Content.	Survey and 2 wells, distribution system, and treatment plant.	100	1,200	10,000	30,000	41,300
				Sub-Totals:	2,000	16,800	70,000	85,200	

TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY: $ 174,000

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

WILD RICE RIVER SUB BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Local surveys of available sources	$ 2,000	
Distribution systems, Abercrombie, Lidgerwood, Milnor, Wahpeton, and Wyndmere.	65,200	
Treatment Plants, Milnor, Wahpeton, and Wyndmere.	60,000	
Total Class "A" Projects:		$ 127,200
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Shallow Wells		16,800
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Distribution systems	20,000	
Treatment Plants	10,000	
Total Class "C" Projects:		30,000
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:		$ 174,000

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

WILD RICE RIVER SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:					
22.	Wahpeton	3,176	Comb. No Treatment. Inadequate.	Primary treatment, Tr.F. Secondary treatment or SSD with Cl.	90,000
23.	Fairmount	611	Comb. No Treatment. Inadequate	Screen. G.C. Imhoff tank, Tr.F.	25,000
24.	Wyndmere	521	No sewerage system	Sewerage system with Sc., G.C., Imhoff tank, Tr.F., Sl. B.	40,000
25.	Milnor	594	No sewerage system.	Sewerage system with Sc., G.C., Imhoff tank., Tr. F. Sl. B.	40,000
26.	Abercrombie	242	Comb. Individual Septic Tanks. Inadequate.	Municipal plant. Imhoff tank and filters.	15,000
			Total Class "A" Projects:		$ 210,000
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
27.	Hankinson	1,400	Comb. Septic Tank., G.C., Sl.B., Inadequate.	Sc. G.C. Primary treatments. Tr. F, Utilize septic tank.	40,000
28.	Lidgerwood	1,029	Comb. Septic tank. Inadequate.	Sc. G.C. Imhoff tank, Tr.F.	30,000
29.	Cogswell	426	No sewerage system.	System with Sc., G.C., Imhoff tank. Tr.F. Sl.B.	40,000
			Total Class "C" Projects:		$ 110,000
TOTAL PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL:					$ 320,000

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

WILD RICE RIVER SUB-BASIN

LEGEND FOR SEWAGE AND SEWAGE TREATMENT:

Comb.	Combined System
Sc.	Screened
G.C.	Grit Chamber
Tr. F.	Trickling Filter
Sl.B.	Sludge Beds
SSD	Separate Sludge Digestion
Cl.	Chlorination

TABLE D

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

WILD RICE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	St
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:										
1.	Cass	2	137	49	345	$14,400	III,IV	E	Dam--Wild Rice River. Near Hickson.	**
2.	Sargent	2	131	53	60	6,000	III,IV	E	Dam--Wild Rice River. Excellent park site.	*
3.	Richland	134/135		48	200	10,000	III	G	Low Dam--Red River. Ft. Abercrombie Park.	*
4.	Richland		132	47	200	10,000	III	G	Low Dam--Red River. For Wahpeton water supply.	*
5.	Entire Basin					20,000	I	G	Clear and rehabilitate drainage ditches in regions of good agricultural land.	*
6.	Entire Basin					15,000		E	Survey of available supplies of water in the Sub-basin which do not contain chemicals harmful to human or livestock. Special attention should be given to the determination of the occurrence and source of fluorides in the waters of the Sub-basin.	*
	Total Class "A" Projects:				805	$75,400				

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

WILD RICE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":										
7.	Cass		138	49		$350,000	I	G	A Floodway from the Dakota Wild Rice River to the Sheyenne River. Contingent on the construction of the Baldhill Reservoir.	*** U
8.	Richland		133	48	60	6,000	IV	E	Dam--Wild Rice River.	*
9.	Richland	9	135	49	60	6,000	IV	E	Dam--Wild Rice River.	*
10.	Cass	34	137	49	60	6,000	IV	E	Dam--Wild Rice River.	*
11.	Sargent	13	131	53	60	6,000	IV	E	Dam--Wild Rice River.	*
12.	Richland	30	132	51	60	6,000	IV	E	Dam--Wild Rice River.	*
13.	Richland	34	130	50	____	1,000	III	F	Dredge swimming pool to Lake Elsie.	*
	Total Class "C" Projects:				300	$381,000				
	TOTAL PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES:				1,105	$456,400				

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

WILD RICE RIVER SUB-BASIN

SURVEY:

*	None
**	Field Inspected by State Engineer
***	Surveyed by U. S. Army Engineers
*****	Surveyed by FERA and WPA
******	Surveyed by County Engineers
*******	Surveyed by State Engineers
U	Survey Underway

USE:

I	Flood Control and Stream Regulation
III	Recreation
IV	Stock Watering and Water Conservation

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE E

PROPOSED IMPROVEMENTS IN STREAM GAGING AND WEATHER OBSERVATION FACILITIES

WILD RICE RIVER SUB-BASIN

PLATE III MAP NO.		Station	New or Rehabilitated	Type of Station	Reading to be Taken	Cost Estimate
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":						
1.	R	Wahpeton	New	Automatic recorder, control, and cableway	Red River discharge rates	$ 4,000
2.	R	Wyndmere	New	Staff Recorder	Wild Rice River Stages	200
3.	R	Abercrombie	Rehabilitated	Automatic recorder	Wild Rice River discharge rates.	1,500
TOTAL PROPOSED IMPROVEMENTS IN STREAM GAGING AND WEATHER OBSERVATION FACILITIES:						$ 5,700

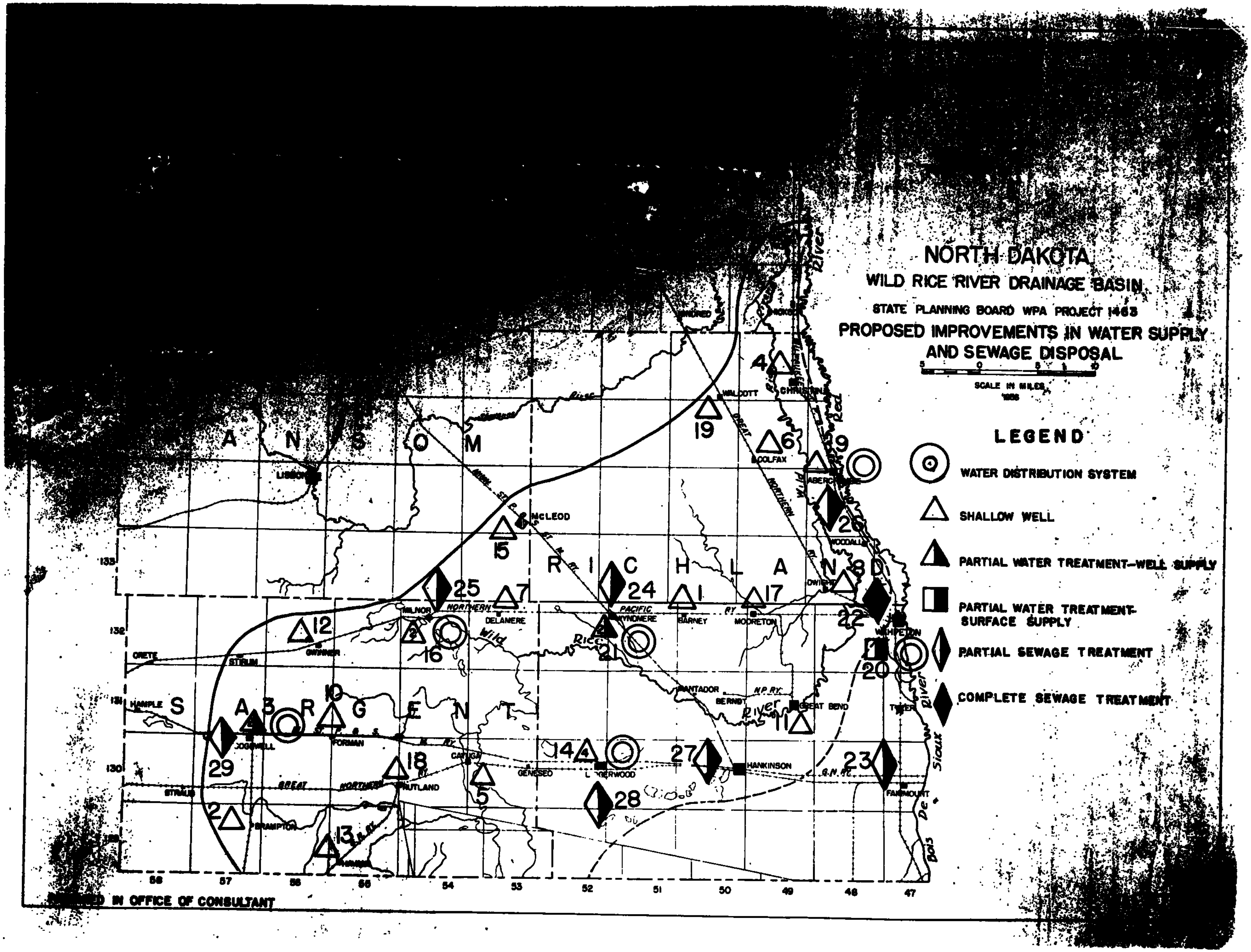
TABLE F

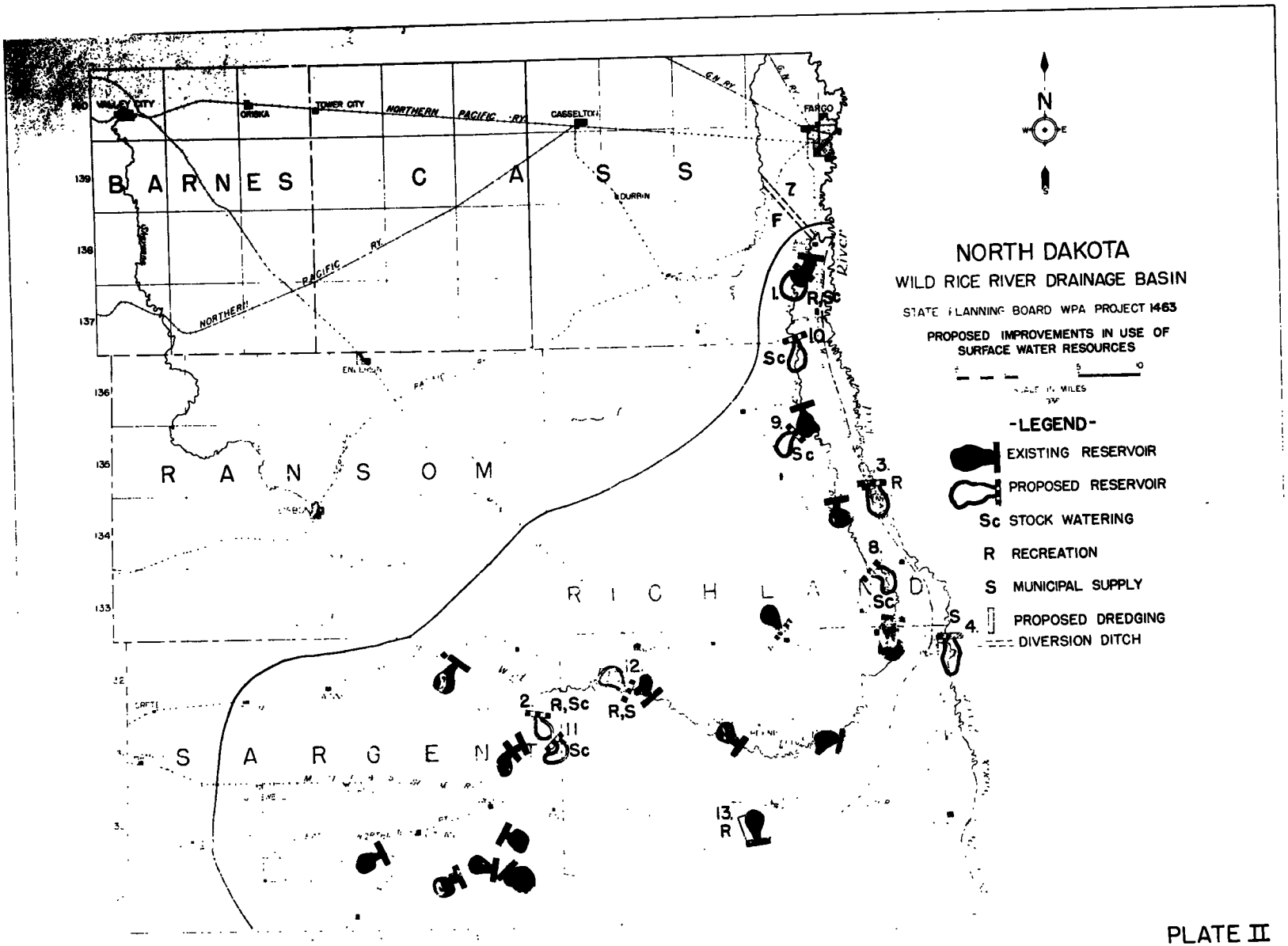
PROPOSED PROJECTS

WILD RICE RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Proposed Improvements in Water Supply	$ 127,200	
Proposed Improvements in Sewage Disposal	210,000	
Proposed Improvements in Use of Surface Water Resources.	75,400	
Total Class "A" Projects:		$ 412,600
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Proposed Improvements in Water Supply		16,800
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Proposed Improvements in Water Supply	30,000	
Proposed Improvements in Sewage Disposal	110,000	
Proposed Improvements in Use of Surface Water Resources.	381,000	
Proposed Improvements in Stream Gaging and Weather Observation Facilities.	5,700	
Total Class "C" Projects:		$ 526,700
TOTAL PROPOSED PROJECTS:		$ 956,100


NORTH DAKOTA
WILD RICE RIVER DRAINAGE BASIN
STATE PLANNING BOARD WPA PROJECT 1463
PROPOSED IMPROVEMENTS IN WATER SUPPLY AND SEWAGE DISPOSAL
SCALE IN MILES
LEGEND
WATER DISTRIBUTION SYSTEM
SHALLOW WELL
PARTIAL WATER TREATMENT—WELL SUPPLY
PARTIAL WATER TREATMENT-SURFACE SUPPLY
PARTIAL SEWAGE TREATMENT
COMPLETE SEWAGE TREATMENT
R I C H L A N D
S A R G E N T
A N S O M
LISBON
McLEOD
WALCOTT
COLFAX
MILNOR
DELAMERE
WYNDMERE
BARNEY
MOORETON
WAHPETON
GWINNER
FORMAN
CAYUGA
GENESEO
HANKINSON
FAIRMOUNT
RUTLAND
BRAMPTON
HAMPLE
CRETE
STIRUM
GREAT NORTHERN
NORTHERN PACIFIC
Wild Rice River
Red River
Sioux
Bois De Sioux River
IN OFFICE OF CONSULTANT



PREPARED IN THE OFFICE OF THE CONSULTANT

PLATE II

WILD RICE SUB-BASIN

STREAM GAGING
and
WEATHER OBSERVATION FACILITIES

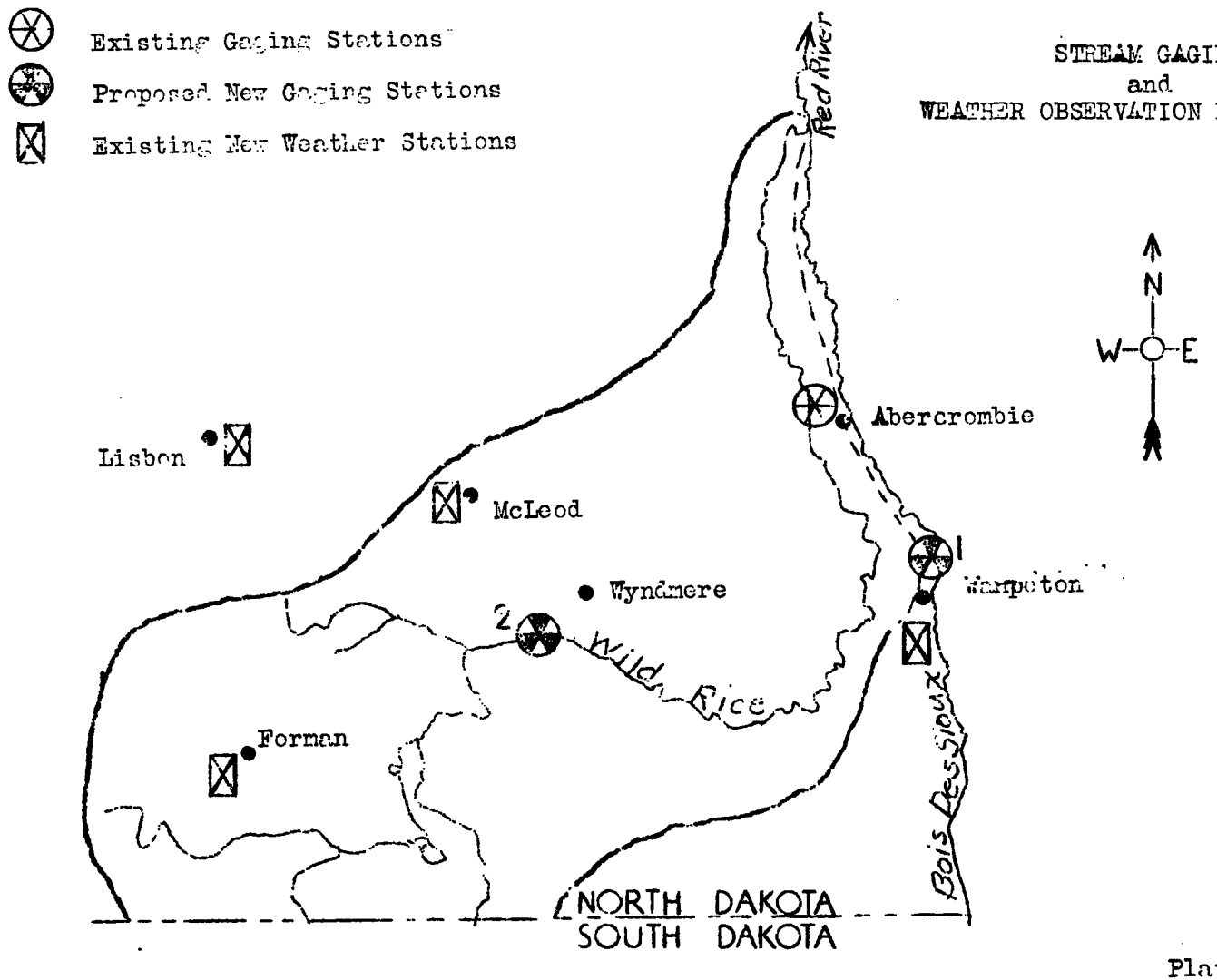


Plate III

CHAPTER II

SHEYENNE SUB-BASIN

CHAPTER II

THE SHEYENNE RIVER SUB-BASIN

GENERAL

The Sheyenne River rises in Sheridan County, North Dakota. In its course to the Red River it flows through Wells, Benson, Eddy, Nelson, Griggs, Barnes, Ransom, Richland and Cass counties. In addition, most of Pierce County and a portion of Foster and Steele counties have their drainage to the Sheyenne River. The total area drained, all of which is in North Dakota, is 7,399 square miles.

POPULATION

The population of the Sheyenne Sub-basin is largely rural. According to the 1930 census, of the total 78,045 persons living in the area, 55,039 resided outside incorporated villages or cities and 23,006 were in incorporated villages or cities. Of the latter, 5,268 were in Valley City Approximately 80,000 persons are directly served by the Sheyenne River and its larger tributaries. Any program for the development of the water resources of the Sheyenne River should benefit these persons directly and those in the entire Sub-basin indirectly.

FEDERAL AID

During the month of peak load, March 1935, there were 19,314 persons or 24.7% of the total population receiving federal aid. The State average for the same month was 31.6%. In the peak month of W.P.A. employment 474 persons were employed on work projects in or near cities and villages and 1302 persons were employed on rural projects, making a total of 1776 persons employed in October, 1936.

TOPOGRAPHY

The Sheyenne Sub-basin lies in three distinct areas: The Red River Valley; the delta and morainal area; and the Drift Prairie area. The source of the river is in the Drift Prairie area. In this region the coulees are two to five miles long, thirty to sixty feet deep, and 1/8 to 3/8 miles in width. The main valley has rather steep sides, is generally about 100 feet deep, and ranges in width, from bluff to bluff, from 3/8 to 3/4 miles in the lower reaches. The depth and width of the valley gradually decreases after it leaves the Drift Prairie. The upland in the plain of the Red River Valley is very level.

SOILS

The soils vary from valley to alluvium, composed of lake silt in the Red River Valley proper. to the glacial till intermixed with sand and gravel which is found in the glacial drift areas. The Sheyenne Delta area has soils that are largely sandy loam and this drifts very easily, creating the sand dunes characteristic of the area.

TRIBUTARIES

The main tributary of the Sheyenne River is the Maple River which drains 1,570 square miles in Steele, Barnes, Ransom and Cass counties. Other tributaries are Baldhill Creek, tributary to the Sheyenne River north of Valley City, and Swan Creek and Rush River tributary to the Maple River in Cass County.

NATURAL RESOURCES

There are no mineral resources in the Sub-basin capable of being developed.

GROUND WATER

Water is obtained from five different aquifers in the Sheyenne River Sub-basin. These are: alluvium which is confined to the main valley of the river; lacustine deposits - delta sand, gravel beaches and lake silts; glacial drifts: cretaceous shale-Pierre, Niobrara, and Benton; and Dakota Sandstone, the deepest water bearer. The ground water level in the Sub-basin has dropped 17 feet during the past 18 years and there has also been a drop in pressure of the artesian wells of the area.

Most of the shallow wells produce water of good quality although some in the drift and alluvium areas yield water that is highly mineralized. Deep wells in the lower portion of the Sub-basin yield water that has fluoride content in excess of the safe limit for human use.

THE WATER PROBLEM

During each year of average run-off there is lost to the Sub-basin about 16[illegible],000 feet of water, the greater portion of which is during the spring months. During summer months and during drought periods there is a great deficiency in stream flow. There is a need during these periods for adequate stream flow for municipal supply, for pollution abatement, for recreation, and for stock watering.

Many towns in the Sub-basin have inadequate or unsatisfactory water supplies. Much of the water used in the lower portion of the Sub-basin contains fluorides to such a high degree as to be injurious to the teeth of those using it.

Existing reservoirs are not sufficiently distributed to provide recreational and stock watering facilities to the maximum number of inhabitants. Additional reservoirs properly located would provide a greatly increased percentage of the population with recreational facilities.

PRECIPITATION

The 20 year average of precipitation in the Basin is 17.77 inches annually. That during the growing season, May through September, is 12.34 inches. The average precipitation during the growing season is sufficient to produce a fair crop.

However, quite frequently there are years of great rainfall deficiency. Although there is seldom a great enough deficiency to cause a crop failure, except in the western portion of the Sub-basin, there are many years in which the yields are materially reduced.

RUN-OFF

The average annual run-off from the Sheyenne River Sub-basin is 0.42 of an inch or approximately 164,000 acre feet. Run-off in the drift area is rather rapid but most of it is retained in the area in shallow lakes and sloughs. The run-off in the Red River Valley portion is very low because of the flat terrain.

FLOODS

There are frequent spring floods along the lower reaches of the Sheyenne River. The drop through the escarpment region is so great that during periods of rapid run-off more water is brought down from the drift areas than can be handled by the relatively small and level channel of the lower portions of the river. As a result, the river frequently overflows its banks in this area.

WILD-LIFE

There were formerly many sloughs and shallow lakes in the western portion of the Sheyenne Sub-basin that served as nesting places for migratory waterfowl. During recent drought years these have completely dried up and have become of no use for any purpose. The U. S. Bureau of Biological Survey, under its easement program, is constructing dams to restore some of these lakes and sloughs.

RECREATION

Recreational facilities are quite well developed in the Sub-Basin. Many towns in the area maintain swimming pools as well as camping and picnic grounds. A number of natural and artificial lakes serve as recreational centers for large areas.

There are a number of recreational centers in Ransom county. Sheldon maintains an outdoor artificial swimming pool. Fort. Ransom and Lisbon make use of reservoirs on the Sheyenne River for recreational purposes and Enderlin utilizes one on the Maple River. A reservoir on the Sheyenne River in Section 9-135-54 and a natural pool in the Sheyenne River in Section 28-134-54 also are used for recreational purposes.

Kathryn and Valley City in Barnes County have reservoirs on the Sheyenne River which are maintained for recreational use. Another reservoir on the Sheyenne River about 12 miles north of Valley City is also used for recreational purposes. A reservoir 10 miles south of Oriska and a natural lake 12 miles north of the same station are also used for recreational purposes.

In Griggs County, Red Willow Lake furnishes recreational facilities for a wide area. A spring fed reservoir at Hannaford is also used for recreational purposes.

A dam in the Maple River in Section 9-144-56 in Steele County serves the recreational needs of a large area.

A number of dams on the Sheyenne and Maple Rivers provide that portion of Cass County that is in the Sheyenne Sub-basin with recreational facilities. Those on the Maple River are located in Sections 24-140-50, 33-139-55, 35-138-52 and 6-139-55. One is located on the Sheyenne River in Section 33-137-59. Reservoirs located on other streams in the county and used for recreation purposes are found in Sections 25-140-54, 9-140-51, 34-140-52 and 22-141-52.

There are a large number of reservoirs available for recreational purposes within the Sheyenne River Sub-basin. Many of these are so small, however, that they are of little use during drought years. The recreational facilities could be greatly increased by increasing the storage capacity of some reservoirs already used for recreational purposes and by constructing additional reservoirs where there is a definite need for them.

POWER & NAVIGATION

The Sheyenne River is not a navigable stream. There has been no considerable development of water power on the stream but small amounts for local use have been developed at Lisbon and at Valley City. Because of the small annual flow of the Sheyenne River it is not capable of developing any considerable amount of power.

CHANNEL IMPROVEMENT

There has been no channel improvement attempted along the Sheyenne River. With the construction of the proposed Baldhill Reservoir, north of Valley City, it would be desirable to straighten and improve the channel of the river from that point to the mouth so that the regulated flow could be carried to the Red River with a minimum of losses. It would also be desirable to construct a diversion ditch from the Sheyenne River to the Red River at a point upstream from Fargo so that part of the regulated flow of the Sheyenne River would be made available to Fargo for water supply and pollution abatement purposes.

MUNICIPAL SUPPLY

Valley City obtains its water indirectly from the Sheyenne River by diverting water from a reservoir on the river into an old gravel pit and by pumping from wells which obtain their water from this gravel vein.

Many towns in the Sheyenne Sub-basin have great difficulty in maintaining adequate and satisfactory supplies of water for their inhabitants. They have seen their shallow wells go dry and have been forced to go to greater depths to obtain a supply. Water from these lower strata are usually highly mineralized and are frequently unfit for human use. In the lower portion of the Sub-basin much of the water being used has a high fluoride content. This is injurious to the teeth of those using it.

Towns along the Sheyenne and Maple Rivers could use a surface supply of water which would be available if reservoirs of suitable size were constructed. Towns along the lower Sheyenne River would be assured of an adequate and satisfactory supply of water if the Baldhill Reservoir were constructed. Towns benefited in this way would be Valley City, Kathryn, Fort Ransom, Lisbon, Anslem, Kindred, Horace, and West Fargo.

Other towns in the Sub-basin must search for improved sources of supply in their localities. They are in need of assistance in making these local surveys.

STREAM POLLUTION

Stream pollution is prevalent in the Sub-basin because of the considerable number of towns located on streams. Many of these have sewerage systems. A regulated flow in the Sheyenne River is needed for pollution abatement. Many towns are in need of assistance in installing sewage systems and treatment plants to eliminate stream pollution and the accompanying health hazards.

IRRIGATION

There is no irrigation practiced in the Sub-basin. There is not enough water available for irrigating any large area nor is the land adapted to such. Although there are frequent deficiencies in precipitation crop failures seldom occur except in the western part of the Sub-basin. Irrigation on a large scale cannot be engaged in unless water is made available. Missouri River diversion would make possible irrigation of some land in the Sub-basin.

MISSOURI RIVER DIVERSION

The Missouri River diversion project as outlined in the Devils Lake report would make a regulated stream flow of 200 cubic feet per second available along the entire length of the Sheyenne River for recreation, for municipal supply, for pollution abatement, and for stock watering.

The Baldhill reservoir as proposed in the water program would be necessary to obtain the fullest benefits from the Missouri River Diversion project. During some periods of the

year when a flow as large as 200 cubic feet per second would not be needed downstream the reservoir could be used to store up water and this would be released at periods when greater stream flow was needed.

EXISTING RESERVOIRS

The present 69 reservoirs in the Sheyenne Sub-basin have a total storage capacity of approximately 14,000 acre feet. These are listed in Table A and are shown on Plate II.

PROPOSED PROGRAM

It is proposed:

1. That a large regulating reservoir known as the "Baldhill Reservoir" be constructed on the Sheyenne River several miles upstream from Valley City. This reservoir would be for flood control and stream flow regulating purposes. The Baldhill Reservoir is listed in Table D and is shown on Plate II .

2. That the Sheyenne River channel from the Baldhill Reservoir site to the mouth of the stream be improved so that the regulated flow provided by the Baldhill Reservoir can be carried with a minimum of losses. This project should be completed simultaneously with the Baldhill Reservoir. This project is also listed in Table D and shown on Plate II.

3. That a diversion ditch capable of carrying at least half the minimum regulated flow of the Sheyenne River be constructed to the Wild Rice River or the Red River above Fargo to make additional low water flow available at that city for municipal supply and pollution abatement. This project should be completed simultaneously with the Baldhill Reservoir. This is listed in Table D and is shown on Plate II.

4. That a number of small dams in the headwater areas of the Sheyenne River and tributary streams be constructed where needed for recreational and stock watering purposes. Proposed small reservoirs are listed in Table D and are shown on Plate II. All dams constructed hereafter in the Sub-basin should be provided with outlet gates for releasing the water stored when a great need arises for it downstream or when it becomes so polluted that it is a definite health hazard to the community. Many existing dams should also be provided with outlet gates.

5. That assistance be given to towns in securing satisfactory water supplies and in installing adequate sewage disposal systems. Proposed improvements in water supply are listed in Table B. Proposed improvements in sewage disposal are listed in Table C. Both are shown on Plate I.

RURAL WATER SUPPLY

A large number of small reservoirs have been proposed for the Sub basin by various agencies. Those that would serve purposes of recreation, irrigation and waterfowl refuges have been included in the proposed program. It is proposed that before any more small dams for stock watering purposes be constructed in the Sub-basin, a detailed survey of rural and urban supply, including a fluoride survey, be undertaken to determine the best and most economical method of securing adequate and satisfactory water supplies for domestic and stock watering purposes. Where an adequate ground water supply is available it is probable that this would be through the construction of community wells. In other localities not having a reliable ground water supply the construction of surface reservoirs would be the only alternative. Following such a survey it is proposed that assistance be given in developing an adequate rural water supply.

STREAM GAGING AND WEATHER OBSERVATION FACILITIES

Proposed stream gagin stations are listed in Table E and these together with present facilities for stream gaging and weather recording are shown on Plate III. It is strongly urged that adequate facilities be established and maintained for the recording of stream flow and weather data for use in future planning.

ULTIMATE DEVELOPMENT

The ultimate development of the water resources of the Cheyenne Sub-basin should include a large headwater reservoir to store the excess run-off during years of drought. Such a plan would also assist in the regulation of the Red River. This is made evident when the distribution of rainfall over the Red River Basin is considered. A study made by Mr. Adolph Meyer show that during a given year the precipitation in the southeastern part of the Red River Basin may be below normal while in part of the Basin there is ample rainfall, the rainfall in the west and northwestern parts of the Basin is average or above average. Such a condition might make the regulating reservoirs that are proposed in the south eastern part of the Basin rather ineffective during such sub-normal periods. It is evident, therefore, that a greater degree of assurance of regulation of the Red River would be had if one or more regulating reservoirs were placed in other parts of the Basin, such as in the Cheyenne River. If it became necessary to decrease the flow of the tributaries in the southeastern part of the Basin to conserve the water resources of this area it would be possible to increase the flow in the Cheyenne River thus keeping the flow in the Red River more nearly constant. The Baldhill reservoir which has been surveyed by the U. S. Army Engineers might serve excellently for such a purpose. The Baldhill reservoir would have a possible maximum capacity of 176,000 acre feet.

BALDHILL RESERVOIR

The proposed Baldhill Reservoir on the Sheyenne River would be located in Section 18-141-58, 14 miles northwest of Valley City. This is in Barnes county, a few miles below the mouth of Baldhill Creek.

A number of towns in the Sheyenne Sub-basin from the proposed Baldhill Reservoir are dependent upon an adequate flow in the Sheyenne River for pollution abatement. A number of those towns also have an inadequate or unsatisfactory water supply. A regulated flow in the Sheyenne River would provide these towns with a satisfactory surface of supply.

Preliminary hydrological calculations made by the U. S. Army Engineers showed that a flow of 62 cubic feet per second could have been maintained below the Baldhill reservoir from October 1923 to September 1935. A more detailed report on the possible operation of this reservoir is being compiled by the U. S. Army Engineers and this should be available at an early date. It is expected that detailed plans and specifications for the dam will also be available within a short time. In addition to the value of the value of the proposed reservoir for flood control and river regulating purposes the construction of the dam would be an ideal work relief project to provide work for drought stricken farmers in the area.

CHANNEL IMPROVEMENT

In order to carry the regulated flow to the Red River, considerable improvement of the channel of the Sheyenne River below the Baldhill Reservoir would be necessary.

DIVERSION TO WILD RICE RIVER

A large benefit Fargo would be derived if part of the regulated flow of the Sheyenne River were diverted to the Red River above that city. From the Fargo quadrangle map of the U. S. Geological Survey it would appear that a diversion ditch two miles in length would lead part of the flow of the Sheyenne River into a coulee tributary to the Wild Rice River. This ditch would start from the Sheyenne River one mile south of Norman and run eastward. The coulee and the channel of the Wild Rice River below the mouth of the coulee would have to be dredged to provide for the carrying of the diverted flow with a minimum of losses.

An alternate method of diversion would be directly from the Sheyenne River to the Red River in Barnes Township, a few miles above Fargo, through a ditch about 5 miles in length. This method was proposed by Mr. R. E. Kennedy, former state State Engineer. The best method of diversion will be known when the results of the recent survey by the U. S. Army Engineers is known.

In either case diversion would include a dam in the Sheyenne River at the point of diversion and the ditch would be provided with a control gate. The capacity of the ditch would be approximately one-half the minimum flow to be maintained in the Sheyenne River. A satisfactory flow in the Sheyenne River Channel through West Fargo and Harwood would be maintained and only excess flow would be diverted to the Red River.

The benefits of the entire project would be greatly increased by the construction of the diversion ditch as outlined above. If a minimum flow of 60 cubic feet per second in the Sheyenne River at Fargo is assured, 30 cubic feet per second continue down the Sheyenne Channel for purposes of recreation, water supply and pollution abatement. Thus a minimum flow of 30 cubic feet per second would be maintained through West Fargo, whereas at present the flow frequently drops below 6 cubic feet per second.

FLOODS OF THE WILD RICE

This diversion would not affect the flood situation on either the Wild Rice or the Sheyenne Rivers. During flood seasons the gate at the inlet to the ditch would be closed and the ditch inoperative. It is also proposed to construct a floodway ditch to divet part of the flood flow of the Wild Rice to the channel of the Sheyenne, as recommended by Simons and King. This will be of considerable value in reducing the flood plane at Fargo. This floodway is covered in more detail in the Dakota Wild Rice report.

CONCLUSION

The construction of projects proposed in this report would make fresh water available to a much greater percentage of the population of the Sheyenne River Basin. The maximum utilization of the water resources of the area would be provided by the construction of a large reservoir for stream flow regulation.

TABLE A

EXISTING RESERVOIRS

SHEYENNE RIVER DRAINAGE BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
1.	Sheridan	33	149	74	108	2,400	IV	E	Dam-Sheyenne River	*
2.	Sheridan	30	149	74	1200	1,600	VII	F	Sheyenne Lake Project	*****
3.	Pierce	12	152	72	1500	11,400	VII	F	Buffalo Lake Project	*****
4.	Pierce	16	154	73	225	6,000	III	G	Dam-Creek	**
5.	Benson	23	151	69	150	4,600	III	E	Dam-Sheyenne River	**
6.	Benson	36	152	70	65	6,200	III	G	Dam-Creek	**
7.	Benson	27	151	65	100	10,000	III,IV	E	Dam-Sheyenne River	**
8.	Benson	27	151	69	117	10,000	III,IV	E	Dam-Sheyenne River	(*) (**)
9.	Benson	20	151	69	93	2,700	IV	E	Dam-Sheyenne River	*
10.	Benson		151	64	200	3,400	VII	E	Wood Lake Marsh Project	*****
11.	Benson	23	152	70	10	2,500	IV,III	E	Dam-Creek near Maddock	*
12.	Wells		150	72	60	5,200	III	E	Dam-Sheyenne River. Near Harvey	**
13.	Wells	18	150	71	132	3,200	III	E	Dam-Sheyenne River	*
14.	Wells	13	149	73	50	500	IV	E	Dam-Sheyenne River	*
15.	Eddy	15	150	63	597	4,100	III	G	Dam-Sheyenne River	*

TABLE A

EXISTING RESERVOIRS

SHEYENNE RIVER DRAINAGE BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
16.	Eddy	9	150	67	200	1,600	IV	E	Dam-Sheyenne River	**
17.	Eddy	5	150	66	157	4,700	III	E	Dam-Sheyenne River	*
18.	Eddy, Nelson	30	149	61	2,000	1,300	VII	F	Johnson Lake Project	*****
19.	Nelson	35	150	59	18	3,000	III,VI	F	G.N. Dam-Creek. At McVille.	****
20.	Nelson	25	150	59	31	7,000	IV	F	Dam-Creek.	*
21.	Nelson	4	150	61	213	15,300	IV	F	Dam-Creek. Near Tolna	*
22.	Nelson	18	150	60	10	1,000	IV	F	Dam-Sheyenne River	**
23.	Griggs	7/5	144	59	9	2,000	III,VI	E	G.N.Dam-Baldhill Creek	****
24.	Griggs	26	145	58	164	11,700	III	F	Dam-Sheyenne River	*
25.	Griggs	16	145	60	70	5,000	III	E	Dam-Branch of Baldhill Creek	**
26.	Griggs	29	147	60	500	5,000	VII	F	Sibley Lake Project	*****
27.	Griggs	21	148	59	37	1,800	IV	F	Dam-Coulee	*
28.	Griggs	18	148	59	115	11,600	IV	F	Dam-Coulee	*
29.	Griggs	18	148	59	199	1,400	IV	P	Dam-Coulee	(*) (
30.	Griggs	26	145	58	10	1,000	IV	F	Dam-Coulee	***
31.	Griggs	22	145	60	10	1,000	IV	G	Dam-Creek	***

TABLE A (Cont'd)

EXISTING RESERVOIRS

SHEYENNE RIVER DRAINAGE BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
32.	Steele	4/9	144	56	140	4,900	III,IV	F	Dam-Creek	**
33.	Steele	5	146	57	141	4,000	IV	P	Dam-Coulee	**
34.	Barnes	28	140	58	900	15,000	III,V	G	City Dam-Sheyenne River. At Valley City.	****
35.	Barnes	28	140	58	103	9,700	III,V	E	Dam-Sheyenne River. At Valley City	*
36.	Barnes	36	141	59	620	10,000	V	G	City Dam-Sheyenne River	****
37.	Barnes	13	137	58	259	7,600	III	G	Dam-Sheyenne River. At Kathryn	*
38.	Barnes	19	143	58	345	10,500	III,IV	G	Dam-Baldhill Creek	*
39.	Barnes	3	142	58	207	10,000	IV	E	Dam-Sheyenne River	*
40.	Barnes	36	143	59	215	8,400	IV	G	Dam-Baldhill Creek	*
41.	Barnes	6	139	59	20	2,600	IV	F	Dam-Outlet of Slough	*
42.	Barnes	11	140	58	31	6,300	IV	F	Dam-Coulee	*
43.	Barnes	9	138	59	238	5,600	IV	F	Dam-Creek	*
44.	Barnes	30	139	58	76	10,000	IV	P	Dam-Creek	*
45.	Barnes	3	138	59	127	10,300	IV	P	Dam-Creek	*
46.	Barnes	10	143	59	180	22,000	III,IV	F	Henson Dam	**

TABLE A (Cont'd)

EXISTING RESERVOIRS

SHEYENNE RIVER DRAINAGE BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
47.	Barnes	28,29,32,33	140	59	300	15,000	IV,VII	F	Hobart Lake Project	*****
48.	Barnes	32,33,34	138	59	183½	10,000	IV,VII	F	Diversion Dam and Ditch. Stony Slough Project.	*****
49.	Barnes	32	142	59	500	9,000	VII	F	Lake Thomas Project	*****
50.	Cass		139	51	250	8,000	III,VI	E	G.N. Dam-Maple River at Durbin	****
51.	Cass	4	138	55	30	1,900	III	E	Dam-Maple River	*
52.	Cass		139	49	58	4,000	III,VI	E	N.P. Dam-Sheyenne River	****
53.	Cass	24	141	52	6	500	III	E	G.N. Dam-Rush River	****
54.	Cass	9	140	51	54	1,000	III	G	Dam-Creek	*
55.	Cass	34	140	52	133	1,300	III,VI	G	G.N. Dug Reservoir	****
56.	Cass	10	139	51	276	7,900	III	G	Dam-Maple River	*
57.	Cass	23	138	52	281	6,600	IV	E	Dam-Maple River	*
58.	Cass	24	140	50	94	9,300	IV	E	Dam-Maple River	*
59.	Cass	36	142	53	47	1,000	IV,VI	E	G.N. Dug Reservoir-Rush River	****
60.	Cass	22	141	52	240	10,500	III,IV	F	Dam-Rush River	
61.	Ransom		135	58	400	12,000	III	G	City Dam-Sheyenne River at Fort Ransom.	****

TABLE A (Cont'd)

EXISTING RESERVOIRS

SHEYENNE RIVER DRAINAGE BASIN

No.	County	Sec.	Twp.	Rge.	Storage A.F.	Cost Est.	Use	Designation	Description and Remarks	Legend
62.	Ransom		134	56	1100	15,000	III	F	City Dam-Sheyenne River at Lisbon.	****
63.	Ransom	17	135	57	60	6,000	IV	P	Maddock Dam-Coulee	
64.	Ransom	29	134	55	60	6,000	IV	F	Big Bend Dam-Coulee	
65.	Ransom	27	133	56	60	6,000	IV	G	Bale Dam-Creek	
66.	Ransom	33	136	57	60	6,000	IV	F	Ted Anderson Dam-Coulee	
67.	Ransom	11	136	56	60	6,000	IV	G	Golbreath Dam-Creek	
68.	Ransom	34	134	56	60	6,000	IV	F	Bixvy Dam-Coulee	
69.	Ransom	33	135	56	60	6,000	IV	F	Reinke Dam-Coulee	
70.	Ransom	15	135	53	60	6,000	IV	F	Stukes Dam-Coulee	
TOTAL EXISTING RESERVOIRS:					14,156	$ 246,100				

Legend:
- * Constructed by CCC
- ** Constructed by FERA and WPA
- *** Constructed by Individuals.
- **** Constructed by railways and municipalities.
- ***** Constructed by U.S. Biological Survey

Use:
- III Recreation
- IV Stock Watering and Water Conservation
- V Municipal Water Supply
- VI Railway Supply
- VII Waterfowl Refuge

Designation:
- E Excellent
- G Good
- F Fair
- P Poor

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SHEYENNE RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
1.	Allsbury	260	Alkaline	Treatment Plant			2,000		2,000
2.	Alice	169	High Fluoride Content.	Survey and 1 well	100	600			700
3.	Amenia	90	Inadequate for fire protection.	One deep well. New Pumping Equipment and Construction.		1,200		5,000	6,200
4.	Anslem	50	High Fluoride Content.	Survey and 1 well.	100	600			700
5.	Ayr	106	Inadequate	Survey and 1 well	100	600			700
6.	Buffalo	242	Inadequate	Survey and 1 well	100	600			700
7.	Buttzville	32	Inadequate for fire protection.	Survey and 1 well	100	600			700
8.	Casselton	1253	High Fluoride Content.	Survey and 5 wells Construction changes	100	3,000		5,000	8,100
9.	Chaffee	150	High Fluoride Content.	Survey and 1 well	100	600			700
10.	Dazey	251	Inadequate	Survey and 1 well	100	600			700
11.	Ekelson	250	Inadequate for fire protection.	One deep well.		2,400			2,400

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SHEYENNE RIVER SUB BASIN

PLATE I MAP NO.	Municip-ality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estima
12.	Enderlin	1139	High Fluoride Content.	Obtain supply from proposed reservoir on Maple River. Construction changes.			10,000	5,000	15,000
13.	Englevale	200	Inadequate	Survey and 1 well	100	600			700
14.	Erie	215	Unsatisfactory	Survey and 1 well	100	600			700
15.	Fingal	324	Inadequate for fire protection.	One deep well		4,400			4,400
16.	Hamar	135	Inadequate	Survey and 1 well	100	600			700
17.	Hamberg	187	Inadequate	Survey and 1 well	100	600			700
18.	Hannaford	351	Inadequate	Survey and 2 wells	100	1200			1,300
19.	Hastings	200	Inadequate	Survey and 1 well	100	600			700
20.	Heimdal	200	Inadequate for fire protection.	Survey and 1 well	100	600			700
21.	Cooperstown	1053	Too Hard	Softening Plant			12,000		12,000
22.	Kindred	429	Inadequate for fire protection.	Water Distribution System and Plant using water from proposed reservoir on Sheyenne River.			10,000	25,000	35,000

TABLE B (CONT'D)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SHEYENNE RIVER SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
23.	Lisbon	1650	High Fluoride Content. Danger of pollution.	Obtain supply from present reservoir in Sheyenne River. Provide new cover for city reservoir.			10,000	2,000	12,000
24.	Litchville	410	No Water System	A water distribution system.			10,000	15,000	25,000
25.	Maddock	631	Inadequate	Survey, 3 wells, and water distribution system.	100	1,800	10,000	25,000	36,900
26.	Marion	211	Unsatisfactory	Survey and 1 well	100	600			700
27.	McHenry	219	Unsatisfactory	Survey and 1 well	100	600			700
28.	Nome	218	Inadequate and Alkaline.	Survey, 1 well and Treatment Plant	100	600	2,000		2,700
29.	Oriska	183	Inadequate	Survey and 1 well	100	600			700
30.	Pekin	210	Inadequate for fire protection.	One deep well		4,500			4,500
31.	Sanborn	343	Inadequate	Survey and 2 wells	100	1,200			1,300
32.	Sheldon	327	High Fluoride Content.	Survey and 2 wells	100	1,200			1,300

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

SHEYENNE RIVER SUB BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist System	Total Est.
33.	Sheyenne	417	Inadequate	Water system using water from C.C.C. Reservoir on Sheyenne River.			8,000	30,000	38,000
34.	Tolna	174	Inadequate	Survey and 1 well	100	600			700
35.	Tower City	435	Inadequate for fire protection.	One deep well and a water distribution system.		2,000	10,000	15,000	27,000
36.	Walum	125	Inadequate for fire protection.	One deep well.		3,000			3,000
37.	Wellsburg	125	Inadequate for fire protection.	Survey and 1 well	100	600			700
38.	Wheatland	150	High Fluoride Content	Survey and 1 well	100	600			700
39.	Wimbledon	421	Inadequate	Survey, 2 wells and water distribution system.	100	1,200	10,000	20,000	31,300
40.	Elliot	106	Unsatisfactory.	Survey and 1 well. New pumping equipment and construction.	100	600		1,000	1,700
			Sub-Totals:		2,700	39,700	94,000	148,000	

TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY: $ 284,100

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

SHEYENNE RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Local surveys of available sources	$ 2,700	
Deep Wells	17,500	
Distribution systems-Amenia, Casselton, Enderlin, Kindred, Lisbon, Maddock, Sheyenne and Elliot	98,000	
Treatment Plants - Enderlin, Kindred, Lisbon, Maddock, Sheyenne.	48,000	
Total Class "A" Projects:		$ 166,200
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Shallow Wells		22,200
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Distribution Systems	50,000	
Treatment Plants	46,000	
Total Class "C" Projects:		96,000
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:		$ 284,400

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

SHEYENNE RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:					
41.	Sheyenne	417	No System	Sewer System with Sc., G.C., Imhoff Tr., F., SI., B.	35,000
42.	Kindred	429	No System	Sewer System with Sc., G.C., Imhoff Tr., F., SI., B.	30,000
43.	McVille	513	Comb. Septic Tank. Inadequate.	Screen Imhoff, Tank. Tr. F.	20,000
44.	West Fargo	350	No System	Sewer System with Sc., G.C. Imhoff Tr., F., Sl., B.	35,000
45.	Cooperstown	1053	Comb. Septic Tank. Inadequate.	Sc. G.C. Imhoff Tank. Tr. F.	30,000
46.	Valley City	5263	Comb. Sc, G.C.P., Cl, Act Sl Sec., Cl, SSD-ScB, Adequate	Preliminary treatment of Creamery Wastes.	19,000
47.	Enderlin	1839	Comb. Septic Tank. Inadequate.	Primary treatment Tr.F. Secondary treatment or SSD with Cl.	55,000
48.	Harvey	2157	Comb. No Treatment. Inadequate.	Primary treatment. Tr. F. Secondary treatment or SSD with Cl.	60,000
49.	Casselton	1253	Comb. Septic Tank. Inadequate.	Screens, G.C. Primary treatment, Tr. F.	30,000
			Total Class "A" Projects:		$ 305,000

TABLE C (Cont'd) PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

SHEYENNE RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
50.	Tower City	435	No System	Sewer System with Sc. G.C., Imhoff, Tr. F. Sl.B.	35,000
51.	Litchville	410	No System	Sewer System with Sc. G.C. Imhoff, Tr. F. Sl.B.	35,000
52.	Wimbledon	421	No System	Sewer System with Sc. G.C., Imhoff, Tr. F.Sl.B.	40,000
53.	Maddock	631	No System	Sewer System with Sc. G.C. Imhoff, Tr. F. Sl. B.	45,000
				Total Class "C" Projects:	$ 155,000
TOTAL PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL:					$ 460,000

LEGEND FOR SEWAGE AND SEWAGE TREATMENT:

Comb.	Combined System	Sl.B.	Sludge Beds
Sc.	Screened	P.C.	Primary Clarifier
G.C.	Grit Chamber	Sec. C.	Secondary Clarifier
SSD	Separate Sludge Digestion	Cl.	Chlorination
Tr.F.	Trickling Filter	Acl. Sl.	Activated Sludge

TABLE D

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SHEYENNE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:										
1.	Barnes	18	141	58	176,000	$777,000	I,III IV,V	E	Baldhill Reservoir on Sheyenne River. Estimates subject to revision upon completion of survey.	*** U
2.	Barnes Ransom Richland Cass	Lower Sheyenne River Channel				100,000	I,V	E	Improvement of river channel simultaneous with the construction of the Baldhill Reservoir.	*** U
3.	Cass	Upstream from Fargo				95,000	I,V	E	Sheyenne diversion ditch to divert a part of the regulated flow of the Sheyenne river to the Wild Rice River or the Red River above Fargo.	*** U
4.	Richland	31	136	51	174	10,000	III	E	Dam--Sheyenne River in American Legion Park.	****
5.	Cass or Richland		136 137	50 50	140	9,000	III,V	E	Dam--Sheyenne River near Kindred.	*
6.	Cass or Ranson		137 136	55	200	10,500	III,V	E	Dam--Maple River near Enderlin.	*
7.	Cass	33	141	49	250	12,000	III,V	E	Dam--Sheyenne River near Harwood.	****
8.	Cass	21	140	50	394	15,000	III,V	E	Dam--Maple River near Mapleton.	****

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SHEYENNE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Dosig-nation	Description and Remarks	Surve
9.	Barnes	34	138	58	350	$14,000	III,	E	Dam--Sheyenne River. In park.	****
9a.	Barnes	28	138	58	(120)				Alternate to No. 9.	*
10.	Barnes	9	143	56	40	5,500	III,V	G	Near Pillsbury.	*
11.	Cass		138	49	140	9,000	III,V	E	Dam--Sheyenne River near Horace.	*
12.	Ransom		135	54	140	9,000	III,V	E	Dam--Sheyenne River near Anslem.	*
13.	Barnes	18	137	58	60	6,500	III,V	F	Dam--Creek near Hastings.	*
14.	Cass		140	55	50	6,000	III,IV	E	Dam--Maple River.	*
15.	Barnes	36	137	58	5	2,500	III,V	E	Dam--Creek.	*
16.	Pierce	36	152	73	60	6,000	III	G	Dam--Creek.	*
17.	Pierce	10	153	72	200	10,000	III	F	Dam--Lake Outlet.	*
18.	Entire Basin					10,000			Survey of small dams proposed for recreation and waterfowl refuge purposes. Survey of available water resources for stock watering where present supplies are inadequate or unsatisfactory. Recommendations to be made for the most satisfactory and economical solution of the problem through the construction of community wells or surface reservoirs.	*
	Total Class "A" Projects:				173,203	$1,107,000				

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SHEYENNE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surv
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":										
19.	Eddy		150	62	(50,000)	$200,000	I,III	G	Dam--Sheyenne River. Possible alter-	
19a.	Nelson		150	60	(Alternate)		IV, V		nate to Baldhill Reservoir. Contin-gent on survey.	*
20.	Griggs	15	145	58	200	10,000	III	E	Dam--Sheyenne River. Contingent on report on Baldhill Reservoir by U. S. Army Engineers as this location might be inundated.	*
21.	Benson	33	153	71	10	1,000	III,IV	G	Dam--Creek near Esmond.	*
22.	Benson	21	154	70	60	6,000	IV	F	Dam--Creek.	*****
23.	Lower Sheyenne	Sub-Basin				10,000	I		Clear and rehabilitate drainage ditches in regions of good agri-cultural land.	*
24.	Barnes	27	142	56	300	14,000	IV	G	Dam--Creek.	*
25.	Barnes	9	139	56	120	8,500	IV	F	Dam--Coulee.	*
26.	Barnes	34	141	56	30	5,000	IV	F	Dam--Coulee.	*
27.	Pierce	17	152	73	30	3,000	IV	F	Dam--Coulee.	*
28.	Griggs	14	147	58	37	5,000	IV	G	Dam--Creek.	*****
29.	Griggs	33	145	59	500	12,000	III,V VI	F	Dam--Baldhill Creek.	*
29a.	Griggs	8	144	59	(50)				Alternate to No. 29.	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

SHEYENNE RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Sur
(18).	Entire Basin					$75,000	IV		Construction of community wells for stock watering and the construction of surface water reservoirs in certain communities after surveys have shown that ground water resources in the areas are unsatisfactory. Possible reservoir sites are: Benson county, S 34-154-71 and S 17-155-71; Nelson county, T 149-58; Griggs county, S 5-145-53; and Barnes county, S 13-139-58, S 6-140-56, S 15-141-59, S 28-138-58, S 35-139-58 and S 36-140-57.	*
	Total Class "C" Projects:				1,287	$149,500				
	TOTAL PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES:				179,490	$1,256,500				

SURVEY:

*	None
***	Surveyed by U. S. Army Engineers
****	Surveyed by CCC
*****	Surveyed by FERA and WPA

USE:

I	Flood Control and Stream Regulation
III	Recreation
IV	Stock Watering and Water Conservation
V	Municipal Water Supply
VI	Railway Supply

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE E

PROPOSED IMPROVEMENTS IN STREAM GAGING AND WEATHER OBSERVATION FACILITIES

SHEYENNE RIVER SUB-BASIN

PLATE III MAP NO.	Station	New or Rehabilitated	Type of Station	Reading to be Taken	Cost Estimate
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
1.	Valley City	New	Automatic recorder and control.	S heyenne River Discharge Rates.	$ 2,000
2.	Mapleton	New	Staff Recorder	Maple River Gage Heights	200
TOTAL PROPOSED IMPROVEMENTS IN STREAM GAGING AND WEATHER OBSERVATION FACILITIES:					$ 2,200

TABLE F

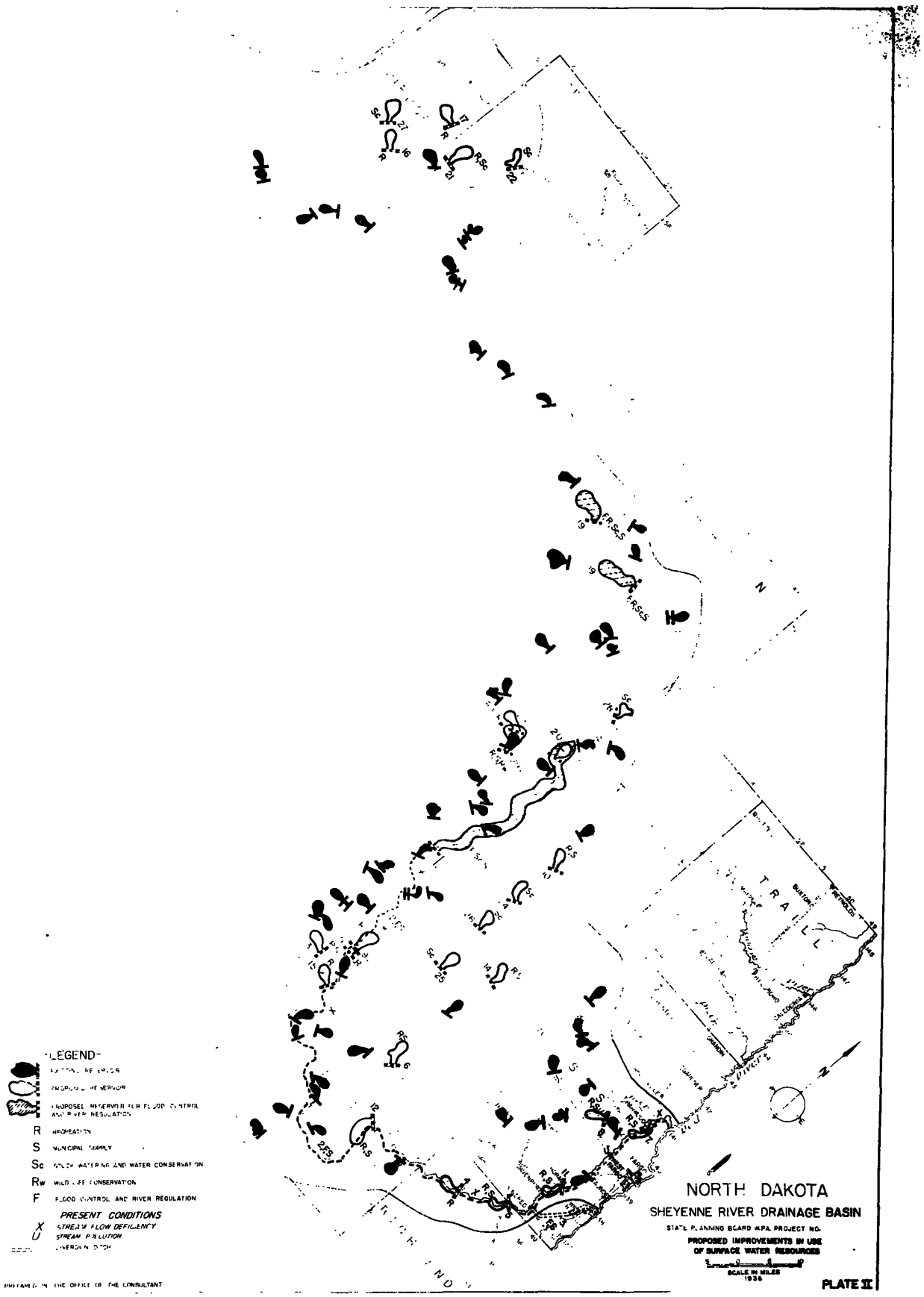
PROPOSED PROJECTS

SHEYENNE RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Proposed Improvements in Water Supply	$ 166,200	
Proposed Improvements in Sewage Disposal	305,000	
Proposed Improvements in Use of Surface Water Resources	1,107,000	
Total Class "A" Projects:		$ 1,578,200
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Proposed Improvements in Water Supply		22,200
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Proposed Improvements in Water Supply	96,000	
Proposed Improvements in Sewage Disposal	155,000	
Proposed Improvements in Use of Surface Water Resources	2,200	
Proposed Improvements in Stream Gaging and Weather Observation Facilities.	149,500	
Total Class "C" Projects:		402,700
TOTAL PROPOSED PROJECTS:		$ 2,003,100

NORTH DAKOTA
SHEYENNE RIVER DRAINAGE BASIN
PLATE I


-LEGEND-
EXISTING RESERVOIR
PROPOSED RESERVOIR
PROPOSED RESERVOIR FOR FLOOD CONTROL AND RIVER REGULATION
R RECREATION
S MUNICIPAL SUPPLY
Sc STOCK WATERING AND WATER CONSERVATION
Rw WILD LIFE CONSERVATION
F FLOOD CONTROL AND RIVER REGULATION
PRESENT CONDITIONS
X STREAM FLOW DEFICIENCY
U STREAM POLLUTION
DIVERSION DITCH
PREPARED IN THE OFFICE OF THE CONSULTANT
NORTH DAKOTA
SHEYENNE RIVER DRAINAGE BASIN
STATE PLANNING BOARD WPA PROJECT NO.
PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES
SCALE IN MILES
1936
PLATE II

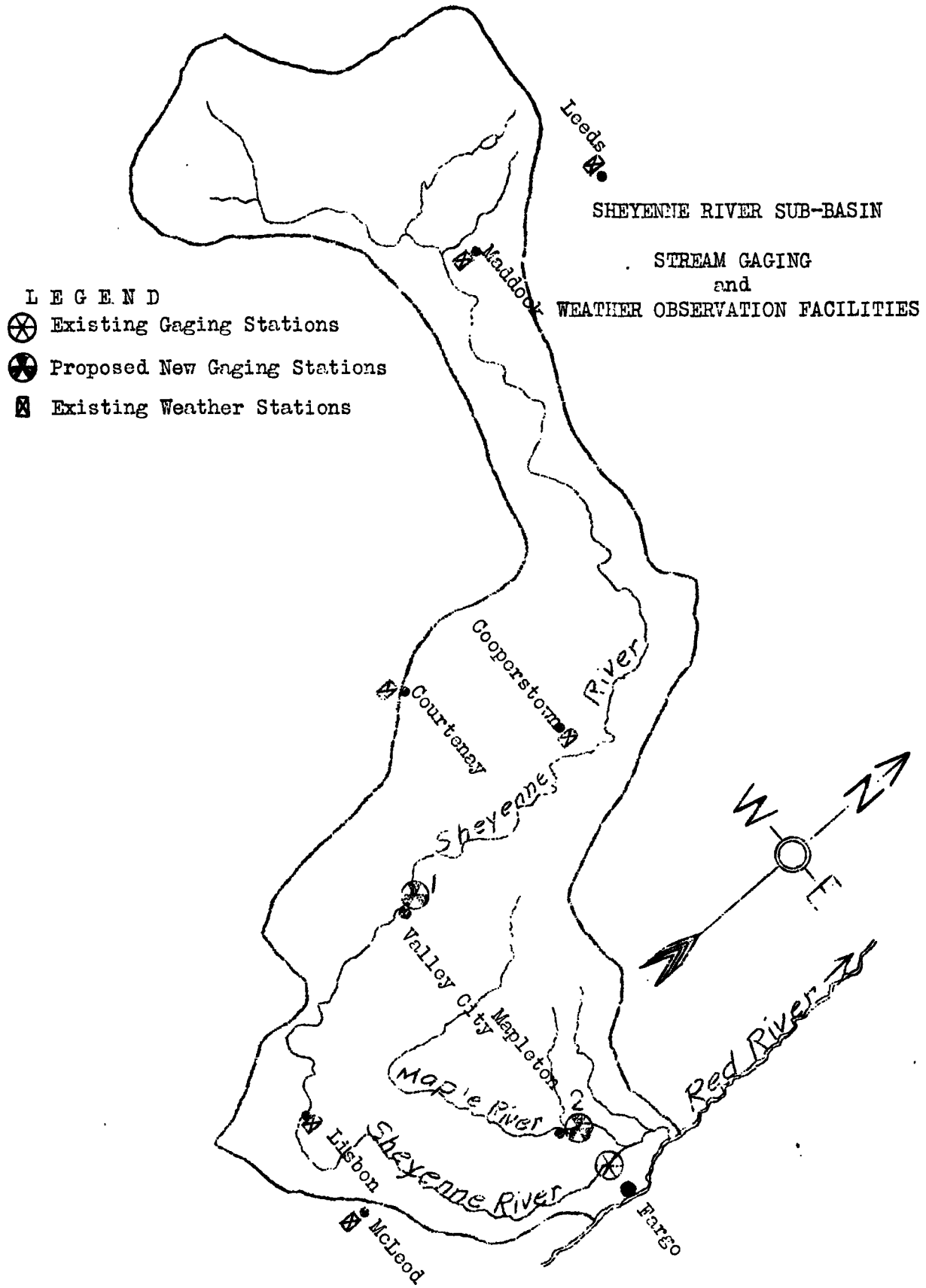

SHEYENNE RIVER SUB-BASIN
STREAM GAGING
and
WEATHER OBSERVATION FACILITIES
L E G E N D
Existing Gaging Stations
Proposed New Gaging Stations
Existing Weather Stations
Leeds
Maddock
Cooperstown
Courtenay
Sheyenne River
Valley City
Mapleton
Maple River
Red River
Lisbon
Sheyenne River
McLeod
Fargo
N
W
E

Plate III

CHAPTER III

LOWER RED SUB-BASIN

CHAPTER III

THE LOWER RED RIVER SUB-BASIN

GENERAL

The Lower Red River Sub-basin as designated in this report, is that area in North Dakota tributary to the Red River of the North not drained by the Dakota Wild Rice and the Sheyenne rivers. This includes an area of 7,329 square miles in the east central and northeastern part of the State. The counties entirely within this area are Traill, Grand Forks, Walsh, and Pembina. In addition, one-sixth of Cass County, two-thirds of Steele County, one-half of Nelson County, 40 or 50 square miles of Ramsey County (in the vicinity of Brocket and Lawton), two-thirds of Cavalier County, the north four townships of Towner County, and one or two tonwships in the northeast corner of Rolette County are also in this Sub-basin.

POPULATION

The relatively large population of the Lower Red River Sub-basin is due to the fact that it contains three urban centers, Fargo, Grand Forks and Grafton. As determined from the 1930 census, the population was 133,917 persons of which 71,366 resided in incorporated villages or cities and 65,423 resided in rural communities.

FEDERAL AID

During the month of peak load, March 1935, 21,726 persons received federal aid. This was 16.2% of the Sub-basin population. The state average for the peak month was 31.6% of the total state population.

TOPOGRAPHY

A large portion of the Sub-basin is located in that area known as the "Red River Valley." Actually, this "Valley" is the old lake bottom of Glacial Lake Agassiz. This old lake bed occupies the eastern portion of the Red River Basin in North Dakota in a belt thirty to forty miles in width immediately to the west of the Red River. To the west of this plain, the country has the gently rolling to hilly topography of the drift prairies. The two parts are separated by a steep rise known as the Pembina Escarpment. This rise of land is more pronounced in the "Pembina Mountains". This section of the Sub-basin is rugged country where the streams have eroded deep, steep-sided valleys and gullies back into the escarpment and the higher Drift Prairie region to the west. In the southern portion, the transition between the Valley Plain and the Drift Prairie becomes much more gradual until, in the upper reaches of the Basin, the transition is indiscernible.

SOILS

The soil in the "Red River Valley" is primarily lake silt. In many areas of this Sub-basin this soil is as fertile as can be found any place in the world. Along the edge of the "Valley",

the Pembina and the Elk Valley deltas were built up by streams that flowed into Glacial Lake Agassiz. The soil in these areas is sandy and very porous. West of the valley proper and of the delta areas, the soil is typical glacial drift. This is black loam intermixed with sand and gravel.

TRIBUTARIES

The main tributaries of the Red River below the Sheyenne on the North Dakota side are the Elm, Goose, Turtle, Forest, Park, and Pembina Rivers. Most of these have their headwaters in the drift Prairie or in the region of the Pembina Escarpment. In the upper parts of these river courses, the valleys are steep-sided, narrow and relatively deep. As the rivers leave the escarpment, the valleys are still narrow, but the depth is greatly decreased, and the courses become more winding. Numerous springs at the foot of the escarpment feed these rivers. Due to the flat country and poor drainage, and to the relatively light rainfall, most of the streams in the Red River Valley Plain are intermittent, and stream erosion is not very noticeable.

The tributaries generally flow southeastward until they reach the floor of the valley at which point they turn eastward and flow across the valley. As they near the Red River they have a tendency to turn northward and in some cases they flow nearly parallel with the main stream for many miles before finally entering it.

ELM RIVER

The Elm River rises in southeastern Steele and northwestern Cass Counties. It winds its way through the southern part of Traill County to its mouth in the southeastern corner of the county. The Elm River drains an area of 460 square miles and has an average annual runoff of 17,000 acre feet.

GOOSE RIVER

The Goose River has its source in central Nelson County. It flows southeastward, through the glacial drift area and the Elk Valley Delta. In doing so, it flows across the southwestern part of Grand Forks County, the northeastern part of Steele County, and into Traill County. Near the central part of Traill County it reaches the floor of the Red River Valley and turns eastward and slightly to the north. It continues in this direction to its confluence with the Red River near Caledonia. The Goose River has a drainage area of 1,260 square miles and an average annual runoff of 47,000 acre feet.

SMALL TRIBUTARIES

Between the mouth of the Goose River and that of the next important tributary, the Turtle River, there are several small streams that have some importance. Buffalo Creek in northeastern Traill County flows northeastward to its mouth which is just across the county line in Grand Forks County.

Cole Creek flows northeastward across the southeastern part of Grand Forks County. There are also a number of coulees draining directly to the Red River. Among these is the English Coulee at Grand Forks.

TURTLE RIVER

The Turtle River has its source in the vicinity of Petersburg in east central Nelson County. It flows eastward and slightly to the south through the Elk Valley Delta and reaches the floor of the Red River Valley near Arvilla in Grand Forks County. From this point it flows northeastward to its confluence with the Red River in the northeast corner of the county. The Turtle River has a drainage area of 700 square miles and an average annual runoff of 30,000 acre feet.

FOREST RIVER

The Forest River rises in the western part of Walsh County. It flows southeastward across the Pembina Delta to Inkster in Grand Forks County. In this vicinity it descends to the floor of the Red River Valley and flows in a tortuous course northeastward to its mouth which is about 11 miles north of the Walsh-Grand Forks County line. The Forest River drains 1,000 square miles and has an average annual runoff of 54,000 acre feet.

PARK RIVER

The Park River has its source in the southeastern part of Cavalier County. It flows southeastward through the Pembina Delta and descends to the floor of the Red River Valley near Park River in central Walsh County. From this point it flows eastward and very slightly to the north in a winding course to its confluence with the Red River 5 miles south of the Walsh-Pembina County line. The drainage area of the Park River is 1,130 square miles and its average annual runoff is 48,000 acre feet.

PEMBINA RIVER

The Pembina River has its source and much of its drainage area in Canada. It enters North Dakota near Elkwood in Cavalier County and flows southeastward to the Cavalier-Pembina County line. It then flows northeastward to Neche, near the international boundary. From Neche it flows eastward and slightly southward to its confluence with Red River at Pembina. The total drainage area of the Pembina River is 3,530 square miles of which 1,570 square miles are in North Dakota. The average total annual run off is 158,000 acre feet. The tributary area in Rolette and Towner Counties and in northwestern Cavalier County drains to small streams which flow northward into Canada and to the Pembina River. The most important tributary of the Pembina River in North Dakota is the Tongue River which has its source in east central Cavalier County. It flows northeastward to its confluence with the Pembina River a few miles up stream from the City of Pembina. The Tongue River drains an area of 510 square miles.

NATURAL RESOURCES

There are no mineral or timber resources in Sub-basin susceptible of commercial development.

GROUND WATER

There are three fairly distinct ground water horizons in the Red River Valley, namely: the shallow lacustrine deposits, the deeper glacial drift composed of till and assorted sand and gravel, and finally, the formations in the bedrock. There are no alluvial deposits in this area that are worth mentioning as a source of water supply.

THE WATER PROBLEM

The primary water problem in Sub-basin is the difficulty of securing adequate water supplies for human consumption. Towns and farms located on the almost impervious valley alluvium have great difficulty in securing wells yielding an adequate supply of satisfactory water. Cities located along the streams and depending upon the surface supplies sometimes face water famines during drought years. Fargo and Grand Forks are particularly in need of additional water supply. During the current drought, reserve supplies in both these cities have become so low that a grave situation is faced during the coming winter if rains do not replenish the supply in surface reservoirs before that time.

The stream flow in the Red River is great during the spring runoff period but becomes very low during drought periods. A number of storage reservoirs on streams tributary to the Red River are needed to store part of the excess spring run-off and to release it during periods of deficient stream flow.

Several localities are in need of small dams for recreation and for stock watering.

PRECIPITATION

The 20 year average of precipitation in the Sub-basin is 18.50 inches annually. That during the growing season, May through September, is 12.34 inches. The average precipitation during the growing season is sufficient to produce a fair crop. However, quite frequently there are years of great rainfall deficiency.

RUN-OFF

The average annual run-off varies over the Sub-basin from a minimum of 0.70 of an inch in the Elm River drainage area to 0.84 of an inch in the Pembina River drainage area. A large part of this occurs in the drift and escarpment areas. The Red River Valley floor is so flat that much of it has no well defined drainage courses. Moisture falling on these areas is largely absorbed by the ground or evaporates from the ground surface before reaching any stream.

FLOODS

The rivers of the Red River Sub-Basin have a rapid fall in the region where they descend to the floor of the Red River Valley, but in the valley itself their slope is slight. At the time of spring run-off these rivers sometimes carry water from the drift areas at a greater rate than the channels in the valley can carry it away, with the result that the rivers overflow their banks and flood the surrounding area.

At a point near Mandt, in Walsh County, the Park River has been known to overflow its banks and spread a thin layer of water over the land southeastward to the Forest River. The Forest River east of Ardock likewise sometimes leaves its channel and floods the land to the east. It appears that there is little or no damage done to livestock or buildings during these flood periods. Probably the only damage done is that the farmers are not able to get in the fields until perhaps ten days later than otherwise. The increased fertility left in the form of silt and the moisture absorbed by the soil more than compensates for this inconvenience. A remedy for floods along The Park River would be the construction of one or more large flood control reservoirs. It is probable that a site for such a project could be found a few miles east of Park River but a large amount of the most valuable farm land in Walsh County would be flooded. The cost of such a project would be greatly in excess of the possible benefits that would be derived therefrom. Local projects for diking and straightening the river channel in the vicinity of Mandt are needed to prevent excessive spring flooding.

WILD LIFE

There were formerly several large sloughs in the Sub-basin which served as breeding grounds for waterfowl. These sloughs were largely drained for use as farming land. They were usually unsuited for such purposes, however, and recently there has been an agitation for the restoration of these sloughs for waterfowl refuge purposes. The U.S. Biological Survey, under its easement program, is engaged in the restoration of such sloughs and lakes. It has undertaken the restoration of Ardock Lake in Walsh County, Twp. 155 N., Range 52W. and Kelly's Slough in Grand Forks County, Twp. 152, N., Range 52 W and several smaller projects. There are other projects in the Sub-Basin that should be investigated. Among these are projects for the raising of Ruch Lake in Cavalier County, Twp. 163 N., Range 62 W., the restoration of Roseau Lake in Cavalier County, Twp. 161 N., Range 58 W. and the restoration of a drained slough in Twp. 160 N., Range 52 W., and Twp. 161 N., Range 52 W.

RECREATION

Recreational facilities are quite well developed in the Sub-basin. Many towns in the area maintain picnic and camping grounds a number of which also include swimming and bathing facilities. In addition, a number of natural and artifical lakes serve the recreational needs of wide areas.

In Traill County recreational facilities are provided by Tobiason Lake near Hatton, by an artificial pond in Mayville, by a G.N. R.R. reservoir at Blanchard, by a reservoir on the Goose River at Portland, and by a reservoir on the Goose River at Hillsboro. The latter is not good due to its proximity to the sewer outlet. The flow in the river below the dam is not adequate to sufficiently dilute the sewage during drought years.

Facilities in Grand Forks include an outdoor artificial pool at Grand Forks, a private reservoir in Section 18-149-54, and another in Section 29-149-55. Swimming is also practiced during periods of good run-off in CCC reservoirs and natural pools along the Turtle River. A project especially worthy of notice is the Grand Forks State Park located near Arvilla which has been developed by C.C.C. workers under the direction of the National Park Service. There are a number of picnic grounds in the county.

Reservoirs on the Pembina River at Walhalla, Neche, and Pembina and on the Tongue River at Cavalier furnish Pembina County with swimming facilities. The Walhalla reservoir is also used for boating. The areas surrounding these reservoirs are used for camping and picnicking purposes. There are a number of picnic grounds in the area in addition to these.

Walsh County is provided with recreational facilities by reservoirs on the Park and Forest Rivers and their tributaries. Minto has a reservoir on the Forest River, and Park River has two on the Park River. Grafton, Forest River and Hooplealso have swimming facilities.

An FERA dam on a creek in Section 17-147-55, Steele County, maintains a reservoir which is used for recreational purposes although the water becomes stagnant during the latter part of each summer because of insufficient run-off.

Although there are a number of reservoirs in the Sub-basin which are used for recreational purposes, it is desirable to create a number of additional reservoirs in the tributaries of the area. These should be so located and of such size that water of suitable quality would be available for recreational purposes even during drought years.

WATER POWER AND NAVIGATION

The tributary streams of the Red River are not navigable and are incapable of producing large amounts of water power. The Red River itself was formerly navigated from Wahpeton to Winnipeg, but during recent years there has been no demand for river navigation and the water has been too low to support such. The slope of the Red River is so slight that the development of water power would necessitate a reservoir of excessive size which would cause prohibitive flowage damages. The height to which a dam could be built and consequently the power that could be produced is definitely limited because of the relatively low second banks of the channel. The flow of the river is not great enough to justify the expense of creating a large reservoir for purposes of developing water power.

CHANNEL IMPROVEMENT

The towns and cities of the Lower Red River Sub-basin have great difficulty in maintaining adequate and satisfactory supplies of water for their inhabitants. Towns depending upon wells for supply have seen their shallow wells go dry and have been forced to go to greater depths for a supply. Water from these lower strata are usually very highly mineralized and are frequently unfit for human consumption. Towns along tributary streams are forced to search for more adequate and satisfactory sources of ground water supplies in their vicinity.

Fargo and Grand Forks have been faced with a critical water shortage during recent drought years due to the greatly decreased flow in the Red and the Red Lake Rivers. Under the proposed program for the entire Red River Sub-basin an adequate stream flow would be maintained in the Red and the Red Lake Rivers to provide sufficient water for municipal supply and for the proper dilution of treated sewage at Fargo and Grand Forks.

Grafton could secure its supply from the Park River during average years if a suitable reservoir were constructed. However, present wells would have to be maintained in good condition so that this supply could be supplemented during drought periods. A more satisfactory, though a much more expensive solution, would be the laying of a pipe line to the Red River, a distance of about 13 miles, for securing an adequate surface water supply.

STREAM POLLUTION

Stream pollution is a serious problem in the Sub-basin. A number of towns have sewage disposal systems discharging into the streams of the area. Many of these do not have adequate sewage treatment plants. During drought years, when there is a great deficiency in stream flow, there is not adequate water for sewage dilution purposes. Hillsboro, on the Goose River is especially in need of additional water for pollution abatement. Sewage discharged below the present dam simply stands in pools and causes a serious health hazard. There is a large amount of industrial waste discharged into the Red River at Fargo and Grand Forks and a particularly acute situation has developed at West Fargo where several packing plants discharge their waste into the Sheyenne River. The flow in the Sheyenne River at this point frequently drops below 5 cubic feet per second, an amount entirely insufficient for the sewage dilution needs. The proposed program, if undertaken, would provide the necessary stream flow for pollution abatement during drought periods.

REGULATION RESERVOIRS

The construction of several large reservoirs on the North Dakota tributaries of the Red River would provide water storage to supplement reservoirs on the Minnesota tributaries. Records show that a year of minimum precipitation in one or more parts of the entire Red River Basin may be accompanied by average or

more than average precipitation in other portions of the Basin. During periods of low run-off in Minnesota it might be possible to store additional water in reservoirs in North Dakota. This water would be used in later months to more nearly maintain a constant flow in the Red River. In addition to stabilizing the flow in the Red River these reservoirs would serve to regulate the flow in the tributaries and would result in recreational facilities, pollution abatement, municipal supply, and stock watering benefits along these streams.

EXISTING DAMS

The present development of the water resources of the Lower Red River Sub-basin is listed in Table A and is shown on Plate II. This shows the total development at present to be 3,046 acre feet of storage. These reservoirs are used for purposes of recreation, stock watering, and railroad supply.

PROPOSED PROGRAM

It is proposed:

1. That several large regulating reservoirs be constructed on tributaries in the Lower Red River Sub-basin listed in Table D and shown on Plate II. These reservoirs would be located on the Pembina, the Goose, and the Tongue Rivers.

2. That a levee on the south side of the Park River be constructed at Mandt to give flood protection and that the river channel be straightened a short distance downstream. This project is also listed in Table D, and is shown on Plate II.

3. That a number of small dams as listed in Table D and shown on Plate II be constructed. All dams constructed hereafter in the Sub-basin should be provided with outlet gates for releasing the water stored when a great need arises for it downstream or when it becomes so polluted that it is a definite health hazard to the community. Many existing dams should also be provided with outlet gates.

4. That towns in the Sub-basin be given assistance in locating and developing adequate and satisfactory water supplies. Local surveys, including fluoride studies, should be undertaken for this purpose. Water supply problems with their probable solution are listed in Table B and are shown on Plate I.

5. That the larger towns be given assistance in installing and improving water supply systems and in developing adequate sewage treatment to prevent stream pollution. Proposed improvements in water supply systems are listed in Table B. Proposed improvements in sewage disposal are listed in Table C. Plate I shows proposed water supply and sewage disposal projects.

RURAL WATER SUPPLY

A large number of small reservoirs have been proposed for the Sub-basin by various agencies. Those that would serve purposes of recreation, irrigation, and waterfowl refuges have been included in the proposed program. It is proposed that before any more small dams for stock watering purposes be constructed in the Sub-basin, a detailed survey of rural water supply be undertaken to determine the best and most economical method of securing adequate and satisfactory water supplies for stock watering purposes. Where an adequate ground water supply is available it is probable that this would be through the construction of community wells. In other localities not having a reliable ground water supply the construction of surface reservoirs would be the only alternative. Following such a survey it is proposed that assistance be given in developing an adequate rural water supply.

STREAM GAGING AND WEATHER OBSERVATION FACILITIES

Proposed stream gaging stations are listed in Table E and these together with present facilities for stream gaging and weather recording are shown on Plate III. It is strongly urged that adequate facilities be established and maintained for the recording of stream flow and weather data for use in future planning.

THE WALHALLA RESERVOIR

The proposed large reservoir on the Pembina River would be created by a dam in section 31-163-56, and would store approximately 100,000 acre feet of water for stream regulating purposes. This would insure an adequate supply of water at Walhalla, Neche, and Pembina for municipal supply and for pollution abatement. In addition to the recreational benefits downstream from the dam this reservoir would furnish the recreational facilities of swimming, boating, and fishing to a large area. The regulation that it would be possible to secure would have a beneficial effect on the flow of the Red River entering Canada. During spring run-off it would diminish the flood peak and during other periods it would return to the river a volume of water equal to that held back by other tributary reservoirs and would thus serve to make the entire project beneficial, rather than detrimental, to our Canadian neighbors. A survey of the project is now underway by the U. S. Army Engineers Corps and the report on the project should be available at an early date.

GOOSE RIVER PROJECT

A large regulating reservoir is particularly needed on the Goose River for purposes of pollution abatement along the stream. A tentative site has been selected in Steele County and is also being surveyed by the U. S. Engineers Corps. This site would place the reservoir above the towns of Portland, Mayville, and Hillsboro and would provide these towns with water for municipal supply and for pollution abatement. There is a great need for water for the latter purpose, especially at Hillsboro, where a

serious health hazard exists. This reservoir would also provide great recreational facilities and would assist in the regulation of the Red River.

TONGUE RIVER RESERVOIR

A regulating reservoir on the Tongue River west of Cavalier would furnish a continuous flow for municipal supply, pollution abatement, and recreation for Cavalier and also for Bathgate. It would also give additional regulated flow in the Pembina River at Pembina. This project is also being investigated at the present time. A possible alternate method of maintaining a flow in the Tongue River would be by diversion from the Walhalla Reservoir on the Pembina River.

PARK RIVER LEVEE AND CHANNEL STRAIGHTENING

A levee is proposed along the south bank of the Park River near Mandt to keep the stream in the channel. Channel straightening below this point would also be necessary.

CONCLUSION

A balanced water program for the entire Red River of the North Drainage Basin should include reservoirs on tributary streams of sufficient size and distribution to adequately control the run-off to the main stream and thereby prevent floods during spring run-off periods and maintain a high minimum flow in the several tributaries and in the main stream itself during drought periods for alleviation of municipal supply and pollution problems along these streams. A number of small dams in headwater areas and on streams not capable of regulation are desirable. Through a detailed survey of the ground waters in the Sub-basin, local communities would be enabled to secure improved sources of water supply for domestic and stock watering purposes.

TABLE A

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
1.	Traill	25	145	52	32	$ 4,500	III,VI	E	Dam—Elm River. At Blanchard.	****
2.	Traill	21	144	53	30	4,000	III	E	Dam—Elm River. At Galesburg.	****
3.	Traill		146	52	15	3,000	III	E	Dam—Goose River. At Mayville.	****
4.	Traill	35	147	53	20	3,500	III	E	Dam—Goose River. At Portland.	****
5.	Traill	5	145	50	35	5,000	III,VI	E	Dam—Goose River. At Hillsboro.	****
6.	Traill	5	146	52	15	3,000	III,VI	E	Dam—Goose River. At Mayville.	****
7.	Traill	35	147	53	20	1,800	III,IV	F	Dam—Goose River. Portland Park Dam.	**
8.	Grand Forks	18	149	54	28	4,100	III	E	Dam—Goose. Near Northwood.	*
9.	Grand Forks	151/152		56	100	2,400	VII	F	Dam—Little Goose River.	*****
10.	Grand Forks	5	150	56	220	14,500	IV	E	Dam—Coulee.	*
11.	Grand Forks	31	152	54	6	6,000	III	E	South Fork of Turtle River.	*
12.	Grand Forks	1	151	55	7	2,000	III,VI	E	South Fork of Turtle River.	****
13.	Grand Forks	7	151	52	57	5,500	III,VI	F	Dam—Hazen Brook.	****
14.	Grand Forks	23	153	56	19	1,600	IV	F	Dam—Creek.	**
15.	Grand Forks	13/14	152	52	400	17,000	VII	F	Kelly's Slough Project.	*****
16.	Grand Forks	7	152	56	100	5,000	IV,VI	F	Dam—Creek. At Niagara.	****

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
17.	Grand Forks	7/8	152	56	96	$ 3,200	III,IV	P	Dam--Coulee.	**
18.	Grand Forks	2	153	55	8	2,100	III	E	Dam--Coulee.	**
19.	Grand Forks	17/18	154	56	40	2,000	IV	G	Dam--Creek.	**
20.	Grand Forks	21	150	56	990	20,000	III,IV VII	G	Dam--Creek.	**
21.	Grand Forks	36	152	54	100	7,500	III	F	Dam--Turtle River.	**
22.	Grand Forks	31	154	54	22	4,000	IV	F	Dam--Coulee.	**
23.	Grand Forks	29	152	50	4	500	III	F	Dam--English Coulee. Grand Forks Rifle Range.	**
24.	Grand Forks	23	152	56	60	6,000	III	F	Dam--Coulee.	**
25.	Grand Forks	31	150	50	60	6,000	III	E	Dam--Coven's Creek.	**
26.	Grand Forks	5	151	50	39	4,000	III,IV	F	Dam--English Coulee. University Campus.	**
27.	Grand Forks	30	153	55	3	3,000	III	E	Gunderson Dam--Creek.	**
28.	Steele	8	146	56	140	8,000	III	G	Dam--Creek.	**
29.	Steele	34	148	54	85	7,000	IV	E	Dam--Goose River.	*
30.	Steele	14	148	55	214	2,600	III	G	Dam--Creek.	**

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
31.	Steele	2	147	56	26	$ 7,000	IV	E	Dam--Creek.	**
32.	Steele	14	148	55	200	2,00	IV,VII	F	Dam--Lake Outlet.	**
33.	Steele	17	147	55	130	11,000	III,IV	F	Dam--South branch of Goose River.	**
34.	Steele	3	145	56	122	7,500	III,IV	F	Dam--Creek.	**
35.	Steele	32	147	56	47	2,000	III,IV	F	Dug reservoir. At Finley.	****
36.	Nelson	33	153	53	65	6,000	III,VII	G	Dam--Coulee.	****
37.	Nelson	25	151	57	54	5,500	IV	G	Dam--Creek.	*
38.	Nelson	5	151	57	47	5,500	IV	G	Dam--Coulee.	**
39.	Nelson	26	152	58	43	3,800	III,VII	G	Dam--Coulee.	*
40.	Nelson	15	154	58	220	8,900	III	F	Dam--Creek.	*
41.	Walsh	32	156	56	21	3,500	III	F	Dam--Creek.	*
42.	Walsh	14	157	58	22	4,900	III	E	Dam--North Branch of Forest River.	*
43.	Walsh	32	156	52	6	1,500	III,VI	E	Dam--Forest River. At Minto.	(*) (****)
44.	Walsh		155	52	2,500	20,000	VII	F	Dam--Ardock Lake Outlet.	*****
45.	Walsh		155	56	150	8,100	III,VI	G	Dam--Forest River. At Fordville.	****

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
46.	Walsh	21	155	56	80	$ 7,600	III	F	Dam--Coulee.	*
47.	Walsh	7	156	58	32	6,700	IV	G	Dam--Coulee.	*
48.	Walsh	31	157	57	135	18,900	IV	F	Dam--North Branch of Forest River.	*
49.	Walsh	28	155	53	12	1,100	VI	G	Dam--Forest River. At Forest River.	(****) (**
50.	Walsh	18	157	52	133	5,000	III	E	Dam--Park River. At Grafton.	*
51.	Walsh	21	157	55	71	3,500	III	E	Dam--South branch of Park River. At Park River.	*
52.	Walsh	5	158	54	20	3,900	III	E	Dam--Creek. At Hoople.	*
53.	Walsh	28	158	58	45	6,300	III	G	Dam--Creek.	*
54.	Walsh	13	157	53	166	8,200	III,VI	E	Dam--Park River. At Grafton.	****
55.	Walsh	20	158	53	33	3,200	IV	E	Dam--Cart Creek.	*
56.	Walsh	15	157	54	24	5,100	IV	E	Dam--South branch of Park River.	*
57.	Walsh	28	158	54	34	4,300	IV	E	Dam--Middle branch of Park River.	*
58.	Walsh	21	157	55	11	2,000	IV,VI	E	Dam--South branch of Park River. At Park River.	(****) (

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
59.	Walsh		155	58	120	$ 2,600	VII	F	Dam--Middle branch Forest River.	**
60.	Penbina	13	159	55	23	3,600	III	E	Dam--Cart Creek. At Crystal.	*
61.	Penbina	15	159	56	8	600	III	E	Dam--Coulee.	**
62.	Penbina	29	159	54	27	5,000	IV	E	Dam--Cart Creek.	*
63.	Penbina	4	163	51	74	6,000	III	E	Dam--Penbina River. At Penbina.	**
64.	Penbina	3	162	53	39	5,000	III	E	Dam--Tongue River. At Bathgate.	**
65.	Penbina	29	163	56	43	4,000	III	E	Dam--Penbina River. At Walhalla.	**
66.	Penbina	4	161	54	6	2,000	III,VI	E	Dam--Tongue River. At Cavalier.	****
67.	Penbina	31	164	53	6	2,000	III,VI	E	Dam--Penbina River. At Neche.	****
68.	Penbina	26	163	52	24	4,200	IV	E	Dam--Tongue River.	*
69.	Penbina	30	164	56	26	3,100	IV	F	Dam--Coulee.	*
70.	Penbina	27	162	54	23	4,900	IV	F	Dam--Tongue River.	*
71.	Penbina	28	164	56	153	3,700	IV	F	Dam--Coulee.	*

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

No.	County	Sec.	Twp.	Rge.	Storage A. F.	Cost Est.	Use	Desig-nation	Description and Remarks	Legend
72.	Cavalier	14	160	58	12	$ 4,100	III	E	Dam--Creek. Near Osnabrock.	*
73.	Cavalier	31	160	57	52	14,100	III	G	Dam--Creek. Near Milton.	**
74.	Cavalier	23	161	60	32	5,000	III,VI	G	Dug reservoir at Langdon.	****
75.	Cavalier	27	164	64	10	500	III	E	Dam--Creek.	**
76.	Cavalier	4	163	64	10	500	III	E	Dam--Creek. Near Sarles.	**
77.	Cavalier	13	163	60	212	11,000	IV	F	Mt. Carmel Dam--Little Pembina River.	**
78.	Cavalier	30	164	61	102	6,000	III,IV	G	Dam--Creek.	**
79.	Cavalier	27	159	58	50	5,000	IV	E	Dam--South branch of Park River.	***
80.	Cavalier	22	163	64	80	2,500	III,IV	F	Dam--Creek. Near Sarles.	**
81.	Nelson	33/34	152	58	500	5,000	VII	F	Lamb's Lake Project.	*****
	TOTAL EXISTING RESERVOIRS:				9,046	$432,200				

TABLE A (Cont'd.)

EXISTING RESERVOIRS

LOWER RED RIVER SUB-BASIN

LEGEND:

*	Constructed by CCC
**	Constructed by FERA and WPA
***	Constructed by Individuals
****	Constructed by Railways and Municipalities
*****	Constructed by U. S. Biological Survey

USE:

III	Recreation
IV	Stock Watering and Water Conservation
VI	Railway Supply
VII	Waterfowl Refuge

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
1.	Neche	502	Inadequate for fire protection. No Distribution system.	Treatment Plant and distribution system using water from Reservoir on Pembina River.			20,000	30,000	50,000
2.	St. Thomas	595	Inadequate. No distribution system.	Survey, 3 wells, treatment plant and distribution system.	100	1800	10,000	34,000	45,900
3.	Finley	587	Not satisfactory. No distribution system. Inadequate.	Survey, 2 wells, treatment plant and distribution system.	100	1200	15,000	33,000	49,300
4.	Hope	535	Inadequate for fire protection. No distribution system.	1 deep well, treatment plant and distribution system.		1600	8,000	30,000	39,600
5.	Hunter	406	Not satisfactory. No distribution system.	Survey, 2 wells, treatment plant and distribution system.	100	1200	5,000	25,000	31,300
6.	Page	443	Inadequate. No distribution system.	Survey, 2 wells, treatment plant and distribution system.	100	1200	5,000	25,000	31,300
7.	Fork River	1131	Not satisfactory	Treatment Plant			25,000		25,000

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municip-ality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estima
8.	Grafton	3136	High Fluoride Content	Dam on Red River. Intake pipe line, and treatment plant. New construction at wells.			40,000	63,000	103,00
9.	Cavalier	850	1½% Alkaline	Treatment Plant using water from reservoir in Tongue River with wells for stand-by supply, new pumping equipment and construction.			25,000	6,000	31,00
10.	Langdon	1221	Not satisfactory. Inadequate.	Survey, 1 well, and treatment plant.	100	600	26,000		26,70
11.	Aneta	558	Inadequate. Not satisfactory.	Survey, 2 wells, treatment plant and distribution system.	100	1200	10,000	33,000	44,30
12.	Michigan	433	Inadequate	Survey, 2 wells, treatment plant and distribution system.	100	1200	5,000	20,000	26,30
13.	Manvel	183	Inadequate	Survey and 1 well	100	600			70
14.	Mekinock	110	Inadequate	Survey and 1 well	100	600			70
15.	McCanna	100	Inadequate for fire protection.	Survey and 1 well	100	600			70
16.	Niagara	207	Inadequate	Survey and 1 well	100	600			70

TABLE B

PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
17.	Reynolds	357	Inadequate. Salty	Survey, 1 well, and treatment plant.	100	600	2,000		2,700
18.	Thompson	273	High Fluoride Content.	Survey and 1 well.	100	600			700
19.	Whitman	125	Inadequate.	Survey and 1 well.	100	600			700
20.	Bowesmont	131	Inadequate.	Survey and 1 well.	100	600			700
21.	Crystal	314	Inadequate.	Survey and 1 well.	100	600			700
22.	Drayton	502	Not satisfactory. Inadequate.	Dam on Red River. Treatment plant and distribution system.			10,000	40,000	50,000
23.	Glasston	160	Not satisfactory. Inadequate.	One shallow well for drinking and one deep well for fire protection.	100	3600			3,700
24.	Hamilton	151	Inadequate. Hard.	Survey, 1 well, treatment plant.	100	400	2,000		2,500
25.	Hensel	125	Inadequate.	Survey and 1 well.	100	600			700
26.	Mountain	150	Inadequate.	Survey and 1 well.	100	600			700
27.	Brocket	276	Alkaline. Inadequate for fire protection.	Survey and 1 well, Treatment Plant	100	600	2,000		2,700

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
28.	Lawton	233	Alkaline. Inadequate.	Survey and 1 well. Treatment Plant.	100	600	2,000		2,700
29.	St. John	372	Inadequate for fire protection.	Survey and 1 well.	100	600			700
30.	Gardner	108	Salty	Survey and 1 well. Treatment plant.	100	600	2,000		2,700
31.	Grandin	172	Inadequate for fire protection. Excess Solids.	Survey and 1 well. Treatment Plant.	100	600	1,000		1,700
32.	Alsen	358	Inadequate for fire protection.	Survey and 2 wells.	100	1200			1,300
33.	Calvin	325	Inadequate. Too hard.	Survey and 1 well. Treatment plant.	100	600	2,000		2,700
34.	Dresden	180	Inadequate for fire protection.	Survey and 1 well.	100	600			700
35.	Olga	100	Inadequate.	Survey and 1 well.	100	600			700
36.	Wales	270	Inadequate for fire protection.	Survey and 1 well.	100	600			700
37.	Arvilla	100	Inadequate for fire protection.	Survey and 1 well.	100	600			700
38.	Emerado	150	Not satisfactory.	Survey and 1 well.	100	600			700

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvement	Surveys	Wells	Treatment Plant	Dist. System	Total Estimat
39.	Gilby	255	Inadequate for fire protection.	One deep well.		2,000			2,000
40.	Inkster	257	Not satisfactory.	Survey and 1 well	100	600			700
41.	Northwood	971	No Distribution System.	Survey, 4 wells, treatment plant, and distribution system.	100	2,400	23,000	34,000	59,500
42.	Orr	101	Inadequate.	Survey and 1 well.	100	600			700
43.	Blabon	100	Inadequate.	Survey and 1 well.	100	600			700
44.	Colgate	51	Inadequate for fire protection.	One deep well.		1,600			1,600
45.	Sharon	328	Inadequate for fire protection.	Survey and 2 wells	100	1,200			1,300
46.	Hansboro	176	Inadequate. Too hard.	Survey and 1 well. Treatment Plant.	100	600	2,000		2,700
47.	Blanchard	100	High Fluoride Content. Inadequate for fire protection.	Survey and 1 well.	100	600			700
48.	Clifford	169	Inadequate. Too hard.	Survey and 1 well. Treatment Plant.	100	600	2,000		2,700
49.	Cummings	100	Not satisfactory	Survey and 1 well	100	600			700

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Objection to Present Supply	Proposed Improvement	Surveys	Well	Treatment Plant	Dist. System	Total Estimate
50.	Galesburg	280	Alkaline	Survey and 1 well. Treatment Plant.	100	600	2,000		2,700
51.	Ardock	110	Inadequate	Survey and 1 well.	100	600			700
52.	Conway	100	Inadequate	Survey and 1 well.	100	600			700
53.	Fairdale	111	Inadequate. Too hard.	Survey and 1 well. Treatment Plant.	100	600	3,000		3,700
54.	Forest River	198	Inadequate.	Survey and 1 well.	100	100			200
55.	Fordville	442	Inadequate for fire protection.	Survey and 1 well.	100	600			700
56.	Hoople	325	Inadequate. Alkaline	Survey and 1 well. Treatment Plant	100	600	2,000		2,700
57.	Lankin	267	Inadequate. Not satisfactory.	Survey and 1 well.	100	600			700
58.	Pisek	225	Inadequate. Not satisfactory.	Survey and 1 well. Treatment Plant.	100	600	2,000		2,700
59.	Minto	565	Inadequate for fire protection.	Treatment plant and distribution system using water from proposed reservoir.			21,000	32,000	53,000

TABLE B (Cont'd) PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municip-ality	Pop.	Objection to Present Supply	Proposed Improvements	Surveys	Wells	Treatment Plant	Dist. System	Total Estimate
60.	Portland	500	Inadequate	Survey and 2 wells. Treatment plant and distribution system.	100	1,200	8,000	30,000	39,300
61.	Hatton	804	Inadequate. No system.	Survey and 3 wells. Distribution system.	100	1,800		40,000	41,900
62.	Buxton	410	Inadequate. Too Hard. No System.	Survey and 1 well. Treatment plant and distribution system.	100	600	5,000	30,000	35,700
			Sub-Totals:		$ 5,300	$48,300	287,000	505,000	
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:									$ 845,600

TABLE B (Cont'd)

PROPOSED IMPROVEMENTS IN WATER SUPPLY

LOWER RED RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Local surveys of available sources	$ 5,300	
Deep wells--Hope, Glasston, Gilby, and Colgate.	8,200	
Distribution systems- Neche, St. Thomas, Finley, Hope, Cavalier, Aneta, Drayton, Northwood, Minto, Portland, and Hatton.	342,000	
Treatment Plants--Neche, St. Thomas, Finley, Hope, Cavalier Langdon, Aneta, Drayton, Northwood, Minto and Portland	176,000	
Total Class "A" Projects:		$ 531,500
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Shallow Wells		40,100
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Distribution systems	163,000	
Treatment Plants	111,000	
Total Class "C" Projects:		$ 274,000
TOTAL PROPOSED IMPROVEMENTS IN WATER SUPPLY:		$ 845,600

TABLE C

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost.
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:					
63.	Neche	502	No System	Sewer System with Sc.G.C., Imhoff, Tr. F., Sl, B.	$ 35,000
64.	Pembina	551	No System	Sewer System with Sc., G.C.,Imhoff, Tr.F., Sl, B.	35,000
65.	Drayton	302	No System	Sewer System with Sc., G.C. Imhoff, Tr.F., Sl, B	35,000
66.	Minto	565	No System	Sewer System with Sc., G.C., Imhoff, Tr.F.,Sl, B.	35,000
67.	Mayville	1199	Comb. Septic Tank. Inadequate.	Screens, G.C., Primary Treatment, Tr.F., Sl.B.	30,000
68.	Hillsboro	1317	Comb. Septic Tank, Inadequate.	Screens, G.C.,Primary Treatment, Tr.F., Sl.B with possible screening, Treatment & Cl, or SSD	35,000
69.	Grafton	3136	Comb. Septic Tank. Inadequate.	Primary treatment, Tr.F., Secondary treatment or SSD. with Cl.	60,000
70.	Park River	1131	Comb. Septic Tank. Inadequate.	Screen,G.C., Imhoff Tank, Tr. F., Sl.B.	35,000
71.	Walhalla	700	Comb. No Treatment.	Screen, G.C., Imhoff Tank, Tr.F.	25,000
72.	Cavalier	850	Comb. Septic Tank, Tr.F. Inadequate.	Same as Walhalla. Utilize septic tank.	25,000
73.	Langdon	1221	Comb. Septic Tank. Inadequate	Screen, G.C., Imhoff Tank, Tr.F., Utilize septic tank.	30,000

TABLE C (Cont'd)

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
74.	Larimore	979	Inadequate	Sc., G.C., Imhoff Tank or SSD, Tr.F.	30,000—
	Total Class "A" Projects:				$ 410,000
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
75.	St. Thomas	595	No System	Sewer System with Sc., G.C., Imhoff Tank, Tr.F., Sl.B.	35,000—
76.	Finley	587	No System	Sewer System with Sc., G.C., Imhoff Tank, Tr.F., Sl.B.	35,000—
77.	Hope	535	No System	Sewer System with Sc., G.C., Imhoff Tank, Tr.F., Sl.B.	35,000—
78.	Hunter	406	No System	Sewer System with Sc., G.C., Imhoff Tank, Tr.F., Sl.B.	35,000—
79.	Page	443	No System	Sewer System with Sc., G.C., Imhoff Tank, Tr.F., Sl.B.	35,000—
80.	Aneta	568	No System	Sewer System with Sc., G.C., Imhoff Tank. Tr.F., Sl.B.	35,000—
81.	Michigan	433	No System	Sewer System with Sc., G.C. Imhoff Tank, Tr.F., Sl.B.	35,000—
82.	Northwood	971	No System	Sewer System with Sc., G.C. Imhoff Tank, or SSD, Tr. F.	60,000—
83.	Portland	500	No System	Sewer System with Sc., G.C. Imhoff Tank, Tr.F., Sl.B.	35,000—

TABLE C (Cont'd)

PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL

LOWER RED RIVER SUB-BASIN

PLATE I MAP NO.	Municipality	Pop.	Type and Adequacy of Sewage Treatment	Proposed Improvements	Estimated Cost
84.	Hatton	503	No System	Sewer System with Sc., G.C., Imhoff Tank, or SSD, Tr.F.	45,000
85.	Buxton	410	No System	Sewer System with Sc., G.C., Imhoff Tank, or Tr.F., Sl.B.	35,000
				Total Class "C" Projects:	$ 420,000
TOTAL PROPOSED IMPROVEMENTS IN SEWAGE DISPOSAL:					$ 830,000

Legend for Sewage and Sewage Treatment:

Comb.	Combined System	SSD.	Separate Sludge Digestion	Sc.	Screened
G.C.	Grit Chamber	Tr.F.	Trickling Filter	Sl.B.	Sludge Beds
		Cl.	Chlorination		

TABLE D

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.		County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Dosig-nation	Description and Remarks	Survey
CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:											
1.	✓	Steele	11/12	147	54	20,000	$195,000	I,III, V	G	Construction of Steele County Reservoir on the Goose River.	*** U
2.	✓	Pembina	31	163	56	100,000	395,000	I,III, V,VII	E	Construction of Walhalla Reservoir on the Pembina River.	*** U
3.	✓	Pembina		161	55	5,000	100,000	I,III, V	F	Construction of Tongue River Reservoir above Cavalier.	*** U
4.	✓	Traill	15	146	49	60	6,000	III,V	E	Dam--Goose River at Caledonia.	*
5.	✓	Grand Forks	13	154	55	10	4,000	III,V	E	Dam--Forest River. Near Inkster.	*****
5a.	✓	Grand Forks	7	154	54	10	2,500	III,V	F	Dam--Forest River near Inkster. Alternate to No. 5.	*
6.	✓	Traill	34	144	50	60	6,000	III,V	E	Dam--Elm River. Near Grandin.	*
7.	✓	Grand Forks	36	150	50	60	6,000	III	E	Dam--Cole Creek. Near Thompson.	*****
8.	✓	Grand Forks	26/27	153	51	1,200	20,000	VII	F	Dam--Outlet to a salt slough. Would prevent contamination of water in Turtle River.	*
9.	✓	Traill	4	144	50	60	6,000	III	E	Dam--North Fork of Elm River. Near Kelso.	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surv
10.	Grand Forks	8	153	53	28	$ 3,600	III	F	Dam--Coulee. Near Gilby.	****
11.	Grand Forks	10	153	51	150	6,000	III,V	G	Dam--Turtle River. Near Manvel.	*
12.	Walsh	12	157	52	60	6,000	III	E	Dam--Park River.	****
13.	Steele	12	146	54	180	10,000	III,V	E	Dam--Creek.	*
13a.	Steele	13	146	54	(60)				Alternate to No. 13.	*
14.	Grand Forks	4	154	52	50	6,000	IV	F	Dam--Creek. Near Ardoch.	*
15.	Grand Forks	12	151	52	331	10,000	VII	G	Dam--Sault Coulee.	*
16.	Walsh	31/32	156	52	60	6,000	III,V	E	Dam--Forest River at Minto.	****
17.	Walsh		155	55	60	6,000	III,V	G	Dam--Creek. Near Conway.	*
(18).	Entire Sub-basin					20,000	IV,V	3000	Survey of small dams proposed for recreation and waterfowl refuge purposes. Survey of available satisfactory ground water supplies, including fluoride survey, to determine localities where satisfactory supplies of ground water may be obtained for domestic and stock watering purposes and others in which surface water must be used.	*
	Total Class "A" Projects:				127,379	$814,100				

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.		County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":											
19.	✓	Walsh	15/16	157	54		$25,000	I	F	Park River Channel Improvement.	*** U
20.	✓	Towner	16	163	68	60	6,000	III	G	Dam--Creek.	*****
21.		Traill	23	144	51	60	6,000	III,IV	E	Dam--Elm River.	*
22.	✓	Traill	16	144	49	60	6,000	IV	E	Dam--Elm River.	*
23.	✓	Walsh	26	158	52	150	8,000	IV	F	Dam--Coulee.	*****
24.	✓	Walsh	25	158	51	60	6,000	IV	E	Dam--Park River.	*****
25.	✓	Cavalier	21	159	58	30	3,000	IV	E	Dam--South branch of Park River.	*****
26.	✓	Walsh	11/14	157	57	9	2,500	III,IV	E	Dam--South branch of Park River.	*****
27.	✓	Grand Forks	15/22	151	56	(168)	(10,000)	IV	F	Dam--Goose River. Deferred construction. Not to be built if Steele County reservoir is approved.	*****
28.	✓	Traill	24/25	148	50	60	6,000	IV	E	Dam--Buffalo Creek.	*
29.	✓	Traill	4/5	148	49	60	6,000	IV	E	Dam--Buffalo Creek.	*
30.	✓	Traill	10/15	148	53	60	6,000	IV	G	Dam--North Fork of Goose River.	*
31.	✓	Steele	27	148	54	(160)	(20,000)	IV	F	Dam--Goose River. Deferred construction. Not to be built if Steele County reservoir is approved.	*****

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
32.	Grand Forks		154	53	20	$ 4,000	III	F	Dam--Creek.	*
33.	Nelson	26	153	57	50	5,000	IV	F	Vogel Dam--Creek.	*
34.	Cavalier	11	162	60	37	2,200	IV	G	Dam--Little Pembina River.	****
35.	Steele	12	144	54	300	6,000	III,IV	G	Dam--Elm River.	*
36.	Grand Forks	2	154	51	10	2,500	IV	E	Dam--Turtle River.	*
37.	Nelson	13	154	57	12	2,000	IV	F	Hamilton Dam--Coulee.	*
38.	Cavalier	4	160	57	7	2,500	IV	F	Dam--Coulee.	****
39.	Traill		145	52	60	6,000	IV	G	Dam--Elm River.	*
40.	Steele	11	147	54	(130)	(10,000)	III	E	Dam--Goose River. Deferred construction. Not to be built if Steele County Reservoir is approved.	*
41.	Grand Forks	5	152	51	20	2,000	IV	F	Dam--Hazen Brook.	*
42.	Cavalier	2	159	59	78	2,800	IV	G	Dam--South branch of Park River.	*
43.	Steele	28	148	55	(2,000)	(25,000)	VII	F	Dam--Little Fork of Goose River Diversion ditch to Golden Lake. Deferred construction. Not to be constructed if Steele County Reservoir is approved.	*

TABLE D (Cont'd.)

PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.-- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Survey
44.	Grand Forks	24/28	153	52	800	$ 2,500	VII	F	Stewart's Lake dam.	*
45.	Cavalier	20	161	59	2,000	10,000	VII	F	Dam--Outlet to Roseau Lake.	*
46.	Grand Forks	2	153	55	. . .	6,000	III	F	Repair dam.	*
47.	Cavalier		163	62	20,000	20,000	VII	F	Dams--Outlets to Rush Lake.	*
48.	Grand Forks	6	151	52	45	4,500	III	G	Dam--Hazen Brook at Emerado.	*
49.	Cavalier	13	162	61	60	6,000	IV	F	Dresden dam--Coulee.	*****
50.	Cavalier	21	163	59	180	8,500	III,IV	E	Westhope Dam--Little Pembina River.	*****
51.	Red River Flats					40,000	I	F	Rehabilitate drainage ditches in regions of good agricultural land.	*
52.	Pembina		162	52	2,000	5,000	IV	F	Reflood a slough. Should be investigated by Biological Survey.	*
53.	Walsh		155	53	60	6,000	III,V	G	Dam--Forest River at Forest River.	*
54.	Grand Forks	29	152	51	41	3,300	IV	F	Dam--Sault Creek.	*
55.	Steele	25	147	54	60	6,000	IV	G	Dam--Creek.	*
56.	Steele	16/9/4	144	55	2,000	25,000	IV	F	Dam in a creek and diversion ditch to a dry lake bed.	*

TABLE D (Cont'd.) PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES

LOWER RED RIVER SUB-BASIN

Plate II Map No.	County	Sec.	Twp.	Rge.	Storage Cap.- A. F. Est.	Cost Est.	Use	Desig-nation	Description and Remarks	Surv
(18).	Entire Sub-basin					$100,000	IV	F	Construction of community wells for stock watering and the construction of surface water reservoirs in certain communities after surveys have shown that ground water resources in the areas are unsatisfactory. Possible reservoir sites are located in: Grand Forks County, S 29-154-55, S 26-154-55, S 32-154-56, S 19-150-52, S 8-150-55, S 33-149-55, S 22-153-53, S 26-153-54, S 33-153-56, S 21-153-56, S 6-153-56, S 19-153-56, S 26-149-56, S 14/15-150-55, S 29-150-55, S 1-151-53, S 15-151-53, S 2-149-56, S 3/5-152-52, and S 19-152-54; Walsh County, S 22-158-59; Pembina County, S 4-160-56, S 35-160-56, S 12-162-56, S 11-159-56, S 17-159-56, S 30-159-56, S 29-159-56, S 10-159-56, and S 16-160-56; and Cavalier County, S 9-163-64.	*
	Total Class "C" Projects:				28,449	$358,300				
	TOTAL PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES:				155,828	$1,172,400				

SURVEY:

*	None
***	Surveyed by U. S. Army Engineers
****	Surveyed by CCC
*****	Surveyed by FERA and WPA
U	Survey Underway

USE:

I	Flood Control and Stream Regulation
III	Recreation
IV	Stock Watering and Water Conservation
V	Municipal Water Supply
VII	Waterfowl Refuge

DESIGNATION:

E	Excellent
G	Good
F	Fair
P	Poor

TABLE E

PROPOSED IMPROVEMENTS IN STREAM GAGING AND W EATHER OBSERVATION FACILITIES

LOWER RED RIVER SUB-BASIN

PLATE III MAP NO.	Station	New or Rehabilitated	Type of Station	Reading to Be Taken	Cost Estimate
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":					
1.	Manvel	New	Staff Recorder	Turtle River, Gage Heights	$ 200
2.	Walhalla	New	Staff Recorder	Pembina River, Gage Heights	200
TOTAL PROPOSED IMPROVEMENTS IN STREAM GAGING AND WEATHER OBSERVATION FACILITIES:					$ 400

TABLE F

PROPOSED PROJECTS

LOWER RED RIVER SUB-BASIN

SUMMARY

CLASS "A" PROJECTS DEMANDING IMMEDIATE ATTENTION:		
Proposed Improvements in Water Supply	$ 531,500	
Proposed Improvements in Sewage Disposal	410,000	
Proposed Improvements in Use of Surface Water Resources	814,100	
Total Class "A" Projects:		$ 1,755,600
CLASS "B" PROJECTS DEMANDING IMMEDIATE ATTENTION UPON COMPLETION OF SURVEY:		
Proposed Improvements in Water Supply		40,100
CLASS "C" PROJECTS IN PLAN NOT INCLUDED IN CLASSES "A" AND "B":		
Proposed Improvements in Water Supply	274,000	
Proposed Improvements in Sewage Disposal	420,000	
Proposed Improvements in Use of Surface Water Resources	358,300	
Proposed Improvements in Stream Gaging and Weather Observation Facilities.	400	
Total Class "C" Projects:		$ 1,052,700
TOTAL PROPOSED PROJECTS:		$ 2,848,400

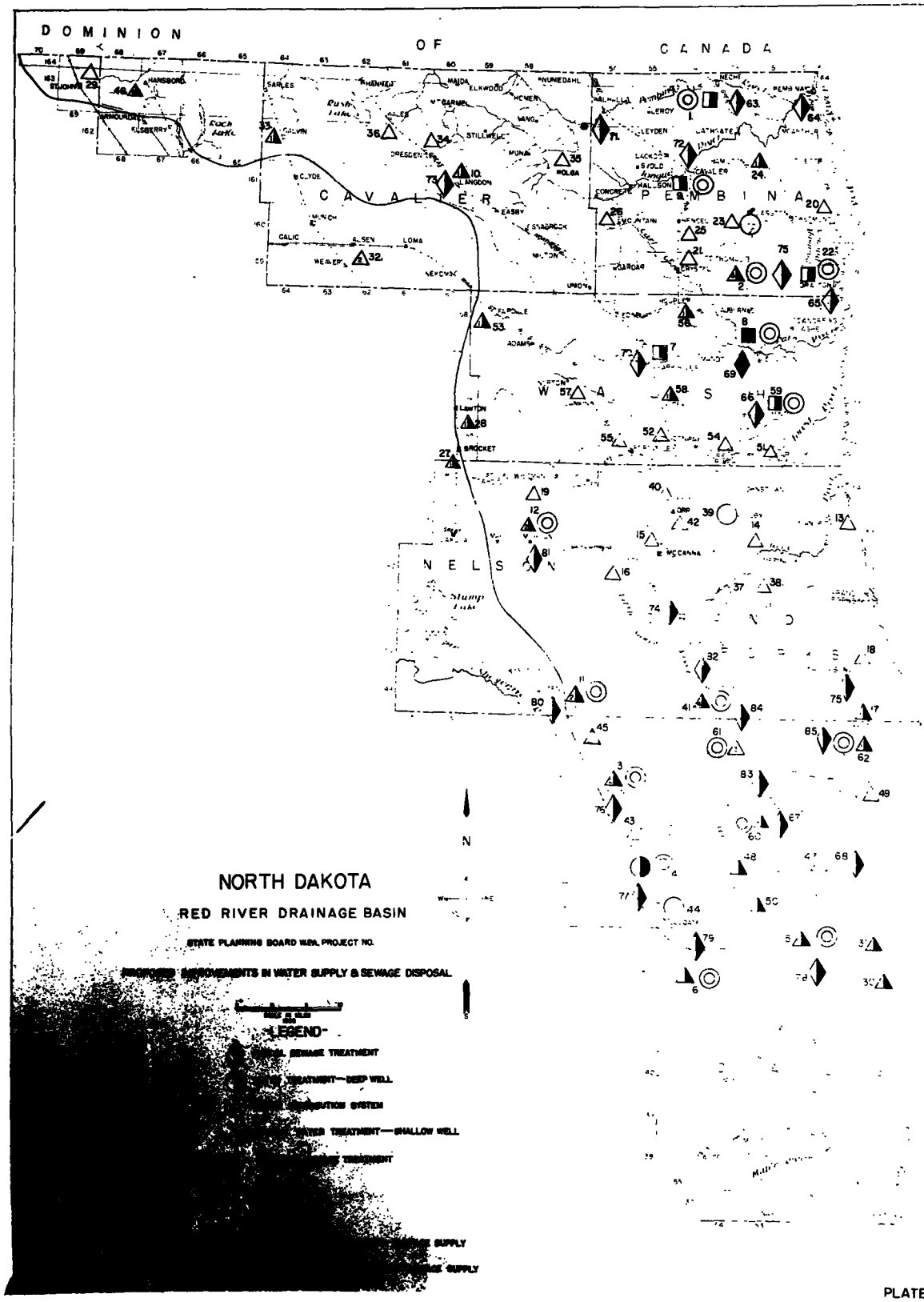
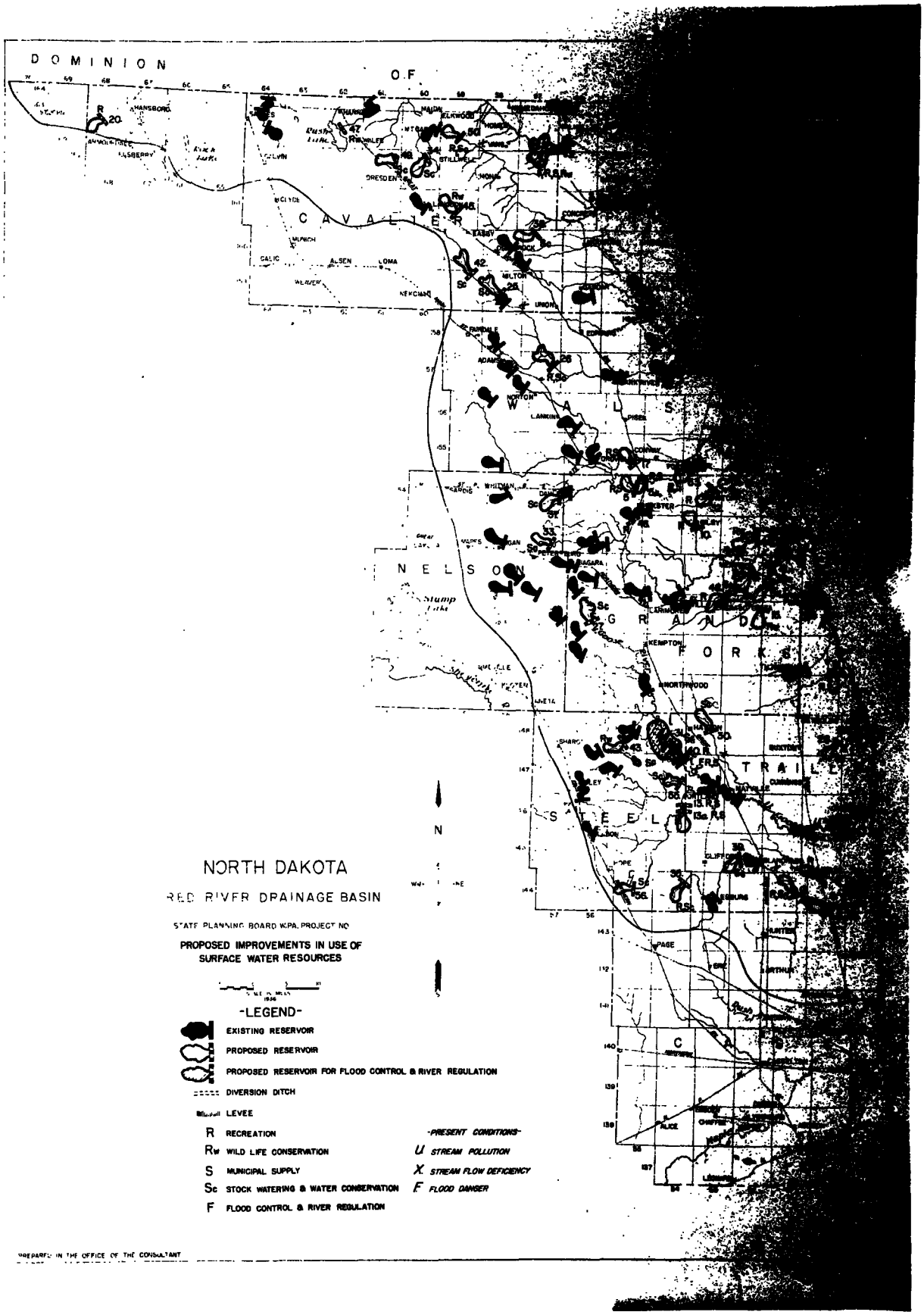

DOMINION OF CANADA
CAVALIER
PEMBINA
WALSH
NELSON
GRAND FORKS
NORTH DAKOTA
RED RIVER DRAINAGE BASIN
STATE PLANNING BOARD W&S PROJECT NO.
PROPOSED IMPROVEMENTS IN WATER SUPPLY & SEWAGE DISPOSAL
-LEGEND-

PLATE I


DOMINION O.F
CAVALIER
NELSON
GRAND FORKS
WALSH
STEELE
TRAILL
NORTH DAKOTA
RED RIVER DRAINAGE BASIN
STATE PLANNING BOARD W.P.A. PROJECT NO
PROPOSED IMPROVEMENTS IN USE OF SURFACE WATER RESOURCES
-LEGEND-
EXISTING RESERVOIR
PROPOSED RESERVOIR
PROPOSED RESERVOIR FOR FLOOD CONTROL & RIVER REGULATION
DIVERSION DITCH
LEVEE
R RECREATION
Rw WILD LIFE CONSERVATION
S MUNICIPAL SUPPLY
Sc STOCK WATERING & WATER CONSERVATION
F FLOOD CONTROL & RIVER REGULATION
-PRESENT CONDITIONS-
U STREAM POLLUTION
X STREAM FLOW DEFICIENCY
F FLOOD DANGER
N
PREPARED IN THE OFFICE OF THE CONSULTANT

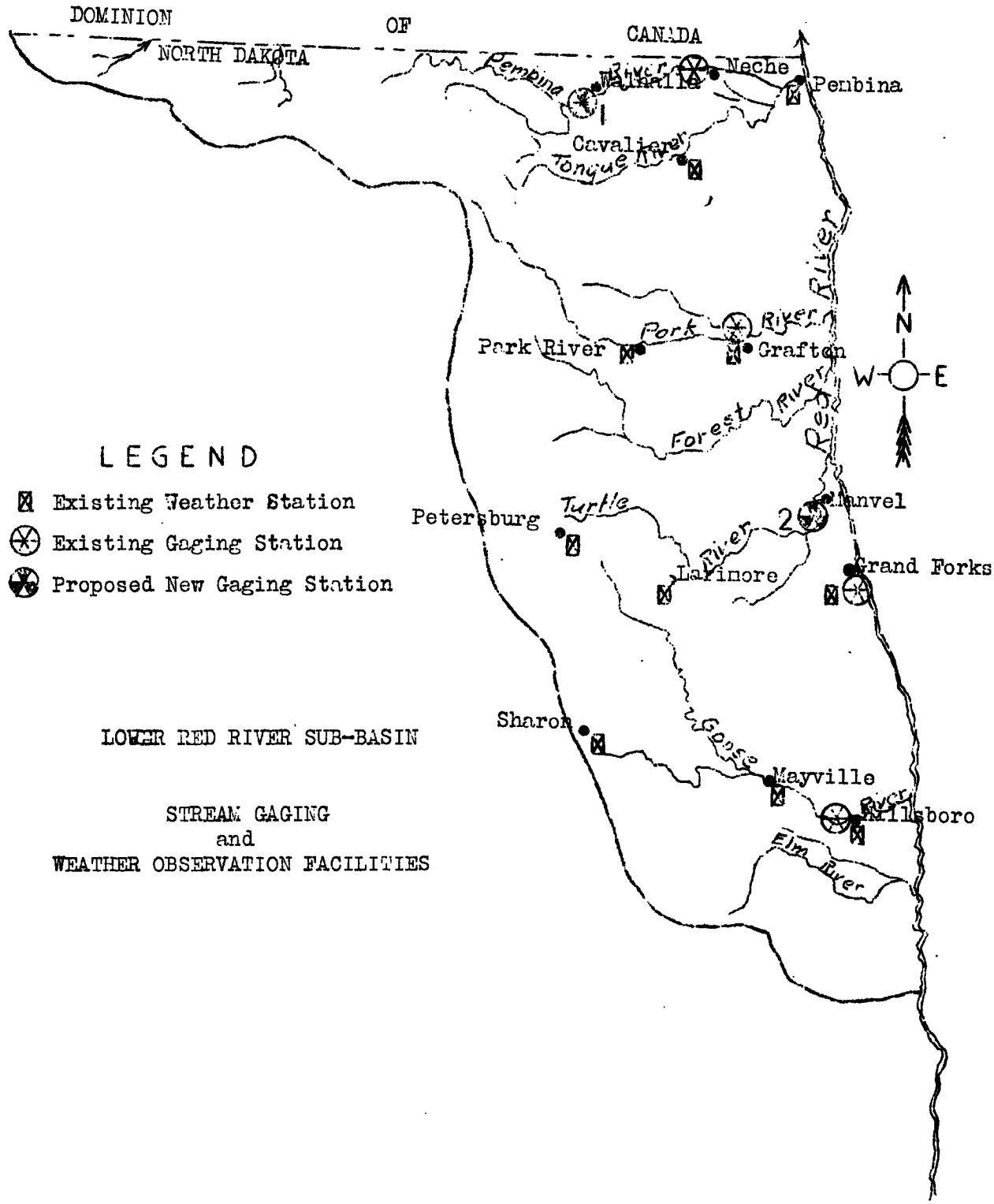

DOMINION OF CANADA
NORTH DAKOTA
Pembina River
Walhalla
Neche
Pembina
Cavalier
Tongue River
Park River
Park River
Grafton
Forest River
Red River
N
W
E
Turtle River
Petersburg
Manvel
2
Larimore
Grand Forks
Sharon
Goose River
Mayville
Hillsboro
Elm River
LEGEND
Existing Weather Station
Existing Gaging Station
Proposed New Gaging Station
LOWER RED RIVER SUB-BASIN
STREAM GAGING
and
WEATHER OBSERVATION FACILITIES

Plate III