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PUBLIC WATER SUPPLY PROFILE

PUBLIC WATER SUPPLY	
NAME	Moorhead Public Service
ADDRESS	500 Center Avenue P.O. Box 779
	Moorhead, MN 56561-0779
TELEPHONE NUMBER	218-299-5400
E-MAIL	mps@mpsutility.com
FAX NUMBER	218-299-5193

WELLHEAD PROTECTION MANAGER	
NAME	Clifford McLain P.E., Water Division Manager
ADDRESS	500 Center Avenue P.O. Box 779
	Moorhead, MN 56561-0779
TELEPHONE NUMBER	218-299-5471
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CONSULTANT	
NAME	Marilyn Bayerl
	Bayerl Water Resources
ADDRESS	9083 State Hwy 114 SW
	Alexandria, MN 56308
TELEPHONE NUMBER	320-283-6127
E-MAIL	bayerl@runestone.net
FAX NUMBER	320-283-6127

GENERAL INFORMATION	
UNIQUE WELL NUMBER(S)	Moorhead: (6) 241492, (6B) 437645
	N. Buffalo: (1) 511085, (2) 511086
	S. Buffalo: (8) 222049, (9) 222050, (10) 222051
POPULATION SERVED:	8,436 Metered Residence, 322 Apartment/Trailer Parks, 671 Commercial, 4 Industrial, 2 Golf
	Courses and 1 Regional (City of Dilworth)
COUNTY:	Clay

DOCUMENTATION LIST

STEP	DATE PERFORMED
Scoping Meeting 2 Held (4720.5340, subp. 1)	February 2, 2002
Scoping 2 Letter Received (4720.5340, subp. 2)	March 11, 2002
Remaining Portion of Plan Submitted to Local Units of Government (LUGs) (4720.5350)	February 3, 2003
Review Received From Local Units of Government (4720.5350, subp. 2)	March 24, 2003
Review Comments Considered (4720.5350, subp. 3)	April 8, 2003
Public Hearing Conducted (4720.5350, subp.4)	April 8, 2003
Remaining Portion WHP Plan Submitted (4720.5360, subp. 1)	
Final WHP Plan Review Received (4720.5360, subp. 4)	

MEMBERS OF THE WELLHEAD PROTECTION TEAM

Local Unit of Government	First	Last	Phone
Buffalo-Red River Watershed District	Jerry	VanAmburg	218.299.3085
Buffalo-Red River Watershed District Staff (Advisor)	Bruce	Albright	218.354.7710
Clay County Board of Commissioners	Jerry	Waller	218.233.2591
Clay County Director of Environmental Health (Advisor)	Bruce	Jaster	218.299.7195
Clay County Local Water Planner (Advisor)	Steve	Hofstad	218.287.2255
Clay County Planner (Advisor)	Tim	Magnusson	218.299.5002
Clay County Planning Commission	Carol	Schoff	218.483.4248
Clay Soil and Water Conservation District(Advisor)	Kevin	Kassenborg	218.287.2255
Dilworth City Council	Gary	Landsem	218.287.2313
Glyndon Township	Angie	Kuehl	218.498.2875
Landowner South Buffalo Aquifer	Steve	Schroeder	701.239.8653
Landowner North Buffalo Aquifer	Bill	Borgen	218.236.4818
Moland Township	Dan	Jacobsen	218.236.1036
Moorhead City Council Member	Jim	Danielson	218.236.2825
Moorhead Commercial Customer	Chuck	Chadwick	218.236.5112
Moorhead Industrial Customer	Joel	Smith	218.236.4347
Moorhead Planning Commission	Camille	Ross	218.236.4961
Moorhead Planning Commission Associate City Planner (Advisor)	Kim	Dupree	218.299.5370
Moorhead Public Service Commission Member	Darvin	Landa	218.287.2838
Moorhead Public Service Staff Member	Barb	Lodin	218.299.5403
Moorhead Public Service Water Division Manager (Advisor)	Clifford	McLain	218.299.5471
Moorhead Public Service General Manager (Advisor)	William	Schwandt	218.299.5404
Moorhead Residential Customer	Larry	Seljevold	218.236.1707
Oakport Town Board	Kevin	Campbell	218.233.4600
Minnesota Dept of Transportation	Mike	Ginnaty	218.847.1553
Burlington Northern Santa Fe Railroad	Greg	Jeffries	763.782.3490
Minnesota Dept of Health	Rich	Soule	651.215.0974
Minnesota Dept of Health	Mike	Howe	320.650.1076
Plan Writer	Marilyn	Bayerl	320.283.6127
Water Plant Supervisor	Troy	Hall	218.299.5470

EXECUTIVE SUMMARY

Part Two of Moorhead Public Service's Wellhead Protection Plan speaks to sections 4720.5220 through 4720.5290 of MN Rules. This portion of the plan addresses data elements and their assessments; impacts of changes on the public water supply well; issues, problems and opportunities; wellhead protection goals, objectives and action plans; program evaluation; and alternative water supply/contingency strategy.

In Part One of the Plan, the delineation of the Wellhead Protection Area (WHPA), the Drinking Water Supply Management Area (DWSMA), vulnerability of the wells, and vulnerability status of the aquifer in which the City's wells are located were completed and approved by the Minnesota Department of Health (MDH). This important information was utilized in the completion of this document.

While Moorhead Public Service (MPS) draws the majority of its public supply water from the Red River of the North, it also has two wells in the Moorhead Aquifer, located within Moorhead and five wells within the Buffalo Aquifer, located to the east of Moorhead. These aquifers lie below part of the Glacial Lake Agassiz lake plain area. This lake plain, formed nearly 10,000 years ago, is an extensively flat area. These wells are drilled to a depth between 114 and 273 feet and exist within a sand and gravel aquifer covered mainly by clay-rich till or lake clay.

The Moorhead Public Service Commission has spent considerable time, effort, and money to protect and facilitate the most effective use of the region's water supplies, including the Buffalo Aquifer. More than thirteen million dollars has been invested in recent years in the construction of a new river water treatment plant and upgrades to the river pumping station. These measures were part of a long-term plan to make greater use of the river water supply when it is available, so as to reserve greater amounts of water from the Buffalo and Moorhead Aquifers for use in periods of long-term drought. In the event of a drought or contamination of the Red River, which is always an imminent possibility, the aquifers will become this region's primary source of drinking water. This plan will only be effective if the aquifers are protected from contamination. MPS cannot wait until a drought occurs before implementing the necessary actions to protect the water quality in the aquifer.

The clay-rich till found throughout the DWSMA of the Moorhead Aquifer suggests a confining layer to the aquifer, and this aquifer, along with Wells Nos. 6 and 6B, was given a non-vulnerable rating. However, Wells Nos. 1, 2, 8, 9, and 10, located within the Buffalo Aquifer, were determined to be vulnerable to contamination. This aquifer was designated anywhere from a very high vulnerability where the water table is at the surface to a low vulnerability with greater than forty feet of clay/silt cover. The vulnerability was determined by the potential for connectivity between land use and the quality of the water within the aquifer.

This vulnerable status calls for focus on all potential contaminant sources located within the DWSMA. The Wellhead Protection Team intends to proactively work with Clay County, the cities of Moorhead and Dilworth, Glyndon Township, and the Buffalo-Red River Watershed District to establish protective regulation within the Buffalo Aquifer. It is the hope of the Wellhead Protection Team that through these regulations and increased public awareness, habits will be established that will decrease the potential for future water problems and the community can continue to enjoy the current quality of water it has come to expect.

CHAPTER ONE

DATA ELEMENTS/ASSESSMENT

Minnesota Rules 4720.5200

I. REQUIRED DATA ELEMENTS

A. PHYSICAL ENVIRONMENT DATA ELEMENTS

1. Precipitation

In the past ten years, the city of Moorhead has received 18 to 35 inches of precipitation annually. Precipitation data is located in ***Table 1.***

Moorhead Aquifer: The study of the Moorhead Aquifer indicates no direct hydraulic connection with surface water. Precipitation data does not apply and need not be considered in the development of management strategies.

Buffalo Aquifer: The high vulnerability of the North and South Drinking Water Supply Management Areas (DWSMAs) and wells located within the Buffalo Aquifer were determined based on the presence of tritium in the well water and the lack of consistency in the confining layers between the land surface and the aquifer. Therefore, the ability of precipitation to carry contaminants from the land to the aquifer during recharge must be considered when developing management strategies within the DWSMA.

2. Geology

Geologic data elements pertinent to Wellhead Protection Area (WHPA) delineation and vulnerability status are included in Part One of this Wellhead Protection Plan (WHPP) and are on file with the Minnesota Department of Health (MDH) and Moorhead Public Service (MPS).

The geologic makeup of the **Moorhead Aquifer** consists of 100 feet or more of relatively low permeable clay and till soils. This forms a confining layer between the surface and the groundwater, making vulnerability of this aquifer a negligible issue.

Within the DWSMAs of the **Buffalo Aquifer**, areas of lowest to highest vulnerability have been delineated as shown in ***Figure 1***. These areas, especially those of highest vulnerability must be addressed in the management strategies of this plan.

3. Soils

Because there is a protective layer of impervious material between the surface and the groundwater of the **Moorhead Aquifer**, this data element does not need to be considered within the DWSMA.

The surficial soils of the **Buffalo Aquifer** are shown in ***Figures 2 and 3.*** Moderately permeable soil textures of Silt Loam and Silty Clay Loam are predominant throughout the DWSMAs of this aquifer. Scattered small areas of gravel pits, sandy loam and alluvial soils, with a higher permeability, are also found. This Plan must verify and address the connection between soils, land use, and local groundwater quality.

4. Water Resources

There are no natural surface waters within the DWSMA of the **Moorhead Aquifer**. Ditch No. 41 flows along the northwestern edge as shown in ***Figure 4***. Since no hydraulic connection between the land surface and this aquifer exists, no consideration of this water resource is required.

The Buffalo River runs through the DWSMA of the north well field and the South Buffalo River runs through the DWSMA of the south well field of the **Buffalo Aquifer.** There are no public drainage ditches located within the DWSMA. Near the north well field, water flows overland from the general direction of southeast to northwest and eventually into the Buffalo River. Near the south well field, a west to east surface water flow exists west of the South Buffalo River. Private and highway ditches aid in the movement of surficial water. Surface water issues must be addressed in the management of the Potential Contaminant Source Inventory (PCSI).

B. LAND USE DATA ELEMENTS

1. Land Use

The land use within the **Moorhead Aquifer** DWSMA ***(Figure 4)*** and listed below is not applicable to this plan except in the context of its relationship to abandoned or unused wells.

Land Use	Acres	% of DWSMA
Grassy Areas	16.33	4
School	21.44	5
Commercial/Industrial	98.91	23
Agricultural	19.08	4
Right-of-way	182.67	43
Residential	86.33	20
Total	**424.76**	**99**

The DWSMAs of the **Buffalo Aquifer** consist of 4,750 acres. Present land use of the North and South DWSMAs is shown in ***Figure 5 and 6*** and as follows:

Land Use	Acres		% Of DWSMA	
	North	South	North	South
Agricultural	1879.96	2363.75	87.07	91.24
Forest	217.63	85.09	10.08	3.28
Residential	33.64	43.64	1.56	1.68
Grassland	27.96	35.34	1.29	1.36
Water		49.22		1.90
Miscellaneous		13.71		0.53
Total	**2,159.19**	**2,590.75**	**100**	**100**

The proposed upgrade of County Road No. 11 and Trunk Highway No. 336 and potential land use shifts to commercial as a result must be taken into consideration in the development of management strategies.

2. Public Utility Services

Moorhead Aquifer: Moorhead's utility map is available at the MPS office. Water and wastewater lines should have negligible impact on groundwater quality. Storm sewers discharge into ditches and, ultimately, into the Red River.

Buffalo Aquifer: Ground transportation corridors provide a potential source of contamination due to accidental spills and discharges. Trunk Highway No. 10 transects the south DWSMA and Trunk Highway No. 336/County Road No. 11 borders the western edge of the south DWSMA and runs through the middle of the north. The Burlington Northern Santa Fe Railroad transects the south DWSMA with eighty plus trains per day. Both the Williams and Tesoro pipelines transect the Buffalo Aquifer south of the DWSMA. A transportation map is available in ***Figure 1***. The MPS Water and Emergency Conservation Plan addresses options for back up water supplies and emergency preparedness in the event of a catastrophic event such as a hazardous release that may impact the public water supply.

Logs of MPS's wells are located in the appendix of Part One of the WHP Plan.

C. WATER QUANTITY DATA ELEMENTS

1. Surface Water Quantity

Moorhead Aquifer: As there is no hydraulic connection between surface water and groundwater within this aquifer, no information regarding surface water quantity is required for development of this plan.

Buffalo Aquifer: USGS gauges exist on the Buffalo Rivers near Sabin, and Dilworth. Annual mean streamflows have been recorded since 1932 at the Dilworth site ***(Table 2)***, and since 1946 at the site near Sabin ***(Table 3).*** The years since 1993 have produced increased flows with 1997 and 1998 having the highest mean flow on record. The South Branch has little or no flow during dry times. Aquifer recharge occurs from this river system, therefore, MPS is encouraged to monitor volume of flow at these sites if low flow becomes an issue.

2. Groundwater Quantity

Moorhead Aquifer: Groundwater recharge of this aquifer appears to be virtually non-existent. Since initial use of this aquifer as a water supply in the early 1900s, approximately 170 feet of volume has been drawn down, leaving an estimated 80 to 90 feet of water. The City of Moorhead has sealed three city wells, and two high capacity wells at Fairmont Creamery. Wells No. 4 and 5 exist at the water plant. They are presently used for monitoring only. There are no known other regular or high capacity wells in this aquifer. Water quantity issues such as artificial recharge must be addressed in this Plan.

Buffalo Aquifer: Adequacy of volume during drought periods has been addressed in Part One of the Plan. According to a Water Resources Investigation Report conducted in 1997 by the U.S. Department of the Interior and the USGS, recharge occurs in areas ***(Figure 7)*** with less than twenty feet of sediment thickness to the aquifer, from the Buffalo River, and from leakage through overlying glacial Lake Agassiz sediments and adjacent till. The general direction of groundwater flow is north/northwest, with some influence during high pumping.

A Contaminant Source Inventory Questionnaire was sent to all parcel owners located within the DWSMAs of the Buffalo Aquifer ***(Appendix Item 7)***. Forty-six of the forty-seven parcels responded, with the Burlington Northern Santa Fe Railroad's response not received. According to this survey, in addition to the City's wells, two high-capacity irrigation wells, seven monitoring wells and twenty-seven residential wells are located within the north and south DWSMAs of the Buffalo Aquifer. Location and ownership of these wells are noted in ***Figures 8 and 9*** and ***Table 4.*** The irrigation wells for agricultural purposes are permitted by the DNR as follows:

- Paul Horn Farms, Incorporated
  - Well #232378
  - Acres – 570
  - Permitted MG/Y – 177
  - Used in 2000 – 76 MG

- Ruth G. Landfield
    - Well #147201
    - Acres – 315
    - Permitted MG/Y – 81.3
    - Used in 2000 – 30.4 MG

Management strategies to address any additional high-capacity wells within this DWSMA will be included in Chapter Five.

D. WATER QUALITY DATA ELEMENTS

1. Surface Water Quality

Moorhead Aquifer: As there is no hydraulic connection between surface water and groundwater within this aquifer, no information regarding surface water quantity is required for development of this Plan.

Buffalo Aquifer: The MPCA has compiled a 305(b) list of "impaired waters" within the state. Portions of the Buffalo and South Buffalo Rivers are on this list due to high turbidity and/or low dissolved oxygen ***(Table 5)***. On these river reaches, TMDLs or Total Maximum Daily Loads will be instituted. The City of Moorhead, Buffalo-Red River Watershed District, and Clay County SWCD and Local Water Planner will work cooperatively with the MPCA to designate these parameters within the watershed.

Treated effluent from the Glyndon, Hawley and Barnesville Wastewater Treatment Plants are discharged to the Buffalo Rivers.

2. Groundwater Quality

A DNR Regional Hydrogeologic Assessment was completed in 2000 and results confirm a very high sensitivity to pollution within areas of the Buffalo Aquifer. These areas were identified utilizing factors such as depth to water table and surficial sediment permeability.

The Appendix contains a copy of the 2001 Consumer Confidence Report. Water quality data is measured on the combined water sources, including approximately 85 to 90 percent river water.

Tritium analysis was conducted as noted in the table below. Tritium is a radioactive isotope of hydrogen that was released into the atmosphere during testing of hydrogen bombs. When Tritium is found in groundwater in amounts greater than one tritium unit, it is an indicator that recharge due to rainfall has occurred since 1953, when atmospheric testing of hydrogen bombs occurred in the United States.

In the **Moorhead Aquifer** the water is considered "old" as tritium wasn't found. This shows that there is no surface activity influence in the aquifer, and the water is not vulnerable to contamination.

In the **Buffalo Aquifer,** the tritium units range from 3.1 to 8.6, as shown below. This indicates the water in the aquifer has entered from the surface since 1953 and could be subject to contamination from surface activities. This relatively "young" age of the water helps determine the vulnerable status of the aquifer and must be addressed in the plan.

Well Number	Aquifer	Tritium Level	Date Sampled
6	Moorhead	Unknown	
6B	Moorhead	<0.8	11/10/1997
1	Buffalo	3.1	08/09/1993
2	Buffalo	Unknown	
8	Buffalo	4.7	11/07/1997
9	Buffalo	8.6	05/04/1990
10	Buffalo	Unknown	

II. ASSESSMENT OF DATA ELEMENTS

A. USE OF THE WELL

The City of Moorhead utilizes seven wells ranging in depth from 111 to 273 feet.

Well Number	Unique Well #	Well Field Site	Depth (ft)
6	241492	Moorhead	270
6B	437645	Moorhead	273
1	511085	North Buffalo	198
2	511086	North Buffalo	203
8	222049	South Buffalo	116
9	222050	South Buffalo	111
10	222051	South Buffalo	124

Moorhead has two water treatment plants with a total capacity of 16 MGD. The new plant built in 1995 has a capacity to treat 10 MGD. It is used to treat both surface and groundwater. Ferric sulfate is added in the influent pipeline. Lime, soda ash, and a flocculent are added in the softening basins. Fluoride is added to the water ahead of the ozone/recarbonation contactors. There are six chambers in each of the two ozone contactors. Ozone is bubbled into the water in the first ozone chamber where the water has a pH of 10.6 to 11.4. Carbon dioxide and ozone are bubbled

into the water in the third chamber of the ozone contactor. The pH is adjusted to 9.4 to 9.6 in the third chamber. Ozone is also bubbled in the fifth chamber. Sodium metabisulfite is added during the cold weather months to neutralize any ozone residual in the ozone contactor effluent water. Phosphate is added into the filter influent chamber. The water is then filtered. Ammonia and chlorine are added in the filter effluent chamber. Soda ash is added into the filter influent chamber or plant clearwell for pH adjustment during the summer months. The water is then pumped into the on-site reservoirs.

The 1960 plant (West Plant) has a capacity of 6 MGD and it is used to soften groundwater. The West Plant is a backup to the new plant. The water is lime-soda ash softened with ferric sulfate as the coagulant. Carbon dioxide is added to adjust pH. Phosphate, fluoride, ammonia, and chlorine are added to the filter influent. The water is filtered and pumped to the on-site reservoirs. The West Plant can be used to clarify and soften surface water, but the water would then be pumped to the new plant for ozone disinfection and filtration.

There are two underground concrete reservoirs located at the water plant site. The East Reservoir has a capacity of 2.4 MG. The West Reservoir has a capacity of 3.0 MG. The reservoirs are connected with a 16-inch transfer line. The East Reservoir has two high service pumps with the capacity of pumping up to 4500 gpm each or a maximum of 7800 gpm with both pumps operating. The West Reservoir has two high service pumps with capacities to pump 2800 gpm and 3500 gpm, respectively. The pumps for each reservoir are on for about the same length of time each day. The pumps are alternated to fluctuate the water levels in MPS's two water towers. Only during peak pumping periods of the summer months is there more than one pump on at a time. After midnight for two to four hours there are no high service pumps on at the water plant. The pumps at the two distribution system underground reservoirs (500,000 gallons each) are operated during this time of night to change water in those tanks. MPS provides service to 9,436 metered service connections, broken down as follows:

o Residential	8,436
o Apartment / Trailer Parks	322
o Commercial	671
o Industrial	4
o Regional (Dilworth)	1
o Raw Water (Golf Courses)	2

The volume of water pumped has averaged four 4 MGD for the past ten years. Water usage from the wells has decreased as pumping from the Red River has increased. The historic water use is as follows:

Historic Water Use Over The Past Ten Years			
(In Million Gallons)			**Annual Water**
Year	**River**	**Wells**	**Pumped***
1992	831.49	622.22	1423.87
1993	790.21	565.96	1381.94
1994	724.37	673.32	1487.56
1995	1112.56	401.89	1473.28
1996	1153.04	384.66	1476.21
1997	1128.18	337.68	1406.94
1998	1174.37	324.66	1482.65
1999	1289.95	219.99	1498.84
2000	1281.25	202.53	1504.16
2001	1291.72	279.44	1521.55
*The difference in annual water pumped and the sum of the river and wells is metering and sales of river water to golf courses.			

The top ten water users in the Moorhead area are Busch Agricultural Resources, the City of Moorhead, American Crystal Sugar, Minnesota State University Moorhead, Concordia College, Pactiv Corporation, Regal Estates, Moorhead Public Schools, Eventide Lutheran Home, and the City of Dilworth. These ten users comprise 40% of the total water sales. New industries are being actively recruited by the City of Moorhead as part of their economic development program. If new high capacity water users are added to the system, the City may need to pursue new groundwater sources. The Red River Water Supply Project is working with the Garrison Diversion Conservancy District to explore the feasibility of utilizing water from the Missouri River as an alternate water supply during drought periods. The installation of other high-capacity wells or increases in water use beyond the volumes used in the computer model for delineation in Part One of this Plan may affect the delineated WHPA and DWSMA and subsequently require a revision of this WHPP.

B. WELLHEAD PROTECTION AREA DELINEATION CRITERIA

The following data inputs were used in determination of the boundaries of the wellhead protection area.

1. **Time of Travel - 20 year**
2. **Flow Boundaries**
3. **Daily Volume**
4. **Groundwater Flow Field**
5. **Aquifer Transmissivity**

A detailed discussion of the delineation is found in Part One of the Plans. Part One of the Moorhead Aquifer was completed by Jim Walsh, MDH, and Part One of the Buffalo Aquifer was completed by Barr Engineering. Both are available at the MDH and MPS for review.

C. Quality and Quantity of Water Supplying the Public Water Supply Well

Results of routine sampling conducted by the MDH in 2001 discovered no violations of any parameters monitored under the Safe Drinking Water Act.

MPS's wells pump about .077 MGD, with river water usage making up the other 3.23 MGD utilized by the City. During the months of November through March, 100% of the drinking water comes from the Red River.

D. The Land and Groundwater Uses in the Drinking Water Supply Management Area

Due to the nonvulnerable status of the **Moorhead Aquifer,** the identification of contaminant sources is limited to the wells located within the DWSMA. No other wells are presently known to be located within this DWSMA.

A Potential Contaminant Source Inventory survey has been sent to landowners within the **Buffalo Aquifer**. A summary of the survey can be reviewed in ***Figures 8 and 9*** and is listed in the beginning of Chapter Five, with a discussion of the results at the beginning of Chapter Five.

Proactive management of existing wells, unused, unsealed wells and underground storage tanks and potential contaminants resulting from land use activity must be included as part of the management strategies of this Plan.

CHAPTER TWO

IMPACT OF CHANGES ON PUBLIC WATER SUPPLY WELL

Minnesota Rules 4720.5220

I. CHANGES IDENTIFIED IN:

A. PHYSICAL ENVIRONMENT

Moorhead Aquifer: No physical changes in the environment are anticipated within the next ten years.

Buffalo Aquifer: The expansion of the Trunk Highway No. 336 corridor is under construction by MNDOT with four lanes between I-94 and Trunk Highway No. 10 with an overpass at Highway No. 10 and the railroad tracks. MNDOT has been purchasing land and intends to construct clay-lined stormwater ponds and has agreed to place at least one foot of clay lining in the road ditches. Within the next ten years, an expansion of this road further north is also planned.

One gravel mine within the DWSMA is below the water table with a direct impact on the aquifer. No restoration has occurred at this site; however, a berm has been erected to prevent overland runoff from entering the site. Future mining within the DWSMA will be discouraged.

B. LAND USE

Moorhead Aquifer: Property along the major highway and railroad corridor has been down zoned from Industrial to Commercial.

Buffalo Aquifer: Anticipated land use changes include pressure for commercial development along the Trunk Highway No. 336 County Road No. 11 corridor. A study has been authorized by the Fargo/Moorhead Metropolitan Council of Governments to discern the future plan for land development adjacent to this route around the cities of Moorhead and Dilworth. Without orderly annexation, potential development may occur without city services. Groundwater sensitivity will need to be considered during this planning process.

C. SURFACE WATER

Moorhead Aquifer: No hydraulic connection exists between the surface water and the Moorhead aquifer. This element need not be considered in the management strategies of this Plan.

Buffalo Aquifer: Regarding the Buffalo and South Branch of the Buffalo Rivers, water quality is anticipated to improve due to the upgrade of Glyndon Sewage Treatment Plant, wetland restorations offered through a variety of programs (including a possible large restoration in the Manston Slough area currently being studied by the Buffalo-Red River Watershed

District), and incentives through the USDA for CRP and buffers along the rivers. Expected pressure for future development and the use of stormwater retention ponds must be a consideration in the management strategies of this Plan.

D. GROUNDWATER

Moorhead Aquifer: Potential artificial recharge to this Aquifer is a consideration. This could have an effect on both quality and quantity of the water contained within it.

Buffalo Aquifer: Any future well fields are expected to be located south of the already delineated DWSMAs. This will accommodate the anticipated growth, both commercial and residential, in the cities of Moorhead and Dilworth. There are no expected changes in the good water quality the community enjoys.

II. IMPACT OF CHANGES

A. EXPECTED CHANGES IN WATER USE

With the additional provision of water to the city of Dilworth and expected increases in industrial and residential development, water use increases are projected in the next eleven years.

Existing space for expansion of the Moorhead Industrial Park and McCara Industrial Park allows for the likely growth that will occur. Anticipated increases in residential development to the northeast and south of the city and commercial growth along I-94, 336, and/or the new Trunk Highway No. 75 will likely affect the need for water usage increases.

B. INFLUENCE OF EXISTING WATER AND LAND GOVERNMENT PROGRAMS AND REGULATION

Moorhead Aquifer: The DWSMA of the Moorhead Aquifer exists within the city limits of Moorhead. The city of Moorhead has regulatory control within the city limits through a locally adopted Zoning and Subdivision Ordinance. The City has been receptive to the recognition of the DWSMA in future land use planning efforts, as evidenced by recent zoning changes along the railroad corridor.

Buffalo Aquifer: The North DWSMA of this aquifer is regulated by Clay County Zoning. The South DWSMA is regulated by 25% Clay County Zoning (Moland Township has no zoning authority) and 75% Glyndon Township Zoning. Potential exists within the south area for extra territorial zoning within the two-mile radius of the cities of Moorhead and Dilworth. This would include subdivision controls beyond county or township zoning. Representative members from these governmental units are actively participating in the writing of this Plan, and have been supportive of the preservation of Moorhead's DWSMA. The 336/11 land use study

commissioned by the Metropolitan Council of Governments (Metro-COG) will provide greater direction from the local government about the extent of development and coordination of land use regulations.

Regulatory control also exists within the Buffalo-Red River Watershed District. An updated overall plan was completed in 1998 and priorities include utilizing existing USGS gauges and initiating water quality studies to provide a water quality database. Other priorities include technical assistance and education. District goals of protection and preservation of surface and groundwater are pertinent to this Plan.

C. ADMINISTRATIVE, TECHNICAL, AND FINANCIAL CONSIDERATIONS

MPS and Clay County have been supportive of Wellhead Protection efforts. A Wellhead Protection Team has been formed and has been actively involved in the planning process. A line-item budget has been established for implementation of priority strategies identified in this Plan.

The WHP Manager will be responsible for implementation of this Plan. A re-allocation of position descriptions to provide staff hours to this endeavor will be completed. The team will continue to meet periodically to review and discuss implementation programs.

Clay County Water Planning, Soil and Water Conservation District, City Planning and County Environmental Services have provided technical assistance for this plan along with the Watershed District and public utility.

In the past, Clay County has implemented protective zoning within sensitive areas of the Buffalo River watershed. NRCS has made wellhead protection a high priority for EQIP funding. Potential exists for legislative issuance of CREP dollars in the Red River Basin. These considerations will assist in development of management strategies for the protection of the groundwater within the Buffalo Aquifer.

CHAPTER THREE

ISSUES, PROBLEMS, AND OPPORTUNITES

Minnesota Rules 4720.5230

I. LAND USE ISSUES, PROBLEMS, AND OPPORTUNITIES RELATED TO:

A. THE AQUIFER

Moorhead Aquifer: The Moorhead Aquifer is confined based on geologic information and tritium results. This non-vulnerable aquifer appears unaffected by land use based on these factors and the quality of the well water.

Due to the limited recharge of this aquifer, quantity becomes an issue. Opportunities presented include: aquifer recharge during winter with treated river water, control of additional wells into this aquifer, and/or pursuit of Sole Source Aquifer Designation through the Safe Drinking Water Act.

Buffalo Aquifer: This aquifer providing Moorhead's Public Water Supply has been determined to be influenced by land use based on tritium dating of the water.

Opportunities presented include: investigation of potential land use impacts such as agricultural and/or commercial; identification of unsealed, unused wells; location of underground storage tanks; and development of a procedure for tracking new wells placed in the aquifer. Public education programs addressing potential contamination of the aquifer will be initiated.

B. THE WELL WATER

The city of Moorhead has adequate water for the projected use in the next ten (10) years. Adding any high-capacity well may affect the WHPA and DWSMA and would require new delineation. MPS will work with the MDH and DNR to assist with location and construction of any proposed new high-capacity wells. Education is one of the main strategies in protection of drinking water supplies.

C. THE DRINKING WATER SUPPLY MANAGEMENT AREA

Moorhead Aquifer: Land use of the DWSMA within this aquifer has been relatively stable for years. A list of property owners, addresses, parcel Identification numbers, and current use classification is located on file at MPS and Moorhead City Hall.

Buffalo Aquifer: The Trunk Highway No. 336/County Road No. 11 corridor study presently being completed presents an opportunity for planning before development occurs. The DWSMA of the south wells abuts the proposed corridor, with the recharge area of the aquifer within close proximity. Development west of Trunk Highway No. 336/County Road No. 11 would be less likely to affect the drinking water supply and should be encouraged, while east of the road is more vulnerable. A list of property owners, addresses, and parcel identification numbers is located in ***Table 4.***

II. IDENTIFICATION OF:

A. PROBLEMS AND OPPORTUNITIES DISCLOSED AT PUBLIC MEETING AND IN WRITTEN COMMENT

The general public has expressed no concerns at public meetings. Issues identified at the WHP Team meetings include public education, agriculture impacts, potential commercial use, and wells.

B. DATA ELEMENTS

The State's Wellhead Protection Rule requires that existing information be utilized in developing the initial Wellhead Protection Plan. Much of the data collected and utilized to delineate Moorhead's WHPA and DWSMA and to determine vulnerability of the aquifer to possible contamination, comes from regional sources on a large scale. While much regional information and data is being used as supplied by MDH, Moorhead has initiated verification of many of the contaminant sites and sources through a survey of all landowners within the **Buffalo Aquifer** to further protect public drinking water supplies.

The City will continue to compile data collected by all entities regarding groundwater and surface water to track potential changes in the quality of either. This plan will be updated on ten-year intervals as required by the State of Minnesota. Updated data will be utilized at that time.

C. STATUS AND ADEQUACY OF OFFICIAL CONTROLS, PLANS, AND OTHER LOCAL, STATE, AND FEDERAL PROGRAMS ON WATER USE AND LAND USE

The WHP Team feels adequate protection of the DWSMA is available through existing land use ordinances in the cities of Moorhead and Dilworth, Glyndon Township, Clay County, and State well and groundwater appropriations permits. The jurisdictions will be reviewing their land use policies related to development of the Trunk Highway No. 336/County Road No. 11 corridor to determine the appropriate extent, if any, of commercial development. Existing education programs, promoting Best Management Practices (BMP) and working with local landowners on issues is the approach proposed by MPS.

CHAPTER FOUR

WELLHEAD PROTECTION GOALS

Minnesota Rules 4720.5240

III. GOALS

A. PRESENT AND FUTURE WATER AND LAND USE

The overall Goals of the Moorhead Public Service's Wellhead Protection Plan are:

- **Quantity:** To promote public health, economic development and community infrastructure by maintaining an adequate drinking water supply for all residents of the community and region, both now and into the future.
- **Quality:** To preserve and protect the quality of groundwater resources to assure continued safe and useable water supply.

The MPS water supply is located underground in two different aquifers. The Moorhead Aquifer, containing Well Nos. 6 and 6B, is classified as non-vulnerable, and the Buffalo Aquifer, containing Well Nos. 1, 2, 8, 9, and 10, is classified as vulnerable. Groundwater from these sources provides approximately 10 to 15 percent of actual water used in the Moorhead area. The rest is acquired from the surface waters of the Red River of the North. The Red River is susceptible to low flow and no flow under drought conditions. The groundwater supplies may provide up to 100 percent of Moorhead's water supply during prolonged periods of drought. This program will focus on management strategies that address these differences.

Moorhead and surrounding communities enjoy a safe and adequate water supply. Through the implementation of this WHP Plan, these elements will be protected and preserved.

The Wellhead Protection Program will achieve these stated goals through existing and planned programs such as:

- **Public Education and Information**
- **Best Management Practices**
- **Well and Tank Identification**
- **Emergency Response Procedures**

CHAPTER FIVE

OBJECTIVES AND PLANS OF ACTION

Minnesota Rules 4720.5252

IV. ESTABLISHING PRIORITIES

A survey was developed by MPS, with assistance from the MDH, and sent to landowners within the DWSMAs of the Buffalo Aquifer to determine potential contaminant sources. A total of forty seven parcels exist within these DWSMAs. The following table summarizes the results of this survey. MPS surveyed 450-plus parcels within the Moorhead Aquifer DWSMA for wells. No wells but the MPS wells were found.

Category	Potential Contaminant	Number Located Within The Buffalo Aquifer		Priority
	Source	**North**	**South**	
Wells	Domestic	**17**	**10**	**M**
	High Capacity	**2**	**5**	**H**
	Monitoring	**5**	**2**	**M**
	Sealed	**5**	**0**	**L**
	Unused, Unsealed	**0**	**1**	**H**
Septic Systems	Tank plus Drain field	**21**	**6**	**M**
	Tank plus Mound	**1**	**0**	**L/M**
	Unknown	**0**	**2**	**H**
Tanks	Underground	**0**	**0**	**H**
	Above Ground	**13** (120-1500 gal)	**4** diesel, **3** gasoline (300-10,000 gal)	**H**
	Heating Fuel	**10** fuel oil basement **1** fuel oil outside **9** propane (125-1500 gal)	**3** fuel oil basement **5** propane **2** natural gas (12-1000 gal)	**M**
Agriculture	Chemical/Fertilizer Storage (bulk)	**0**	**1**	**H**
	Livestock	**1**(5 horses)	**1**(200 cattle)	**M**
	Potato Warehouse	**0**	**2**	**M**
Mining	Gravel Mining	**0**	**1**	**H**
	Asphalt Plants	**0**	**0**	**H**
	Borrow Pit	**0**	**1**	**H**
	Concrete Plant	**0**	**1**	**L**
Transportation	Major Highway	**1** Clay Co. 11	**3** US 10, TH 336, Clay Co. 11,	**H**
/Pipelines	Railroad	**0**	**1**	**H**
	Pipeline (Petroleum)	**0**	0	**H**

V. OBJECTIVES

The following management strategies apply to the Buffalo Aquifer unless denoted by an asterisk, which would indicate applicability to both the Buffalo and Moorhead Aquifers.

A. LAND USE

OBJECTIVE A-1: MANAGE SEWAGE TREATMENT LOCATED WITHIN THE DWSMA FOR THE PROTECTION OF THE AQUIFER.

MEASURE A-1-1: Continue to inspect Individual Sewage Treatment Systems (ISTS) upon sale of property and/or when adding a bedroom. Systems not meeting regulations will be required to become compliant within ten months.

Source of Action:	Clay County Public Health, WHP Manager
Cooperators:	WHP Team, landowners
Timeline:	Ongoing
Estimated Cost:	Staff time and cost of upgrade to landowners
Goal Achieved:	Facilitate systematic upgrade of non-conforming ISTS, education for owners of conforming systems.

MEASURE A-1-2: Require that new commercial businesses within the WHPA/DWSMA be connected to municipal sewage treatment and water supply.

Source of Action:	MPS, WHP Manager
Cooperators:	Clay County, cities of Moorhead and Dilworth, Glyndon Township
Time Frame:	Spring 2003 and ongoing
Estimated Cost:	$2 Million to serve the entire area
Goal Achieved:	Preservation of existing groundwater resources by preventing potential contaminant sources.

OBJECTIVE A-2: MANAGE POTENTIAL HAZARDOUS DISCHARGES, UNDERGROUND TANKS, AND GRAVEL PITS WITHIN THE DWSMA FOR PROTECTION OF THE AQUIFER.

MEASURE A-2-1: Propose Clay County adoption of Sensitive Areas Map RHA-3 (map 4 of 4) from the DNR Hydrogeologic Assessment completed in 2000.

Source of Action: Clay County, WHP Manager
Cooperators: WHP Team, cities of Dilworth and Moorhead, MPS
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Designation of sensitive areas in a defensible manner for preservation of groundwater resources.

MEASURE A-2-2: Propose land use zoning regulations to prevent placement of new underground tanks or bulk storage of hazardous materials within designated sensitive areas.

Source of Action: WHP Team, WHP Manager
Cooperators: Clay County, cities of Dilworth and Moorhead, MPS, Glyndon Township
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Prevent contamination of aquifer from land use in areas of known sensitivity.

MEASURE A-2-3: Propose setback and land use regulations on existing gravel pits within the DWSMA.

Source of Action: WHP Team, WHP Manager
Cooperators: Clay County, cities of Dilworth and Moorhead, MPS, Glyndon Township
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Prevent contamination of aquifer from land use in areas of known sensitivity.

MEASURE A-2-4: Prohibit expansion of existing and new gravel and mining operations within sensitive areas of the Buffalo Aquifer.

Source of Action: WHP Team, WHP Manager
Cooperators: Clay County, Cities of Dilworth/Moorhead, MPS, Glyndon Township
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Prevent contamination of aquifer from land use in areas of known sensitivity.

MEASURE A-2-5: Prohibit temporary and permanent asphalt plants within sensitive areas of the Buffalo Aquifer.

Source of Action: WHP Team, WHP Manager
Cooperators: Clay County, cities of Dilworth and Moorhead, MPS, Glyndon Township
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Prevent contamination of aquifer from land use in areas of known sensitivity.

MEASURE A-2-6: Investigate regulatory and permitting process for closed loop vertical cooling with antifreeze (geothermal). Lobby for proper oversight of this process.

Source of Action: MPS, WHP Team, WHP Manager
Cooperators: Clay County, Cities of Dilworth/Moorhead
Timeline: 2003
Estimated Cost: Staff time
Goal Achieved: Prevent contamination of aquifer from land use in areas of known sensitivity.

MEASURE A-2-7: Establish pesticide waste and waste container collection dates and locations. Notify land owners within the DWSMA of these dates and locations and provide information on wellhead protection.

Source of Action: Clay County, USDA, WHP Manager
Cooperators: WHP Team, MPS
Timeline: 2003 and as needed
Estimated Cost: Staff time
Goal Achieved: Education of land owners and prevention of contamination of aquifer from land use in areas of known sensitivity.

OBJECTIVE A-3: MANAGE ABOVE GROUND TANKS WITHIN THE DWSMA FOR THE PROTECTION OF THE AQUIFER.

MEASURE A-3-1: Inventory above ground tanks within the sensitive areas of the DWSMA for existing containment status.

Source of Action: MPS, WHP Manager
Cooperators: WHP Team
Timeline: 2003 and ongoing
Estimated Cost: Staff time
Goal Achieved: Knowledge of areas of potential contamination.

MEASURE A-3-2: Offer cost sharing incentives on the voluntary construction of containment systems for above ground tanks at existing operations and/or farmsteads within the WHPA/DWSMA not covered by existing regulations.

Source of Action:	MPS, WHP Manager
Cooperators:	WHP Team
Timeline:	2003 and ongoing
Estimated Cost:	$5,000
Goal Achieved:	Prevent accidental spills from contaminating the aquifer.

MEASURE A-3-3: Require construction of containment systems around dispensing areas and around above ground tanks larger than 300 gallons at new development sites within the WHPA/DWSMA.

Source of Action:	MPS, WHP Manager
Cooperators:	Clay County, Cities of Moorhead/Dilworth, Glyndon Township, WHP Team
Timeline:	2003 and ongoing
Estimated Cost:	Actual cost to landowner
Goal Achieved:	Prevent accidental spills from contaminating the aquifer.

MEASURE A-3-4: Notify property owners in DWSMA about Conservation Reserve Program (CRP) eligibility. Promote CRP as a less intensive land use option in the DWSMA.

Source of Action:	NRCS, SWCD, WHP Manager
Cooperator:	Watershed District, WHP Team
Time Frame:	Ongoing with plan adoption
Estimated Cost:	Staff time, Intern hours
Goal Achieved:	Less intensive land use would provide an additional level of protection in the WHP areas.

OBJECTIVE A-4: SEAL UNUSED OR ABANDONED WELLS.

* **MEASURE A-4-1: Offer cost sharing incentives of 75% up to $500 to seal unused, unsealed wells within the DWSMA.**

Source of Action:	Clay County CLWP, WHP Manager
Cooperators:	MPS, WHP Team
Time Frame:	2003-2004 and ongoing
Estimated Cost:	$300-500 per well

Goal Achieved: Private well owners will become more likely to properly seal their unused wells and MPS becomes aware of changes in well status.

*** MEASURE A-4-2: Offer cost sharing incentives of remaining 25% up to $500 to seal unused, unsealed wells within the DWSMA.**

Source of Action: MPS, WHP Manager
Cooperators: WHP Team
Time Frame: 2003-2004 and ongoing
Estimated Cost: $500 per well
Goal Achieved: Private well owners will become more likely to properly seal their unused wells and MPS becomes aware of changes in well status.

OBJECTIVE A-5: RAISE WELL OWNER AWARENESS AND PREVENT CONTAMINATION OF MPS WATER SUPPLY VIA PRIVATE WELLS.

MEASURE A-5-1: MPS and members of the WHP Team will obtain and distribute brochures, describing proper well maintenance and operation to private landowners within the DWSMA.

Source of Action: WHP Manager, MPS
Cooperators: CLWP, Extension Service, MRWA, MDH
Time Frame: 2003
Estimated Cost: $100-$150 plus staff time
Goal Achieved: Private well owners will learn proper operation and maintenance of private wells, thereby reducing potential for contamination of City water supply.

*** MEASURE A-5-2: Request that Buffalo-Red River Watershed District, Clay County, the Cities of Moorhead and Dilworth, and Glyndon Township formally identify the WHPA and DWSMA of wellfield sites when revising the County Water Plan, Watershed District Plan or County / City Comprehensive Land Use Plans.**

Source of Action: WHP Manager
Cooperators: Cities of Moorhead and Dilworth, Clay County, Glyndon Township, Watershed District
Time Frame: During update process
Estimate Cost: Staff time

Goal Achieved: DWSMA formally identified in Clay County Comprehensive Plan and CLWP for consideration in future land use decisions.

OBJECTIVE A-6: DEVELOP A LOCAL ADMINISTRATIVE PROCESS TO EVALUATE IMPACTS NEW WELLS MAY HAVE ON AN APPROVED WHPA/DWSMA.

*** Measure A-6-1: The public water supplier will a.) Request copies of any new or revised groundwater appropriation permits that are submitted to the DNR for any high capacity wells in or near the approved DWSMA, and b.) Develop an administrative process to assess requests for proposed wells or increased pump rates from existing high-capacity wells in an approved DWSMA.**

Source of Action: MPS, DNR, SWCD, WHP Manager
Cooperators: MDH, well operators, well drillers
Time Frame: Begin in 2003 and ongoing thereafter
Estimated Cost: Staff time and special studies if needed
Goal Achieved: This action will assist with the City of Moorhead's goal of identifying and reviewing new wells that are proposed for construction or increased pumping of existing high-capacity wells within the DWSMA and determine if those wells will affect MPS's ability to provide an adequate and safe supply of drinking water.

*** MEASURE A-6-2: Review regulations regarding test well drilling and work with the MDH to ensure proper sealing of test wells within the DWSMA.**

Source of Action: Wellhead Protection Manager, MPS
Cooperator: MDH
Time Frame: 2003 and ongoing
Estimated Costs: Staff time
Goal Achieved: Preservation of the Buffalo Aquifer in areas determined to be sensitive to surface contamination.

OBJECTIVE A-7: DEVELOP A STORMWATER MANAGEMENT PROGRAM UTILIZING MPCA GUIDELINES FOR PHASE II NPDES PERMITTING TO PROTECT THE BUFFALO AQUIFER WITHIN THE WHPA/DWSMA.

Measure A-7-1: Work closely with the MPCA to develop a stormwater management plan based on guidelines for Phase II of the National Pollutant Discharge Elimination System/State Disposal Permit Program (NPDES). Follow through of permitting process on new construction including inspections and filing of completion report.

Source of Action:	Buffalo-Red River Watershed District, MPCA, WHP Manager
Cooperators:	MPS
Time Frame:	2003 and ongoing
Estimated Cost:	Staff time
Goal Achieved:	Increased water quality within the Buffalo Aquifer due to better land management practices.

OBJECTIVE A-8: WORK TO ESTABLISH A COORDINATED SPILL RESPONSE PLAN WITH AREA AND STATE EMERGENCY MANAGEMENT ENTITIES.

MEASURE A-8-1: Establish working relationship with and coordinate spill response efforts with other agencies. Continue current practice with MNDOT of lining road ditches with clay within the sensitive areas of the DWSMA.

Source of Action:	MPS, WHP Manager
Cooperators:	MNDOT, Clay County Highway Department, Burlington Northern Santa Fe Railroad, MPCA, MDA
Timeline:	2003
Estimated Cost:	Time
Goal Achieved:	Spills along Trunk Highway No. 10, County Road No. 11 / Trunk Highway No. 336 and BNSF Railroad will be abated before aquifer contamination occurs.

B. Public Education and Information

Objective B-1: Develop Public Education Programs Aimed at Awareness and Protection of Public Water Supply.

*** MEASURE B-1-1: Post signs at the perimeter of the WHPA on major roadway corridors to notify the public that they are in the DWSMA and to serve as a physical boundary identifier.**

Source of Action: MPS, WHP Manager
Cooperators: WHP Team
Time Frame: 2003
Estimated Cost: $500
Goal Achieved: General public notified of boundaries of the drinking water supply area.

MEASURE B-1-2: Information and brochures will be sent to utility customers in utility bills. County residents in the DWSMA will be sent letters educating and informing them of the Wellhead Protection Plan and Goals.

Source of Action: MPS, WHP Manager, WHP Team
Cooperators: CLWP in quarterly newsletter, MRWA
Time Frame: Annually
Estimate Cost: Staff time, printing costs
Goal Achieved: Public becomes more aware of issues related to protecting drinking water and how to care for their wells properly.

MEASURE B-1-3: Community Youth Water Festival: Groundwater Flow Model will be utilized to demonstrate the connection between land use and groundwater to area students. Discussion of Wellhead Protection needs will be included in the demonstration.

Source of Action: River Keepers, WHP Manager
Cooperator: WHP Team, CLWP, MPS, Watershed District, Fish and Wildlife Service, North Dakota Department of Health
Time Frame: Annually
Estimated Costs: Staff time
Goal Achieved: Students and parents become more aware of the WHPP and the reasons for aquifer preservation needs.

*** MEASURE B-1-4: Information on WHPP will be published on Moorhead Public Service website with links to the City and County.**

Source of Action:	MPS, WHP Manager
Cooperators:	City of Moorhead, Clay County
Time Frame:	2003 and ongoing
Estimated Cost:	Staff time
Goal Achieved:	Increased public awareness of the WHP for web-users.

MEASURE B-1-5: A nitrate clinic will be sponsored and mailings will be sent to all landowners of the 27 domestic wells within the Buffalo DWSMA notifying them of the clinic and the importance of protecting the aquifer.

Source of Action:	MPS, CLWP, WHP Manager, Clay County Environmental Health
Cooperator:	WHP Team
Time Frame:	Once in ten years – repeat if necessary
Estimated Costs:	Staff time
Goal Achieved:	Maintain public awareness of the connection between groundwater and land use.

*** MEASURE B-1-6: Local media articles will be published after adoption of MPS WHPP.**

Source of Action:	MPS, WHP Manager
Cooperator:	WHP Team
Time Frame:	2003
Estimated Costs:	Staff time
Goal Achieved:	Educate and maintain public awareness of the Wellhead Protection Plan.

*** MEASURE B-1-7: Presentations will be made to local service organizations.**

Source of Action:	MPS, WHP Manager
Cooperator:	WHP Team
Time Frame:	Ongoing
Estimated Costs:	Staff time
Goal Achieved:	Community understanding and support of WHP priorities and regulatory needs.

MEASURE B-1-8: Maps of DWSMA, educational posters, and brochures will be displayed at the Clay County Fair and other similar events.

Source of Action:	SWCD, MPS, WHP Manager
Cooperator:	WHP Team
Time Frame:	Annually
Estimated Costs:	Staff time
Goal Achieved:	Public awareness of DWSMA and WHPP.

MEASURE B-1-9: Support students in the area school districts for participation in the River Watch Program, monitoring the South Branch of the Buffalo River for Water Temperature, Transparency (using the MPCA derived T-Tube), Turbidity in NTUs, Conductivity (us/cm), pH, Dissolved Oxygen (mg/l), Dissolved Oxygen (% saturation), Total Phosphorus (mg/l), NO3 (mg/l), Total Suspended Solids (mg/l).

Source of Action:	CLWP, WHP Manager
Cooperator:	WHP Team, River Watch coordinator, area schools, Watershed District
Time Frame:	Monthly during open water season
Estimated Costs:	Staff time
Goal Achieved:	Information for local water resource management in the TMDL process. Education of high school age students on the connection between groundwater and surface water.

MEASURE B-1-10: Establish education workshops for landowners within the DWSMA on ag irrigation and chemigation.

Source of Action:	Clay County Extension Services, WHP Manager
Cooperators:	CLWP, MPS, SWCD
Timeline:	2003
Estimated Cost:	Staff time
Goal Achieved:	Prevent contamination of aquifer from land use in areas of known sensitivity.

C. MONITORING AND DATA COLLECTION

OBJECTIVE C-1: COLLECT ADDITIONAL DATA REGARDING THE BUFFALO AQUIFER FROM LOCAL WELL DRILLERS AND THROUGH ADDITIONAL CHEMICAL TESTING.

MEASURE C-1-1: Monitoring for general chemistry and petroleum products will be conducted on samples acquired from municipal and other area wells.

Source of Action: MPS, WHP Manager
Cooperators: SWCD, DNR, WHP Team
Time Frame: 2003 and to be determined thereafter
Estimated Cost: $500 per sample, staff time
Goal Achieved: By monitoring numerous wells that surround MPS wells, changes in groundwater supplies and contaminants can be detected before they reach the PWS. Private owners gain information about the safety of their own drinking water.

MEASURE C-1-2: Gather new and existing well construction logs by working with SWCD. Well logs from areas within the DWSMA will be sent to MPS for evaluation and mapping.

Source of Action: SWCD**,** MPS, WHP Manager
Cooperators: MDH, WHP Team
Time Frame: Ongoing
Estimated Cost: Staff time
Goal Achieved: Better geologic information about the aquifer will be obtained in a cost effective manner that will enhance and improve future WHP planning efforts.

MEASURE C-1-3: Work with the MPCA to establish a monitoring program on the South Buffalo River as part of the TMDL process – including hydrologic and hydrogeologic modeling.

Source of Action: Watershed District, WHP Manager
Cooperators: SWCD, CLWP, MPCA, WHP Team
Time Frame: 2004 and ongoing
Estimated Cost: Staff time, monitoring costs
Goal Achieved: The WHP team will become involved in the establishment of discharge limits on the river, thus helping to preserve the quality of the waters flowing through the DWSMA.

MEASURE C-1-4: Work with the USGS to establish a low flow monitoring program on the Buffalo and South Buffalo Rivers.

Source of Action:	Watershed District, WHP Manager
Cooperators:	SWCD, CLWP, WHP Team
Time Frame:	2003 and ongoing
Estimated Cost:	Staff time
Goal Achieved:	Establishment of database to monitor trends in losing and gaining reaches of the river and surface water quantity.

*** MEASURE C-1-5: Explore possible sources for recharge of the Moorhead Aquifer.**

Source of Action:	MPS, WHP Manager
Cooperators:	SWCD, CLWP, WHP Team
Time Frame:	2003 and ongoing
Estimated Cost:	Staff time
Goal Achieved:	Potential replenishment of limited resource of groundwater within the Moorhead Aquifer.

CHAPTER SIX

EVALUATION PROGRAM

Minnesota Rules 4720.5270

The success of the Potential Contaminant Source Management Strategy must be measured regularly to ensure the plan is meeting the community needs on wellhead understanding and compliance.

Moorhead's WHPA has been designated as non-vulnerable within the Moorhead Aquifer and vulnerable within the Buffalo Aquifer. The designation of vulnerability requires monitoring of all potential contaminant sources within the Buffalo DWSMA. A program to ensure this is completed has been documented in Chapters One through Five. In addition to this, to ensure compliance, MPS will:

- Track the implementation efforts completed;
- Determine the effectiveness of these efforts; and
- Identify any implementation changes needed to accomplish the goal of the plan.

To accomplish the above, the following activities will be completed:

1. Changes in land use and other development within the Buffalo Aquifer will be monitored. MPS employees will conduct a review of air photography annually within the Buffalo DWSMA to identify these and any changes in contaminant source management practices and their potential impact on the aquifer.

2. The WHP Team will meet as needed but at least annually to review completed objectives and their effectiveness. Necessary modifications to the Plan will be discussed with strategies added as needed.

3. An annual written report will be presented to the MPS Commission, Moorhead City Council and Clay County Board of Commissioners stating progress in implementation of objectives. This report will be sent to the Minnesota Department of Health, Source Water Protection Planner; Minnesota Rural Water Association, Wellhead Liaison; The County Local Water Plan Coordinator; and be placed on file at the Moorhead Public Library, MPS, and on their web site.

CHAPTER SEVEN

ALTERNATIVE WATER SUPPLY; CONTINGENCY STRATEGY

Minnesota Rules 4720.5280

The Moorhead Public Service Emergency and Conservation Plan has been completed under Minnesota Statute 186 and Minnesota Rules, part 6115.0770 and was approved by the Minnesota DNR on December 17, 1996.

This Plan meets the requirements of a contingency strategy as documented in Minnesota Rule 4720.5280, subpart 2.

A copy of the DNR approval letter is included in the Appendices of this Plan and the complete document is on file at MPS.