

Comprehensive Watershed Management Plan



Red River of the North Watershed
June 2017



US Army Corps
of Engineers[®]
St. Paul District



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ACKNOWLEDGEMENTS

This Comprehensive Watershed Management Plan was developed under the specifically-authorized Red River Basin Feasibility Study. The Minnesota Red River Watershed Management Board and the North Dakota Red River Joint Water Resource District are the sponsors. The Red River Basin Commission cooperated extensively on development of the Comprehensive Watershed Management Plan. The Red River Basin Commission is an international watershed-focused non-profit organization led by 42 directors representing local, state, provincial and First Nation government agencies, the environmental community and citizen members. Several federal agencies also participate with the Red River Basin Commission as ex-officio members.

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COMPREHENSIVE WATERSHED MANAGEMENT PLAN

EXECUTIVE SUMMARY

On June 4, 2008, the U.S. Army Corps of Engineers St. Paul District, the North Dakota Red River Joint Water Resource District and the Minnesota Red River Watershed Management Board, acting as sponsors on behalf of the Red River Basin Commission (RRBC), signed a feasibility cost share agreement encompassing a broad effort to gather data, perform modeling, enhance management tools and conduct studies needed to manage the vast resource that is the Red River of the North. The culminating task of that effort is the preparation of this Comprehensive Watershed Management Plan (CWMP). The intent of this CWMP is to fully identify the problems, opportunities, goals and constraints facing local, state and federal watershed managers and to recommend some actionable items that will lead to improvement of the basin.

Work on this CWMP began in April 2014. This CWMP used the RRBC's May 2005 Red River Basin Natural Resources Framework Plan (NRFP) as its starting point. The intent is that this CWMP will be adopted as the successor to the NRFP. This CWMP will also be used to support future federal involvement in the basin, where appropriate.

This CWMP adopts the vision of the RRBC NRFP:

Vision Statement: A Red River Basin where residents, organizations and governments work together to achieve basin-wide commitment to comprehensive integrated watershed stewardship and management.

This CWMP combined the nine NRFP inventory teams and simplified the thirteen NRFP goal areas into six new focus areas:

1. Flood Risk Management and Hydrology
2. Fish, Wildlife and Ecosystem Health
3. Water Quality
4. Water Supply
5. Recreation
6. Soil Health

As part of the CWMP effort, interagency working groups were formed for each of these focus areas, with the aim of coming up with refreshed goals, objectives, strategies and recommended actions for

each area. The recommendations of the individual working groups were incorporated into an overall strategy, which is summarized in the main section of this document.

Working group participants include local and regional government units, Tribal nations, state and federal agencies, landowners, non-governmental organizations, the public and any other interested parties.

Federal agency participants include:

- U.S. Department of Commerce - National Oceanic and Atmospheric Administration (Flood Risk Management and Hydrology)
- U.S. Environmental Protection Agency (Water Quality)
- U.S. Fish and Wildlife Service (Fish, Wildlife and Ecosystem Health and Water Quality)
- U.S. Geological Survey (Fish, Wildlife and Ecosystem Health and Water Quality)
- U.S. Department of Agriculture - Natural Resources Conservation Service (Water Quality and Soil Health)

This CWMP adopted a similar framework to that used in the NRFP, in that individuals were assigned to working groups that developed goals and objectives for each of the focus areas. The recommendations of the working groups were then incorporated into an overall plan. Similar to the NRFP, the CWMP identifies the agency or organization responsible for implementing each of the recommendations.

The purpose of the Red River Basin CWMP is to:

- Develop a watershed plan to direct future activities and investments in the basin that comprehensively address the watershed's problems and to assist in achieving watershed goals and objectives.
- Develop a basin-wide comprehensive watershed management plan consistent with the framework, vision, goals and objectives of ongoing collaborative basin efforts, which incorporates improved flood risk management, ecosystem restoration, water quality, water supply, recreation and soil conservation.
- Recommend strategies, broad plans and further study of activities or projects that address the identified watershed problems, achieve the identified watershed objectives and identify the entity best suited for accomplishing such activities.
- Provide supporting documentation for further federal action.

The Red River CWMP identifies six goals, respective to the six resource focus areas:

1. To develop a more flood resilient Red River Basin.
2. To maintain existing habitat and restore natural systems in the Red River Basin.
3. To maintain, protect and restore surface and ground water quality in the Red River Basin.
4. To develop a basin-wide strategy for future water supply needs to ensure an adequate supply for beneficial uses.
5. To inform and increase the enhancement and development of recreational opportunities within the Red River Basin.
6. To maintain and enhance soil health within the Red River Basin.

This CWMP recommends a number of follow-up actions by both the federal government and the local sponsors:

Candidate studies and projects recommended for federal action

- Deauthorization of old clearing and snagging projects on the Lower Branch of the Rush River and the Lower Wild Rice River (see Appendix B – *Fish, Wildlife and Ecosystem Health*)
- Utilize existing programs to restore and enhance the environment (e.g., wetland and prairie restoration; see Appendix B – *Fish, Wildlife and Ecosystem Health*)

Candidate studies and projects recommended for action by other entities

- Increased access to water-associated and water-dependent recreation in the Red River Basin
- Implementing “soft path” recommendations for water conservation (see Appendix D – *Water Supply*)
- Create an environmental education curriculum that can be easily adopted by primary and secondary educators
- Develop a basin-wide nutrient management strategy for the International Red River Watershed (see Appendix C – *Water Quality*)
- Water quality modeling
- Water quality monitoring
- Develop a basin-wide drought preparedness plan (see Appendix D – *Water Supply*)
- Develop recreation baselines for the basin (see Appendix E – *Recreation*)
- Encourage holistic planning efforts for the basin
- Develop a soil sampling system across the basin to determine a baseline assessment of the current soil health conditions (see Appendix F – *Soil Health*)

Looking Forward: The Red River Basin local sponsors are committed to long-term management of their resources. While flood risk management has been the focus of many previous projects and will continue to be an important focus area, the local sponsors recognize that stewardship extends to the management of water supply, water quality, fish and wildlife, recreation and soil health, which are all interconnected. The next step toward achieving the Red River Basin watershed goals is to conduct feasibility studies that analyze, evaluate, design and implement the candidate projects identified in this report.

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DISCLAIMER

The information presented in this report is to provide a strategic framework of potential options to address problems within the Red River of the North watershed. Options identified will follow normal authorization and budgetary processes of the appropriate agencies. Any costs presented are rough order magnitude estimates used for screening purposes only.

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COMPREHENSIVE WATERSHED MANAGEMENT PLAN

1 INTRODUCTION

1.1 Background

On June 4, 2008, the U.S. Army Corps of Engineers (Corps) St. Paul District, the North Dakota Red River Joint Water Resource District (RRJWRD) and the Minnesota Red River Watershed Management Board (RRWMB), acting as sponsors on behalf of the Red River Basin Commission (RRBC), signed a feasibility cost share agreement encompassing a broad effort to gather data, perform modeling, enhance management tools and conduct studies needed to manage the vast resource that is the Red River of the North (also known as Red River). The culminating task of that effort is the preparation of this Comprehensive Watershed Management Plan (CWMP).

The Corps and the RRBC begin discussions in July 2013 regarding the scope of the CWMP effort. This effort was seen as an opportunity to update the 2005 Red River Basin Natural Resources Framework Plan (NRFP), which has been the guide for water resource-related activities in the basin. The CWMP, in addition, would identify opportunities for federal involvement in the basin.

The 2005 NRFP was built upon the work of nine inventory teams, which each developed an inventory report focusing on the following areas:

1. Flood Damage Reduction
2. Hydrology
3. Water Quantity
4. Fish, Wildlife and Outdoor Recreation
5. Water Institutions
6. Drainage
7. Water Quality
8. Conservation
9. Water Law

*Red River Basin is also
known as Red River Basin of
the North and simply RRB*

Along with the nine inventory reports, the 2005 NRFP contained thirteen stated goals for the basin.

1. Manage natural resources in the Red River Basin by watershed boundaries rather than political boundaries
2. Integrate natural resource management
3. Increase applied research and data management to support decision making
4. Improve stakeholder participation and awareness of land and water issues
5. Maintain state-of-the-art flood forecasting tools for the Red River Basin
6. Reduce risk of flood damages for people, property and the environment in the main stem floodplain and tributary waters
7. Ensure that flood (natural disaster) response and recovery programs meet the needs of all Red River Basin residents

8. Manage urban and agricultural drainage systems to enhance productivity, while minimizing impacts to others.
9. Maintain, protect and restore surface and ground water quality in the Red River Basin
10. Ensure the appropriate use and sustainability of the basin's surface and ground water
11. Increase soil conservation efforts within the basin
12. Conserve, manage and restore diversity and viability of native fish and wildlife populations and their habitats
13. Enhance and develop recreational infrastructure and access to the basin's natural resources

The nine focus areas defined in the NRP were combined into six focus areas for the purposes of the CWMP:

1. Flood Risk Management and Hydrology
2. Fish, Wildlife and Ecosystem Health
3. Water Quality
4. Water Supply
5. Recreation
6. Soil Health

The proposed work effort was introduced publicly in January 2014 at the Red River Basin Land and Water Summit Conference, and individuals were invited to participate in six working groups—one for each focus area, each composed of a broad cross-section of stakeholders, experts, RRBC and Corps staff and jurisdictional representatives. These interagency working groups were to follow the Corps' 6-step planning process in order to come up with refreshed goals, objectives, strategies and recommended actions for each focus area. The recommendations of the individual working groups were incorporated into an overall strategy, which is summarized in this document.

The working groups began work in April 2014.

1.2 Purpose

The intent of this CWMP is to fully identify the problems, opportunities, goals and constraints facing local, state and federal watershed managers and to recommend some actionable items that will lead to improvement of the basin. This CWMP used the RRBC's May 2005 NRP as its starting point. The intent is that this CWMP will be adopted as the successor to the NRP. This CWMP will also be used to support future federal involvement in the basin, where appropriate.

The purpose of this CWMP is to:

- Develop a watershed plan to direct future activities and investments in the basin that comprehensively address the watershed's problems and to assist in achieving watershed goals and objectives.
- Develop a basin-wide comprehensive watershed management plan, consistent with the framework, vision,



goals and objectives of ongoing collaborative basin efforts, that incorporates improved flood risk management, ecosystem health, water quality, water supply, recreation and soil conservation.

- Recommend strategies, broad plans and further study of activities or projects that address the identified watershed problems and achieve the identified watershed objectives and identify the entity best suited for accomplishing such activities.
- Provide supporting documentation for further federal action.

1.2.1 Vision Statement

A Red River Basin where residents, organizations and governments work together to achieve basin-wide commitment to comprehensive integrated watershed stewardship and management.

The CWMP is a tool that contributes to developing a unified approach to managing the basin's resources, while working towards the basin vision. The CWMP and supporting working group reports outlines ways in which studies, projects and activities can help achieve the vision of basin-wide comprehensive integrated watershed stewardship and management.

1.2.2 Report Organization

The Red River of the North CWMP is focused on six resource areas:

1. Flood Risk Management and Hydrology
2. Fish, Wildlife and Ecosystem Health
3. Water Quality
4. Water Supply
5. Recreation
6. Soil Health

Interagency working groups were formed for each of these focus areas, with the aim of coming up with refreshed goals, objectives, strategies and recommended actions for each area. The recommendations of the individual working groups are summarized in Sections 6 and 7 of this document.

This report has separately bound supporting appendices documenting the working group reports for each of the six resource areas listed above. The purpose of the main CWMP is to concisely summarize the multidisciplinary efforts of the Corps; RRBC; federal, state and local government entities; and the public that lead to the overall study recommendations.

The report is organized into the following sections:

1. **Introduction:** highlights the study authority, purpose and scope, and background of the study.
2. **Study Area: Red River of the North Watershed:** description of the study area.
3. **Existing Conditions:** summary of basin conditions and expected future conditions.
4. **Plan Formulation:** description of the resource area working group process, study vision and goals; an assessment of problems, opportunities, objectives and constraints; and summaries of the formulation and evaluation of alternatives.
5. **Study Findings and Recommendations:** summary of findings from each resource area working group; recommendations for further study, action or implementation; and identification of agency or entity best suited to carry recommendation forward.
6. **Conclusion**

7. **Public Involvement and Agency Coordination:** summary of coordination, public views and comments.

1.3 Authority

Development of the CWMP is being performed as part of specifically-authorized Red River Basin Feasibility Study (Feasibility Study). The CWMP is being developed as a unique standalone document; however, the entire CWMP effort is part of the larger Feasibility Study.

The Feasibility Study is a specifically-authorized General Investigations Study, recommended under the 2001 Red River Reconnaissance Study, which was authorized by a 30 Sep 74 Resolution of Senate Committee on Public Works:



RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review reports on the Red River of the North Drainage Basin, Minnesota, South Dakota and North Dakota, submitted in House Document Numbered 185, 81st Congress, 1st Session, and prior reports, with a view to determining if the recommendations contained therein should be modified at this time, with particular reference to flood control, water supply, waste water management and allied purposes.

A § 905(b) analysis was prepared as part of the Red River Reconnaissance Study, Red River Basin, Minnesota, North Dakota, South Dakota and Manitoba, which recommended a study of:

Basin-wide/main stem: One of the basin-wide/main stem feasibility study's objectives is to develop a comprehensive perspective of the basin's water resources-related problems and opportunities and, thus, to articulate basin-wide goals and integrate local planning efforts. In theory, a holistic planning approach should facilitate subbasin efforts to implement local protection while simultaneously providing Red River main stem benefits. This feasibility study would create a basin-wide water resources management plan, identify structural and nonstructural measures to address water quality and water quantity problems, and generate watershed models to support development of the comprehensive plan. The basin-wide/main stem feasibility study would offer a broad flood damage reduction/natural resource enhancement blueprint to which subbasins could refer when they update their watershed management plans and when they and the Corps partner on subbasin feasibility studies. This would ensure that all stakeholders consider common goals in their planning efforts. In addition, the basin-wide/main stem feasibility study is the appropriate vehicle to analyze opportunities that subbasin feasibility studies will not address, e.g., the main stem Greenway concept and the ND and MN agricultural levees.

Congress authorized the expenditure of funds on this study in Public Law 110-161, Consolidated Appropriations Act, 2008, approved 26 December 2007. A Feasibility Cost Share Agreement (FCSA) was signed on June 4, 2008. The FCSA defines the study as:

“ . . . the activities and tasks required to identify and evaluate alternatives and the preparation of a decision document that; when appropriate, recommends a coordinated and implementable solution for flood damage reduction, ecosystem restoration, and recreation at the Red River of the North Drainage Basin, Minnesota, South Dakota, and North Dakota, as generally described in the Reconnaissance Study . . . approved by the Commander, U.S. Army Corps of Engineers on September 19, 2002.”

1.4 Study Sponsor

This is a specifically-authorized General Investigations Study. Development of the CWMP is being performed as part of the Feasibility Study. The Minnesota RRWMB and the North Dakota (RRJWRD) are the sponsors. The sponsors are supported by a number of partnering agencies, organizations and cities including the Red River Retention Authority; Southeast Cass County Water Resources District; International Water Institute (IWI); the State of North Dakota (State Water Commission); the State of Minnesota (Department of Natural Resources, Department of Transportation and the Governor’s Council on Geographic Information Systems [GIS]); Buffalo-Red Watershed District, Fargo, ND; West Fargo, ND; Moorhead, MN; Breckenridge, MN; Wahpeton, ND; Grand Forks, ND; East Grand Forks, MN; the U.S. Natural Resource Conservation Service; and the U.S. Geological Survey (USGS). In addition to those partners a number of other stakeholders have indicated their support including the Minnesota Association of Wheat Growers; North Dakota Grain Growers Association; North Dakota Corn Growers Association; Precision Partners Inc.; Greenway on the Red; Red River Valley Sugarbeet Growers Association; North Dakota Soybean Growers Association; Cass County ND; North Dakota Farmers Union; RRBC; and the International Red River Board (IRRB).

*Development of the CWMP is
being performed as part of Red
River Basin Watershed
Feasibility Study*

1.5 Specifically-Authorized Red River Basin Feasibility Study

The basin-wide Feasibility Study integrates several ongoing planning efforts, which build upon IRRB and RRBC initiatives. Study tasks include collecting basin-wide LiDAR mapping data, refining hydrologic and hydraulic models to be used for project planning and flood forecasting, updating the floodplain information and management tools available on the Red River Basin Decision Information Network (RRBDIN) (<http://www.rrbdin.org/>), developing a basin-wide flood storage strategy and developing this CWMP. The study supports local officials’ efforts to set reasonable and attainable goals that provide both local and regional benefits.

As part of Corps’ Feasibility Study, several interim products have been completed. These include:

- Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) modeling
- Update to unsteady Hydrologic Engineering Center-River Analysis System (HEC-RAS) modeling
- A Non-Structural Flood Risk Management Feasibility Study

- The RRBC’s Red River Basin Long Term Flood Solutions Report (RRBLTFSR)
- Update to the Red River Basin Decision Information Network

The Feasibility Study is divided into four major phases:

1. Data Collection
2. Modeling and Planning
3. Decision Support System
4. Reporting

Development of the CWMP is a part of the reporting phase.

1.6 Reference Documents

Since the 1940s, the Corps and others have prepared numerous reports on the Red River Basin. The following paragraphs are a summary of the most relevant documents.

- House Document 185, 81st Congress, 1st Session, dated May 24, 1948. This report proposed a comprehensive plan for the Red River Basin. The plan included channel improvements, levees and floodwalls in Fargo and Moorhead. Other components of the plan included the Orwell Reservoir on the Otter Tail River in Minnesota; channel improvements on the lower Sheyenne, Maple and Rush Rivers in North Dakota; channel improvements on the Mustinka, Otter Tail, Wild Rice, Marsh and Sand Hill Rivers in Minnesota; channel improvements along the Bois de Sioux and upper Red Rivers near Wahpeton, North Dakota/Breckenridge, Minnesota; and local flood protection works on the Red River in Grand Forks, North Dakota/East Grand Forks, Minnesota.
- Federal Tier 1/State Generic Environmental Impact Study of Flood Control Impoundments in Northwestern Minnesota, Corps and Minnesota Department of Natural Resources (DNR), July 1996. This study was a joint federal and state effort, and it addressed the potential water surface impoundments in the Red River watershed. This joint environmental impact study was challenged in Minnesota District Court, and in 1997, the Minnesota Legislature authorized funding for a “Mediation” process to resolve disputed issues and permitting gridlock.
- Reconnaissance Study, Red River Basin, Minnesota, North Dakota, South Dakota, Corps of Engineers, September 2001.
- Red River Basin Natural Resources Framework Plan, RRBC, May 2005. This report was developed as a tool to contribute toward a basin-wide approach for effective, integrated land and water management.



- “Red River Inventory Reports,” RRBC, 2000. The inventory reports were put together to support the various goal areas in developing the NRFP.
 - Conservation Inventory Report
 - Fish, Wildlife and Outdoor Recreation Inventory Report
 - Flood Damage Reduction Inventory Report
 - Drainage Inventory Report
 - Hydrology Inventory Report
 - Water Institutions Inventory Report
 - Water Quality Inventory Report
 - Water Supply Inventory Report
 - Water Law Inventory Report
- RRBC’s Red River Basin Long Term Flood Solutions Report. Final report to the States of Minnesota Pursuant to Session Laws (2009 Chapter 93) and North Dakota Pursuant to the 2009 North Dakota Chapter 20, House Bill 1046, section 9, September 2011.

2 STUDY AREA: RED RIVER OF THE NORTH WATERSHED

The Red River of the North Basin (also known as Red River Basin) is an international, multi-jurisdictional watershed of 45,000 square miles, with 80 percent of the basin lying in the United States and 20 percent in Manitoba, Canada. Eighteen Minnesota counties, 22 North Dakota counties and two South Dakota counties lie wholly or partially in the basin (Figure 1).

The economic impact of the basin, from both urban-generated activity and a vibrant agricultural economy, is significant. This basin is home to more than a million people and serves as a jobs, education and medical hub, in addition to a world-renowned agricultural producer.



Lake Orwell Dam, Minnesota

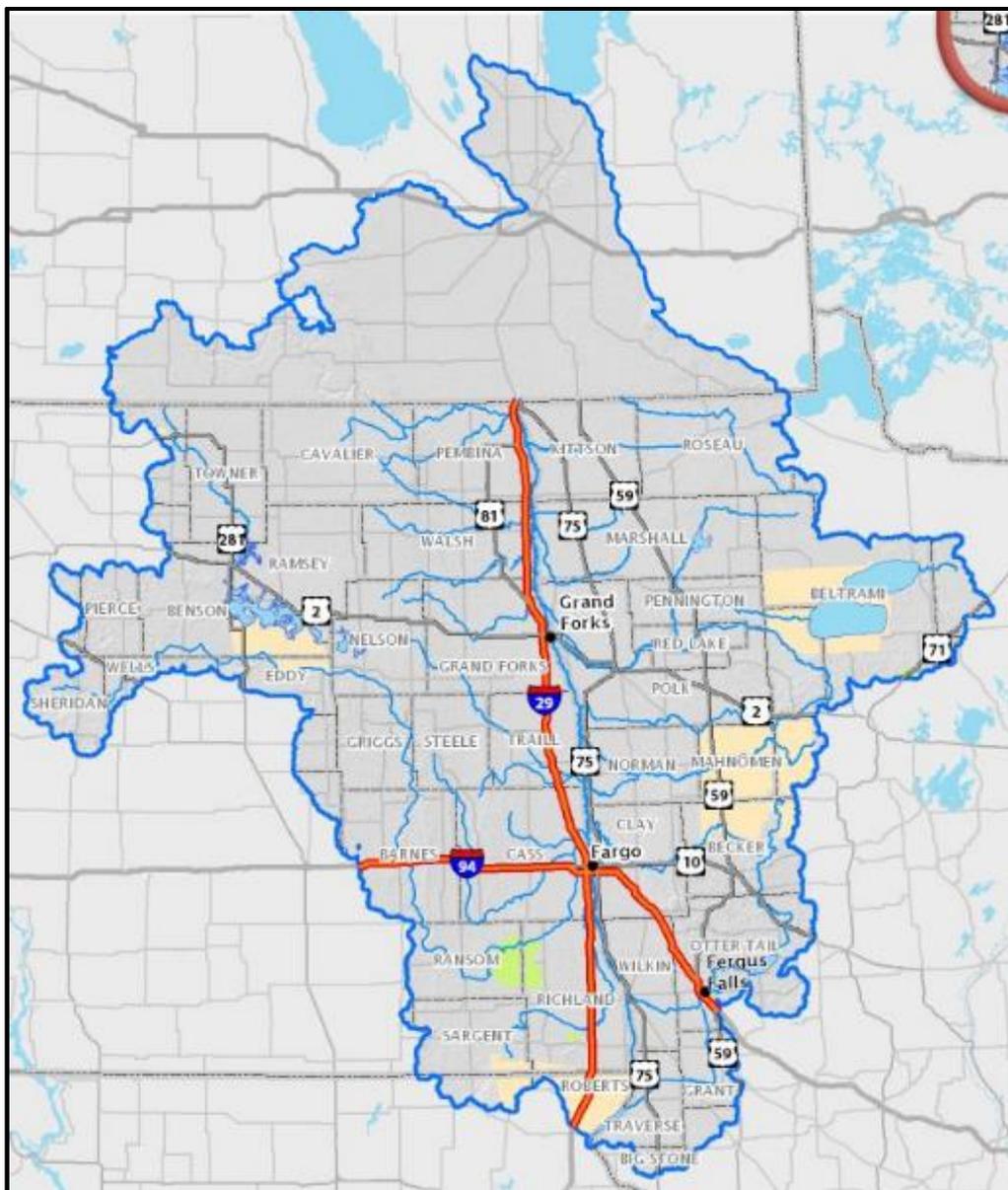


Figure 1: Red River Basin Location

2.1 Jurisdictional Setting and Stakeholders

Water resource management in the Red River Basin is an international effort. The hydrologic system of the basin is complex, and the multi-jurisdictional approaches to addressing resources in the basin are numerous.

2.1.1 Congressional Districts

On the Canadian side, the study area is located in the province of Manitoba. The study area is located in the At Large Congressional District of North Dakota. In Minnesota, the study area is located in the 7th

Congressional District. A small portion of South Dakota At Large Congressional District is at the far southern tip of the basin.

2.1.2 Tribal Nations

Tribal coordination was done with assistance from the RRBC. Participation in the working groups was open for sign up at the 2014 Red River Basin Land and Water Summit Conference, and notification was extended more broadly, including to tribes. The RRBC members include a tribal/First Nations representative who had equal opportunity to participate in the CWMP and will be given the opportunity to review the recommendations. In addition, related to the Flood Risk Management and Hydrology recommended actions for the Fargo-Moorhead Flood Risk Reduction Project, the Corps coordinated with tribal chairpersons and the Tribal Historic Preservation Office of the following tribes: Sisseton Wahpeton, White Earth, Leech Lake, Yankton Sioux, Bois Forte, Turtle Mountain, Upper Sioux, Lower Sioux, Spirit Lake, Red Lake, Fort Peck, Three Affiliated Tribes, Northern Cheyenne and Standing Rock. As a result of this coordination, a Programmatic Agreement was developed for the project and a Traditional Cultural Properties study was developed and completed for the specifically-authorized Fargo-Moorhead Metro Project.

2.1.3 International Joint Committee

The International Joint Committee (IJC) is an international organization created by the Boundary Waters Treaty, signed by Canada and the United States in 1909. The IJC prevents and resolves disputes between the United States and Canada and pursues the common good of both countries. Canada and the United States each appoint three of the six IJC commissioners, including one chair from each country. Once appointed, the commissioners do not represent the national governments; rather they operate at arm's length. The IJC has established more than 20 boards and task forces to help meet its responsibilities along the Canada-United States boundary.

The International Joint Committee (IJC) is an international organization created by the Boundary Waters Treaty, signed by Canada and the United States in 1909.

2.1.4 International Red River Board

The IJC established the IRRB in 2001 with members from United States and Canadian federal, state, provincial and local agencies (including the Corps' St. Paul District Engineer).

2.1.5 Red River Basin Commission

The RRBC is an international watershed-focused, non-profit organization led by 42 directors representing local, state, provincial and First Nation government agencies, the environmental community and citizen members. Several federal agencies also participate with the RRBC as ex-officio members.

RRBC VISION: A Red River Basin where residents, organizations and governments work together to achieve basin-wide commitment to comprehensive integrated water stewardship and management.

RRBC MISSION: To create a comprehensive integrated basin-wide vision, to build consensus and commitment to the vision and to speak with a unified voice for the Red River Basin.

In 2005 the RRBC completed an NRFP, which is a guide for a basin-wide approach to integrated resource management using multi-jurisdictional decision making and cooperation. The NRFP outlines thirteen basin-wide goals and associated objectives that address integrated resource management, soil conservation, water quality, sustainability, agricultural productivity, flood forecasting, flood risk reduction and recovery, data management; fish, wildlife and recreation; and stakeholder participation.

2.1.6 International Water Institute

The IWI is a 501(c)(3) organization governed by an international board of directors. The IWI was formed following the 1997 Red River flood to facilitate research, public education, training and information dissemination related to flood damage reduction, water resource protection and enhancement in the Red River Basin.

2.1.7 Red River Retention Authority

The Red River Retention Authority is comprised of representatives from the Red River Joint Water Resource District (North Dakota) and the Red River Watershed Management Board (Minnesota). The primary objective of the Red River Retention Authority is to ensure joint, comprehensive and strategic coordination of retention projects in the Red River watershed and facilitating implementation and construction of retention in the Red River Valley.

2.1.8 Minnesota Red River Watershed Management Board

Eight watershed districts within the Red River Valley form the Minnesota RRWMB, including the Joe River, Two Rivers, Roseau River, Middle-Snake-Tamarac Rivers, Red Lake, Sand Hill River, Wild Rice and Bois de Sioux. The Minnesota RRWMB was created by an act of the Minnesota legislature in 1976 to provide an organization with a basin-wide perspective concerning flooding. Historically, the activities of the Minnesota RRWMB have centered on flood control. The Minnesota RRWMB actively promotes a basin-wide perspective for water management within Minnesota.

2.1.9 North Dakota Red River Joint Water Resource District

The North Dakota RRJWRD is a joint board under North Dakota law comprised of 14 individual Water Resource Districts in the Red River Basin. The North Dakota RRJWRD provides for a coordinated and cooperative approach to water management and provides critical funding to member districts for the purpose of developing and financing water retention projects. The 14 member districts include these thirteen counties: Barnes, Cass (North and Southeast), Grand Forks, Maple River, Nelson, Pembina, Ransom, Richland, Rush River, Sargent, Steele, Trail and Walsh.

2.1.10 Province of Manitoba

The province of Manitoba is a Canadian prairie province. The province, with an area of 649,950 square kilometers (250,900 square miles), has a largely continental climate, with thousands of lakes and many

rivers. Agriculture, mostly concentrated in the fertile southern and western parts of the province, is vital to the province's economy. Other major industries are transportation, manufacturing, mining, forestry, energy and tourism. Manitoba's capital and largest city, Winnipeg, is Canada's eighth-largest census metropolitan area and home to 60 percent of the population of the province with a population of 663,617 (2011 census). Canada's provinces are an integral layer of the nation's governmental system. Under Canada's Constitution, provincial governments have many key powers and jurisdictions, such as the provision of fundamental social service, control over civil and property rights and power over local government.

2.1.11 Study Participants

The Corps and the Red River Basin Commission reached out to a broad array of stakeholders when forming the six working groups for the study. Not all stakeholders were able to actively participate. However, the study participants included representatives from local and regional government units, other state and federal agencies, landowners, the public and any other interested parties. A partial list includes:

- AAE Tech Services Inc.
- Agriculture and Agri-Food Canada
- Cardno JFNew
- City of Grand Forks, North Dakota
- City of Moorhead Public Service, Water Division
- City of Winnipeg, Water and Waste Department
- Conservation & Water Stewardship—Fisheries Division
- Emmons & Olivier Resources, Inc.
- Environment Canada
- U.S. Environmental Protection Agency, International Institute for Sustainable Development
- International Water Institute
- Manitoba Agriculture, Food and Rural Development
- Manitoba Conservation and Water Stewardship
- Manitoba local government
- Minnesota Board of Water and Soil Resources
- Minnesota Department of Agriculture
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- National Oceanic and Atmospheric Administration (U.S. Department of Commerce)
- Natural Resources Conservation Service (U.S. Department of Agriculture)
- North Dakota Department of Health
- North Dakota Game and Fish Department
- North Dakota Parks and Recreation Department
- North Dakota State University
- North Dakota State Water Commission
- Pembina Valley Water Cooperative Inc.
- Red River Basin Commission

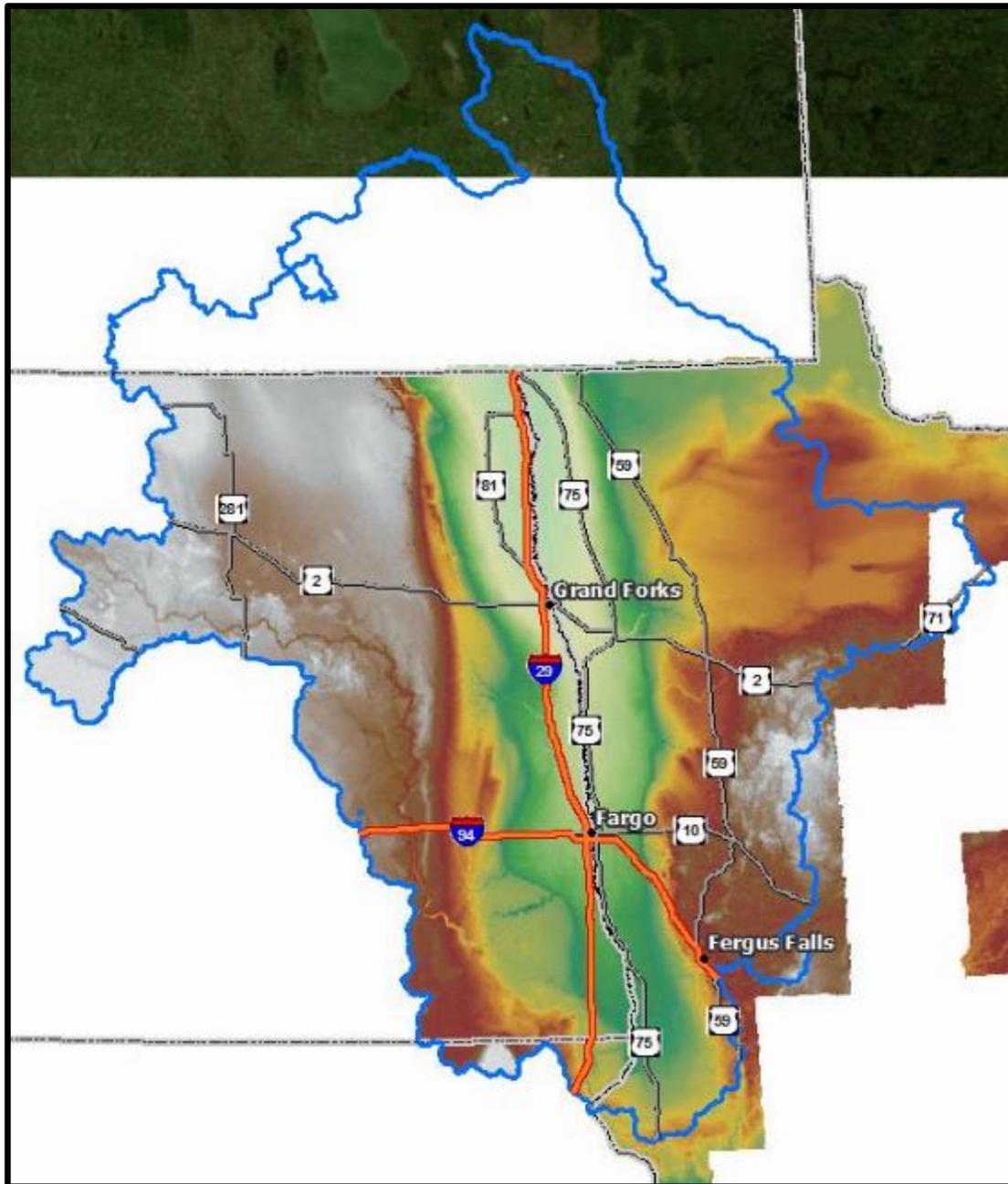
- Red River Basin Commission, Long-Range Planning
- Red River Joint Water Resources District (North Dakota)
- Red River Retention Authority
- Red River Watershed Management Board (Minnesota)
- River Keepers
- Rivers West
- Seine-Rat River Conservation District
- The Nature Conservancy
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- University of Manitoba
- University of Minnesota Extension and Northwest Regional Sustainable Development Partnership
- University of Minnesota Regional Partnership
- URS Corporation
- U.S. Fish and Wildlife Service

3 EXISTING CONDITIONS

This section summarizes the existing or baseline conditions in the Red River Basin, including the watershed's physical condition and other resource conditions.

3.1 Physical Setting

The Red River Basin (Figure 2) encompasses large portions of Minnesota, North Dakota and Manitoba. Approximately one percent of the Red River Basin is located in the extreme northeast corner of South Dakota. The basin includes the metropolitan areas of Winnipeg, Manitoba; Grand Forks, ND; East Grand Forks, MN; Fargo, ND; and Moorhead, MN. The Red River flows north and is approximately 545 miles long. Roughly 80 percent of the basin lies within the United States and 20 percent lies in Canada. The watershed includes natural resources of significant value, including tillable lands, lakes, wetlands, rivers, forests and native prairies. It is largely an agricultural area with rich soils that were originally deposited some 9,000 years ago as the lakebed of Glacial Lake Agassiz. Periodic flooding deposits sediment within the floodplain along the main stem of the Red River and its tributaries. The basin's eastern portion consists of a number of lakes and wetlands. The western portion is marked by "prairie potholes" that are ecologically rich depressional wetlands. The basin topography is extremely flat, with a slope that varies between 0.2 and 1.0 feet per mile. The floodplain extends over vast areas of land threatened by frequent flooding. The area is characterized by a very flat north-south valley, surrounded by relatively steep escarpments to the east and west. The slope also adds to extreme flow variability. The main stem of the Red River flows in a northerly direction, with Lake Winnipeg at its terminus. Because of these characteristics, the area is a naturally flood-prone river basin. Major cities sit at the center of the Red River Valley and the lake plain and include Fargo, Moorhead and Grand Forks, ND and Winnipeg in Canada.



**Figure 2: Red River Topography – United States Portion of Basin
(From RRBDIN LiDAR Viewer)**

3.2 Geomorphology

The Red River originates at the confluence of the Otter Tail and Bois de Sioux Rivers south of Fargo, ND. It flows northward into Canada and forms most of the boundary between Minnesota and North Dakota. The annual mean flow of the Red River at Fargo-Moorhead for the period of record (1901 to the present) averages approximately 677 cubic feet per second.

The central feature of the Red River Basin is the Red River Valley, the flat plain that once was the bed of Glacial Lake Agassiz. The lake formed at the southern edge of the Laurentide Ice Sheet and remained in existence from approximately 11,500 to 7,500 years before present. Over much of the old lakebed, the lake left behind a 150- to 300-foot layer of primarily silts and clays over a 50- to 60-mile wide area stretching from south of Breckenridge, MN to Winnipeg, Manitoba. This area is known as the “lake plain.” Within the lake plain, topographic relief is minimal, and the typical slope varies between 0.2 and 1.0 feet per mile. The lake plain is bordered by steeper beach ridges, which formed the shoreline of Glacial Lake Agassiz. Glacial rivers flowing into the lake deposited coarser sediment (sands and gravels) in these areas creating deltas that are mostly buried beneath later lake-deposited fine sediment.

Sediment transport in the Red River is dominated by the movement of suspended fine material. This suspended material is well-distributed throughout the vertical water column and is transported with minimal interaction with the streambed.

Bank failures (Figure 3) are extremely common throughout rivers and streams of the Red River Valley. This is largely due to soil conditions that result in poor strength of the bank. Many variables can influence bank stability. The condition that most often triggers or exacerbates existing slides is low water during drought conditions, where water elevations are reduced to levels below those that have occurred for many previous weeks, months or even years.



Figure 3: Stream Bank Failure on the Sheyenne River

3.3 Climate

The Red River Basin area is a region classified as a subhumid to humid continental climate with cold winters and moderately warm summers. Rapid changes in daily weather patterns are common. Frequent passage of weather fronts and high and low pressure systems result in a wide variety of weather conditions. In the Fargo, ND area, the average temperature between November and March is below 32 °F, resulting in an average of 185 days per year at or below 32 °F. The average temperature of the warmest month, July, is 71.1 °F. The annual average normal temperature of 41.2 °F reflects the northern location of the basin. The average annual precipitation in the Fargo area is about 19.5 inches. Nearly three-fourths of the annual precipitation occurs between April and September, with the remainder occurring during the winter. The average annual snowfall is about 50 inches.

3.3.1 Climate Change

The Corps' 2015 regional climate change assessment report for the Red River Basin summarizes observed and projected climate and hydrological patterns cited in literature and reports. There is overall literary consensus that air temperatures will trend upwards, and there is an expected increase in projected annual precipitation, recurrence of large rain events and dry days in the region. Due to the high level of uncertainty in modeling future climate change driven impacts to streamflow, the projected impacts in the literature are not in agreement. See Appendix A – *Flood Risk Management and Hydrology* for further discussion.

3.4 Flooding

Flooding and loss of native habitat are significant issues in the Red River Basin. Due to its geomorphology and hydrology, flooding is a major concern for residents in the basin; frequent flood events impact urban and rural infrastructure and agricultural production (Figure 4). The flat north-south river valley and the extremely limited topography throughout the basin exacerbate the flooding problems in the area.

3.5 Stream Network

There are 25 major sub-watersheds in the Red River Basin—approximately 10 on the North Dakota side, 10 on the Minnesota side and 5 in Manitoba. However, the watershed boundaries do not adhere to political boundaries. These sub-watersheds are shown in Figure 5.

- Four sub-watersheds are inter-jurisdictional—Pembina (shared by North Dakota and Manitoba), Roseau (shared by Minnesota and Manitoba), Wild Rice (shared by North Dakota and South Dakota) and Bois de Sioux (shared by North Dakota and South Dakota).
- Seven are located entirely in North Dakota, including Devils Lake, Park, Forest, Turtle, Goose, Elm and Sheyenne.
- Nine are located entirely in Minnesota—Two Rivers, Tamarac, Middle Snake, Red Lake, Sandhill, Wild Rice-Marsh, Buffalo, Otter Tail and Mustinka-Rabbit.
- Five are situated entirely in Manitoba—La Salle, Morris, Riviere Aux Marais/Plum and Seine-Rat.



Figure 4: Extent of the Red River of the North Floodwaters in 1997 and 2009 in Fargo, ND

3.6 Land Use Distribution

Prior to European settlement, the area was part of the prairie ecosystem with trees mostly limited to corridors along watercourses. The productive soils of the basin attracted early settlers and the use of waterways as transportation corridors resulted in establishment of towns and homesteads near the Red

River and its tributaries. With the development of drainage systems in the 1880s, farmland became even more valuable and productive, forming the basis of the Red River Basin economy. Agricultural activities and urban and rural development have altered the terrestrial and aquatic ecology of the area. As the dominant land use in the area, agriculture has been a primary cause of the loss of grassland and wetland habitat and encroachment on riparian corridors dating back to major land conversions and wetland drainage beginning in the 1800s. Impoundments, levees, cutoffs, clearing and snagging and erosion protection have changed many areas of the river and contributed to the loss of riparian woodland and in-stream habitat. Land use by cover type is depicted in Table 1 and shown in Figure 6.

Table 1: Distribution of Land Cover/Land Use Across the Red River Basin

Cover Type	Acres	RRB Coverage	U.S. Acres	U.S. Coverage	Manitoba Acres	Manitoba Coverage
Ag Land	21,555,34	69%	17,060,93	68%	4,494,414	71%
Woodland	3,661,563	12%	2,670,252	11%	991,311	16%
Wetland	2,067,808	7%	1,889,351	8%	178,457	3%
Developed	1,438,712	5%	1,164,408	5%	274,304	4%
Grasslands	1,362,385	4%	1,080,114	4%	282,271	4%
Water	1,294,070	4%	1,191,368	5%	102,702	2%
No	20,335	0%	6,783	0%	13,552	0%
Total Acres	31,400,22		25,063,21		6,337,012	

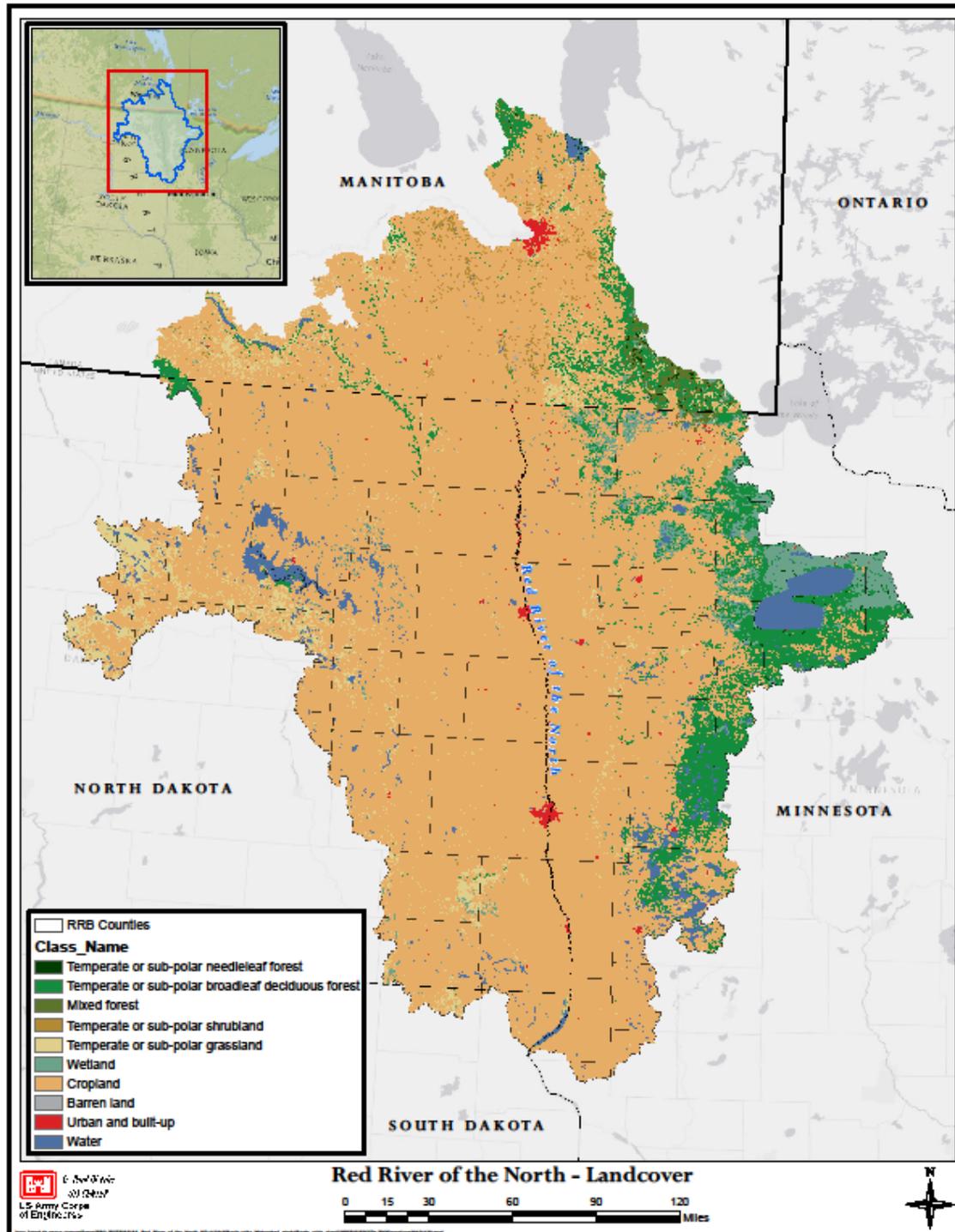


Figure 6: Land Cover of the Red River Basin

3.7 Environmental Conditions

3.7.1 Ecoregions

While land cover data is a good way to show the current distribution of land use, it does not necessarily reflect the natural habitat potential for the basin. A number of different classification systems have been developed to describe ecological patterns at the regional, national and international levels. These classes, often referred to as ecoregions, are defined by a variety of important ecological attributes.

Seven ecoregions encompass the Red River Basin (Table 2). Approximately 83 percent of the basin falls into ecoregions that would naturally support prairie flora and fauna: the Lake Manitoba and Lake Agassiz Plain, the Aspen Parkland/Northern Glaciated Plains and the Northwestern Glaciated Plains Ecoregions. The remaining 17 percent of the basin is made up of ecoregions that can be described as forested or mixed forest areas. These ecoregions include the Northern Minnesota Wetlands, North Central Hardwood Forests, Northern Lakes and Forests and Mid-Boreal Lowland and Interlake Plain Ecoregions. A detailed description of each ecoregion is provided in the working group report located in Appendix B – *Fish, Wildlife and Ecosystem Health*.

Table 2: Ecoregions of the Red River Basin

Ecoregion	General Habitat Description	Acres	Percentage of Basin
Lake Manitoba and Lake Agassiz Plain	Prairie	14,795,495	47.2%
Aspen Parkland/Northern Glaciated Plains	Prairie	10,963,161	35.0%
Northern Minnesota Wetlands	Forest/Wetland	2,682,254	8.6%
North Central Hardwood Forests	Forest	1,513,344	4.8%
Northern Lakes and Forests	Forest	764,419	2.4%
Mid-Boreal Lowland and Interlake Plain	Forest	455,425	1.5%
Northwestern Glaciated Plains	Prairie	151,228	0.5%

3.7.2 Fish Communities

The Red River is a warm water system that is dominated by turbid conditions during the open-water months. Its habitat consists largely of a main channel, with little to no side-channels, islands or backwaters. The vast majority of the habitat for the Red River would be considered “pool” or “run” habitat. Little submerged aquatic plant growth occurs due to the river’s turbid conditions. Fallen trees, log jams and snags provide important physical habitat for Red River fishes.

The Red River is home to 87 fish species. Major game species include channel catfish, walleye, sauger, smallmouth bass and northern pike (Figure 7). Other notable species include black bullhead, brown bullhead, lake sturgeon, freshwater drum, goldeye, mooneye and common carp.

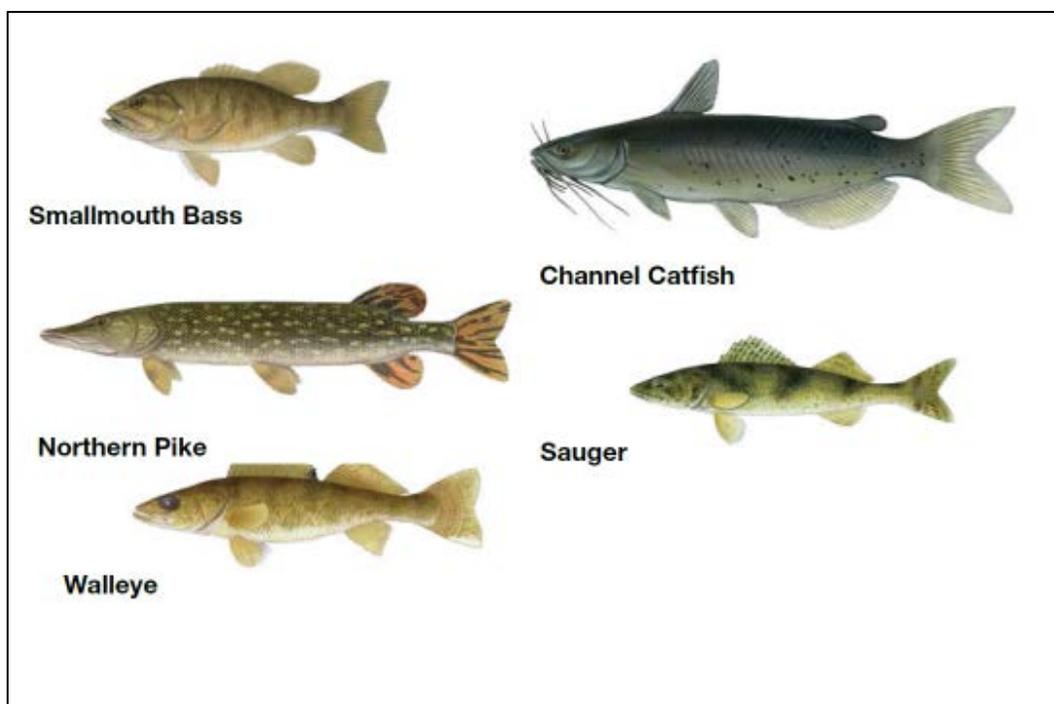


Figure 7: Red River Game Fish Species

3.7.3 Wildlife

Wildlife species found in the basin are typically tolerant of human activities and are well adapted to agricultural landscapes. Common species include the white-tailed deer, ring-necked pheasant, wild turkey, jack rabbit, squirrel, raccoon, bald eagle, as well as a number of waterfowl species.

Several species were extirpated or significantly reduced following the settlement of the basin. During this time much of the basin's grasslands were converted to agriculture. In addition, animals were overharvested for food and their value in the fur trade. Bison, antelope and other wildlife dependent on large blocks of open continuous grasslands vanished from the basin. Elk, wolves and bear were also extirpated or significantly reduced in numbers but have been able to rebound to varying degrees from reintroduction and conservation efforts.

3.7.4 Macroinvertebrates

Macroinvertebrates include a wide variety of creatures, including snails, worms, mussels, crayfish, beetles, aquatic insects (mayflies, stoneflies, caddisflies, midges, etc.), bees, butterflies, among others. They are extremely important ecologically as they drive the balance and flow of energy and nutrients. The benefits provided by macroinvertebrates are vital to many of the basin's activities but go largely unnoticed. Macroinvertebrates provide food for larger organisms, increase the fertility of soils by processing dead or decaying matter, allow crops and plants to produce grains and fruit through pollination, and can be used as indicators for aquatic health.

3.7.5 Federally Threatened, Endangered or Candidate Species

As of October 15, 2015, there were 12 species in the Red River Basin labeled as proposed, candidate, threatened or endangered by the U.S. Fish and Wildlife Service (USFWS) Endangered Species Program. Two species, the piping plover and the gray wolf, had multiple status designations (endangered and threatened) at different locations within the basin.

Specific geographic areas that contain features essential for the conservation of a threatened or endangered species may be identified as critical habitat. The gray wolf is the only species with critical habitat identified in the Red River Basin. The Dakota skipper (Figure 8) and Poweshiek skipperling both have proposed critical habitat in the basin.



Figure 8: Dakota Skipper

In addition to federally listed species, each state also has lists of species that fall under special state designations. For a complete list of federally listed and species with special state designations, see the working group report in Appendix B – *Fish, Wildlife and Ecosystem Health*.

3.7.6 Invasive Species

Invasive species are species that are non-native to an ecosystem and cause economic or environmental harm. Invasive species can displace native fish, wildlife and plants; decrease biodiversity and reduce agricultural productivity. Both terrestrial and aquatic invasive species are problematic in the Red River Basin. Major aquatic invasive species problems in the basin include zebra mussels, common carp, spiny waterflea, curly leaf pondweed, Eurasian watermilfoil, flowing rush and faucet snail. Major terrestrial invasive species in the basin include buckthorn, reed canarygrass, phragmites and purple loosestrife. Invasive species and their impacts throughout the Red River Basin are listed in detail in Appendix B – *Fish, Wildlife and Ecosystem Health*.

Problems related to fish, wildlife and ecosystem health include habitat loss, habitat degradation and unfamiliarity with ecosystem functions and values/lack of comparable data across the basin (Appendix B).

3.8 Water Quality

Water quality is impaired in much of the Red River Basin. Problems related to water quality include eutrophication, high sulfate levels, turbidity, pesticides and fecal coliform. These problems are primarily caused by nutrient loads (point and non-point), altered hydrology, climate change, land-use alteration,

wastewater, fertilizer and manure run-off, livestock overgrazing in riparian areas, failing septic systems and urbanization.

Much of the temporal variation in water quality is seasonal. Seasonally, winter brings cold temperatures, snow and ice. Surface waters tend to have less dissolved oxygen, lower concentrations of suspended sediment and higher concentrations of nutrients than during other seasons. Ammonia and dissolved phosphorus concentrations can be high under ice conditions. Spring brings cool temperatures, melting snow and ice, flooded fields and high flows into rivers along with a corresponding increase in dissolved-oxygen, suspended-



sediment and nutrient concentrations. Snowmelt and precipitation runoff delivers nutrients, pesticides and sediment to streams. Soil preparation and the application of chemicals relative to the occurrence of precipitation account for some of the variability in the amount of contaminants that reaches rivers and streams. Summer brings warm temperatures, thunderstorms and generally declining water levels in rivers. Periodic rainstorms increase suspended sediment and can transport pesticides from agricultural fields to surface waters. Fall brings cool temperatures, falling leaves and low stream-water levels. Stream flows approach the annual minimum and correspond to reduced suspended sediment, nutrient and pesticide concentrations (Stoner et al. 1998).

3.9 Water Supply

The Red River Basin is a semi-arid watershed with limited and sporadic precipitation. Within the basin there are limited surface and ground water resources. The demands on water resources have the potential to outstrip the availability based on population growth and an extended dry cycle. Drought is also a reality for the basin. A drought that would extend from months to years has the potential for an economic catastrophe far surpassing any flood. In addition the impact on residents, businesses, wildlife and the environment throughout the basin would be devastating. The “Red River Basin Water Conservation for Residential, Municipal, Commercial and Industrial Needs” report discusses water conservation approaches and the potential to reduce demand for water as a means to improve the basin’s resiliency and mitigate the impacts of drought. The purpose of the report is to identify water conservation approaches that have the goal of maintaining the same level of residential and business services with reduced water use. A summary of this document is included in Appendix D – *Water Supply* and the full report is included as an attachment in Appendix D.

3.9.1 Water Law

Water law and rights differ significantly among states and between the United States and Canada. Water rights are based on “prior appropriation” in Manitoba and North Dakota, following Western water law. Prior appropriation means the first user of water has a continued right to the beneficial use of that water. In Minnesota, following Eastern water law, water rights are assigned according to the “riparian doctrine,” meaning land ownership confers water use rights for those adjacent to surface

water or above aquifers. Currently there are limited interstate and international agreements on water supply management. The report “Red River Basin Immediate Drought Response Process” is included as an attachment to Appendix D – *Water Supply* and includes more detailed information on the process for each of the different jurisdictions.

3.10 Recreation

There are abundant types of recreation in the Red River Basin; outdoor activities include bicycling, hiking, canoeing, bird watching, boating, fishing, ice skating and much more. Water-dependent and water-associated recreation within the basin is mostly on or adjacent the Red River and its tributaries as well as the basin’s numerous lakes, including Upper and Lower Red Lakes, Devils Lake and Lake Winnipeg.

Water-dependent recreation, as the name suggests, is recreation that requires water such as fishing, canoeing, kayaking, swimming, tubing, paddleboarding, motorized boating, ice fishing, ice skating, duck hunting, trapping, jet skiing, waterskiing and sailing.

Water-associated recreation does not necessarily depend on the basin’s lakes, rivers and streams but are typically in close proximity to them and have been developed due to their proximity to the water. These include camping, bird watching, hunting, trail use, scenic driving, floodplain activities – playgrounds, disc golf, parks, etc.; photography, wildlife viewing, geocaching, picnicking, interpretation – cultural, historic, natural; dogsledding, cross-country skiing, trapping, motorized off-roading and snowmobiling.



3.11 Soil Health

The basin’s soil health conditions can lead to impacts on soil erosion, water quality, flooding and land use. The major concerns in the basin are soil erosion, water quality, flooding and land use conflicts. Soil erosion from both wind and water and the resulting sedimentation of waterways is a significant problem in the basin.

3.12 Tile Drainage

Objectives related to drainage were included in the NRFP. The NRFP drainage goal is to “Manage urban and agricultural drainage systems to enhance productivity, while minimizing impact to others.” The NRFP objectives are to manage drainage systems to protect agricultural land and minimize environmental impacts; to design and improve drainage systems with consideration of local, sub-watershed and main stem effects; and to design and implement urban and rural storm water strategies that minimize environmental impacts.

The CWMP does not include a separate working group appendix for drainage; however, it is an issue that impacts other resource areas and is significant in the basin. The Red River Retention Authority Basin Technical and Scientific Advisory Committee (BTSAC) developed two briefing papers on drainage in

2011 and 2012. The reports included the status and trends of agricultural drainage in the basin, a literature review, summary of hydrologic effects of subsurface drainage and descriptions of recommendations and preferred drainage management options.

Drainage systems and practices are part of a complex web of land use changes that affect hydrology downstream at the field, watershed and basin scale. Many landscape-scale changes have occurred in addition to agricultural drainage that can increase or decrease downstream flood flows, including drained or restored lakes and wetlands, urbanization, on and off channel dams, channelization and road and field crossing culverts. Agricultural drainage is essential to the Red River Basin's agricultural industry and is a key component of the basin's infrastructure and economy. The impact of subsurface drainage on flooding is complex and should not be generalized; timing and volume of runoff are key variables. The cumulative impacts of drainage on peak flows are unclear and additional analysis was recommended. The BTSAC preferred subsurface drainage management options, including controlled subsurface drainage and water storage trading. It must be noted that there are many complex water management policy issues involved with implementing the BTSAC preferred drainage management options, including the balance of public and private cost, risk, benefit and equity.

3.13 Expected Future Conditions

The following describe basic assumptions about several issue areas in the Red River Basin that are key to expected future conditions.

- Agriculture will continue to be the dominant land use throughout the basin. Adequate surface drainage has been and will continue to be integral to maintaining productivity of cropland. Sub-surface drainage is likely to become increasingly utilized.
- Current development trends will continue into the foreseeable future. The major urban centers and communities will continue in their present locations. The major metropolitan areas will continue to grow. Future development will occur in compliance with floodplain management regulations.
- Floods will continue into the future. Increased annual precipitation and larger precipitation events are projected in the basin (Corps' 2015 report, Recent U.S. Climate Change and Hydrology Literature Applicable to US Army Corps of Engineers Missions – Souris-Red-Rainy Region 09). Floods larger than historically experienced can be expected to occur. The Fargo-Moorhead metropolitan area will be at reduced flood risk if the diversion project is completed.
- Flood damage reduction will need to be implemented in the basin based primarily on the identified needs of the basin residents and their willingness to provide or seek the funding necessary to implement the measures that they believe are appropriate, effective and justified. State and federal agencies will support the implementation of the various measures based on their policies, regulations and availability of funding.
- Flood damage reduction is just one issue that affects the sustainability of the region. Other key resource issues need to be considered as this plan is developed and implemented, including droughts, water supply, water quality, recreation and other natural resource areas.
- Degradation of water quality will be a growing concern. Growth of urban areas will increase the demand for good quality water, while urban wastewater and agricultural use will continue to introduce compounds that will challenge water quality downstream.

4 PLAN FORMULATION

4.1 Ecosystem Services

Plan formulation for the CWMP is guided by the Corps' Planning Guidance Notebook ER 1105-2-100 but expands beyond the plan formulation process required for a decision document to include additional considerations relevant to the Red River Basin. To more holistically consider the problems, potential solutions and benefits across six resource areas in the basin, the study team and the working groups took ecosystem services into account where appropriate.

The field of ecosystem services is an interdisciplinary or transdisciplinary approach merging ecological and economic principles. Historically, both the fields of Ecology and Economics converged on the concepts somewhat independently, and therefore the literature documents inconsistent definitions of terms and approaches. The federal government is working toward developing policy on ecosystem services; the 7 October 2015 memo from the Office of Management and Budget directs agencies to “develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments and regulatory contexts.” The CWMP working groups chose to consider ecosystem services, even though it has not been defined in Army policy and the Corps does not have guidance on incorporating ecosystem services in plan formulation or project justification.

The study team adopted this definition of ecosystem services for the purpose of the CWMP: Ecosystem services are the direct or indirect contributions, including economic, environmental and social effects, which ecosystems make to the environment and human populations.

There are four general kinds of ecosystem services to consider:

1. Provisioning services refer to the food, fuel, fiber and clean water that ecosystems provide.
2. Regulating services refer to specific ecosystem processes for which people are willing to pay. Examples include pollination, storm protection, climate regulation and water regulation.
3. *Cultural services* refer to the benefits ecosystems confer that do not directly relate to our physical health or material well-being. Examples include recreation, aesthetic, spiritual, existence and option “values.” Whereas the first two of these are experiential, the latter “non-use” values depend simply on the continued survival of the ecosystem and its attributes.
4. Supporting *services* refer to soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

Cultural services refer to the benefits ecosystems confer that do not directly relate to our physical health or material well-being. Examples include recreation, aesthetic, spiritual, existence, and option “values.”

The value of provisioning services can typically be estimated using market data; however, quantifying the value of regulating and cultural services can be more challenging. For the purpose of the CWMP, ecosystem services are assessed qualitatively with input from the multi-agency inter-jurisdictional working groups. This approach allows more transparent consideration of trade-offs in watershed

planning, provides opportunities for considering a broad array of needs and opportunities and affords collaboration among agencies.

4.2 Strategy

The CWMP vision, goals and objectives were created based upon the vision, goals and objectives outlined in the RRBC's Red River Basin Natural Resources Framework Plan and supporting inventory reports. These reports, completed in 2005, were developed with extensive stakeholder input and regional participation and using the best available data in the watershed. It was intended that the NRFP be a living document, which would be updated every 5 to 10 years. In coordination with the non-federal sponsors and other stakeholders, the decision was made to integrate the CWMP with the local intent to update the NRFP. This economizes efforts, leverages local resources, ensures collaborative stakeholder involvement and generates a broad set of solutions for multiple stakeholders; and it ultimately has led to comprehensive long-term recommendations and actionable solutions for the basin.

Building upon the earlier work done in the NRFP and utilizing the work being performed by several active focus groups provides the CWMP with good public support for major issues in the watershed. The NRFP outlines 13 focus areas:

1. Watershed
2. Integration
3. Data/Technology
4. Education/Information
5. Flood Damage Reduction: Forecasting,
6. Flood Damage Reduction: Mitigation
7. Flood Damage Reduction: Response & Recovery
8. Drainage
9. Water Quality
10. Water Supply
11. Conservation
12. Fish & Wildlife
13. Outdoor Recreation



These 13 focus areas were combined into six new focus areas, which are further developed in this CWMP:

1. Flood Risk Management and Hydrology
2. Fish, Wildlife and Ecosystem Health
3. Water Quality
4. Water Supply
5. Recreation
6. Soil Health

Six coordinating committees corresponding to each of the six CWMP focus areas were formed. The six CWMP coordinating committees were built upon the existing NRFP working groups, and where possible the groups were incorporated as sub-committees to the existing working groups. The effort to update the NRFP and develop the CWMP has been integrated through regularly scheduled working group meetings.



4.2.1 Coordinating Committee Structure

A subject matter expert from the Corps served as the secretary for each coordinating committee. The secretary role had the primary responsibility for writing the report. Each coordinating committee included a facilitator or chair, an RRBC staff member and subject matter experts from other agencies and stakeholder groups. Coordinating committee members for the CWMP effort are listed below (Table 3).

4.2.1.1 Canadian Participation

Water management today has grown substantially more complicated than it was in the past. Today, with the technology and equipment basin residents have at their disposal, water management activities undertaken in one part of the basin can have dramatic impacts on other parts. As a consequence, the decision-making process must accommodate the views of individuals, governmental agencies and others throughout the basin. This includes participation from North Dakota, South Dakota, Minnesota and Manitoba. The RRBC working groups are comprised of all levels of basin participation and interest and represent all areas of the RRB from grassroots citizens all the way to federal and provincial levels.

According to the RRBC: "A major challenge will be development of an integrated, coordinated basin planning approach to water management in the Red River Basin that encompasses strong public input; recognizes the uniqueness and limitations of each watershed; and involves all resource owners, managers and users working together as a planning team." The RRBC has been successful working together despite the differences amongst the various jurisdictions and countries.

4.2.2 Meetings

The CWMP effort was introduced at the 2014 Annual Red River Basin Land and Water International Summit Conference (Figure 9), and participants were invited to join any of the coordinating committees. The participants were varied stakeholders, including local, state and federal



Figure 9: Corps Staff Registering Working Group Participants at the January 2014 Red River Land and Water International Summit Conference

agencies as well as jurisdictional representation from Minnesota, North Dakota and Manitoba. A coordinating committee kick-off meeting was held on April 3, 2014 where the groups met in plenary and then in break-out coordinating committee meetings. The working groups' first challenge was to come up with a refreshed goal statement for each focus area. Following the joint session meeting, each of the groups progressed independently through the tasks listed in Section 4.2.3. As the groups continued to work independently, periodic joint meeting were also held to keep everyone focused to provide resources where needed. Each working group is unique, and independent progress allows each group to take the necessary time and resources to progress through the planning process; however, the joint meetings were useful to keep the groups generally aligned and tracking towards the same end product.

4.2.3 Coordinating Committee Tasks

The working group tasks generally followed the path of the Corps 6-step planning process described in Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983) and the Planning Guidance Notebook ER 1105-2-100 (April 2000). The working group secretaries often served as a facilitator as the teams worked through the process.

The six steps in the iterative plan formulation process are:

1. Specify the water and related land resources problems and opportunities of the study area;
2. Inventory and forecast existing conditions;
3. Formulate alternative plans;
4. Evaluate alternative plans;
5. Compare alternative plans; and

6. Select the recommended plan.

The working groups were given the following list of tasks to guide them through the 6-step planning process to reach a final product:

- ✓ Examine the root foundations of the problems in the area
- ✓ Identify opportunities
- ✓ Develop goal statements
- ✓ Identify objectives based on the problems and goal statement
- ✓ Identify and discuss areas of risk and uncertainty
- ✓ Develop array of strategies, activities and alternatives that achieve the objectives
- ✓ Evaluate and screen alternatives
- ✓ Recommended strategies and actions for further study and possible implementation
- ✓ Identify agency or entity best suited to implement alternatives
- ✓ Input to working group report
- ✓ Input to CWMP

The six groups documented an array of recommendations that could address the specified problems and achieve the objectives for each focus area. Each group documented their discussions, findings and recommendations in an individual working group report. These working group reports are attached as appendices to this CWMP. These recommendations are summarized in the following sections. These recommendations may be carried forward for further study, action or implementation by the Corps or other identified entity.

4.3 Vision and Goals

The elements of a watershed management plan include an overarching vision for the watershed supported by specific goal areas. In addition, there may be more specific visions for each focus area. The vision is used to express a goal for each focus area. Each goal describes a desired future condition and based on the goals, specific objectives are established. Strategies, activities and alternative plans will be evaluated and recommended to achieve each objective. Figure 10 illustrates how the vision, goals and objectives fit together into the overall CWMP.

Vision:

The overarching vision adopted for the purpose of this CWMP is: “A Red River Basin where residents, organizations and governments work together to achieve basin-wide commitment to comprehensive integrated water stewardship and management.” Using this overarching vision, each focus area developed the following goals:

Goal by Focus Area:

1. Flood Risk Management and Hydrology – A more flood resilient Red River Basin.
2. Fish, Wildlife and Ecosystem Health – Maintain existing habitat, and restore natural systems in the Red River Basin.
3. Water Quality – Maintain, protect and restore surface and ground water quality in the Red River Basin.
4. Water Supply – Develop a basin-wide strategy for future water supply needs to ensure an adequate supply for beneficial uses.
5. Recreation – To inform and increase the enhancement and development of recreational opportunities within the Red River Basin.
6. Soil Health – Maintain and enhance soil health within the Red River Basin.



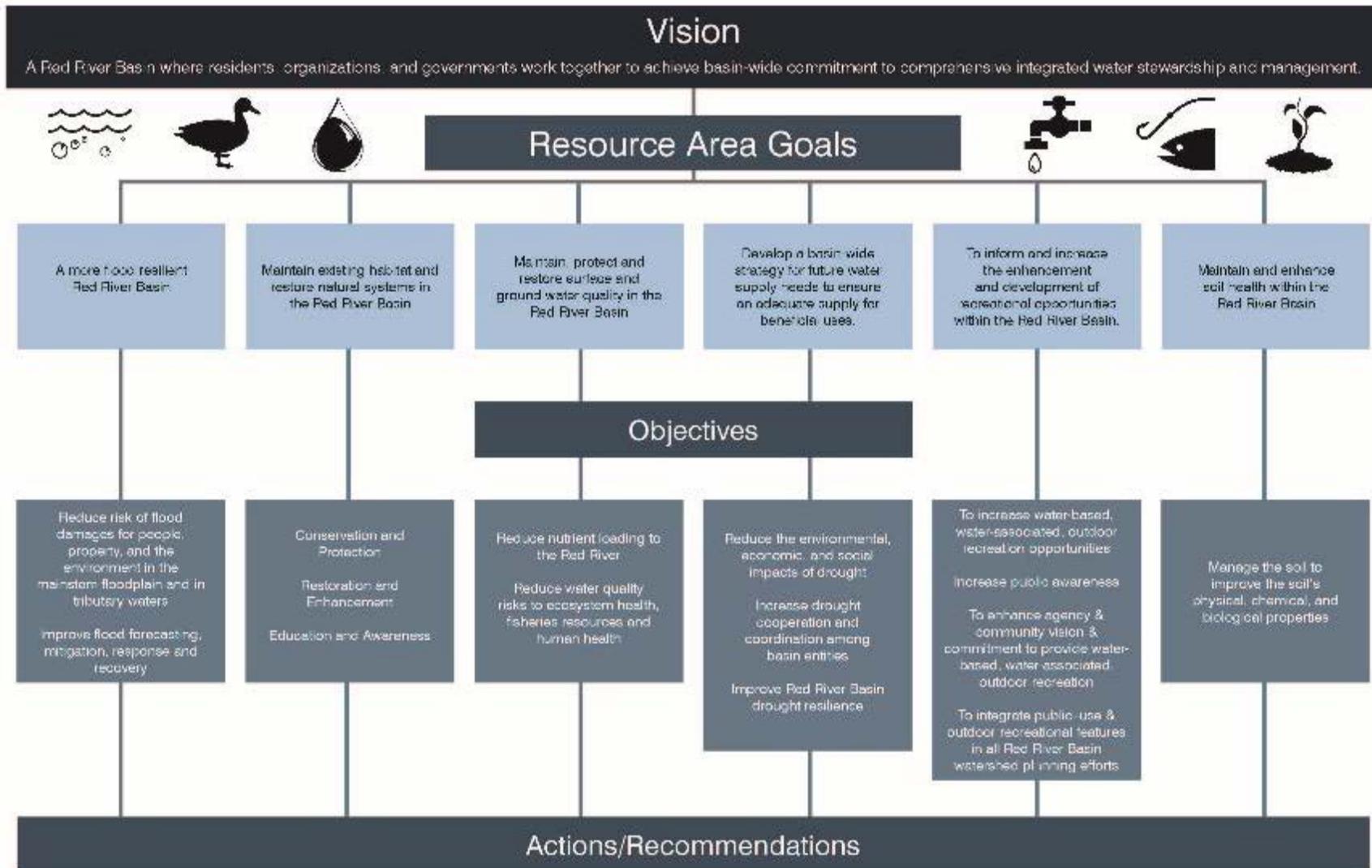


Figure 10: Framework of Red River Comprehensive Watershed Management Plan

4.4 Problems, Opportunities, Objectives, Constraints Strategies and Recommendations

The working groups are composed of interagency, multi-jurisdictional subject matter experts in the basin. Each working group developed a goal statement, its own problem and opportunity statements, and unique objectives. Each working group was asked to consider the following basin-wide constraints in addition to identifying constraints related to their particular area:

Basin-Wide Constraints:

- There is uncertainty in both the local and federal funding streams – The timing and scheduling of recommended studies and actions will be dependent on the available resources of the Corps, the local sponsors or other entities identified as the implementing or lead for a particular action.
- International agreements – The Red River flows north into Canada, therefore adding cross-border considerations to actions proposed in the United States, which may affect downstream areas in Canada. These actions and effects may be constrained by international treaties.
- Existing, on-going initiatives, which have not been implemented – There may be planned activities for a particular area which the working groups may not be aware of, which could conflict with recommendations for an alternative use of the area by the working group.

Each working group applied the Corps' 6-step planning process to come up with recommended actions for their area. A summary of each working group is shown in the following sections.

4.5 Flood Risk Management and Hydrology

Background:

The Flood Risk Management and Hydrology Working Group was already well established prior to this CWMP effort and had a history of working together on Red River Basin flooding issues (Figure 11). The working group was comprised of a variety of stakeholders from the Corps, the RRBC, the City of Grand Forks, the Minnesota DNR, the RRWMB, the Red River Retention Authority, the North Dakota State Water Commission, the National Weather Service and the IWI. Flooding is the most recognized and well-studied issue in the basin, as documented by the 2011 Red River Basin Long Term Flood Solutions Report (RRBLTFSR), which was completed as part of the larger Feasibility Study. In 2015, the RRBC prepared an update to the RRBLTFSR, which enumerated the progress that has been made on recommendations from that report.

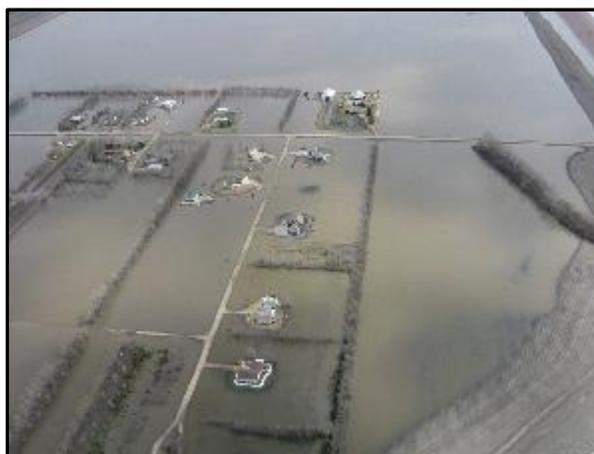


Figure 11: Red River Basin Flooding

Goal:

The Flood Risk Management and Hydrology working group made the decision to adopt and build from the RRBC's 2011 RRBLTFSR and adopted the following goal: **A More Flood-resilient Red River Basin.**

Resiliency refers to the ability to prepare and plan for flood events, to absorb and withstand impacts from floods, to rapidly recover from flood events and also to adapt to the more successfully resilient in the future.

Future Conditions:

Although progress has been made, flooding in the Red River Basin is expected to continue to be a problem in the future; floods larger than historically experienced are expected to occur. It is expected that the Fargo-Moorhead metropolitan area will be at reduced risk of flooding and flood damages after the diversion project has been completed.

Problems:

The following are problems that the Red River Basin stakeholders face in trying to achieve the goal of a more flood-resilient Red River Basin:

- Increase in frequency and magnitude of flooding in the Red River Basin.
 - Since 2000, the basin has experienced major floods in 2001, 2006, 2009, 2010 and 2011.
 - Since 1997, most sites along the main stem Red River have seen levels of flooding at or close to 100-year levels (one percent exceedance frequency in any given year).
- Risk of flood damages for urban areas, critical infrastructure, small cities, rural residences and farmsteads, agricultural cropland and critical transportation systems and emergency services.

Opportunities:

The following are opportunities that arise in trying to achieve the goal of a more flood-resilient Red River Basin:

- Decrease the damages from flooding to urban areas, critical infrastructure, small cities, rural residences and farmsteads, agricultural cropland and critical transportation systems and emergency services.

Objectives:

Based on the overall goal and the problems and opportunities, the Flood Risk Management and Hydrology working group developed the following objectives upon which specific actions will be recommended:

1. Reduce risk of flood damages for people, property and the environment in the main stem floodplain and in tributary waters.
2. Improve flood forecasting, mitigation, response and recovery.
3. Use non-structural measures to move beyond minimum standards for flood risk management.

Constraints:

- No additional constraints to those stated for the basin overall.

Discussion:

Since flooding is the most recognized and well-studied issue in the basin, the Flood Risk Management and Hydrology working group's efforts focused on reviewing the 2011 RRBLTFSR, and the 2015 update to that report. An excerpt from the 2011 RRBLTFSR and the 2015 update are included as attachments to the Appendix A – *Flood Risk Management and Hydrology*.

Flood Risk Management Strategies:

The Flood Risk Management and Hydrology working group retained the same strategies to address flooding problems as were developed during development of the RRBLTFSR. These strategies are grouped into four major categories:

1. Basin-Wide Retention Strategies
 - Strategically located storage to help reduce peak flows on the main stem while mitigating local flooding on the tributaries.
 - Increased water storage at existing reservoirs.
 - Development of a prioritization process for retention projects.
 - Streamlining of the water retention project permitting process.
 - Analysis of aged dams and restoration potential for increased flood control capacity.
2. Nonstructural Strategies
 - Mitigating existing development and protecting future growth to a higher standard.
 - Identification of barriers to increased participation in the community rating system.
 - Education and outreach of floodplain information to residents.
 - Local floodplain ordinances should be updated.
 - New development adjacent to high risk areas should not be permitted.
3. Fargo-Moorhead
 - Fargo-Moorhead is the most populous metropolitan city in the United States portion of the basin and is at severe risk of significant damage as the result of flooding. Without a comprehensive flood risk management project in the area, the metropolitan region will continue to be subject to flooding and will rely on emergency responses to prevent flood damage in the community. The area remains at risk; however, a full array of strategies in this category is not developed as it is assumed the diversion project will reduce risk to this area in the future.
4. Development of further information and tools
 - Advanced collaboration and facilitation of the multijurisdictional issues.
 - Creative alternatives for federal agency participation across jurisdictions.
 - Expansion of these efforts to Manitoba and South Dakota.
 - Improved flood forecasting measures.
 - Development of a consistent and seamless stream gage system.

Progress towards Flood Risk Management Goals:

The RRBC, the States of North Dakota and Minnesota and the Canadian province of Manitoba have been making progress towards the above-stated goals though the strategies and actions defined in the RRBLTFSR. Key items among the accomplishments include levee improvements at the mainstream communities of Wahpeton-Breckinridge and Oxbow-Hickson-Bakke; the Minnesota communities of Georgetown, Perley, Hendrum, Oslo, Pembina, Ada, Alvarado, Crookston and Roseau; the North Dakota communities of Argusville and Devils Lake; progress towards improved protection at Fargo-Moorhead; and proposals for improvements at Halstad, Grafton, Lisbon and Valley City.

Progress has been made towards improved flood forecasting, including development of HEC-HMS models for all U.S. sub-basins and border sub-basins of the Red River, and progress towards completing a main stem HEC-RAS model; completion of studies to identify the potential for retention in the U.S. sub-basins; and progress towards combining the HEC-RAS, HEC-HMS and retention information to evaluate the relative effectiveness of retention projects in reducing the peak flows on the Red River.

Flood Risk Management and Hydrology Working Group Recommendations:

The Red River Basin stakeholders and partners should continue to work towards the goal of a more flood-resilient Red River Basin, using the strategies and actions recommended in the RRBLTFSR. The recommendations are identified as either a project or a study. Status of the recommendation and lead agency for implementing the project or study is also stated. Recommendations are summarized in Table 4.

Table 4: Flood Risk Management and Hydrology Working Group Recommendations

Ref. No.	Recommended Action	Study	Project	Status	Lead Agency
1.1	Fargo-Moorhead (FM) – continue supporting dike construction, property acquisition, flowage easements and flood infrastructure projects to fight the 100 to 500 year flood ¹ .		√	In progress	Local, state, federal
1.2	Fargo-Moorhead – progress towards diversion project.		√	In progress	FM diversion authority
1.3	Advance retention above Hickson and Abercrombie for a flow reduction of 20%.		√	In progress	FM diversion authority
1.4	Determine non-federal cost share for locally preferred Fargo diversion plan.	√		Complete	ND and MN state leaders
1.5	Continue to support Devils Lake Collaborative working group.	√		In progress	ND, local authorities, federal and tribal gov'ts
1.6	Distribute information on progress and timelines on Devils Lake activities.	√		In progress	RRDC and IRRB
1.7	Examine need for developing a comprehensive real-time model to determine effects of releasing Devils Lake water via various outlet channels.	√			Local, state, federal
2A.1	Revise state floodplain regulations and local zoning ordinances with new criteria for residential, commercial, industrial and agri-business development.	√			State and local

¹ The frequently-used terms of 100-year, 200-year and 500-year flood correspond to yearly flood exceedance frequencies of 1 percent, 0.5 percent and 0.2 percent, respectively; or 1 percent chance, 0.5 percent chance and 0.2 percent chance of occurring in any given year.

2A.2	Acquire and remove buildings located in at-risk areas when it is not feasible to protect them.	√			Local governments
2A.3	Update floodplain ordinance to not permit new development in areas of high risk of flooding. Minimize use of variances.	√			Local governments
2A.4	Review floodplain regulations and programs, evaluate standards and regulations for development, analyze compliance with flood insurance program, analyze use of variances by local governments.	√			Agencies and stakeholders
2A.5	Work toward joining or improving rating in the FEMA Community Rating System.	√			Communities
2A.6	Develop Floodplain Bill of Rights.	√			RRBC
2A.7	Develop educational materials.	√			RRBC
2A.8	Expand nonstructural assessment beyond Fargo-Moorhead to the entire main stem Red River. Identify local sponsor and appropriate federal funds.	√		Complete; no federal interest	Corps, local sponsors
2A.9	Use Silver Jackets program to contribute towards a collaborative interstate strategy for flood recovery and projects for mitigation efforts.	√			MN and ND
2B.1	Request 500-year or greater level of protection for Grand Forks and East Grand Forks.		√		GF and EGF
2B.2	Facilitate exchange between officials in Winnipeg and Fargo-Moorhead to share experiences and expertise in the expansion of Winnipeg's diversion structure.	√			RRBC
2B.3	Identify and document at-risk critical basin infrastructure and report to state legislatures.	√			State emergency management officers
2B.4	Achieve protection to the 100-year level plus 3 feet of freeboard, or the largest flood plus 3 feet of freeboard for all cities in the Red River Basin, and move towards providing 200-year level of protection using upstream retention. Provide 100-year level plus 3 feet of freeboard, or the largest flood plus 3 feet of freeboard for rural residents and farmsteads.		√		RRWMB and RRJWRD with local communities

2B.5	Provide funding for rural areas, including ring dikes and rural property acquisitions. Use strategies that slow water or hold in on the land longer, such as the Natural Resources Conservation Service (NRCS) program for reducing runoff and erosion and improving water quality.		√		States in collaboration with RRWMB and RRJWRD
2B.6	Develop a multi-purpose drainage strategy.	√			Red River Retention Authority (RRRA), RRWMB and RRJWRD, with state agencies, local government and commodity group support
2B.7	Continue river channel maintenance to prevent trees blocking flows.		√		MN and ND
2B.8	Provide funding for the Reinvest in Minnesota (RIM) easements to match or supplement federal U.S. Department of Agriculture (USDA) conservation funding.		√		MN
2B.9	Develop a basin wetland bank to purchase and exchange wetland credits.		√		MN, ND, SD with NRCS
2B.10.1	Analyze how to use surface drainage system to lower rising side of spring flood hydrographs.	√			RRRA
2B.10.2	Analyze benefits of a basin-wide culvert inventory.	√			RRBC
2B.10.3	Partner with NRCS to analyze benefits of small distributed and culvert-sizing retention.	√			NRCS and local water boards
2B.10.4	Update 1980 and 2003 agriculture flood damage reports.	√			USDA funds
2B.10.5	Pilot project to draw down wetlands in the autumn to enable spring storage.		√		NRCS and RRRA
2B.10.6	Pilot project to gather data on timing and impacts from tile drainage, surface drainage, wetland restoration, early water ditch drainage and culvert sizing.		√		RRBC with farm and commodity groups

2B.10.7	Tile drainage analysis by the IWI.	√			RRRA through BTSAC
2B.10.8	Establish and reinforce buffer strips to a minimum 16.5 feet, maximum 50 feet (with incentives) to reduce sediment and slow the flow of water into waterways.		√		MN and ND
2B.11	Facilitate discussion with regional organizations, state and federal departments of transportation and environmental management offices to identify a strategy for preserving critical transportation during the 100-, 200- and 500-year flood events.	√			RRBC
2B.16	Explore issues surrounding dedicating a portion of state aid for highway funding for culvert sizing and related road modifications.	√			MN and ND
2B.17	Develop an analysis of planned and proposed road elevations for 100-, 200- and 500- year flood protection for emergency, population sustainability and agricultural and economic production needs.	√			RRWMB, RRJWRD and state agencies
2B.18	Develop a state and local funding strategy to assist with county and township flood-related road repairs.	√			MN and MN Dept of Trans
2B.19	Identify a strategy for critical transportation preservation during the 100-, 200- and 500-year flood levels to identify funding needs.	√			RRBC
2C.1	Provide federal funding for retention projects to achieve a 20% reduction in peak flows on the Red River.		√		NRCS
2C.2	Continue local share of federally-funded retention projects.		√		MN, ND, RRWMB, RRJWRD and local watershed districts (WDs)
2C.3	Review federally-operated reservoirs to identify potential for increased storage.	√			Corps, state agencies and USFWS

2C.4	Work with individual water management boards to plan, design and implement retention projects to achieve 25% of the retention goal every 5 years.		√		RRRA
2C.5	Develop a project prioritizing methodology.	√			RRRA
2C.6	Work with federal agencies to streamline the permitting process.	√			RRRA
2C.7	Provide funding to expand the project planning and permit evaluation demonstration project to the entire Red River.	√			NRCS with MN and ND
2C.8	Conduct a survey and public outreach to determine landowner interest in storing water on their lands.	√			RRWMB and RRJWRD
2C.9	Continue Feasibility Study to update the HMS models to identify retention projects, model the main stem using HEC-RAS, and use models as the basis for the project prioritization process.	√		In progress	Corps with RRWMB and RRJWRD
2C.10	Evaluate Public Law 83-566 and dams that have flood control capacity to determine the feasibility of restoration.	√			NRCS with RRRA
3.1	Perform an annual evaluation of flood mitigation progress towards implementing the RRBLTFSR recommendations.	√			RRBC
3.2	Conduct periodic meetings between the Minnesota, North Dakota, South Dakota governors and the Manitoba premier; the international legislators' forum; the Board of Water and Soil Resources, etc. to coordinate and update progress on the RRBLTFSR recommendations and other flood-related topics.	√			MN, ND, SD, RRBC, Manitoba, WDS
3.3	Expand the RRBLTFSR to include the entire Red River Basin, including LiDAR data collection in Manitoba, and establishing watershed organizations in South Dakota.	√			Manitoba and SD
3.4	Identify funding for improving flood forecasting, including relevant time appropriate data and on-site decision support service.	√			RRBC

3.5	Develop a stream gage strategy	v			USGS, RRWMB, RRJWRD, watershed boards, NDSWC, Minnesota DNR and stakeholders
3.6	Update the RRBLTFSR in 2021	v			RRBC

4.6 Fish, Wildlife and Ecosystem Health

Background:

Prior to the CWMP effort, the Fish, Wildlife and Ecosystem Health working group was not a well-established group. The 2014 outreach effort was very successful, and a diverse group of participants came together to support this working group. The Fish, Wildlife and Ecosystem Health (FWEH) working group is comprised of a variety of stakeholders from the Corps, the RRBC, the Minnesota DNR, the USFWS, North Dakota Game and Fish Department, the USGS, several conservation and sustainability groups, both United States and Canadian universities, the North and South Dakota Departments of Health, the Minnesota Pollution Control Agency, North Dakota Parks and Recreation, and other stakeholders and experts.

The Red River Basin is a highly agricultural region, with nearly 70 percent of the basin used for agricultural purposes. Woodlands make up 12 percent of the basin, wetlands make up 7 percent, developed areas make up 5 percent, grasslands make up 4 percent, and water makes up the remaining 4 percent. Seven distinct ecoregions can be identified in the Red River Basin: the Lake Manitoba and Lake Agassiz Plains, Aspen Parkland/Northern Glaciated Plains, Northern Minnesota Wetlands, North Central Hardwood Forests, Northern Lakes and Forests, Mid-Boreal Lowland and Interlake Plains and Northwestern Glaciated Plain. Each ecoregion is distinctive in its hydrologic and geologic conditions and the flora, fauna and human uses that it supports.



Figure 12: Red River of the North Riparian Area

The Red River Basin contains three categories of unique and important habitats: Tallgrass Prairie/Prairie Pothole, Riparian (Figure 12) and Beach Ridge/Calcareous Fens. The Red River Basin supports a variety of fish and wildlife species, including nine that are either proposed, candidate, threatened or endangered species under the USFWS Endangered Species Program; and, under the Committee on the Status of Endangered Wildlife in Canada, 22 species are listed as endangered, 24 as threatened and 26 species are of concern in Manitoba. Aquatic and terrestrial invasive species also are emerging in the Red River Basin.

Over 95 percent of the prairie in the Red River Basin has disappeared since European settlement in the late 1800s. Between 1780 and 1980, 49 percent of wetlands in North Dakota and 42 percent of wetlands in Minnesota were lost. Extrapolation from nationwide data, between 70 and 90 percent of the natural riparian ecosystems have been destroyed. Forested areas have declined due to encroachment by development, farming practices, disease and flood mortality. Other stressors include the present climate cycle, invasive species, degradation of water quality and change in water supply.

Goal:

The Fish, Wildlife and Ecosystem Health working group determined that a simple and focused goal statement was best, and that the public and resource managers within the Red River Basin could most easily relate to the following goal: **Maintain Existing Habitat and Restore Natural Systems in the Red River Basin.**

Future Conditions:

It is assumed that the same stressors and conditions will continue to contribute to the loss and degradation of habitat in the Red River Basin, which will continue to impact the natural environment.

Problems:

The following are problems that the Fish, Wildlife and Ecosystem Health working group determined stakeholders would face in trying to achieve the goal of maintaining existing habitat and restoring natural systems in the Red River Basin:

- Habitat loss
 - Loss of prairies
 - Loss of wetlands
 - Loss of riparian habitat
 - Loss of wooded areas
- Habitat degradation
 - Changes in connectivity
 - Climate change
 - Invasive species
 - Water quality
 - Water supply
 - Restoration and enhancement obstacles
- Unfamiliarity with ecosystem functions and values.

Opportunities:

The following are opportunities that arise in trying to achieve the goal of maintaining existing habitat and restoring natural systems in the Red River Basin:

- There is an opportunity to conserve and enhance ecosystem health in concert with ongoing basin-wide projects, including flood risk management and others.
- There is a goal for 20 percent flow reduction in the basin. Distributed storage basins have been identified as an option to obtain this goal. Environmental design considerations have the potential to create habitat.

- Improve opportunities for outdoor recreation where compatible with overall ecosystem health conservation and enhancement objectives.

Objectives:

The vision for Fish, Wildlife and Ecosystem Health, which is to maintain existing habitat and restore natural systems in the Red River Basin, focuses on conservation and restoration. Based on the overall goal and the problems and opportunities, the Fish, Wildlife and Ecosystem Health working group developed the following objectives related to conservation and restoration. The group included objectives for a third focus area: education and awareness.

1. Goal – Conserve remnant natural habitat and protect fish and wildlife throughout the Red River Basin.
 - 1.1 Maintain or increase the current acreage of woodlands, grasslands, wetlands and riparian corridors.
 - 1.2 Prevent the introduction and spread of invasive species in the RRB.
 - 1.3 Provide support for the continued existence of state, province and federally listed species as well as unique habitats through conservation of critical habitat.
2. Goal – Restore and enhance degraded habitat and natural processes that support fish and wildlife.
 - 2.1 Restore and enhance degraded habitat and natural processes that support fish and wildlife.
 - 2.2 Increase biodiversity of native species, and promote the distribution of these species across the RRB.
 - 2.3 Decrease the contaminants, nutrients and turbidity of the Red River and its major tributaries.
 - 2.4 Restore hydrology to provide additional geomorphic stability.
 - 2.5 Promote the integration of features that provide environmental benefit in projects with other primary purposes.
 - 2.6 Reduce the time, process and bureaucracy involved in environmental projects.
3. Goal – Develop opportunities for education to aid in the understanding and appreciation of fish, wildlife and natural processes.
 - 3.1 Develop opportunities for education to aid in the understanding and appreciation of fish, wildlife and natural processes.
 - 3.2 Increase stakeholder and public knowledge of fish, wildlife and natural processes through environmental education and outdoor activities.
 - 3.3 Improve cultural competencies amongst various social and cultural groups in the RRB.

Constraints:

- No additional constraints to those stated for the basin overall.

Discussion:

The Fish, Wildlife and Ecosystem Health working group developed a number of strategies to respond to the problems identified and the objectives outlined above. Strategies are focused on conservation,

restoration and enhancement, and education and public engagement. These strategies are enumerated below and are discussed more fully in Appendix B.

Strategies:

1. **Consistent enforcement of current regulations.** Federal, state and local agencies have developed regulations to protect the environment, but in some instances the enforcement agencies fail to enforce them adequately and/or lack consistency over their jurisdictional area.
2. **Identify gaps in current regulations.** To effectively develop environmental laws and regulations it is important to inventory those currently in place, identify stressors contributing to the degradation of the environment, and formulate new regulations that consider the direct and indirect effects associated with them.
3. **Increase penalties for breaking regulations.** Certain regulations protecting the environment do not impose penalties harsh enough to deter people from breaking the law.
4. **Runoff-based fees.** Poor land practices can degrade the water quality of the drainage system and have detrimental impacts on aquatic environments. Fees influenced by environmental impacts could provide accountability for those failing to use good land use practices.
5. **Diversify incentive programs.** Current incentive programs have strict criteria that evaluate sites and rank them, giving priority of funding for the best sites for conservation, but not for their diversity. Some unique and high quality habitats continue to be ranked low or fail to qualify for incentives. Additional conservation programs, with varying evaluation criteria, could help reduce the likelihood that these unique areas are passed over.
6. **Improve incentive calculation.** Environmental processes, such as improved water quality, increased water supply, flood storage, carbon sequestration and erosion control provide beneficial goods and services. These benefits are hard to calculate and they are often left out or given only a small consideration in the calculation and ranking of alternatives and receipt of incentives.
7. **Targeted property acquisition and conservation easements.** Property acquisition and conservation easements for the protection of natural resources and habitat are limited due to the high cost of purchasing and managing lands. Therefore, it is important to have current and reliable information that is comparable when targeting lands throughout the basin.
8. **Continue interbasin coordination meetings.** Meetings held in preparation of Fish, Wildlife and Ecosystem Health appendix brought together natural resource agencies and environmental professionals from across the region. Continued discussion between these groups could lead to collaboration on projects and data acquisition that span multiple jurisdictional areas. In addition, frequent exchange of ideas between agencies could result in the mutual understanding of priorities and conservation in the basin. Cooperative efforts have a greater potential for cost savings and could result in products that are more comparable across borders.
9. **Update wetlands inventory.** There are no recent and comprehensive inventories of wetlands for the entire Red River Basin, making it difficult for evaluation and planning at the basin level. The National Wetland Inventory in the United States is out of date, and only a small portion of the basin in Canada is being mapped. The Minnesota DNR is working on providing new wetland maps for the Minnesota portion of the basin in 2019. Other jurisdictional areas could update and complete similar wetland mapping exercises for their areas.

10. **Create more decontamination stations on infested waters.** Decontamination stations are typically comprised of high-temperature power washers that can remove or kill aquatic invasives. Some stations have already been placed at public access points in the basin to help prevent the spread of invasive species. Additional strategically placed stations could help prevent the spread of invasives from infested waters.
11. **Deauthorization of projects.** There are several existing Corps clearing and snagging projects that have outlived their usefulness and are no longer needed for the purpose for which they were originally constructed, yet maintenance responsibilities and restrictions on these lands still remain. Responding to a solicitation from the Corps, the local sponsors for the Lower Branch of the Rush River (Cass County, ND) and the Lower Wild Rice River (Norman County, MN) expressed interest in deauthorizing their projects. Deauthorization would require congressional approval.
12. **Utilize existing programs.** There are numerous programs in the basin that support the restoration and enhancement of the environment. Coordinating the efforts of these various programs could lead to more efficient use of funding and a higher likelihood for attainment of the basin's goals and objectives. The Fish, Wildlife and Ecosystem Health working group could be tasked with developing a summary of potential restoration projects in the basin to be used to initiate the planning and design of restoration when funding becomes available.
13. **Update education curriculum to include environmental education.** Schools are required to comply with federal and state education standards. Including environmental education in the curriculum could ensure that the basin's youth receive basic environmental principles. Many agencies at the state and federal level have prepared lesson plans that can aid educators in teaching environmental education.
14. **Create groups that encourage public participation in outdoor activities.** Various groups that encourage outdoor activities can be found throughout the basin. However, sometimes these groups meet at locations that are inconvenient or can be intimidating to the public. Creating additional groups at the local level could alleviate these problems and encourage involvement.
15. **Increase or replace kiosks at restoration projects and natural areas.** There are currently a number of educational kiosks throughout the basin. Interpretive signs could be placed at additional locations that demonstrate particular environmental conditions or processes. Fading or aging signs could be updated or replaced. Kiosks could incorporate interactive technologies, such as quick response (QR) codes linking kiosks to related web pages, which would allow users to access additional information.
16. **Create new or utilize existing phone apps.** When people show interest in the basin's environment it is important to provide them with tools to keep them informed and engaged in the basin's activities. Many of the agencies in the basin currently utilize apps, but they are often limited to areas within designated state and international boundaries. This has resulted in numerous apps that provide incomplete information across the basin and have limited utility for those traveling across borders. An app that delivers information from across the basin may be able to provide more complete information and be more appealing to users. In addition the Red River Basin could make use of existing environmental apps by submitting information to these databases.

Fish, Wildlife and Ecosystem Health Working Group Recommendations:

The Fish, Wildlife and Ecosystem Health working group collectively agreed upon a combination of realistic actions that would meet the goals and objectives established for the basin. The group developed evaluation criteria and with internal group discussions, screened out actions and came up with the following recommended actions for the basin (Table 5). The path forward identifies if the recommended action can be implemented as a project without further study or if it needs further study. The path forward also indicates the entity that should implement or study the recommended action.

Table 5: Fish, Wildlife and Ecosystem Health Working Group Recommendations

Recommended Actions			Path Forward		
Goals	Ref No.	Actions	Project	Study	Suggested Responsible Entity
Conservation.	2.1	Diversify incentive programs.	√		Public agencies
	2.2	Improve calculation of incentives.		√	NRCS
	1.1	Enforce laws and regulations.	√		All reg agencies
	6.1	Continue interbasin meetings.	√		RRBC lead
	n/a	Update wetlands inventory.	√		All agencies
	1.2	Identify regulation gaps.		√	FWEH group
Restoration and enhancement.	6.1	Continue interbasin meetings.	√		RRBC lead
	5.1	Deauthorization of projects.		√	Corps
	7.1	Utilize existing programs.	√		All agencies
Education and public engagement.	8.2	Update education curriculum.	√		All agencies
	9.1	Increase outdoor activity programs.	√		All agencies
	9.2	Increase/replace kiosks.		√	FWEH group
	9.3	Multi-agency phone app.		√	RRBC

4.7 Water Quality

Background:

The Water Quality working group was well established prior to the start of the CWMP effort. For the CWMP efforts, the working group joined forces with the IRRB Water Quality Committee, which has great representation from North Dakota, Minnesota and Canada, across federal, state and local jurisdictions. The Water Quality working group is comprised of a variety of stakeholders from the Corps, the RRBC, the Manitoba Conservation and Water Stewardship, the Minnesota Pollution Control Agency, Environment Canada, the North Dakota Department of Health, the Natural Resources Conservation Service, Agri-Food Canada, the Minnesota Department of Agriculture, the U.S. Environmental Protection Agency (USEPA) and the USGS.

This group is engaged with multiple efforts throughout the basin. Highlights include a basin-wide nutrient reduction strategy and development of the Lake Friendly Accord. This working group focused their work on updating the work done in the 2005 NRFP, adding in recent water quality information and including the perspectives of the IRRB Water Quality Committee.

Water quality in the Red River Basin varies with the time of year (Figure 13). Ice-covered surface waters in the winter tend to have less dissolved oxygen, lower concentrations of sediment and higher concentrations of sulfate and ammonia. The cool temperatures and higher flows during spring snowmelt result in an increase in dissolved oxygen, suspended sediment and nitrite and nitrate concentrations. The warmer weather and the decrease in flows in the summer result in reduced suspended sediment, nutrient and pesticide concentrations. Summer rainfall events result in varying particulate and pollution loads. Median dissolved phosphorus is relatively steady between seasons, but total phosphorus is higher in the summer.



Figure 13: Algal Bloom

Water quality directly affects the diversity of fish species. Water quality is influenced by human activities, agriculture, tile drainage, storm water runoff, wastewater and point sources.

Goal:

The Water Quality working group developed the following goal as part of the Comprehensive Watershed Management Plan effort: **Maintain, Protect and Restore Surface and Ground Water Quality in the Red River Basin.**

Future Conditions:

The Water Quality working group assumed that the basin's existing trends of land use, population growth, climatology and production practices would continue for the next few decades. The Water Quality working group predicts that eutrophication will worsen, that there will be an increase in suspended and dissolved solids in the water, that better practices for agriculture and wastewater treatment will improve the concentrations of bacteria in the water, and that the level of pesticides will depend upon future restrictions and agricultural practices.

Problems:

The following are problems that the Water Quality working group determined would be challenges in reaching the goal of maintaining, protecting and restoring surface and ground water quality in the Red River Basin:

- Eutrophication caused by excess nutrients (nitrogen and phosphorus) loading in waterways.
 - The growth of blue-green algae (*cyanobacteria*) is the major concern for lakes experiencing advanced eutrophication.
- Elevated sulfate loading and increased total dissolved solids.
- Total suspended solids (TSS) and turbidity are elevated in most tributaries and main stem reaches in the Red River Basin.

- Occurrence of fecal coliform bacteria in the Red River Basin and its tributaries.
- Waterways contaminated with pesticides from agricultural sources, residential lawns, parks and golf courses.
 - Pesticides in water can be directly digested or absorbed by an organism or bioaccumulated up the food chain and affect predatory fish and terrestrial species.

Opportunities:

The following is an opportunity that arises in trying to achieve the goal of maintaining, protecting and restoring surface and ground water quality in the Red River Basin:

- There is an opportunity to bring together citizens, local units of government, state and federal interests to put together a comprehensive plan to address water quality issues within the basin, focusing on sediment and nutrients.

Objectives:

1. Reduce both dissolved and particulate nutrient loadings to the Red River and its tributaries and Lake Winnipeg by reducing phosphorus and nitrogen concentrations and loading.
2. Reduce average and peak flow throughout the basin. Increase storage and infiltration to limit downstream total solids and the transfer of nutrients, biological and chemical contaminants.
3. Reduce fecal coliform contamination in the waterways.
4. Promote efficient use of pesticides in the basin to reduce transfer to waterways.

Constraints:

- No additional constraints to those stated for the basin overall.

Discussion:

The Water Quality working group developed a number of strategies to respond to the problems identified and the objectives outlined above. These strategies are enumerated below and are discussed more fully in Appendix C.

Strategies:

1. Develop a basin-wide nutrient management strategy for the International Red River Watershed.
2. Develop nutrient reduction limits and standards.
3. Prioritize and implement proposed restoration or improvement projects.
4. Provide incentives for best management practices.

The Water Quality working group developed a number of potential actions within each of the four strategies. These actions are enumerated below and are discussed more fully in Appendix C.

Actions:

1. Develop a basin-wide nutrient management strategy for the International Red River Watershed.
 - Component One: Seek endorsement of the proposed approach from the IRRB.
 - Component Two: Develop a shared understanding of jurisdictions' nutrient regulatory frameworks and identify current nutrient reduction actions, activities and plans for the Red River Watershed.
 - Component Three: Recommend and implement nutrient load allocation and/or water quality targets for nutrients.

- Component Four: Monitor and report on progress towards meeting water quality targets and nutrient load allocations.
 - Component Five: Facilitate ongoing technical, scientific and methodological dialogue and information sharing relevant to nutrients and nutrient loading in the Red River Watershed, including exchanging information on the goals and scientific basis for the long-term ecologically relevant objectives that are under development for Lake Winnipeg.
 - Component Six: Adapt the nutrient management strategy based on progress and ongoing evaluation.
2. Develop nutrient reduction limits and standards.
 - Manitoba Nutrient Reduction Limits
 - Manitoba Water Quality Standards, Objectives and Guidelines Regulation
 - Onsite Wastewater Management System Regulation
 - Nutrient Management Regulation
 - North End Water Pollution Control Centre
 - Phosphorus Reduction Act
 - Minnesota Phosphorus Limit to Lakes
 - Minnesota 2008–2012 Triennial Water Quality Rule Review Process
 - North Dakota Non-point Source 319 Program
 - Environment Canada National Wastewater Effluent Regulations
 - The Lake Winnipeg Stewardship Board
 - North Dakota Establishment of Nutrient Strategy Stakeholder Task Force
 3. Prioritize and implement proposed restoration or improvement projects.
 - Antelope Creek Watershed/Wild Rice Corridor Project – Phase II North Dakota
 - NPS Management Program, Forestry Practices and Water Resources Program – USEPA Red Lake Nation (Minnesota)
 - Nutrient management activities – Lake Traverse/Mud Lake and the Bois de Sioux River Sisseton Wahpeton Oyate Tribe (South Dakota)
 - Targeting Best Management Practices on the Upper South Branch of the Buffalo River (Minnesota)
 - Lake Alice Conservation Wetland Program (CWP) Phase I (Ottetail River, MN)
 - Pearl Lake CWP Phase I (Pelican River, MN)
 - Wild Rice River Restoration and Riparian Project (Sargent County, ND)
 - Maple River Watershed Enhancement (North Dakota)
 - Turtle River Watershed Restoration (North Dakota)
 4. Provide incentives for best management practices.
 - Alternative Land Use Services Program in the Municipality of Blanchard (Manitoba)
 - The Riparian Tax Credit Program (Manitoba)
 - Rush River Watershed and Brewer Lake (North Dakota)
 - Minnesota Department of Agriculture BMP Loan Program (Minnesota)
 - Minnesota Department of Agriculture Water Quality Certification Program <http://www.mda.state.mn.us/protecting/waterprotection/awqcprogram.aspx> (Minnesota)

- U.S. Department of Agriculture Environmental Quality Incentives Program (North Dakota and Minnesota)
5. Pursue education, research and outreach.
 - Lake Friendly Products Campaign (Manitoba)
 - Lake Winnipeg specific Grade 8 science curriculum (Manitoba)
 - International and Domestic Water Committees/Boards (Environment Canada)
 - Canada Excellence Research Chair in Water Security, Dr. Wheeler
 - Growing Forward (GF) Policy Framework (5 Year Agreement) (Agriculture and Agri-Food Canada (AAFC))
 - Red-Assiniboine Project (AAFC)
 - Red-Assiniboine Project (Environment Canada)
 - Technical Guide for Watershed-Based Ag-Water Management & Planning (AAFC)
 - Wide distribution of “Manitoba’s Water Protection Handbook”
 - Red Lake Education Initiatives (Red Lake Nation)
 - Sisseton Wahpeton Tribe (South Dakota) Workplan Initiatives
 - Manitoba Nutrient Management Planning Beneficial Management Practices
 - North Dakota Discovery Farms Program
 - Watershed Evaluation of BMPs (WEBs) Project (AAFC Lead)
 - Minnesota River Watch
 - Environment Canada – Lake Winnipeg Basin Portal
 - Environment Canada – Lake Winnipeg Basin Initiative
 - Upper Red River Valley Riparian Project (North Dakota)
 6. Pursue agriculture and land use restrictions.
 - Pig Moratorium in Manitoba
 - The Livestock Manure and Mortalities Management Regulation, under The Environment Act, Manitoba
 - Minnesota Agri-Environmental Regulations: Animal Feedlot Waste Management, Land Application of Manure, Livestock Water Access, Ambient Air Quality Standards, Animal Carcass Disposal, Feedlot Discharge Effluent Standards, Minnesota Environmental Policy Act, Riparian Farming, Excessive Soil Loss, Public Road Ditch Farming, Ground Water Protection Act, Agricultural Chemical, Agricultural Chemical Spill Liability and Cleanup Cost Assistance, Chemigation, Biosolid/Sewage Sludge Fertilizer, Endangered Species Protection, Wetland Conservation Act, Water Use, Agricultural Well Construction, and Water Quality Standards (<http://www.house.leg.state.mn.us/hrd/pubs/agenvtlaw.pdf>; http://agcentric.org/wp-content/uploads/2016/10/Minnesota_Environmental_Laws_for_Agriculture.pdf)
 - USEPA Laws and Programs: Safe Drinking Water Act, Clean Water Act; Federal Insecticide, Fungicide, and Rodenticide Act; Endangered Species Act, Toxic Substances Control Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act (<https://nepis.epa.gov/Exe/ZyPDF.cgi/P1003E7I.PDF?Dockey=P1003E7I.PDF>)
 7. Use water quality modeling.
 - International Watersheds Initiative – Souris-Assiniboine-Red River Watershed – SPARROW modeling (Environment Canada)

- SPARROW model for the Red River Basin that combines United States and Canada (North Dakota)
8. Use water quality monitoring.
 - White Earth Nation (Minnesota) monitoring 45 lakes for Total Nitrogen & Phosphorus on a rotating basis
 - North Dakota – Ambient water quality monitoring network
 - Environment Canada Hydrometric Program
 - North Dakota – High/low flow stream monitoring network
 - North Dakota – Real-time water quality probe at Fargo
 - North Dakota – Real-time water quality probe at Grand Forks
 - Year-long evaluation of Tulaby Lake (Minnesota)
 - Spirit Lake Tribe (North Dakota) nutrient management monitoring
 - FDR (Flood Damage Reduction) project monitoring – 3 Pilots (Minnesota)
 - FDR project monitoring at all impoundments built with State of Minnesota flood damage
 - Thief River sediment investigation (Minnesota)
 - Red River Valley Tile Drainage Water Quality Assessment Project (North Dakota)
 - Environment Canada – Water Quality Monitoring
 9. Pursue wetland restoration.
 - Delta Marsh and Netley Libau Marsh (Manitoba)
 - Wetland Restoration Incentive Program (Manitoba)
 10. Follow management plans and total maximum daily loads (TMDL).
 - Integrated Watershed Management Plans – local level conservation districts (Manitoba)
 - nutrient monitoring plan for all point source dischargers on the Red River (North Dakota)
 - The Minnesota Pollution Control Agency (MPCA) Phosphorus Strategy (Minnesota)
 - Lower Ottetail River turbidity TMDL Implementation Plan (Minnesota)
 - Rabbit River Turbidity TMDL Implementation Plan (Minnesota)
 - Mustinka River Turbidity TMDL Implementation Plan (Minnesota)
 - Buffalo River Watershed Restoration and Protection Project (Minnesota)
 - Mustinka River Watershed Restoration and Protection Project (Minnesota)
 - Upper Red River Watershed Restoration and Protection Project (Minnesota)
 - Bois de Sioux Watershed Restoration and Protection Project (Minnesota)
 - Wild Rice Sedimentation Study (USGS)
 - Buffalo Red Watershed District Sediment Modeling for Best Management Practices Implementation (Minnesota)
 - Lower Ottetail River Sediment Reduction Project (Minnesota)
 - North Ottawa Flood Damage Reduction Project (Minnesota)
 - Red Path Flood Damage Reduction Project (Minnesota)
 - Manston Slough Restoration Project (Minnesota)
 - Thief River Major Watershed Restoration and Protection Project (Minnesota)
 - Red Lake River Major Watershed Restoration and Protection Project (Minnesota)
 - Lower Red Major Watershed Restoration and Protection Project (Minnesota); includes Tamarac River and Joe River

- Ag management zone (Minnesota)
- Two Rivers WD (Minnesota)
- Homme Dam Water Quality Assessment and TMDL (North Dakota)
- Matejcek Dam Water Quality Assessment (North Dakota)
- Fordville Dam Water Quality Assessment and TMDL (North Dakota)
- Upper and Middle Sheyenne Water Quality Assessment (North Dakota)
- English Coulee Water Quality Assessment (North Dakota)
- Dead Colt Creek Dam Nutrient TMDL (North Dakota)
- Armordale Dam Nutrient TMDL (North Dakota)
- Brewer Lake Nutrient TMDL (North Dakota)
- Larimore Dam Nutrient TMDL (North Dakota)

Water Quality Working Group Recommendations:

While many of the above ideas were considered by the Water Quality working group, Table 6 below summarizes their final recommendations. The path forward identifies if the recommended action involves a study or a project. The path forward also indicates the entity that should implement or study the recommended action, and it indicates a timeline for efforts that are on-going or have not begun.

Table 6: Water Quality Working Group Recommendations

Recommended Alternatives			Path Forward			
Strategies	Ref. No.	Actions	Study	Project	Suggested Responsible Entity	Timeline
Strategy #1 Develop a basin-wide nutrient management strategy for the International Red River Watershed.	1.1	IRRB Nutrient Management Strategy Component One.	√		IRRB	Complete
	1.2	IRRB Nutrient Management Strategy Component Two.	√		IRRB	Complete
	1.3	IRRB Nutrient Management Strategy Component Three.	√		IRRB	2018
	1.4	IRRB Nutrient Management Strategy Component Four.	√		IRRB	2018
	1.5	IRRB Nutrient Management Strategy Component Five.	√		IRRB	2018
	1.6	IRRB Nutrient Management Strategy Component Six.	√		IRRB	2018
Strategy #2 Develop nutrient reduction strategies, targets, limits and/or standards	2.1	Long-term nutrient loading targets for Lake Winnipeg.	√		Manitoba	2019
	2.2	Nutrient targets for the Red River at the United States/Canada boundary.	√		IJC	2019
	2.3	North Dakota nutrient management strategy.	√		North Dakota	2019
Strategy #3	3.1	Prioritize BMP types and locations in the basin.		√	Federal, provinces and states	2020

Prioritize and implement restoration and improvement projects.	3.2	Implement biomass harvesting opportunities in the basin.		√	Federal, provinces and states	2020
	3.3	Riparian restoration in the basin.		√	Federal, provinces and states	2020
	3.4	Stream bank and in-stream restoration in the basin.		√	Federal, provinces and states	2020
	3.5	Retention and infiltration projects in the basin.		√	Federal, provinces and states	2020
Strategy #4 Provide incentives for best management practices.	4.1	Promote and strengthen funding for land retirement programs.	√		Federal, provinces and states	2018
	4.2	Promote and strengthen land purchase and set aside programs.	√		Federal, provinces and states	2018
	4.3	Provide financial assistance to implement best management practices for the management of urban storm water.	√		Federal, provinces and states	2018
Strategy #5 Pursue education, research and outreach.	5.1	Lake Friendly Initiative.	√		Manitoba	2016
	5.5	Develop technical guides for Watershed-Based Water Management & Planning.	√		Federal	2019
	5.6	Wide distribution of <i>Manitoba's Water Protection Handbook</i> .	√		Manitoba	2018
	5.7	Expand Discovery Farms Program.	√		States	2017
	5.8	Create and maintain web-based Decision Support Systems.	√		Federal	2020
Strategy #6 Pursue agriculture and land use restrictions.	6.1	Require nutrient application to match crop uptake rates.		√	Provinces and states	2020
	6.3	Prohibition on nutrient application to frozen land.		√	Provinces and states	2020
	6.4	Promote the adoption of the "four Rs" (application of nutrients at the right time, right place, right source and right rate).		√	Provinces and states	2020
	6.5	All drainage projects including surface and tile drains.		√	Provinces and states	2020

Strategy #7 Use water quality modeling.	7.1	International Watersheds Initiative – Souris-Assiniboine-Red River Watershed – SPARROW modeling.	√		Federal	2022
	7.3	Encourage consistent LiDAR development, and use basin-wide.	√		Federal	2016
Strategy #8 Use water quality monitoring.	8.1	Establish more research sites to study controlled drainage and subirrigation tile drainage systems.	√		Provinces and states	2018
	8.2	Enhance consistency in the basin-wide ambient water quality monitoring network.	√		Federal	2020
	8.5	Develop and implement a water quality monitoring plan for all point source dischargers in the basin.	√		Federal	2020
Strategy #9 Pursue wetland restoration.	9.3	Prioritize and implement wetland restoration projects in the basin.		√	Federal, provinces and states	2018
	9.2	Mandate no net loss of wetlands benefits.		√	Federal, provinces and states	2018
Strategy #10 Follow management plans and TMDLs.	10.1	Integrated Watershed Management Plans.	√		Provinces and states	2025

4.8 Water Supply

Background:

The Water Supply working group was a well-established group prior to this CWMP effort. The group recognizes the very real need for a basin approach in developing a drought strategy for the Red River Basin. The working group was comprised of a variety of stakeholders from the Corps, the RRBC, the Pembina Valley Water Cooperative Inc., the Moorhead Public Service Water Division, the City of Winnipeg Water and Wastewater Department and the North Dakota State Water Commission.

Despite the well-known flood risks, the Red River Basin is a semi-arid watershed with limited and sporadic precipitation. There have been several periods of drought observed over the last 120 years, lasting anywhere from as short as 2 months, to as long as 151 months. Jurisdictional water laws vary between North Dakota, Minnesota and Manitoba, dictating who or what uses have priority for water use. North Dakota, Minnesota, Manitoba and other jurisdictional areas have varying drought response and water conservation plans in place (Figure 14).



Figure 14: Baldhill Dam and Lake Ashtabula

Before the CWMP effort, the Water Supply working group had already developed several key documents including *The Red River Basin Immediate Drought Response Process*; *The Red River Basin Water Conservation for Residential, Municipal, Commercial and Industrial Needs*; and a *Drought Preparedness Strategy Scoping Document*. The Water Supply working group effort picks up where the scoping document left off; the team developed and documented recommendations for drought preparedness.

Goal:

The Water Supply working group developed the following goal for water supply in the Red River Basin: **Develop a basin-wide strategy for future water supply needs to ensure an adequate supply for beneficial uses.**

Future Conditions:

The basin has limited surface and ground water resources. With on-going development and population growth, the demands on these resources will exceed the supply during an extended dry cycle.

Problems:

- The Red River Basin is a semi-arid watershed with limited surface and ground water resources and is at risk for drought events with widespread impacts.
- Demands on water increases as the area population grows, increasing the negative impacts of drought events.
- Each jurisdiction operates within the framework of its own laws and regulation.
- There are fragmented and inconsistent approaches to drought management strategies.

Opportunities:

There is an opportunity to develop a coherent approach to water supply issues in the Red River Basin.

The basin entities need a strategy of what can be done under the current conditions for addressing dry cycle stresses. A drought that would extend from months to years has the potential for an economic catastrophe far surpassing any flood. In addition, the impact on residents, businesses, wildlife and the environment would be equally devastating. While current approaches contain elements of drought mitigation management in various forms, there is no formalized coordinated or comprehensive basin approach.

Objectives:

1. Reduce the environmental, economic and social impacts of drought.
2. Increase drought cooperation and coordination among basin entities.
3. Improve Red River Basin drought resilience.*

The Water Supply working group is drawing on existing documents, information and work already completed in the basin. Several of the alternatives are developed from these sources and recommend implementing some of the strategies that were outlined in these documents, but have not yet been implemented.

*Resilience is defined as the ability to prepare and plan for an event, to absorb and withstand impacts from the event, to rapidly recover from the event and also to adapt to be more successfully resilient in the future.

Constraints:

- No additional constraints to those stated for the basin overall.

Discussion:

The issues of water supply and drought preparedness are a well-documented concern in the Red River Basin, and several responses to this issue are already underway. The Water Supply working group centered their efforts on examination of the recommendations made in the “Red River Basin Drought Preparedness Strategy Scoping Document,” completed in January 2008, the “Red River Basin Immediate Drought Response,” completed in February 2009 and the “Red River Basin Water Conservation for Residential, Municipal, Commercial and Industrial Needs” report, completed in March of 2010. These documents are included as attachments to Appendix D.

Strategies:

The Water Supply working group focused on the four following strategies. These strategies are discussed more fully in Appendix D.

1. **Process for the immediate future.** This strategy addresses the immediate needs of drought preparedness in advance of any large water supply project. The strategy addresses various forms and types of drought and drought responses. The process for the immediate future examines conjunctive uses, disaster relief, drought forecasting, drought plan coordination, emergency supplies, water marketing/risk adjustment, water rights enforcement coordination and recommendations for jurisdictional consideration.
2. **Soft path conservation approaches.** The “Red River Basin Water Conservation for Residential, Municipal, Commercial and Industrial Needs” report was completed in March of 2010. The report describes soft path as a philosophy of water management that examines the processes in

which water is used and determines ways to achieve the same outcomes with reduced water use. Public perception and appreciation of the value of water is also emphasized to encourage interest in voluntary conservation. These soft path approaches in the Red River Basin should be reviewed to determine additional conservation opportunities.

3. **Model evaluation.** Modeling can predict the impacts and effectiveness of various existing and proposed drought strategies. This strategy examines the existing models and recommends that a set of baseline and “no-action” scenarios be developed. The model results would identify the future-without-action condition and predict the effects, impacts and limitations of the existing drought approaches as well as any new proposals.
4. **Basin-wide drought preparedness plan.** This strategy is to develop a basin-wide drought preparedness plan. The plan would recommend procedures and mechanisms of drought management that would be implemented during various types of drought (meteorological, agricultural, hydrologic and socioeconomic). The plan would define where, when and what actions would be taken under various conditions. After public input, the final strategy will represent a consensus-driven vision of drought management in the basin.

Water Supply Working Group Recommendations:

Table 7 below summarizes the recommendations of the Water Supply working group. The path forward identifies if the recommended action is a study or a project. The path forward also indicates which entity should implement the action.

Table 7: Water Supply Working Group Recommendations

Recommended Alternatives			Path Forward		
Strategies	Ref. No.	Actions	Study	Project	Suggested Responsible Entity
Process for the immediate future.	1.2	Implement recommendations from the “Red River Basin Immediate Drought Response Process.”		√	Communities
Soft path conservations approaches.	2.2	Implement Soft Path recommendations from the “Red River Basin Water Conservation for Residential, Municipal, Commercial and Industrial Needs” report.		√	Communities
Model evaluation.	5.2	Model alternatives for additional water supply sources/storage in the basin.	√		TBD
	5.4	Implement recommended additional water supply sources/storage options.		√	Communities, state government, federal government
Basin-wide drought preparedness plan.	6.1	Develop Long-Term Basin-wide Drought Preparedness Strategy.	√		Water supply group
	6.2	Public review.	√		Public

4.9 Recreation

Background:

The Recreation working group was newly-established for the CWMP effort. Under the NRFP, Recreation was grouped with the fish and wildlife group and focused primarily on hunting and fishing activities. The 2014 CWMP outreach effort was very successful, and a diverse group of participants came together to support this working group. The Recreation working group is comprised of a variety of stakeholders from the Corps, the RRBC, River Keepers, Rivers West, University of Minnesota Regional Partnership,



Figure 15: Fishing at a Corps Reservoir

Minnesota DNR, North Dakota Parks and Recreation, IWI, and Manitoba and North Dakota local governments.

Unlike some of the other working groups, this group did not have any previous group efforts to draw from. The group needed more time to settle on a goal for the focus area and had to go through multiple iterations of the Corps' 6-step planning process. Due to the diverse nature of recreation and the variety of agencies and local organizations that develop and maintain the recreation facilities, the working group found that existing information is plentiful but has to be drawn from many sources.

The Red River provides a wide variety of recreation opportunities both along the Red River, its tributaries and numerous lakes in

the basin. While the setting is predominately rural, the river passes through several urban areas, including Wahpeton-Breckenridge-, Fargo-Moorhead, Grand Forks-East Grand Forks and Winnipeg. Public lands provided for wildlife are heavily used by outdoor enthusiasts for hunting, fishing, hiking, bird watching, snowmobiling and cross-country skiing (Figure 15).

Goal:

After much discussion, the Recreation working group settled on the following goal: **To inform and increase the enhancement and development of recreational opportunities within the Red River Basin.** The Recreation working group further refined this goal to concentrate on recreational opportunities that may be tied to the proximity of water.

Future Conditions:

A growing population will increase the need for public access for recreational activities.

Problems:

- Insufficient recreation opportunities
 - Limited river and recreation site access and connectivity
 - Underdeveloped recreational infrastructure
 - Limited Signage and wayfinding
- Inadequate holistic basin-wide planning

- Lack of safe passage along rivers
- Juggling water management and recreation
- Impaired waters and Aquatic Invasive Species (AIS) and recreation
- Deficient recreation data
 - Dispersed and varied existing recreation information
 - Limited recreation user data

Opportunities:

The following are opportunities that arise in trying to achieve the goal of informing and increasing the enhancement and development of recreational opportunities within the Red River Basin.

- Enhance the use of rivers and lakes in the basin to attract visitors.
- Support public education on outdoor recreation.
- There is an opportunity for planned and coordinated efforts with different working groups such as water quality; fish, wildlife & ecosystem health; and soil conservation to develop a strategy to encourage improved water quality and overall ecosystem health while increasing recreation.
- Improve opportunities for holistic planning efforts with local and state transportation projects to include and prioritize recreation at the beginning of the planning phases of new projects.
- Support and promote the inclusion of recreation in the water management planning for the basin.
- Leverage all the existing recreation data within the basin to determine a baseline for recreation use to facilitate in recreation planning in the basin.

Objectives:

The Red River NRFP Recreation Vision is to restore and maintain an environment in the Red River Basin that provides for quality human life, prosperous agriculture, flourishing communities, improved water quality, abundant wildlife and healthy habitats, holistic water management and increased outdoor recreation, all which support compatible long-term economic growth and basin environmental health. The following objectives were developed to address problems with recreation in the basin.

1. Increase water-based, water associated, outdoor recreation opportunities within the Red River Basin.
2. Integrate public-use and outdoor recreation features in all Red River Basin watershed planning efforts.
3. Increase awareness and the promotion of existing and future water-based, water associated, outdoor recreational opportunities within the Red River Basin.

Constraints:

- Inconsistent planning and varying goals – Recreation facilities are often planned at various levels of government agencies as well as by private recreation organizations. Each of these agencies and organizations have varying goals and authorities that influence decisions and govern their actions.
- Lack of Data – Data collection and studies are often carried out to better inform these agencies on the status and trends within their jurisdictional areas. Data covering the whole basin is rarely

collected and in instances where basin-wide data is collected, it is often at very coarse resolutions, limiting its usefulness to analysis at the national or continental scale.

- International Border – The basin’s international border and the difficulty in which a visitor is able to recreate on rivers that pass the border negatively impacts the planning of recreation for the basin.

Discussion:

The Recreation working group was able to draw from numerous studies, reports and websites in order to assess the condition of existing recreational opportunities in the Red River Basin. The full discussion is summarized in Appendix E.

Strategies:

Drawing from the information they gathered and their own knowledge and expertise, the Recreation working group came up with the following strategies and actions for meeting the recreational objectives.

1. Increase access to rivers.
2. Provide connections to communities and recreation facilities.
3. Develop new recreation facilities, and preserve/restore existing.
4. Encourage interdisciplinary approach to basin management planning and implementation.
5. Ensure recreation is considered in planning efforts in the basin.
6. Create agency vision and commitment to recreation in the basin.
7. Develop recreation baseline for the basin.
8. Increase availability of recreation data.
9. Enhance promotion and marketing of recreation opportunities for the basin.

Recreation Working Group Recommendations:

The Recreation working group developed an extensive list of possible actions under each of the strategies listed above. After developing evaluation criteria and screening the list of possible actions for completeness, effectiveness, efficiency and acceptability, the Recreation working group prioritized the actions and came up with the following recommendations (Table 8). The path forward identifies if the recommended action is a study or a project. The path forward also indicates which entity should implement the action.

Table 8: Recreation Working Group Recommendations

Actions		Path Forward		
	Ref. No.	Study	Project	Suggested Responsible Entity
Develop a fishing access program.	1.1	√	√	Public agencies
Retrofit existing infrastructure to accommodate The Americans with Disabilities Act (ADA) access.	n/a		√	Public agencies
Implement existing access plans.	1.5		√	Public agencies
Develop planning assessment of river access in the United States.	1.6	√		RRBC lead
Obtain recreation user counts.	2.1		√	RRBC lead
Take inventory and assess conditions.	2.4	√		RRBC lead
Improve and enhance signage and wayfinding.	3.5		√	Public agencies
Optimize existing recreation facility usage.	3.9		√	Public agencies
Use of social media to promote.	4.8		√	Public agencies, RRBC, tourism
Work with visitor centers and tourism groups.	4.9		√	Public agencies, RRBC, tourism
Develop a partnership forum.	5.1		√	RRBC lead
Develop recreation planning checklist.	5.2	√	√	Public agencies
Develop recreation best management practices.	5.3	√	√	Public agencies
Present successful examples of holistic planning efforts.	5.4		√	RRBC lead

4.10 Soil Health

Background:

Prior to the CWMP effort, the Soil Health working group had not met for several years but did have a participant base from the NRFP. Participants include the Corps, the RRBC, the Minnesota Board of Water and Soil Resources, the North Dakota Department of Health, the Minnesota Department of Agriculture, the Minnesota DNR, the Natural Resource Conservation Service, the Minnesota Pollution Control Agency, Manitoba Agriculture, Agriculture and Agri-Food Canada and the University of Manitoba Department of Soil Science.

Many other working groups recognize that soil health is one of the most important factors influencing the condition of other resources in the basin. Soil Health is defined in the agricultural terms as soil's fitness to support crop growth without becoming degraded or otherwise harming the environment. In broader terms, soil health

is used to describe the state of soil as "Sustaining plant and animal productivity and diversity; Maintaining or enhancing water and air quality; Supporting human health and habitation." The Red River Basin soils are made up of clayey textured soils with poor internal drainage. Floods occur frequently due to small slope gradients and the northward flow of the Red River, towards the direction of snowmelt.



Figure 16: Agricultural Field, Red River Basin

Land use is predominantly agricultural (Figure 16).

Goal:

The Soil Health working group decided not to adopt the NRFP goal statement and spent their first team meeting brainstorming and developing a new goal statement: **Maintain and enhance soil health within the Red River Basin to improve the physical, chemical and biological properties and effective functions.**

Future Conditions:

Agricultural management practices will continue to influence the future. Use of tillage practices, which lead to more erosion, less infiltration and a decline in soil health will continue to decrease the productivity of agricultural lands. Agricultural management practices will either be done correctly or incorrectly, depending upon education and promotion of sustainable land use.

Problems:

- Surface/subsurface runoff, erosion and water quality
 - Erosion (sediment transport)
 - Loss of topsoil
 - Land cover
 - Wind
 - Poor drainage
 - Reduced infiltration and water holding capacity
 - Water quantity (rate and volume)
 - Runoff, flooding
 - Water supply (drought)
 - Poor water quality
 - Polluted water resources (nutrient movement)
 - Salinity
 - Aquatic life impacts
 - High water table
 - Inefficient water cycle
- Land use/productivity
 - Loss of agricultural land
 - Farming practices
 - Management and crop selections
 - Irresponsible irrigation
 - Reduced agricultural productivity
 - Increasing crop input costs
 - Fertilizers, fuel, manpower, pesticides
 - Lack of stewardship and education
 - Ineffective farm programs
 - Low soil organic matter
 - Poor soil structure
 - Low soil biodiversity, abundance and activity
 - Human activity (altered landscape)
 - Increased compaction

Opportunities:

Improving soil health can lead to opportunities such as a decrease in erosion and loss of topsoil, improved water quality and improved water-holding capacity. Improving soil health could also bolster

support for alternative farming practices and lead to improved biodiversity and soil organic material content.

Objective:

The group developed just one objective, feeling that alternatives that are complete, effective, efficient and acceptable in meeting this objective would address the majority of the identified problems and contribute to the overall goal.

1. Improve soils ability to store water, nutrients and carbon to ensure their effective availability.

Constraints:

The Soil Health working group did not identify any additional constraints.

Discussion:

The Soil Health working group examined the strategies outlined in previous studies and reports, which included:

- Conservation management techniques and storm water best management practices,
- Public education and outreach, and
- Laws, regulations and government programs.

Additionally, the Soil Health working group adheres to the USDA NRCS four principles for improving soil health.

- Keep the soil covered.
- Disturb the soil as little as possible.
- Keep plants growing throughout the year to feed the soil.
- Diversify as much as possible using crop rotation and cover crops.

Building on these principles, the Soil Health working group developed a list of strategies that can be used to improve soil health.

Strategies:

1. **Structural efforts.** Involve design by an engineer and installation by a contractor.
 - Grassed waterways
 - Terraces, contour terraces, water diversion terraces
 - Tile outlet terraces, water and sediment control basins (WASCoBs)
 - Grade stabilization structures
 - Subsurface drainage, tile drainage
 - Controlled patterned tile drainage outlets
 - Reduce surface drainage
 - Controlled surface drainage outlets
 - Surface water retention/detention ponds
 - Restored wetlands (block drainage structures)
 - Soil-landscape restoration, return eroded topsoil to hilltops
2. **Management efforts.** Involve planning by landowner and consultation with agronomist.
 - Land Management Systems

- Increase permanent vegetative cover (Conservation Reserve Program [CRP], Reinvest in Minnesota [RIM])
 - Filter and buffer strips (contour, vegetative, riparian)
 - Windbreaks, reduced fetch length
 - Increase conservation cover
 - Pasture and hayland planting
 - Soil Management Systems
 - Conservation tillage (minimum tillage, no-till/zero-till, reduced till)
 - Mulching
 - Increase annual crop residue cover
 - Reduce soil movement during field operations
 - Soil-landscape restoration, return eroded topsoil to hilltops (increase organics on hilltops)
 - Crop Management Systems
 - Diversity crop rotation
 - Cover and green manure crop
 - Contour strip cropping
 - Increase stubble height
 - Increase cover crops
3. **Integrated systems approach/conservation planning efforts.**
- Conservation management systems
 - Drainage water management plans
 - Nutrient management plans
 - Cropping plans
4. **Miscellaneous.**
- Communication
 - Land owner/manager extension
 - Public awareness and education

Soil Health Working Group Recommendations:

The Soil Health working group did not develop alternatives, as any of the above measures can be combined to produce acceptable alternatives. Instead, the Soil Health Working group recommends a broader strategy. In addition to implementing the recommendations identified in the Conservation Inventory Team Report and NRFP, the Soil Health working group recommends the following studies and projects with the responsible entity suggested to implement. Recommendations are summarized in Table 9. A more complete description of these recommendations is included in Appendix F:

1. **Advise crop consultants and public and private technical advisers.** Work with Certified Crop and other trusted advisors to develop a mechanism to help crop consultants promote management efforts, providing them with a unified message to communicate to landowners.
2. **Inventory surveys, case studies, census.** Perform and expand inventory surveys of land practices, perform and publish case studies of best management practices and support agricultural census to be able to assess the current soil health conditions and identify trends within the RRB.

3. **RRB soil health assessment.** Develop a basin-wide set of minimum indicators to be able to assess the current soil health conditions of the basin, identify trends and to determine a baseline assessment within the RRB.
4. **Soil health initiative.** Develop a basin-wide soil health strategy, with an integrated systems approach to conservation planning, which coordinates planning efforts while raising awareness of, and expanding on, existing programs.
5. **Land, soil, crop management systems case studies.** Investigate case studies and reports, identify actions and activities in the basin that are improving soil health, and develop a systematic targeted marketing approach on the long-term benefits of soil health management systems.
6. **Soil loss ordinance.** Research and study the benefits and results of implementing soil loss ordinances, and identify and explore the effectiveness of soil loss targets. Evaluate the effectiveness of the Minnesota soil loss law and program, and evaluate the success of implementing soil loss law in Minnesota.
7. **Education and outreach campaign.** Continue to work on and support opportunities for education and outreach to the general public, landowners, consultants and technical advisors.
 - A. **Land, soil, crop management systems.** Develop a systematic targeted campaign on the long-term benefits of soil health management systems using case studies.
 - B. **RRB stewardship award.** Recognize producers with an “incentive-based” stewardship award at the annual RRBC conference for improving soil health.
 - C. **RRB soil health education.** Host an annual soil health education session for soil watershed conservation districts and crop consultants to discuss soil health topics in the region.
 - D. **Drainage water management.** Increase awareness of conditions, issues and effects patterned tile drainage has on soil health. Continue to support analysis to better understand tile drainage effects.
8. **Comprehensive resource management plans.** Encourage and support agricultural producers to participate in developing comprehensive resource management plans for farms within the RRB.
9. **Voluntary programs.** Continue to educate and inform residents, landowners and leaders in the basin on current, new and innovative voluntary practices being utilized in the RRB through its current outreach methods. RRBC will continue to partner and support programs within the RRB.

Table 9: Soil Health Working Group Recommendations

Recommended Actions			
Recommended Actions	Path Forward		
Actions	Study	Project	Suggested Responsible Entity
1. Advise crop consultants and public and private technical advisers. A. Certified Crop Advisors B. Other Trusted Advisors		√ √ √	RRBC RRBC, universities' Dept. of Ag. Universities, state agencies (Dept. of Ag.), Board of Soil and Water Resources (BWSR)
2. Inventory surveys, case studies, census. A. NRI Inventory Surveys/ Conservation Effects Assessment Project Census B. BWSR Tillage and Erosion Survey Program		√	USDA/NRCS BWSR Iowa State University/University of Minnesota
3. RRB soil health assessment.		√	TBD
4. Soil health initiative.	√		NRCS in collaboration with RRBC Manitoba Agriculture
5. Land, soil, crop management systems case studies.	√		TBD
6. Soil loss ordinance.	√		RRBC
7. Education and outreach campaign. A. Land, Soil, Crop Management Systems B. RRB stewardship award C. RRB Soil Health Education D. Drainage Water Management	√	√ √ √	RRBC RRBC, universities' Dept. of Ag. Universities, state agencies (Dept. of Ag.), BWSR NRCS, drainage authorities (watershed districts, IWI)
8. Comprehensive resource management plans.		√	SWCS conservation districts, NRCS, crop consultants
9. Voluntary programs.		√	RRBC

5 STUDY FINDINGS AND RECOMMENDATIONS

The complex nature of the Red River Basin has resulted in challenges to effective, integrated land and water management. The Comprehensive Watershed Management Plan will aid in achieving a basin-wide approach to integrated natural resource management and provides a framework for overcoming barriers to coordinated implementation. The six working groups evaluated a full array of alternatives to address the resource area problems and achieve the specified resource area objectives. The working group recommendations are summarized in the preceding sections of this plan. The recommendations in the working group reports are not simply for the Corps, the RRBC or any single entity to enact or enforce. The recommendations are intended to direct future activities and investments in the basin that comprehensively address the watershed's problems and to assist in achieving watershed goals and objectives. The CWMP provides a guide to move the basin forward with a unified purpose and a unified voice.

5.1 Matrix of Working Group Findings – Identification of Overlaps and Conflicts

A draft of the CWMP and supporting appendices was completed in Spring 2016, and the six coordinating committees met in plenary at that time to review the draft documents, identify conflicts and overlaps among the different groups' recommendations, and to determine the path forward to report completion. The purpose of this meeting and these activities was to enhance the integration of the CWMP and its six resource area appendices.

Prior to the meeting, spreadsheets had been prepared, based on the recommendations contained in each appendix. The worksheets included a summary of the problems and goals for each area and objectives for each goal. The spreadsheet contained the following information: strategies for meeting one or more objectives, actions related to each strategy, whether the action was a study or a project, the current status of the action, and the implementing agency. Each coordinating committee examined and verified the information for its respective group. Additionally, each coordination committee examined the recommendations of the other working groups and indicated if any recommendations overlapped or conflicted with actions recommended by their own group. Conflicts could be discussed and compromises reached. Similar actions could be combined to avoid duplication of effort. The six spreadsheets were later synthesized into one master document and is included as an attachment to this report.

5.2 Discussion of Overlaps between Working Group Recommendations.

There are several instances of overlap among the working group recommendations. These overlaps are illustrated in Tables 5.2.1 to 5.2.6 below. When the users of this CWMP wish to prioritize or select actions for implementation, as identified in Sections 4.5 through 4.10, these tables would be useful in identifying actions that may overlap many areas. For instance, the Flood Risk Management and Hydrology working group recommended action 1.3, shown in the table below, which overlaps with objectives, strategies or actions identified by the Fish, Wildlife and Ecosystem Health (FWEH), and the Water Quality and the Water Supply working groups. Implementation of this action could benefit in more than one area. In many instances the efforts can be combined and duplication minimized. In this way, more of the basin goals can be met more economically. Note, if any actions are added to the

working groups list of recommendations, these tables should be updated to reflect any additional overlaps.

Table 5.2.1: Potential Overlaps Between Flood Risk Management Recommended Actions and Other Working Groups

Ref. No.	Flood Risk Management and Hydrology actions that may overlap with other areas	FW&E	Water Quality	Water Supply	Recreation	Soil Health
1.1	Fargo-Moorhead – continue supporting dike construction, property acquisition, flowage easements and flood infrastructure projects to fight the 100 to 500 year flood.		TBD		√	
1.2	Fargo-Moorhead – progress towards diversion project.		TBD		√	
1.3	Advance retention above Hickson and Abercrombie for a flow reduction of 20%.	√	√	√		
1.5	Continue to support Devils Lake Collaborative working group.		√	√		
1.6	Distribute information on progress and timelines on Devils Lake activities.			√		
1.7	Examine need for developing a comprehensive real-time model to determine effects of releasing Devils Lake water via various outlet channels.		√			
2A.1	Revise state floodplain regulations and local zoning ordinances with new criteria for residential, commercial, industrial and agri-business development.		√			
2A.2	Acquire and remove buildings located in at-risk areas when it is not feasible to protect them.	√				
2A.3	Update floodplain ordinance to not permit new development in areas of high risk of flooding. Minimize use of variances.	√	√		√	
2A.7	Develop educational materials.		√	√	√	
2A.8	Expand nonstructural assessment beyond Fargo-Moorhead to the entire main stem Red River. Identify local sponsor and appropriate federal funds.			√	√	
2A.9	Use Silver Jackets program to contribute towards a collaborative interstate strategy for flood recovery and projects for mitigation efforts.	√				
2B.1	Request 500-year or greater level of protection for Grand Forks and East Grand Forks.	√				
2B.3	Identify and document at-risk critical basin infrastructure, and report to state legislatures.			√		

2B.4	Achieve protection to the 100-year level plus 3 feet of freeboard, or the largest flood plus 3 feet of freeboard for all cities in the Red River Basin, and move towards providing 200-year level of protection using upstream retention. Provide 100-year level plus 3 feet of freeboard, or the largest flood plus 3 feet of freeboard for rural residents and farmsteads.	√	√			
2B.5	Provide funding for rural areas, including ring dikes and rural property acquisitions. Use strategies that slow water or hold in on the land longer, such as the NRCS program for reducing runoff and erosion and improving water quality.	√	√	√		
2B.6	Develop a multi-purpose drainage strategy.	√	√	√		
2B.7	Continue river channel maintenance to prevent trees blocking flows.			√	√	
2B.8	Provide funding for the RIM easements to match or supplement federal USDA conservation funding.	√	√		√	
2B.9	Develop a basin wetland bank to purchase and exchange wetland credits.	√			√	
2B.10.1	Analyze how to use surface drainage system to lower rising side of spring flood hydrographs.		√			√
2B.10.2	Analyze benefits of a basin-wide culvert inventory.			√		
2B.10.3	Partner with NRCS to analyze benefits of small distributed and culvert-sizing retention.			√		
2B.10.6	Pilot project to gather data on timing and impacts from tile drainage, surface drainage, wetland restoration, early water ditch drainage and culvert sizing.		√	√		√
2B.10.7	Tile drainage analysis by the IWI.					√
2B.10.8	Establish and reinforce buffer strips to a minimum 16.5 feet, maximum 50 feet (with incentives) to reduce sediment and slow the flow of water into waterways.	√	√		√	√
2C.1	Provide federal funding for retention projects to achieve a 20% reduction in peak flows on the Red River.	√	√	√	√	
2C.2	Continue local share of federally-funded retention projects.	√	√	√	√	
2C.3	Review federally-operated reservoirs to identify potential for increased storage.			√	√	

2C.4	Work with individual water management boards to plan, design, and implement retention projects to achieve 25% of the retention goal every 5 years.		√	√	√	
2C.5	Develop a project prioritizing methodology.		?	√		
2C.6	Work with federal agencies to streamline the permitting process.	√		√	√	
2C.7	Provide funding to expand the project planning and permit evaluation demonstration project to the entire Red River.			√		
2C.8	Conduct a survey and public outreach to determine landowner interest in storing water on their lands.	√	√	√		√
2C.9	Continue Feasibility Study to update the HMS models to identify retention projects, model the main stem using HEC-RAS, use models as basis for project prioritization process.		√	√		
2C.10	Evaluate PL 83-566 and other dams that have flood control capacity to determine the feasibility of restoration.			√		
3.2	Conduct periodic meetings between the Minnesota, North Dakota, South Dakota governors and the Manitoba premier; the international legislators forum; the Board of Water and Soil Resources, etc. to coordinate and update progress on the RRBLTFSR recommendations and other flood-related topics.		√	√		
3.3	Expand the RRBLTFSR to include the entire Red River Basin, including LiDAR data collection in Manitoba and establishing watershed organizations in South Dakota.		√			
3.5	Develop a stream gage strategy.			√		

Table 5.2.2: Potential Overlaps Between Fish, Wildlife and Ecosystem Health Recommended Actions and Other Working Groups

Ref. No.	Fish, Wildlife and Ecosystem Health actions that may overlap with other areas	FRM&H	Water Quality	Water Supply	Recreation	Soil Health
1.1	Enforce current laws and regulations.	√			√	
1.2	Look at problems and develop regulations to alleviate them.	√			√	
2.1	Create addition programs to provide incentives for different environmental benefits.				√	
2.2	Develop new methods for calculating value of habitat to more accurately reimburse for lands providing more value or services.				√	
5.1	Deauthorize existing Corps projects that have outlived their usefulness.				√	
6.1	Continue to hold interbasin meetings to increase coordination, knowledge and collaboration between agencies.	√	√	√	√	
7.1	Utilize the existing agency authorities to seek out restoration and enhancement opportunities.		√		√	
8.2	Update education curriculum to ensure youth exposure to basic environmental education.	√	√	√	√	
9.1	Increase the availability of programs that encourage the public to participate in outdoor activities.		√		√	
9.2	Create kiosks explaining natural processes at sites likely to get exposure.	√			√	
9.3	Create a phone app focused on the basin's environmental issues that is updated by agencies across the basin.				√	

Table 5.2.3: Potential Overlaps Between Water Quality Recommended Actions and Other Working Groups

Ref. No.	Water Quality actions that may overlap with other areas	FRM&H	FW&E	Water Supply	Recreation	Soil Health
1.2	Component Two. Develop a shared understanding of jurisdictions' nutrient regulatory frameworks, and identify current nutrient reduction actions, activities and plans for the Red River watershed.		√			√
1.3	Component Three. Recommend and implement nutrient load allocation and/or water quality targets for nutrients.					√
1.5	Component Five. Facilitate ongoing technical, scientific and methodological dialogue and information sharing relevant to nutrients and nutrient loading in the Red River watershed, including exchanging information on the goals and scientific basis for the long-term ecologically relevant objectives that are under development for Lake Winnipeg.					√
1.6	Component Six. Adapt the nutrient management strategy based on progress and ongoing evaluation.					√
2.1	Long-term nutrient loading targets for Lake Winnipeg and its tributaries. Use of a Water Quality Analysis Simulation (WASP) eutrophication model developed for Lake Winnipeg to simulate nutrient reduction scenarios and to develop nutrient targets for Lake Winnipeg's main tributaries, including the Red River that can support future nutrient management strategies and activities.					√
2.3	North Dakota nutrient management strategy.				√	√
3.1	Prioritize BMP types and locations in the basin by using existing information and tools or by developing new tools. This action will define priority areas in the basin and pair them with the appropriate BMPS. The project will focus on the implementation of BMPs that will reduce the concentrations/loadings of phosphorus, nitrogen and fecal coliform bacteria. Additional BMPs will also be used to improve riparian conditions. To improve the recreational uses, a variety of BMP such as buffer strips, grassed waterways, nutrient management, no-till cropping systems and CRP will be planned and installed in the watershed.		√		√	√

3.2	Implement biomass harvesting opportunities in the basin. Projects that harvest wetland plants, such as cattails, can extract significant amounts of nutrients, be used for bioenergy or biomaterial, This can potentially be a profitable method for nutrient management.		√		√	
3.3	Riparian restoration in the basin. To improve the effectiveness of riparian zones for nutrient removal, sediment capture and in-stream nutrient cycling projects are identified and implemented to protect high quality riparian zones and restore degraded reaches.		√		√	√
3.4	Stream bank and in-stream restoration in the basin. Identify and implement projects that restore or protect stream bank reaches. Focus of projects will be to reduce excessive erosion and promote in-stream nutrient cycling.		√		√	
3.5	Retention and infiltration projects in the basin. Identify and implement projects that capture excess runoff and promote infiltration. Prioritize projects based on effectiveness and cost. Encourage the construction of water retention projects to meet the 20% peak flood reduction goal.		√	√	√	√
4.1	Promote and strengthen funding for land retirement programs like the CRP that remove land from agricultural production for at least 10 years and support high-priority, partial-field practices such as field-edge filter strips and grass waterways.		√		√	√
4.2	Promote and strengthen land purchase and set aside programs that are designed to encourage farm operators to upgrade their management of lakeshores and river/stream banks and recognizes those that have already done so. Benefits are available to farmers and livestock producers who make a commitment to protect land for five years.		√		√	√
4.3	Provide financial assistance to implement best management practices for the management of urban storm water.		√		√	
5.1	Lake Friendly Initiative was started by the South Basin Mayors and Reeves in partnership with Manitoba Conservation and Water Stewardship. The initiative is a community-to-community approach designed to create public awareness of the serious issues facing Lake Winnipeg and other freshwater lakes throughout		√		√	

	the world. The purpose of the initiative is to engage all sectors of society in a solutions approach to preserve our freshwater resources.					
5.5	Develop technical guides for watershed-based water management and planning. Develop guides that will assist users (watershed groups, planners, consultants, etc.). For example, Agriculture and Agri-Food Canada has developed a publication on "Sustainable Management of Nutrients on the Landscape for In-Field Livestock Winter Feeding Systems" that could be applied basin-wide.		√		√	√
5.6	More demonstration sites for drainage water management practices.					
5.7	Deliver wide distribution of <i>Manitoba's Water Protection Handbook</i> , which provides information on water resources, water quality, what one can do to protect our waters with specific information on algae and reducing nutrient loadings.		√		√	√
5.8	Expand Discovery Farms Program. The goal of the program is to establish a network of working farms to evaluate the water quality impacts associated with animal feeding operations, tile drainage and common farming practices and, more importantly, measure the effectiveness of BMPs applied to address those impacts. A Discovery Farm is a working farm or ranch voluntarily cooperating with the program to demonstrate and evaluate the effectiveness of BMPs at reducing environmental impacts.		√		√	√
6.1	Require nutrient application to match crop uptake rates.		√			√
6.3	Promote the adoption of the four Rs. This is the application of nutrients at the right time, right place, right source and right rate.		√			√
6.4	All drainage projects including surface and tile drains (or alterations) must be licensed. Implementation of BMPs to reduce nutrients is done through inclusion of license conditions. Permit prohibits drainage of seasonal, permanent and semi-permanent wetlands.		√			√
7.1	International Watersheds Initiative – Souris-Assiniboine-Red River Watershed – SPARROW modeling. A modeling tool for the regional interpretation of water quality monitoring data. The model relates in-stream water quality measurements to spatially referenced		√		√	√

	characteristics of watersheds, including contaminant sources and factors influencing terrestrial and aquatic transport. SPARROW empirically estimates the origin and fate of contaminants in river networks and quantifies uncertainties in model predictions.					
7.3	Encourage consistent LiDAR development, and use basin-wide. Adoption of basin-wide and consistent LiDAR will facilitate the development of water quality and quantity models that can be used to support integrated watershed management planning and development of surface water management plans, etc.		√	√		√
8.1	Establish more research sites to study controlled drainage and sub irrigation tile drainage systems. Water quality monitoring, soil moisture and crop performance and water/nutrient utilization are evaluated at these study sites.		√			√
8.2	Enhance consistency in the basin-wide ambient water quality monitoring network across the different jurisdictional units, and use comparable methods and sampling plans that allow statistically appropriate analyses.		√			
8.5	Develop and implement a water quality monitoring plan for all point source dischargers in the basin.		√		√	
9.2	Mandate no net loss of wetlands benefits.		√			
9.3	Prioritize and implement wetland restoration projects in the basin.		√		√	
10.1	Integrated watershed management plans for all tributaries to the Red River similar to the MPCA's Watershed Restoration and Protection Strategy (WRAPS) and Manitoba's Integrated Watershed Management Plans. Including public outreach aspects in the watershed planning processes.		√	√	√	

Table 5.2.4: Potential Overlaps Between Water Supply Recommended Actions and Other Working Groups

Ref. No.	Water Supply actions that may overlap with other areas	FRM&H	FW&E	Water Quality	Recreation	Soil Health
	None.					

Table 5.2.5: Potential Overlaps Between Recreation Recommended Actions and Other Working Groups

Ref. No.	Recreation actions that may overlap with other areas	FRM&H	FW&E	Water Quality	Water Supply	Soil Health
1.1	Develop a fishing access program to include year round access to private and public lands and to allow fishing on private lands.		√			
1.5	Implement existing access plans such as Rivers West Rivers Access Assessment.		√			
1.6	Develop planning assessment of river access in the basin for the United States similar to what was done for Canada by Rivers West.		√			
2.1	Obtain recreation user counts on various recreation facilities and activities to establish a user baseline.		√			
3.5	Improve and enhance signage and wayfinding for land, water and snow trails.		√			
3.9	Optimize existing recreation facility usage.		√			
4.8	Use of social media to promote events and activities.		√			
4.9	Work with visitor centers and tourism groups within the basin to promote recreation.		√			
5.1	Develop a partnership forum to address development, ownership, operation and management, and funding of a recreation and wildlife corridor.		√			
5.4	Present successful examples of holistic planning efforts that include recreation in the basin at the Annual Red River Basin Land and Water International Summit Conference.			√		

Table 5.2.6: Potential Overlaps Between Soil Health Recommended Actions and Other Working Groups

Ref. No.	Soil Health actions that may overlap with other areas	FRM&H	FW&E	Water Quality	Water Supply	Recreation
6	Soil Loss Ordinance.		√			
7	Education and Outreach Campaign.					√
8	Comprehensive Resource Management Plans.		√		√	√

5.3 Discussion of Conflicts between Working Group Recommendations

There were substantially fewer instances of conflict than of overlap identified. These conflicts are illustrated in Tables 5.3.1 through 5.3.6 below. While it is encouraging to note the relatively few occasions of conflict, it will be important to acknowledge and resolve these conflicts where possible prior to implementation of any working group recommendations or to plan for mitigating any effects. For instance, the Flood Risk Management and Hydrology working group recommendation 1.1 appears to conflict with objectives, strategies or actions recommended by the Fish Wildlife and Ecosystem Health, Water Quality and Recreation working groups. If any actions are added to the working groups' lists of recommendations, these tables should be updated to reflect any additional conflicts.

Table 5.3.1: Potential Conflicts Between Flood Risk Management and Hydrology Recommended Actions and Other Working Groups

Ref. No.	Flood Risk Mgt and Hydrology actions that may conflict with other areas.	FW&E	Water Quality	Water Supply	Recreation	Soil Health
1.1	Fargo-Moorhead – continue supporting dike construction, property acquisition, flowage easements and flood infrastructure projects to fight the 100 to 500 year flood.	√	TBD		√	
1.2	Fargo-Moorhead – Progress towards diversion project.	√	TBD			
1.3	Advance retention above Hickson and Abercrombie for a flow reduction of 20%.	√				
2B.6	Develop a multi-purpose drainage strategy.	√				
2B.7	Continue river channel maintenance to prevent trees blocking flows.	√	√			
2B.10.5	Pilot project to draw down wetlands in the autumn to enable spring storage.	√	√	√	√	
2B.10.6	Pilot project to gather data on timing and impacts from tile drainage, surface drainage, wetland restoration, early water ditch drainage and culvert sizing.			√		
2B.10.8	Establish and reinforce buffer strips to a minimum 16.5 feet, maximum 50 feet (with incentives) to reduce sediment and slow the flow of water into waterways.				√	
2C.1	Provide federal funding for retention projects to achieve a 20% reduction in peak flows on the Red River.	√				
2C.2	Continue local share of federally-funded retention projects.	√				
2C.6	Work with federal agencies to streamline the permitting process.	√				

Table 5.3.2: Potential Conflicts Between Fish, Wildlife and Ecosystem Health Recommended Actions and Other Working Groups

Ref. No.	Fish, Wildlife and Ecosystem Health actions that may conflict with other areas.	FRM&H	Water Quality	Water Supply	Recreation	Soil Health
1.1	Enforce current laws and regulations.			√		
7.1	Utilize the existing agency authorities to seek out restoration and enhancement opportunities.				√	

Table 5.3.3: Potential Conflicts Between Water Quality Recommended Actions and Other Working Groups

Ref. No.	Water Quality actions that may conflict with other areas.	FRM&H	FW&E	Water Supply	Recreation	Soil Health
3.2	Implement biomass harvesting opportunities in the basin. Projects that harvest wetland plants, such as cattails, can extract significant amounts of nutrients and be used for bioenergy or biomaterial. This can potentially be a profitable method for nutrient management.		√			
9.2	Mandate no net loss of wetlands benefits.				√	

Table 5.3.4: Potential Conflicts Between Water Supply Recommended Actions and Other Working Groups

Ref. No.	Water Supply actions that may conflict with other areas.	FRM&H	FW&E	Water Quality	Recreation	Soil Health
	None.					

Table 5.3.5: Potential Conflicts Between Recreation Recommended Actions and Other Working Groups

Ref. No.	Recreation actions that may conflict with other areas.	FRM&H	FW&E	Water Quality	Water Supply	Soil Health
	None.					

Table 5.3.6: Potential Conflicts Between Soil Health Recommended Actions and Other Working Groups

Ref. No.	Soil Health actions that may conflict with other areas.	FRM&H	FW&E	Water Quality	Water Supply	Recreation
	None.					

5.4 Discussion of How Recommendations Were Screened

Each working group evaluated and screened all alternatives to identify the alternatives retained for further consideration. This evaluation and screening process was used to aid in the formulation and selection of recommended actions. The evaluation criteria used for screening were adopted from the *Economic and Environmental Principles & Guidelines for Water and Related Land Resources Implementation Studies* (United States Water Resources Council 1983). The purpose of evaluation and screening is to narrow down the number of alternatives. The alternatives that were retained derived from the problems and objectives in the working group resource area.

The Principles & Guidelines screening criteria used are as follows:

- **Completeness:** Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planned effects.
- **Effectiveness:** Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified objectives.
- **Efficiency:** Efficiency refers to cost-effectiveness and the most efficient allocation of other resources. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and achieving the specified objectives.
- **Acceptability:** Acceptability refers to the workability and viability of the alternative with respect to acceptance by state and local entities and the public compatibility with existing laws.

5.5 Discussion of How Recommendations May Be Prioritized

The overall goal is a watershed plan to direct future activities and investments in the basin that comprehensively address the watershed's problems and to assist in achieving watershed goals and objectives. The CWMP is intended to be used both as a local planning document for developing a new NRP and as a guide for further federal support of local projects.

As discussed in Section 4.4, constraints to planning and implementing actions in the Red River Basin include:

- Uncertainty in both the local and federal funding streams.
- Timing and scheduling of recommended studies and actions will be dependent on the available resources of the Corps, the local sponsors or other responsible entities.
- International agreements – The Red River flows north into Canada.
- Combining existing efforts and solutions that are awaiting implementation and may be conflicting.

A few recommendations contained in this document involve further studies by the Corps. The Corps will request funding for each of these actions and will pursue them as funding allows.

Most of the recommended actions will be driven and funded by local and state entities. The next step for the Red River Basin stakeholders is to discuss and decide how to assign priority to the recommended actions. Priority may be based upon available funding. Implementation of these actions will require coordination with other stakeholders, including local and regional government units, other state and federal agencies, landowners, the public, non-profits and any other interested parties.

Several of the working groups recommended that their working groups continue to convene to work towards the goals adopted by each group. The ongoing focus of each of the RRBC working groups is to collaborate, share and identify gaps and opportunities from a basin-wide perspective. This includes working across jurisdictional boundaries to seek opportunities for collaboration and maximization of our resources. Prioritization and implementation of projects many times will be impeded by practical and social factors. Building upon the earlier work done by the RRBC working groups in the NRRFP and utilizing the work being performed by several active focus groups provides the CWMP with good public support for major issues in the watershed.

5.6 Discussion of How Recommendations Will Be Assigned for Implementation

Each of the actions delineated by the working groups in Section 4 of this document included a recommendation for lead or implementing agency for that action. These assignments were based on recommendations from the RRBC staff. The RRBC is an international, basin-wide organization and was formed for and is uniquely positioned to initiate the collaboration and partnerships to shape solutions.

The Red River has been at a crossroads for some time of national, state, provincial and local jurisdictions that add layers of difficulty in achieving a shared vision for solving natural resource issues in the Red River Basin. The RRBC lacks the authority to make project specific decisions; that is left up to local and state interests. However, the RRBC is a vehicle to educate, inform and break down the barriers that impede progress on projects.

The assignment of which entity should be the lead or implementing agency for that action was based on a number of factors: scope, impact, location and jurisdiction. The various stages of a project require participation from different levels of participation.

The Minnesota RRWMB and the North Dakota Red River Joint Water Resources Board serve as a catalyst to proposing projects in the RRB for the purpose of hearing presentations from cities, counties, watershed districts, resource management agencies and nongovernmental organizations regarding their top priority problem areas with natural resource management needs that will be addressed by projects they have. There is a holistic focus concerning all aspects of watershed management and will be an opportunity to build partnerships among all participants.

The participants include the watershed districts; state, federal and tribal agency personnel; local government officials, affected landowners and interested citizens, and interest group representatives. State agency personnel will be assigned participation as part of their position description.

5.7 Corps Role in Implementing Recommended Actions

Implementation of the CWMP recommendations will require participation from various national, state, local and provincial entities as described throughout this document. However, as the CWMP was

completed, the working groups generated interest in more Corps involvement implementing the recommendations identified in this report and supporting appendices. The CWMP is a part of the Corps' Feasibility Study. Although the CWMP effort is part of the larger specifically-authorized Feasibility Study, the CWMP is being developed as a unique standalone document, and by design is a broader document with recommendations that extend beyond the authority or mission of a single entity including the Corps. The Corps is best suited to pursue additional study or implementation of some of the recommendations in the CWMP; it is noted here that the working group team members contributing to the CWMP effort expressed an interest in more Corps involvement. However, the majority of the recommendations will require collaboration and partnership among multiple entities and across jurisdictions, and the Corps would not be the lead agency or may play only a small part in future efforts. The following actions are recommended for Corps leadership:

1. Continue supporting the Fargo-Moorhead dike construction, property acquisition, flowage easements and flood infrastructure projects to fight the 100 to 500 year flood.
2. Continue to support the Devils Lake Collaborative working group.
3. Examine the need for developing a comprehensive real-time model to determine effects of releasing Devils Lake water via various outlet channels.
4. Review federally-operated reservoirs to identify potential for increased storage.
5. Continue the Feasibility Study to update HMS models to identify retention projects, model the main stem using HEC-RAS and use models as basis for project prioritization process.
6. Advocate for deauthorization of existing Corps projects that have outlived their usefulness.

5.8 Working Group Recommendations

5.8.1 Flood Risk Management and Hydrology

The Red River Basin has historically been subject to widespread chronic flooding and regularly sustains millions of dollars in economic damages for each flood event. The Flood Risk Management and Hydrology working group adopted the recommendations developed for the RRBC RRBLTFSR. The RRBC, the states of North Dakota and Minnesota and the Canadian province of Manitoba have been making progress toward the above-stated goals through the actions defined in the RRBLTFSR. Recommendations are detailed in the RRBLTFSR and are summarized in the CWMP Appendix A.



Key items among the accomplishments towards the flood risk management goals include:

- Levee improvements at the main stem communities of Wahpeton-Breckenridge and Oxbow-Hickson-Bakke; the Minnesota communities of Georgetown, Perley, Hendrum, Oslo, Pembina, Ada, Alvarado, Crookston and Roseau; the North Dakota communities of Argusville and Devils Lake.
- Progress towards improved protection at Fargo-Moorhead
- Proposals for improvements at Halstad, Grafton, Lisbon and Valley City.

Progress that has been made towards the hydraulic and hydrologic modeling goals include:

- The development of HEC-HMS models for all of the U.S. border sub-basins of the Red River and completing a main stem HEC-RAS model.
- Studies to identify the potential for retention in the U.S. sub-basins have been completed.
- Work is underway to combine the HEC-RAS, HEC-HMS and retention information to evaluate the relative effectiveness of retention projects in accomplishing the peak reduction goal.

The RRBLTFSR and its periodic updates should be referred to when considering the flood risk management and hydrology aspects of this CWMP. The parties will continue to work towards the goals and actions enumerated in the RRBLTFSR and its periodic progress reports. It should be noted that Corps implementation of any of the actions described in the RRBLTFSR would be subject to the standard Corps planning process and must be economically justified for federal investment.

The Corps projects that address Flood Risk Management issues typically employ standard benefit-cost procedures to analyze National Economic Development (NED) benefits and costs. Among the considerations in the conduct of economic studies that support the Corps' planning process are definition of without and with project conditions, discounting of future benefits and costs, expression of benefits and costs on an average annual basis, risk and uncertainty of key study parameters, geographic scope of project impacts, price levels of costs and benefits, and period of analysis.

The standard criteria for selecting a plan is the net benefits metric (i.e., benefits minus costs). The alternative plan that is reasonable and maximizes the net economic benefits, the NED Plan, shall be selected for implementation. However, when overriding reasons for selecting another plan exist based on other federal, state, local or international concerns (affordability? social/political acceptability?), an exception to the NED plan selection rule may be granted. A plan such as this that deviates from the NED plan is referred to in Corps planning guidance as the Locally Preferred Plan (LPP). If an LPP smaller in scope than the NED plan is recommended, the LPP must have greater net benefits than other smaller scale plans and enough alternatives must be analyzed to ensure this. If the sponsor prefers a plan more costly than the NED plan, an exception may be granted as long as the sponsor pays the difference in cost between the NED plan and the LPP. In this case the LPP must have benefits similar in kind and equal to or greater than the benefits of the NED plan.

5.8.2 Fish, Wildlife and Ecosystem Health

The Fish, Wildlife and Ecosystem Health working group evaluated a complete array of alternative solutions to address the problems of habitat loss, habitat degradation and lack of comparable data. The working group recommendations were developed collectively from input provided by various agencies with environmental interests throughout the basin. The recommendations are intended to improve environmental conditions and to prevent further degradation from problems areas identified in the basin. Appendix B – *Fish, Wildlife and Ecosystem Health* describes all recommendation in detail, and they are summarized in the following list.

- Conservation to avoid loss of habitat:
 - Diversify incentive programs.
 - Improve calculation of incentives.
 - Enforce laws and regulations.
 - Continue interbasin meetings.
 - Update wetlands inventory.
 - Identify regulation gaps.
- Restoration and enhancement:
 - Corps projects that have outlived their usefulness and are no longer needed for the purpose for which they were originally constructed may be deauthorized by Congress. Local watershed managers support project deauthorization on the Lower Branch of the Rush River (Cass County, ND) and the Lower Wild Rice River (Norman County, MN), and the CWMP recommends deauthorization of old Clearing and Snagging projects at these sites. Currently the Corps does not have a vehicle to implement this deauthorization.
 - Continue interbasin coordination.
 - Utilize existing programs to help restore and enhance the environment.
- Education:
 - Create curriculum that can be easily adopted by primary and secondary educators.
 - Create groups that encourage public participation in outdoor activities.
 - Increase or replace kiosks at restoration projects and natural areas.
 - Create or utilize existing phone apps.



5.8.3 Water Quality

An integrated basin-wide approach to water quality is critical. The Water Quality working group developed solutions to address the basin water quality problems. All recommendations are described in detail in Appendix C – *Water Quality* and listed below.



- Develop a basin-wide nutrient management strategy for the International Red River Watershed.
- Develop nutrient reduction strategies, targets, limits and/or standards.
- Prioritize and implement restoration or improvement projects.
- Provide incentives for best management practices.
- Pursue education, research and outreach.
- Pursue agriculture and land use restrictions.
- Use water quality modeling.
- Use water quality monitoring.
- Pursue wetland restoration.
- Follow management plans and TMDLs.

5.8.4 Water Supply



The water supply framework for the future is that every resident of the Red River Basin will have adequate, clean water to address their basic human need and their ability to earn a living. It is recommended that a basin approach be initiated, which brings together a wide range of water users to discuss and develop plans

and strategies that beneficially reduces the susceptibility of the basin to, and improves the recovery from drought. This approach combines the specificity of local and regional planning with the multiple uses and regional principals in state and provincial level management. The ultimate goal is increased and enhanced drought cooperation and coordination between basin entities. The CWMP recommendation is to continue the process to develop a basin-wide drought preparedness plan as outlined in Appendix D – *Water Supply* along with following the recommendations below:

- Process for the immediate future:
 - Conjunctive Uses – Ability to use both surface water and ground water resources as a water supply.
 - Disaster Relief – In a severe and extended drought, there may be critical water uses that cannot be satisfied with other approaches. A drought event is regional and would require coordination from the federal, state and local emergency response agencies, both in planning and response
 - Drought Forecasting – Forecasting supply, demand or anticipated shortages can have benefits in proactive water management.
 - Drought Plan Coordination – Drought plans exist for municipalities and reservoirs in the basin. These drought plans have not been utilized during an extended or severe drought nor has coordination between various plans been established.
 - Emergency Supplies – During a severe and extended drought, emergency supplies should be examined to supplement shortages. Reservoirs in the basin serve multiple purposes, including habitat, water supply, flood control, water quality enhancement, recreation and tribal water rights. Operational changes may provide additional water supply during drought, although such changes would require permit and regulatory adjustments.
 - Water Marketing/Risk Adjustment – This risk and the consequences of water shortage are not evenly distributed. Marketing irrigation water uses to municipal uses might have a significant benefit in a long drought.
 - Water Rights Enforcement Coordination – Each jurisdiction has provisions to curtail certain water uses during a drought. While currently no agreement exists on how water is shared between jurisdictions during a drought, coordinating water rights enforcement actions may be beneficial.
 - Recommendations for Jurisdictional Consideration – The establishment of a basin-wide Drought Action Committee (Committee) is recommended. The Committee could be comprised of emergency management and water resources agencies from each jurisdiction. Initial tasks for this Committee will be to develop and refine the definition of drought for the basin as a natural hazard. The drought response options described in

Appendix D – *Water Supply* would be reviewed by the Committee for refinement.

- Soft path conservation approaches:
 - Implementing soft path recommendations as described in Appendix D – *Water Supply*.
- Minnesota Department of Agriculture recommendations:
 - Consider how DWM could help with water supply during future studies on farm water storage, crop irrigation scheduling and other agricultural BMPs.

5.8.5 Recreation

The CWMP vision for recreation, adopted from the NRFP, is to restore and maintain an environment in the Red River Basin that provides for quality human life, prosperous agriculture, flourishing communities, improved water quality, abundant wildlife and healthy habitats, holistic water management, and increased outdoor recreation, all which support compatible long-term economic growth and basin environmental health. Some of the NRFP recreation objectives have been met; however, recreation is still often overlooked and only considered at the end of planning and implementation of projects in the basin. This has created a somewhat segmented and insular effect on recreation. With recreation forecasted to increase over time, additional well-planned recreation opportunities are needed.



The Recreation working group evaluated a full array of alternative actions. The top priorities were identified as these: to increase accessibility for recreational opportunities in the basin and to inform agencies, planners, engineers, policy makers and the public of the importance of integrating recreation early in the planning process. These priorities can help guide successful recreation projects in the basin, which contributes to the overarching objective of their land and water management goals for the basin. The CWMP recommendations for recreation are described in detail in Appendix E – *Recreation* and are summarized below. While no action was screened out completely because it was felt that all the actions held value, the working group prioritized what actions are the basin’s highest priority for recreation.

- Develop a fishing access program.
- Retrofit existing infrastructure to accommodate ADA access.
- Implement existing access plans.
- Develop planning assessment of river access in the United States.
- Obtain recreation user counts.
- Take inventory and assess conditions.
- Improve and enhance signage and wayfinding.
- Optimize existing recreation facility usage.
- Use of social media to promote.
- Work with visitor centers and tourism groups.
- Develop a partnership forum.
- Develop recreation planning checklist.
- Develop recreation best management practices.
- Present successful examples of holistic planning efforts.

5.8.6 Soil Health

The Soil Health working group recommendations for studies and projects are described in detail in Appendix F – *Soil Health* and summarized below.



1. **Inventory surveys, case studies, census.** Perform and expand inventory surveys on land practices, perform and publish case studies on best management practices and support agricultural census to be able to assess the current soil health conditions and identify trends within the RRB.
 - A. National resources inventory surveys
 - B. Land, Soil, Crop Management Systems Case Studies
 - C. National Resources Inventory (NRI) Conservation Effects Assessment Project (CEAP) Census
2. **RRB soil health assessment.** Develop a basin-wide set of minimum indicators to be able to assess the current soil health conditions of the basin, identify trends and to determine a baseline assessment within the RRB.
3. **Drainage Water Management (DWM).** Increase awareness of conditions and the issues and effects patterned tile drainage has on soil health.
4. **Soil health Initiative.** Identify the need for a basin-wide soil health strategy regarding an integrated systems approach to conservation planning.
5. **Soil loss and sediment delivery targets.** Research and study the benefits and results of implementing soil loss ordinance.
6. **Education and outreach.** The RRBC will continue to work on opportunities for education and outreach to the general public, landowners and consultants and technical advisors. Education, awareness, incentives and regulations for soil health are essential.
 - A. Land, soil, crop management systems
 - B. RRB stewardship award
 - C. Advise crop consultants and private/public technical advisors
7. **Comprehensive land management plans.** Support agricultural producers in developing comprehensive land management plans for farms within the RRB that address the soil erosion and soil health concerns for those particular farms.
8. **Voluntary programs.** The RRBC will continue to educate and inform residents, landowners and leaders in the basin on current, new and innovative voluntary practices being utilized in the RRB through its current outreach methods.

5.9 Candidate Studies and Projects/Implementation Strategies/Entity Best Suited to Carry Forward Recommendations

This CWMP recommends a number of follow-up actions by the federal government, the local sponsor, state agencies, local watersheds and other entities within the Red River Basin. Successful implementation of the recommended studies and projects will require continued coordination across the basin among different jurisdictions and resource management agencies (Table 10).

Table 10: Recommendations: Candidate Studies and Projects

Candidate studies and projects	Implementing Entity	Working Group
Continue advancement of RRBLTFSR recommendations.	Corps, RBBC, RRWMB, North Dakota Joint Board	Flood Damage Reduction and Hydrology
Deauthorization of old clearing and snagging projects on the Lower Branch of the Rush River and the Lower Wild Rice River.	Corps	Fish, Wildlife and Ecosystem Health
Wetland restoration.	Corps	Fish, Wildlife and Ecosystem Health
Continue basin-wide working group collaboration and discussion.	All entities involved with natural and water resources management in the basin	Fish, Wildlife and Ecosystem Health
Create environmental education curriculum that can be easily adopted by primary and secondary educators.	RBBC, Extension, local watershed districts	Fish, Wildlife and Ecosystem Health
Develop a basin-wide nutrient management strategy for the International Red River Basin.	IRRB Water Quality Committee	Water Quality
Water quality modeling.	USEPA, MPCA, ND Dept of Health	Water Quality
Water quality monitoring.	USEPA, MPCA, ND Dept of Health	Water Quality
Develop a basin-wide long-term drought preparedness strategy.	RBBC, Minnesota, North Dakota, Manitoba	Water Supply
Increased access to water based recreation in the Red River Basin.	River Keepers, RBBC, Minnesota DNR, ND Game and Fish	Recreation
Develop recreation baselines for basin.	River Keepers, RBBC, Minnesota DNR, ND Game and Fish	Recreation
Develop a soil sampling system across the basin to determine a baseline assessment of the current soil health conditions.	NRCS	Soil Health
Encourage holistic planning efforts for the basin.	All entities involved with natural and water resources management in the basin	All

6 CONCLUSION

The success of the CWMP will be due to the actions of various organizations within the Red River Basin. The RRBC is a regional entity that serves as a convener and coordinator for the basin water and resource management activities; however, it is the agencies and local governments that have the real authority, skilled staff and financial resources to implement the recommendations in this report and supporting appendices. The Corps, the RRBC, other federal, state and local agencies, nongovernmental organizations and tribal nations working in the basin share the responsibility for plan implementation and comprehensive integrated watershed management.

The CWMP recommendations cannot all be achieved at the same time or by one authority or stakeholder. The CWMP is not a regulation to be enforced by the Corps or the RRBC. It is a guide to be used by Red River water and resource management entities in their decision-making processes. It is a guide to move the basin forward with a unified purpose and a unified voice.

7 PUBLIC INVOLVEMENT AND AGENCY COORDINATION

The RRBC's Red River Basin Natural Resources Framework Plan was intended to be a living document, which would be updated periodically. In 2013, the RRBC and the Corps began talking about using the Comprehensive Watershed Management Plan effort as a means to update the NRFP. Through interagency coordination, the team consolidated the 13 NRFP focus areas into six focus areas, and a working group was to be assigned to each focus area. The RRBC Executive Director and Corps staff introduced the six-working group concept at the January 2014 Red River Basin Land and Water Conference and invited participation on the six teams by any interested individuals. The working groups were formed in February and March 2014, and an integrated working group kick-off meeting was held in April 2014.

Each working group was comprised of:

- RRBC staff member
- Chairperson (RRBC board member)
- Corps staff in the role of facilitator and secretary
- Subject matter experts
- Representatives of interested agencies
- Jurisdictional representatives to provide a balance of perspectives

After the April 2014 kickoff meeting, the six groups met independently to work through the Corps' 6-step planning process. Another integrated joint working meeting was held in April 2015 to assess progress and compare notes. After the April 2015 meeting, each working group began developing a draft report to be incorporated into the Comprehensive Watershed Management Plan. Once the draft working group reports and the draft CWMP were completed, all working group members were provided the opportunity to review the full report complete with working group appendices. In April 2016 the working groups met once again for an integrated multi-agency joint working group meeting to provide feedback on the draft report and coordinate the path forward to the final report.

Public involvement not only has consisted of the coordination committee participants but also the posting of the draft and final CWMP on the RRBC website, providing opportunity for review of draft

reports, annual presentations at the Red River Basin Land and Water Conference and other outreach efforts.