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ENVIRONMENTAL IMPACT STATEMENT

LINCOLN-PIPESTONE RURAL WATER

Lake Benton, Minnesota

Existing System North/Lyon County Phase
Northeast Phase Expansion

United States Department of Agriculture

RURAL UTILITIES SERVICE
(THE LEAD AGENCY)
and

U. S. ENVIRONMENTAL PROTECTION AGENCY REGION 8
(A COOPERATING AGENCY)

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EXECUTIVE SUMMARY

This Environmental Impact Statement (EIS) is being prepared by the U. S. Department of Agriculture (USDA), Rural Utilities Service (RUS) in accordance with the procedural provisions of the National Environmental Policy Act (NEPA) of 1969. The purpose of the EIS is to evaluate the potential environmental impacts of a project proposal located in southwestern Minnesota. The proposal to which the Agency is responding to involves providing financial assistance for the development and expansion of a public rural water system. The applicant for this proposal is a public body named Lincoln-Pipestone Rural Water (LPRW) and whose main offices are located in Lake Benton, Minnesota. Specific project activities are and have included the development of groundwater sources and production well fields and the construction of water treatment facilities and water distribution networks. The counties in Minnesota affected by this proposal include Yellow Medicine, Lincoln, and Lyon Counties and Deuel County in South Dakota

LPRW is a political subdivision of the State of Minnesota. Under Minnesota statutes, LPRW was granted broad statutory powers to “do all things necessary to establish, construct, operate, and maintain a [rural water] system.” In addition, LPRW has been authorized to “construct, enlarge, improve, replace, repair, maintain, and operate any system determined to be necessary or convenient for the … distribution of water in its jurisdiction.”

Some of the issues evaluated in this EIS date back to previous decisions made in funding one of the phases of a multi-phase system expansion project initiated by LPRW in 1991. Due to the reality of Congressional funding cycles, RUS and LPRW have administratively pursued LPRW’s requests for financial assistance of this expansion project in discrete fundable phases. As part of the last construction phase, known as the Existing System North/Lyon County (ESN/LC) Phase project, a water source was developed along with the construction of a Water Treatment Plant that was designed to provide potable water to the northern portion of LPRW’s service area (see Figure ES-1). The water source developed in this phase was the Burr Well Field. The Burr Well Field is located close to Burr, MN between Clear Lake, South Dakota and Canby, MN and is within ½ mile of the South Dakota - Minnesota state line. The water-bearing formations utilized at this well field underlie portions of both South Dakota and Minnesota.

FIGURE ES-1 LINCOLN-PIPESTONE RURAL WATER SYSTEM SERVICE AREA AND CONSTRUCTION PHASES

Source: Dewild Grant Reckert and Associates

During construction of the Burr Well Field (started on April 19, 1993) and subsequent to its operations, public and regulatory concerns were raised and continue to be raised regarding potential environmental effects of groundwater appropriations from one of the water-bearing formations (called the Burr Unit) utilized by the well field. The second aquifer utilized at the Burr Well Field is called the Altamont aquifer. The Altamont is a deeper formation that appears to be hydraulically isolated from the Burr Unit.

Because of geologic factors and the topographic position of the Burr Unit in relation to ground surface elevations, groundwater discharges onto the land surface in both South Dakota and Minnesota as springs or seeps creating unique wetland features called patterned calcareous fens. In addition after performing geologic investigations in the area, the South Dakota Department of Environment and Natural Resources concluded that one of the lakes in the area, Lake Cochrane, was also receiving groundwater discharges from the Burr Unit aquifer.

Calcareous Fens in the study area are characterized by a partially mineralized peat mass through which a groundwater discharge (a “spring head”) occurs throughout the peat mass. This peat mass is referred to as a fen dome and in most areas the domes are elevated 5-10 feet above the ground surface. Calcareous fens are listed as “Outstanding Resource Value Waters” in Minnesota’s Rules 7050 and are protected under the Minnesota Wetland Conservation Act of 1991 (Minn. Stat. 103G).

An Environmental Assessment was prepared for the ESN/LC Phase project by the Farmers Home Administration (FmHA) in accordance with its Environmental Policies and Procedures (7 CFR Part 1940-G). FmHA published a Finding of No Significant Impact for the project on February 7, 1992. Because of concerns raised regarding the Burr Well Field, the EA was amended to address these concerns by an agency newly created by a 1993 USDA reorganization, the Rural Development Administration (RDA). RDA published a draft copy of the amended EA for public review and comment on October 14, 1994. Upon receipt of the public comments, it was decided to prepare an EIS. During the time this decision was being made USDA again reorganized its programs and the RDA programs were combined with the utility programs of the Rural Electrification Administration to form a new agency -- the Rural Utilities Service.

RUS announced its intent to prepare an EIS and hold public scoping meetings in a Notice of Intent published in the *Federal Register* on June 8, 1995, and in public notices in the *Marshall Independent, Minneota Mascot, Canby News, Ivanhoe Times, RFD News, Clear Lake Courier*, and *Brookings Register*. Public meetings were held on July 18, 1995, in Canby, MN, and July 19, 1995, in Brookings, SD, for the purpose of describing the project and soliciting the public’s comments about the issues to be considered in the EIS.

After considering comments received from federal and state agencies and the public at and following the scoping meetings, the Agency determined the significant issues that would be evaluated in the EIS and the range of alternatives, as required by NEPA, that could meet the purpose and need of the proposed action. It should be mentioned that the environmental impact analyses and discussion of alternatives presented in this EIS, particularly as they relate to the Burr Well Field, are being performed subsequent to the decision made on March 24,1992 to fund LPRW's ESN/LC Phase proposal. This situation presents the Agency with a procedural dilemma as to the ultimate purpose of the analyses to be presented in this EIS. The dilemma is that NEPA, as a procedural law, requires consideration of the potential environmental impacts of a proposed action before a decision is made. Even though decisions have already been made and significant public funds committed to the development and construction of the ESN/LC Phase which includes the Burr Well Field and Water Treatment Plant, the Agency decided, based on information and evidence presented, that the letter and spirit of NEPA would be advanced by taking a "harder" look at the outstanding issues from the 1992 FmHA EA and the 1994 RDA amended EA. This was particularly relevant, because the Agency had on file an application from LPRW to complete the last phase of the original system expansion project -- the Northeast Phase Expansion. In addition, the Burr Well Field was originally designed and built to serve as a source of water for the Northeast Phase Expansion, two previous construction phases -- the ESN/LC Phase and the Yellow Medicine Phase -- and other areas within the northern portions of LPRW's service area.

It was determined that, because the activities of the two expansion phases (the ESN/LC and the Northeast Phase Expansion) were so completely interrelated and interdependent, separating the phases into two environmental impact analyses would circumvent the letter and spirit of NEPA, as stated in the Council on Environmental Quality's Procedures for Implementing the Procedural Provisions of the NEPA, 40 CFR § 1502.4, "Major Federal actions requiring the preparation of environmental impact statements". The regulation states: "Proposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement." Therefore, the impact analyses for both phases are included in this EIS.

Therefore, the primary issues to be evaluated in the EIS include the outstanding concerns from the earlier 1992 EA, that is, the environmental effects on fens and Lake Cochrane (herein referred to as surface water resources) from groundwater appropriations at the Burr Well Field, and the potential environment impacts from the construction of the Northeast Phase Expansion proposal. The primary objective of the Northeast Phase Expansion proposal is to provide rural water service to rural residents (240 rural users) who have requested service and to the rural communities of Hazel Run and Echo, Minnesota. The proposal includes the installation of 170 miles of 2- to 8-in pipelines, an elevated water storage tank near Minneota, and a booster station near Green Valley.

Another issue that was of particular interest to numerous commenters during the scoping phase of the EIS was whether providing higher quality potable water in areas where water quality has been historically poor would in and of itself promote an influx of large-scale animal confinement operations and/or the expansion of any existing operations. These commenters noted that an influx of large-scale animal confinement operations and the associated animal wastes that would be produced would potentially contaminate groundwater resources in an area that has already been affected by nitrate contamination, particularly if the waste-handling activities of these facilities were carelessly implemented or unregulated. This issue was analyzed in this EIS.

Because all of the decisions and funding obligations have been made on the previous ESN/LC Phase project, the only decision facing the Agency at this time is whether or not to provide financial assistance to LPRW for the construction of the Northeast Phase Expansion proposal. All decisions regarding the issuance and disposition of the Water Appropriation Permit authorizing groundwater appropriations at the Burr Well Field are subject to the regulatory authority of the Minnesota Department of Natural Resources (MNDNR), Division of Water.

After the Agency made the decision to prepare an EIS, the Agency requested, pursuant to 40 CFR 1501.6, “Cooperating Agencies”, that the U. S. Environmental Protection Agency (USEPA), Region 8 in Denver, CO, serve in the capacity of a cooperating agency. This request was made because of USEPA’s specialized expertise in groundwater issues. USEPA agreed to the Agency’s request, therefore, RUS is the lead agency for this action and was responsible for the preparation of the EIS, and, USEPA provided technical assistance to RUS through its role as a cooperating agency.

For purposes of this EIS, the proposed action to which the Agency is responding to and for which all of the environmental impacts of past and present actions were evaluated, is the application LPRW submitted to the Agency to fund the Northeast Phase Expansion. In addition to this application, LPRW submitted a Water Appropriation Permit application to the MNDNR to increase groundwater appropriation rates from the present 750 gallons per minute (gpm) and 400 million gallons per year (Mgpy) to 1,500 gpm/800 Mgpy. Both of these actions encompass what was termed the “proposed action.”

In order to establish a clear purpose for the analyses presented in the EIS, the purpose and need of the proposed action needs to be properly defined. The overall purpose of this and previous actions by LPRW is to assist citizens in southwestern Minnesota in obtaining a consistent, reliable and safe supply of high-quality, affordable drinking water in an area that has difficulty in obtaining good quality drinking water. To achieve this purpose and meet the existing and future projected needs of the Northeast Phase Expansion area and other parts of the system, LPRW needs a minimum of 1,349 Mgpy. This need is defined within the context of LPRW's present well field configuration, the Holland, Verdi, and Burr Well Field.

Table ES-1 summarizes LPRW's present water source supply per well field. For primary and backup source areas for each well field see Figure ES-2.

Table ES-1

SUMMARY OF LPRW WATER SOURCE NEEDS AND ANNUAL APPROPRIATIONS

LPRW Source Needs	Annual Use, MGal		DNR Permitted Capacity Mgpy	Total Water Pumped				
	Primary Area	Total Area		1993 Mgpy	1994 Mgpy	1995 Mgpy	1996 Mgpy	1997 Mgpy
Verdi	500	892	683	403	403	425	424	383
Holland	306	346	500	172	244	287	333	355
Edgerton Well					0	0	0	0
Burr Burr Wells	492	628	400		9	145	215	274
Altamont Wells						27	2	55
Canby (Requires plant improvement)*	51	51	0					
Total Design Capacity	**1,349**	**N.A.**	**1,583**	**574**	**656**	**884**	**975**	**1067**

* Canby source refers to the needs of the Yellow Medicine Phase service area. LPRW and the City of Canby have previously served customers in this area.

Because the yields of the aquifers utilized at the Holland and Verdi Well Fields are reported by LPRW to be at or nearing safe capacity, the minimum annual needs from the Burr Well Field, as projected from an analysis of existing and long-term future needs, are approximately 628 Mgpy. Present permitted amount is 400 Mgpy; LPRW's permit application with the MNDNR is for 800 Mgpy.

NEPA requires that when federal agencies are considering taking a federal action (in this case, whether or not to provide financial assistance) they must identify and assess the reasonable alternatives to that action that would avoid or minimize adverse environmental impacts. Taking into consideration all of the input received from federal and state agencies and the public, the Agency evaluated in-depth the following alternatives to the proposed action. In addition, NEPA requires federal agencies to examine the effects on not taking any action -- that is, the No-Action alternative. Table ES-2 outlines the alternatives evaluated in this EIS.

FIGURE ES-2 LPRW PRIMARY AND BACKUP SERVICE AREAS FOR EACH WELL FIELD

Source: Dewild Grant and Reckert and Associates

Table ES-2

List of the Alternatives Considered

Alternative	Northeast Phase Expansion Status	Burr Well Field Status
Current Status	LPRW submitted application to RUS to fund construction of the Northeast Phase Expansion	LPRW is authorized under their current Water Appropriation Permit to appropriate groundwater at the rate of 750 gpm/400 Mgpy. LPRW submitted an application to the MNDNR to increase groundwater appropriations 1,500 gpm/800 Mgpy.
Proposed Action	Fund the Northeast Phase Expansion	Increase groundwater appropriations at the Burr Well Field to 1,500 gpm/800 Mgpy.
Alternative 1	Fund the Northeast Phase Expansion	Discontinue use of Burr Well Field
Alternative 2	Fund the Northeast Phase Expansion	Discontinue use of Burr Well Field Supplement water needs from other sources: Adjacent Rural Water Systems Lewis and Clark System Altamont Aquifer Canby Aquifer Other Aquifers
Alternative 3	Fund the Northeast Phase Expansion	Maintain current appropriations at Burr Well Field
Alternative 4	Fund the Northeast Phase Expansion	Maintain current or reduce appropriations at Burr Well Field Fund and construct new well field and Water Treatment Plant in the Wood Lake area.
Alternative 5	Do not fund the Northeast Phase Expansion; Finance Point-of-Use systems in Northeast Phase Expansion area.	Maintain current appropriations at Burr Well Field
Alternative 6 – No Action Alternative	Do Not Fund the Northeast Phase Expansion	Maintain current appropriations at Burr Well Field

The alternative analyses were performed in two phases: the first phase determined reasonableness; and secondly, those alternatives determined to be reasonable were subjected to an in-depth economic analysis to determine the economic feasibility of each alternative.

Table ES-3 summarized the issues that were evaluated as part of the alternative analysis and conclusions drawn from the analyses.

Table ES-3

SUMMARY OF ALTERNATIVE ANALYSES

Alternative	Groundwater Source			Environmental Effects			
	Burr	Altamont	Other	Fens	Lake Cochrane	Biological	Comments
Proposed Action	Y	Y	N	PS	PS	N - FED PS-ST	At pumping at 1,500 gpm/800 Mgpy there is a potential for significant adverse impacts to surface water resources, particularly during drought. Not enough data to predict impacts with certainty. User rates increase - 17%.
Alternative 1	N	N	N	N	N	N	LPRW unable to meet the needs of the system without third well field. Potential for significant adverse economic impacts for rural businesses.
Alternative 2	N	N	Y	N			Only source that would be feasible at this time would be the Altamont aquifer. At Burr Well Field the Altamont would be unable to sustain high levels of appropriations. Water from Altamont would require treatment, could use Burr Water Treatment Plant. Not enough information available to determine if Canby aquifer is large enough to be a significant source of water supply.
Lewis and Clark	N	N	Y	N	N	N	
Altamont	N	Y	Y	N	N	N	
Canby	N	N	Y	N	N	N	
Alternative 3	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 gpm there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty.
Alternative 4 **Wood Lake Alt.**	Y	Y	y	M	M	N-FED M-ST	At 750 gpm/400 Mgpy there would be minimal potential for adverse impacts to surface water resources because a well field and treatment plant would be built decreasing reliance on Burr Well Field. Very expensive, user rate increases - 31%. MNDNR's preferred alternative.
Alternative 5	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 Mgpy there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty. Point-of-use systems more expensive than rural water system and labor intensive.
Alternative 6 – No Action Alternative	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 gpm there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty. Users in Northeast Phase Expansion would not be served. User rate increases - 11%
Y - Yes; N - No; M - Minimal Effects; P - Potential Effects; PS - Potentially Significant Effects; FED - Federal List for Threatened/Endangered Species; ST - State List of Threatened/Special Concern/Rare Species							

The alternatives determined to be reasonable and selected for an in-depth economic analysis were the Proposed Action, Alternative 4 - Wood Lake aquifer, and Alternative 6 - No-Action alternative. In addition, the Agency has developed a Preferred Alternative and included that option in the economic evaluation. Table ES-4 provides a summary of total project costs for each of the selected alternatives and estimates the economic effect each alternative will have on system-wide user rates. These costs include all of the financial decisions currently under consideration by LPRW.

Table ES-4

SUMMARY OF THE TOTAL PROJECT COSTS FOR SELECTED ALTERNATIVES*

Alternative	**Total Project Cost ($000)**	**Cost/1,000 gallons (dollars)**	**Impact on User Rates (dollars)** (Current rate $1.35)	**Percent User Rate Increase**
No-Action Alternative	$5,032	N.A.	$1.49	10.5%
Proposed Action	$9,362	$1.69	$1.57	16.6%
Preferred Alternative	$10,782	$1.95	$1.63	20.6%
Wood Lake Alternative **Option 1** – 500 gpm/140 Mgpy	$13,046	$2.38	$1.72	27.4%
Option 2 – 750 gpm/210 Mgpy	$14,225	$2.56	$1.77	31.1%

* Includes the consideration of all financial obligations and requirements (includes cost of Holland Water Treatment Plant upgrade for nitrate problems and overall debt burden) facing LPRW at the present time.

The critical issues addressed in the EIS related to what effect groundwater appropriations at the Burr Well Field have on surface water resources in the area surrounding the well field. Because of the uncertainty in determining the extent or magnitude of such effects, particularly in the long-term, the alternative analysis focussed on the source of LPRW's water supply for the northern portions of its service area. The most important factor explored was whether or not the existing or alternative sources of water could meet current and future needs of the citizens in this area and what environmental effects the utilization of each source would have on the area's environmental resources. Due to limited information concerning aquifers in this area of Minnesota, the only alternatives that were concluded to be reasonable as potential sources of water included the Burr Unit, Altamont and Wood Lake aquifers. The Burr Unit and Altamont aquifer occur in the same general area but are hydraulically isolated from one another, the Altamont being the deeper aquifer of the two. The Wood Lake aquifer is located within the Northeast Phase Expansion area.

As the above table indicates, the Wood Lake Alternative, is the most expensive alternative, primarily because a new well field and water treatment plant would be required in order to utilize the water from this aquifer. The user rate increases for this option range from 27-31% depending on the size of the treatment plant constructed. This rate increase is projected to exceed the citizens' ability to pay and will increase LPRW's debt service burden beyond their financial capabilities. It is likely that if this alternative is the only one available to LPRW, the Northeast Phase Expansion will not be built.

If it is concluded that the Wood Lake Alternative is unfeasible for economic reasons, then the two remaining alternatives both propose to continue using the Burr Unit and Altamont aquifers. These alternatives propose to pump at either 1,500 gpm/800 Mgpy (Proposed Action) or 750 gpm/400 Mgpy (No-Action alternative). The user rate increases for each alternative are 17 to 11%, respectively.

Because the remaining alternatives propose to continue utilizing the Burr Unit and Altamont aquifers at the Burr Well Field, the environmental consequences of how each alternative could effect surface water resources of the area were examined. In an attempt to determine the extent and magnitude of potential effects, the Burr Unit and Altamont aquifers' relationship with surface water resources had to be evaluated.

As a result of detailed investigations of water chemistry, changes in hydraulic head during production pumping and pump tests, tritium content and age-dating of aquifer water and water being discharged at two of the area's fens that were monitored -- the Fairchild and Sioux Nation Fens -- it has been clearly demonstrated and established that a hydraulic connection exists between the Burr Unit and the fens. In addition, further evidence indicates that reductions in the potentiometric surface caused by pumping the Burr Unit at the Burr Well Field causes reciprocal responses in the hydraulic head measured in observation wells and piezometers installed in and adjacent to selected fens. No evidence of a similar hydraulic connection between the Altamont aquifer and the fens was observed.

Drawing conclusions based on limited information concerning Lake Cochrane was not as conclusive. However, based on the information that is available, the Agency has concluded that all lines of evidence indicate that it is likely Lake Cochrane is receiving a groundwater contribution to its water budget from both shallow and deeper (Burr Unit) aquifers. The information that would be necessary to quantify the overall percentage of groundwater contribution in relation to surface water inputs to Lake Cochrane's water budget and the percentage of the contribution from shallow aquifers versus the Burr Unit is incomplete and unavailable. The cost and technical difficulty of obtaining such information for evaluating reasonably foreseeable impacts by the Agency has been determined to exorbitant and unreasonable.

Therefore, given that the evidence indicates that the Burr Unit is hydraulically connected to the fens and, most likely, to Lake Cochrane, determining the extent and magnitude of what effect groundwater appropriations from the Burr Unit could have on these resources is limited to the following information and conclusions:

Sustainable Yield of the Burr Unit

- Sustainable yield of the aquifer is unknown.
- Recharge mechanics are not clearly understood.
- All pump tests and monitoring completed to date have occurred during periods of high precipitation.

Significant Data Gaps/Uncertainties

- Long-term impacts to surface water resources from groundwater appropriations are unknown.
- Magnitude of existing or future impacts are not accurately known or understood.
- Recharge and discharge conditions for the Burr Unit are not well understood.
- Significant uncertainties related to the water budget and groundwater contributions or discharges from the Burr Unit to Lake Cochrane exist.
- The gathering of data on the effects of pumping from the Burr Unit on surface water resources is technically difficult, time consuming, and expensive.
- Determining the relationship between groundwater appropriations from the Burr Unit and natural-occurring climatic fluctuations and how these effects impact surface water resources in the area is not well understood or quantified.

Potential Impacts to Surface Water Resources of the Area.

- Pump tests have demonstrated that the Burr Unit is hydraulically connected to groundwater discharges at the fens.
- Multiple lines of evidence indicate that groundwater contributions or discharges from the Burr Unit to Lake Cochrane are likely.

- Pumping from the Burr Unit at the Burr Well Field reduces the potentiometric surface in the aquifer and would cause proportional reductions in discharges to fens and Lake Cochrane.
- The ecological integrity of a fen is sensitive to changes in groundwater flow.

Based on a systematic and objective evaluation of the environmental and economic issues related to the remaining alternatives, the Agency has concluded that the proposed action (to appropriate groundwater at 1,500 gpm/800 Mgpy from the Burr Unit at the Burr Well Field) poses an unreasonable environmental risk to surface water resources in the area. Because of the uncertainty and potential for long-term environmental impacts on surface water resources in the area around the Burr Well Field, the Agency has concluded that pumping at the proposed appropriation rate under drought conditions is likely to cause significant adverse environmental impacts to these resources.

Conversely, in analyzing the information available, the Agency has concluded that through mitigation and a groundwater appropriation rate lower than the proposed action, adverse environmental effects could be avoided or minimized. Therefore, it could be feasible to continue using the Burr Well Field at certain appropriation rates without causing significant adverse environmental effects.

Attempting to establish an appropriation rate that could avoid or minimize adverse environment effects to the fens and Lake Cochrane is the major dilemma of the EIS. Because of limited baseline data and period of record, the only information that can be evaluated is data that has been collected since 1992. The entire time period since 1992 to the present has been dominated by a sustained period of relatively high precipitation. Therefore, these climatic conditions have prevented detailed observations of aquifer responses from pumping during a drought cycle or what effects current pumping has had on surface water resources. Because of this uncertainty and the reality of periodic and cyclic drought conditions, it is prudent to manage this aquifer system and withdrawals from it in a conservative manner.

Notwithstanding a lack of long-term data, taking into account current data sets and through consultations with state and federal agencies and experts in the field of hydrogeology, the Agency has concluded the following:

- There could be effects to Lake Cochrane from long-term pumping from the Burr Unit at the Burr Well Field. Based on data collected from the various pump tests and in consultation with experts in the field of hydrology and geology, it is the Agency' opinion that effects to Lake Cochrane from the continuation of pumping from wells screened in the Burr Unit at the Burr Well Field at the rate of 400-525 gpm would not have significant environmental impacts. That is not to say that Lake

Cochrane could not be affected, but that in the range of 400 -525 gpm it is unlikely that any effects would have significant or catastrophic consequences. In addition, at these appropriation rates it would be extremely difficult to distinguish any impacts from reduced groundwater inputs into the lake from the biological effects of ongoing management practices or human influences at the lake.

- During all of the pump tests and production pumping for the last three years at current and maximum pumping rates of 400-525 gpm (1997 appropriations from the Burr Unit equaled 274 million gallons for an average of 521 gallons per minute), the effects from pumping at the Burr Well Field at the fens, as represented by the Sioux Nation Fen, have been minor. At no time did the hydraulic head or water table elevations in the fens or potentiometric surface fall close to or below the surface elevations of the peat domes. Therefore, the Agency has concluded that as long as the hydraulic gradient remains above the surface elevation of the fen dome and the dome itself remains under saturated conditions it appears unlikely that appropriation rates between the range of 400 - 525 gpm will adversely affect the fens.

In order to avoid or minimize any adverse environmental effects to surface water resources, the Agency has developed mitigation measures it believes could be protective of surface water resources and at the same time support LPRW in its need to secure a reliable water supply for the northern portions of its service area. The mitigation measures listed below constitute the Agency's preferred alternative. It is estimated that if these mitigation measures are implemented, user rates for the overall system would increase approximately 21%. Although this rate increase is higher than the proposed action, LPRW concludes that its membership would be able to sustain this increase. The Agency believes that implementing the preferred alternative will help meet LPRW and its customers' long-term water supply needs, but yet be protective of the area's surface water resources.

The Agency' preferred alternative includes:

- Continue to maintain the Burr Well Field as a primary water source. The Agency supports reducing or limiting ground water appropriations at the Burr Well Field from **each** of the two aquifers -- the Burr Unit and Altamont aquifer -- to 400-525 gpm with a corresponding annual appropriation rate.

- Supplement existing wells at the Burr Well Field with a new well field in an area south-southeast of the current Burr Well Field. This new well field could utilize both the Burr Unit and Altamont aquifers in a configuration similar to that at the Burr Well Field. Water from the new wells could be transported to the Burr Water Treatment Plant for treatment and distribution to LPRW customers.

- The Agency recommends that the appropriation rates of the supplemental wells be similar to those permitted at the Burr Well Field or higher in the case of the Altamont aquifer. This configuration would give LPRW two well fields and enable it to continue utilizing the existing treatment capacity at the Burr Water Treatment Plant to meet the primary and secondary needs in the northern portion of its service area. This recommendation would likely "spread out" the effects or reductions in the potentiometric surface of the Burr Unit caused by production pumping, thus potentially avoiding or minimizing any adverse effects to surface water resources in the area.

- The Agency recommends that MNDNR establish, as part of its permitting requirements for LPRW, protocols and standard operating procedures for well field operations that are designed to minimize drawdowns in the potentiometric surface in the Burr Unit. These protocols could include regulating pumping rates and annual withdrawals for each well and aquifer.

- Formalize a water resource management plan that will continue to use existing monitoring points at fen locations and observation wells in the Burr Unit in Minnesota and South Dakota. This monitoring plan would enable LPRW and natural resource management agencies in both Minnesota and South Dakota to monitor and develop a long-term strategy for evaluating groundwater appropriations and their effects on surface water features in the area.

The Agency will condition approval on LPRW's application for financial assistance for the Northeast Phase Expansion and other associated costs on successful completion of the following terms. This approval is subject to LPRW's being able to obtain the appropriate water appropriation permit(s) from the MNDNR.

- Explore the development of a supplemental well field in the area south of the Burr Well Field determined by various geologic exploration efforts as containing aquifer materials that would be capable of supplying municipal quantities of water. The new well field should utilize both the Burr Unit and the Altamont aquifer providing for more reliance on the Altamont than it does at the Burr Well Field. Raw water from this well field should be transported to the existing Burr Water Treatment Plant to take advantage of the facility's existing water treatment capacity.

- LPRW shall formalize a water resource management plan with the MNDNR to establish monitoring procedures and protocols to evaluate the effects of pumping the Burr Unit on surface water resources in Minnesota. Included within this plan LPRW shall develop standard operating procedures to manage and implement groundwater appropriations from the Burr Unit at both the new well field and Burr Well Field to minimize drawdown of the potentiometric surface from production pumping.

- LPRW shall formalize an agreement with SDDENR to establish monitoring procedures and protocols to evaluate the effects of pumping the Burr Unit on surface water resources in South Dakota.

Provided these conditions are met and LPRW has formalized all the above with the appropriate regulatory authorities, the Agency is prepared to approve LPRW's application for construction of the Northeast Phase Expansion proposal subject to the availability of funding.

All direct construction related activities associated with the funding of the Northeast Phase Expansion by themselves will have no significant environmental impact. The environmental effects of constructing an elevated water storage tank near Minneota, booster stations near Minneota and Green Valley, and 170 miles of pipeline will be minimal consisting of temporary disturbances consistent with standard construction practices. All environmental impacts will be mitigated as is appropriate for these individual construction activities.

No historic or cultural resources or threatened and endangered species will be affected by the Northeast Phase Expansion action. Less than 2 acres of important farmland will be converted at the water storage and booster station sites. However, the majority of the land within the Northeast Phase Expansion area has been identified as important farmland, so the overall impact to this resource will be minimal.

The final issue explored in-depth in the EIS was whether providing higher quality potable water in areas where water quality has been historically poor would in and of itself promote an influx of new large-scale confined animal operations and/or the expansion of current operations. The study focussed on large-scale hog operations as they were the types of facilities most commonly brought out in scoping. The studied area included all of southwestern Minnesota south of the Minnesota River and the adjacent counties in South Dakota. The Agency's analyses indicated that the single most important factor in the siting of hog operations was the availability of land, and, second, was the proximity to a slaughterhouse. The supply of potable water appears to have no bearing on the expansion of large-scale hog farming.

For example, in counties such as Lincoln and Rock Counties, if availability of potable water was a significant factor in promoting an influx of large-scale hog operations, then as rural water became available it would be expected that the number of hog farms would have increased rather than declined as it did in these counties. While the number of farms did decline, it might also have been expected that there would have been no loss in total farm acreage and the average acreage per farm would have risen as farms consolidated into larger agri-business units. In addition, it would also be expected that the numbers of hogs and pigs would have risen sharply with continuous growth. None of this has occurred and, in fact, these and all counties in the study followed the same general trends that affected the entire pork industry nationwide.

These trends indicated that during the last 10-year period, the trend in 12 regional counties was that the hog and pig populations decreased during the first 5 years then increased for the second 5 years with the gains generally exceeding earlier losses. The trend of the decrease and then increase in the hog population in the study region mirrored the consumption of pork in the United States for the same period. It is interesting to note that the counties with the highest increases in hogs and pigs were Rock, Jackson, and Nobles Counties, the counties closest to the slaughtering facilities in Worthington, MN located in Nobles County. This fact does show that a more significant factor in the location of large-scale hog operations is the proximity to slaughterhouses. From these analyses the Agency concludes that 1) potable water availability does not, therefore, appear to be a parameter that will by itself cause an increase in large-scale hog operations, and 2) continued expansion of LPRW will not cause an increase in the hog and/or pig population, nor an increase in hog and/or pig farms.

The Agency has concluded that the availability of potable water in the LPRW service area will have minimal effects on the socio-economic conditions in the study area, except for increasing the quality-of-life with regard to accessibility to a consistent, reliable source of good quality potable water and stabilizing the agricultural economy in the area by allowing farmers the option to diversify their operations should other market conditions warrant.

LINCOLN-PIPESTONE RURAL WATER ENVIRONMENTAL IMPACT STATEMENT

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS USED IN REPORT

Abbreviations	Term
EA	Environmental Assessment
EIS	Environmental Impact Statement
ft	feet; foot
gpm	gallons per minute
in/yr	inches per year
MCL	Maximum Contaminant Levels
Mgpy	million gallons per year
MNDNR	Minnesota Department of Natural Resources
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NRCS	Natural Resource Conservation Service
OHWM	ordinary high water mark
RUS	Rural Utilities Service
SDWA	Safe Drinking Water Act
SDDENR	South Dakota Department of the Environment and Natural Resources
SMCL	Secondary Maximum Contaminant Levels
USDA	United States Department of Agriculture
USEPA	U. S. Environmental Protection Agency
USGS	U. S. Geological Survey

TABLE OF TABLES

TABLE OF FIGURES

INTRODUCTION

Report Objective

This Environmental Impact Statement (EIS) evaluated the potential environmental effects of water appropriations by the Lincoln-Pipestone Rural Water (LPRW) system at the Burr Well Field in southwestern Minnesota. In addition the EIS evaluated potential impacts to the environment if LPRW continues to appropriate groundwater at the Burr Well Field and expands its service area into the proposed Northeast Phase service area.

Purpose of the Report

The National Environmental Policy Act (NEPA) and the regulations that implement it require Federal agencies to consider the potential environmental impacts whenever they are planning or making a decision regarding a proposed action. To bring that about, regulations require an agency, such as the Rural Utilities Service (RUS), an agency of the United States Department of Agriculture, to make the EIS available to the public to seek the public's and other agencies' comments on the proposed action. The Agency must consider the public's comments on the EIS before a decision is made regarding the proposed action.

The purpose of the EIS is to ensure that environmental information is available to federal decision-makers and citizens before decisions are made and actions taken. The availability of this information is intended to assist federal decision-makers and the public in understanding the environmental consequences of the proposed action.

Involved Agencies

LPRW has applied and is applying to RUS, the successor agency to the Water and Waste Program of two previous USDA agencies -- the Farmers Home Administration and the Rural Development Administration -- for loans and grants to help finance rural water system development and expansions. RUS is the lead agency for the preparation of this EIS, and the U. S. Environmental Protection Agency, Region VIII, has agreed, because of its expertise in groundwater issues, to serve as a cooperating agency.

The Scoping Process

When Federal agencies prepare an EIS, they ask the public and other agencies to help identify which activities, alternatives, and consequences should be included in the scope of the study. This is termed the "Scoping Process" and is required by NEPA and RUS regulations.

For this proposed action, the Agency announced its intent to prepare an EIS and hold public scoping meetings in a Notice of Intent published in the Federal Register on June 8, 1995, and in public notices in the *Marshall Independent, Minneota Mascot, Canby News, Ivanhoe Times, RFD News, Clear Lake Courier*, and *Brookings Register*. Public meetings were held on July 18, 1995, in Canby, MN, and July 19, 1995, in Brookings, SD, to describe the project, discuss the range of alternatives and solicit public comments about the issues to be considered in the EIS. The Agency also invited other agencies, organizations, and citizens to send comments by U.S. mail and set up a 1-800 hotline for the public to call-in comments. The official comment period was open for 30 calendar days after the public meetings.

The concerns raised at the public scoping meeting and in written comments have helped shape the scope of this EIS. Further details on the scoping process are presented in Section 1.

1 PURPOSE AND NEED FOR ACTION

1.1 Purpose and Need

The purpose of the proposed action and all previous phases to the Lincoln-Pipestone Rural Water (LPRW) system is and has been to provide a good quality, reliable, and affordable source of potable water to the rural residents, municipalities, and businesses in an area of Minnesota that has had difficulty in securing satisfactory water supplies.

In order to logically present the purpose and need of the action, this section will first discuss the difficulty certain portions of southwest Minnesota has had in finding, maintaining and treating existing water supplies at a reasonable cost. In addition, this section will discuss some of the underlying water quality problems experienced in the area. All of these discussions will illustrate the underlying purpose and need to which the Agency is responding to with financial support.

The specific need that this EIS will be evaluating will be how to meet LPRW's specific water supply needs given their current well field configuration and what are the potential environmental impacts of meeting those needs. By way of introducing the reader to the primary issues to be evaluated, LPRW's projected water supply needs are estimated at 1,349 Mgpy (for specific data and discussion see Section 1.4). Included within this estimate are the supply needs of the rural customers in part of the proposed action to be evaluated in this EIS -- the Northeast Phase Expansion proposal.

The Minnesota Department of Natural Resources (MNDNR) has issued groundwater appropriation permits for LPRW's three existing well fields (Burr, Holland and Verdi) at volumes of 1,583 Mgpy. Even though the permitted volumes appear to be sufficient to meet LPRW's immediate needs, the deficiency in needs is at the Burr source. Based on the Burr source's original design requirements, the minimum existing need is estimated at 628 Mgpy (the Existing System North/Lyon County Phase, Northeast Phase Expansion and Yellow Medicine Phase – see Figure 1-1), whereas the current appropriation is limited to 400 gallons per year.

FIGURE 1-1 LINCOLN-PIPESTONE RURAL SYSTEM AND CONSTRUCTION PHASES

Source: Dewild Grant Reckert and Associates Company, 1994

LPRW has applied to the MNDNR to modify its Water Appropriation Permit from 750 gpm/400 Mgpy to 1,500 gpm/800 Mgpy. In addition, LPRW has submitted an application to the Agency for financial assistance to fund the Northeast Phase Expansion proposal. If LPRW is successful in completing the construction of the Northeast Phase Expansion it will complete a multi-year/multi-phase system expansion project started in 1991. Previous requests to increase appropriation rates at the Burr Well Field have not been acted on by the MNDNR because of concerns that groundwater withdrawals at the well field may have adverse effects on surface water resources in the area surrounding the well field, namely patterned calcareous fens and Lake Cochrane. These issues and alternative ways to meet LPRW's needs are evaluated in this EIS.

LRPW was originally created in the late 1970's to pool the energies and resources of the region to solve water supply and quality problems for rural residents, municipalities, and businesses in southwestern Minnesota. LPRW is a political subdivision of the State of Minnesota that was established by the Lyon County District Court pursuant to Minnesota Statutes Chapter 116A. LPRW was granted broad statutory powers to "do all things necessary to establish, construct, operate, and maintain a [rural water] system" (Minnesota Statute §116A.24, subd. 2). In addition, Minnesota Statute §116A.24, subd. 2(f), authorized LPRW to "construct, enlarge, improve, replace, repair, maintain, and operate any system determined to be necessary or convenient for the … distribution of water in its jurisdiction."

RUS, an agency of the United States Department of Agriculture, derives its authority to fund projects such as LPRW's from the Consolidated Farm and Rural Development Act, Title III of the Agricultural Act of 1961 (Public Law 87-128, 75 Stat. 294, as amended through P.L. 104-130, April 9, 1996), Section 306 [7 U.S.C. 1926] (a)(1):

> "The Secretary [of Agriculture] is also authorized to make or insure loans to associations, including corporations not operated for profit, Indian tribes on Federal and State reservations and other federally recognized Indian tribes, and public and quasi-public agencies to provide for the application or establishment of … the conservation, development, use, and control of water, the installation or improvement of drainage or waste disposal facilities, recreational developments, and essential community facilities including necessary related equipment, all primarily serving farmers, ranchers, farm tenants, farm laborers, rural businesses, and other rural residents, and to furnish financial assistance or other aid in planning projects for such purposes."

The regulations that implement the Agency's legislative authority are promulgated at 7 CFR Part 1780, Water and Waste Loans and Grants (older system components funded prior to 1997 are regulated under 7 CFR 1942 Part

A - Community Facilities Loans). Eligible loan purposes include using funds to "construct, enlarge, extend, or otherwise improve rural water, sanitary sewage, solid waste disposal, and storm wastewater disposal facilities " providing service to "rural residents, rural businesses, and other rural users."

RUS programs are administered locally by USDA, Rural Development offices in every state. The Rural Development State Office in Minnesota, which also administers the USDA, Rural Housing Service and Rural Business/Cooperative Service, is located in St. Paul, Minnesota. In addition to the office in St. Paul, RD has offices in local areas. The closest RD office to the proposed action is in Marshall, Minnesota.

1.2 Groundwater Availability and Quality in Southwestern Minnesota

The following discussion provides a starting point to establish the purpose and need for the actions being considered in this EIS. Much of the information is from a memorandum prepared by Beckie Fuller, B. A. Liesch Associates, *Groundwater Availability and Quality in Southwestern Minnesota*, (Fuller, 1995). This discussion attempts to document the water supply and water quality problems faced by municipalities and rural residents in southwestern Minnesota.

Both the availability and the natural quality of groundwater in the region restrict development of high-capacity municipal water supply sources in the southwestern portion of Minnesota. Fuller reviewed the available literature on water quality and the availability of groundwater in southwestern Minnesota. Each of the counties in the LPRW service distribution area was contacted for information. In addition, the Minnesota Department of Health (MDH), the Minnesota Geological Survey (MGS), the Minnesota Department of Agriculture (MDA), the Minnesota Pollution Control Agency (MPCA), and the United States Geological Survey (USGS) were contacted for any available, relevant information. The USGS Hydrologic Atlases for the area were consulted for information regarding source availability, natural water quality, and aquifer vulnerability to contamination. Publications produced by the Minnesota Extension Service, the MPCA, and the USGS were also consulted as well as the files and library of B. A. Liesch Associates regarding previous investigations in the region.

Southwestern Minnesota has long been identified as a difficult area to obtain good quality drinking water. This is primarily due to the geologic history of the area. In general, the geology of the area consists of Precambrian igneous and metamorphic rocks of mostly granitic composition. Overlying the Precambrian rocks are Cretaceous-aged shales with lenses and layers of sandstone. (Liesch, 1985). Thick deposits of glacial deposits deposited by several glacial episodes overlie the Cretaceous sediments. These glacial deposits consist of unconsolidated materials that are clay rich. Included within these materials, termed glacial till, are lenses of sorted sand and gravel. The sand and gravel deposits are buried at various depths within the glacial till.

In 1944, the MGS published *The Geology and Undergroundwaters of Southern Minnesota* (Thiel, 1944) in which the groundwater of southwestern Minnesota is described as being high in calcium and magnesium, which makes the water very hard. Water quality analyses included in the Thiel publication indicate very high iron (>3 parts per million (ppm)) and very high total dissolved solids (>1200 ppm) in water collected from drilled or driven wells deeper than 50 ft. Thiel described sulfates in Cretaceous aquifers in the area as "in abundance" and in many areas "the quantity is excessive." The average sulfate contents of Cretaceous waters were listed as ranging between 584 ppm and 837 ppm. Thiel also indicates that the waters of the Cretaceous aquifers are high in chlorides and some are distinctly salty to the taste. Thiel states that there is a great amount of solids dissolved in all Cretaceous waters with an average content in excess of 1500 ppm.

Throughout LPRW's service area four primary aquifer types may be available as sources for municipal and domestic water supplies. None of these aquifers are present as a continuous aquifer throughout the region. The most widely utilized aquifers are found within the glacial drift and are generally irregular and discontinuous surficial sand and gravel and buried sand and gravel deposits. Surficial aquifers are present in portions of the LPRW service area, where they are often associated with modern or ancient drainage patterns. While these aquifers are described as providing adequate yields with good recharge, they are relatively shallow and vulnerable to contamination from surface sources and in many areas are of limited extent.

Glacial Drift--Refers to rocks and soil materials transported by glacial ice and includes materials deposited by glacial ice and from meltwaters as the glaciers receded and melted. Glacial deposits consist primarily of: glacial till, a heterogeneous, unsorted deposit of soil materials of various grain sizes, and sediments deposited by water that are commonly sorted and stratified depending on weight or grain sizes, often referred to as outwash deposits.

In general, the buried sand and gravel aquifers are present only in areas where the glacial drift is sufficiently thick. Where these aquifers are present, they are by definition confined or protected by overlying clayey glacial till deposits that limits infiltration of surface-derived contamination. These aquifers commonly occur as irregular bodies of sand and gravel within thick sequences of clayey glacial till. Because of the irregular nature of these deposits, they are typically difficult to locate and delineate through test hole drilling alone. Yields from the buried drift aquifers are highly variable and dependent on the thickness, extent, and recharge characteristics of the aquifer.

Cretaceous shale formations are present throughout much of southwestern Minnesota, however, Cretaceous aquifers of adequate production capacity and good water quality are difficult to locate and develop. This difficulty is due to great depths; low permeability of aquifer materials; and variable geochemical compositions of aquifer materials, which can produce poor water quality. Cretaceous aquifers are usually investigated only if the overlying glacial deposits yield little water or water of poor quality.

In the southwest corner of the state, Rock County and parts of Pipestone and Nobles Counties, the Sioux Quartzite formation is used as a water source (see Figure 1-2). The Sioux Quartzite is used where it directly underlies thin glacial drift. In areas of Rock and Pipestone Counties, where the Sioux Quartzite forms a bedrock high, this formation may be the only available aquifer. Yields from these wells reportedly range from 1 - 450 gpm. The yield of water from the quartzite depends on the number and size of joints and the degree of cementation of aquifer materials. Generally, the joints or crevices are small and the beds are only slightly pervious. It is, therefore, necessary to drill relatively deep wells to penetrate enough water-bearing openings to obtain an adequate supply of water.

FIGURE 1-2 GENERALIZED CROSS SECTION OF GEOLOGY IN STUDY AREA

Source: USDA, Soil Conservation Service,
Lyon County Soil Survey, 1978

Aquifers in the southwestern portion of the State are variable and their productivity varies by location. Liesch has conducted numerous surface geophysical surveys followed by test-drilling programs and well-field development for municipalities in this part of the State. Multiple well fields are sometimes required for larger municipalities because of limited aquifer availability and high withdrawal rates. In some locations, existing aquifers may be adequate for domestic supply but cannot support municipal demands. In areas where the water supplies may be generally adequate, periodic water shortages may occur during drought conditions as a result of limited recharge.

In addition to limited availability, aquifer use may be restricted by natural groundwater quality. Figure 1-3 is reproduced from DNR Bulletin 26, “The Natural Quality of Groundwater in Minnesota.” This figure outlines the regions in Minnesota where the dissolved solids content was found to be greater than 1,000 milligrams per liter (mg/L). Groundwater in this area is also known to be high in iron, manganese, sulfate, calcium, magnesium, and chlorides. Most groundwater in this region is classified as very hard (>180 mg/l as $CaCO_3$) with the exception of some wells constructed in Cretaceous aquifers, the Sioux Quartzite, and some surficial sources. Excess iron in groundwater causes reddish- brown stains on porcelain fixtures and clothing. Iron bacteria can develop, which use the dissolved iron, changing iron to an insoluble form and producing a slime that may plug water system facilities and water-bearing formations in the vicinity of the infected well. Bacteria can also impart a bad taste and odor to water (USGS, Water Supply Paper 1749). Excess manganese in groundwater causes dark brown to black stains on porcelain fixtures and clothing. Groundwater high in chlorides generally has an unpleasant saline taste. Many of these constituents contribute to encrustation on well screens and clogging of water system facilities.

Total Dissolved Solids (TDS)--This is the most common measurement of the quality of water. It is a measure of the amount of dissolved minerals in parts per million. The dissolved minerals are referred to as inorganic salts; thus the term “salinity” is another way to describe these mineral concentrations. As a general rule, water with TDS values over 1,000 ppm is considered brackish and is limited for use for human consumption.

FIGURE 1-3 AREAS OF HIGHLY MINERALIZED GROUNDWATER

Source: MNDNR, Bulletin 26, The Natural Quality of Groundwater in Minnesota

The quality of water used for human consumption is regulated by the Safe Drinking Water Act (SDWA) (Public Law 93-523, as amended). The SDWA required USEPA to promulgate enforcement standards for regulating drinking water quality. These standards are called Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs). In brief, MCLs are based on the volume of water consumed by a person and the potential risk of a particular parameter to human health. SMCLs are established based on aesthetic criteria, such as taste, odor, color, and hardness, however, by definition they – "apply to public water supplies and which, in the judgement of the [U. S. Environmental Protection Agency] Administrator, are requisite to protect the public welfare. Maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of [a] public water system" (40 CFR 143.2(F)). Although exceeding SMCLs is generally not considered to be an acute health risk, it may decrease the palatability of the water and limit its use for certain human populations. For example, high concentrations of sulfate in drinking water result in transitory diarrhea. Acute diarrhea can cause dehydration, particularly in infants and young children. People living in areas of high concentrations typically adjust to high levels with no ill effects. The USEPA is currently considering a MCL of 400 mg/l to protect infants, whereas, the current SMCL is 250 mg/l.

The SMCLs and MCLs for selected parameters most commonly found in the area are shown in the Table 1-1.

TABLE 1-1 MCL AND SMCL FOR SELECTED PARAMETERS

Parameter	**SMCL (mg/L) (40CFR143.3)**
Chloride	250
Manganese	0.05
Iron	0.3
Sulfate	250
Total Dissolved Solids	500
Parameter	**MCL (40CFR141.60)**
Nitrate	10

Another measure of water quality is hardness. The classification for relative hardness is shown in shown in Table 1-2):

TABLE 1-2 WATER HARDNESS CLASSIFICATIONS

mg/L as CaCO3	Hardness
0-60	soft
61-120	moderately hard
121-180	hard
>180	very hard

Source: USGS, Water Supply Paper 2254

The water in southwestern Minnesota is considered very hard and is generally high in iron and manganese. Some areas report high chloride and sulfate levels. The deposits groundwater comes in contact with over time commonly control aquifer water quality. Generally, groundwater sources overlain by substantial till thicknesses have a higher dissolved solids content than groundwater from shallow aquifers not overlain by till. As a result, surficial sand and gravel aquifers in the area tend to have a lower dissolved solids content; however, these aquifers are generally more vulnerable to surface contamination than deeper aquifers. In much of the area, test results indicate that iron, manganese and sulfates are above their respective SMCLs.

Hardness--This term refers to concentrations of calcium and magnesium ions in water and is usually expressed in terms of milligrams per liter as calcium carbonate. In general, it is desirable to soften water that is hard for domestic or industrial uses.

The watersheds within the LPRW service area, as described in the USGS Hydrologic Atlas, are as follows: Lac qui Parle (HA-269), Yellow Medicine River (HA-320), Redwood River (HA-345), Des Moines River (HA-553), and Rock River (HA-320) (see Figure 1-4). Water quality samples collected from wells in the Des Moines River watershed (HA-553) constructed into the buried sand and gravel aquifers, the Cretaceous aquifers, and the Sioux Quartzite all report iron, sulfate, and dissolved solids concentrations above their respective SMCLs. In the other watersheds, similar tests indicated that the water from the majority of the tested wells was over the SMCLs for these parameters.

High local levels of sodium have been reported in the surficial sand and gravel, buried sand and gravel, the Cretaceous, and the Sioux Quartzite aquifers. Boron and dissolved solids concentrations in the Sioux Quartzite may be too high for irrigation use.

FIGURE 1-4 WATERSHEDS WITHIN LPRW SERVICE AREA

Source: USGS, Hydrologic Atlas

Water quality information was reported in the USGS Hydrologic Atlas No. HA-555 for 18 municipalities, including 21 wells. These wells utilize the surficial sand and gravel, buried sand and gravel, and the Sioux Quartzite aquifers. Sixteen of the wells reported iron concentrations greater than the SMCLs, and 13 wells reported manganese levels over the SMCLs. Seven municipal wells reported sulfate levels over the SMCLs, and all wells indicated extremely hard water, ranging from 210 mg/L to 1,800 mg/L as CaCO3.

Nitrate--This is the most common form of nitrogen in groundwater. Nitrate usually enters a groundwater system from waste materials or fertilizers applied to the land surface. In general, nitrate is a very stable form of dissolved nitrogen and is very mobile in groundwater. Drinking water standards are 10 mg/L.

Additional water quality data from the northeastern portions of LPRW's service area (Wood Lake and Cottonwood area) indicates that total hardness ranges from 370 mg/l – 770 mg/l; TDS 1300 mg/l – 2000 mg/l; and sulfates 470 mg/l – 820 mg/l (MNDNR, 1997, Attachment 30 and Liesch, 1984).

In addition to natural water quality problems, southwestern Minnesota is experiencing water quality problems related to agricultural operations and chemicals. In 1991, the Minnesota Pollution Control Agency (MPCA) produced a report entitled *Nitrate in Groundwater--Existing Conditions and Trends*. In this document, MPCA used existing data sets to summarize nitrate impact on groundwater quality throughout the State. This study found that, based on available data, the southwestern corner appears to be one of the areas of the State that is experiencing more impact. Analyses of the data provided for the MPCA study by the Nobles-Rock Health Service, the Nobles and Rock County Extension Service, Nobles and Rock Soil and Water Conservation Districts, local township boards, and affected watershed districts showed that the average nitrate-nitrogen (NO_3-N) concentration from all 1,350 samples in these counties was 9.6 mg/L. In Rock County, 36% of all well samples indicated NO_3-N levels above 10 mg/L, and 33% of sampled wells in Nobles County were above 10 mg/L.

The MPCA study found that surficial drift aquifers were more susceptible to impact from nitrates than buried drift aquifers. This study found that older formation aquifers in southeastern and northeastern Minnesota, surficial drift aquifers, and aquifers in the Sioux Quartzite formation were among those experiencing more effects. Statewide sampling of surficial drift aquifers indicated that 15.6% of sampled wells recorded a nitrate-nitrogen level of greater than 10 mg/L, buried drift aquifers indicated 5.1% of wells over 10 mg/L, and 37.5% of the Sioux Quartzite wells sampled had more than 10 mg/L nitrate-nitrogen.

As a result of the geology and hydrology of southwestern Minnesota, most municipalities in the area now encompassed by the LPRW service area have struggled with inadequate water supplies or water quality problems. Because the cost associated with developing a rural water supply and distribution network is typically beyond the financial resources of smaller municipalities, rural populations typically had to depend on whatever groundwater supplies were available locally. In an attempt to improve their water supply, many municipalities have pursued extensive water exploration efforts and have generally explored the water supply options that are available within relative close proximity to their locations. They have had limited success and have had to be satisfied with low-yielding intermediate depth wells and bedrock wells that produce water that is generally very hard; many wells exceed SMCLs for iron, manganese, sulfate, and TDS. Water treatment has not been a feasible option for smaller communities, because such costly and energy-intensive techniques would be required to improve the water quality.

Similarly, rural residents not served by municipal or rural water systems have limited opportunities to improve their water supply and must rely on whatever groundwater is present locally. In some cases, the naturally occurring groundwater is of such poor quality that expensive home water treatment units are required to make the water usable. The economic impact and effect on the quality-of-life that this situation imposes on rural residents can be significant.

Farmers, in particular, may face economic impediments, such as the inability to diversify their farming operations because poor water quality may limit the agricultural options available to them. For example, sulfates are commonly found in the area and in high concentrations may cause particular problems with livestock operations (MPCA, 1987). Sulfates in the concentrations present in many areas of southwestern Minnesota cause diarrhea in many farm animals, particularly immature animals. Therefore prior to the availability of treated water, many farmers were unable to diversify their farming operations to include the raising of livestock. This issue will be discussed in greater detail in Section 4.0.

In addition to water supply and quality problems in the area, Congress has passed increasingly stringent drinking water standards making it difficult for such areas as southwestern Minnesota to maintain drinking water supplies within these standards. The alternatives available to solve the water supply and quality problems of the magnitude found in LPRW service area, particularly for communities of populations less than 1,500 are very limited. For many of the communities that have difficulty developing and maintaining economically feasible water systems that meet all USEPA and State requirements, the most reasonable opportunity for an improved supply is to coordinate activities with other municipalities and rural residents in a regional water supply project, such as LPRW.

This, in fact, has been the history behind the LPRW system. LPRW has over time consolidated a number of individual small community public water systems.

The centralization and consolidation of small community water systems is one of the most effective tools utilized by the Agency, USEPA and States throughout the nation to ensure long-term availability of safe, adequate water supplies for rural residents. The centralization and consolidation of small community water systems is strongly encouraged by the USEPA and is consistent with the stated objectives of the SDWA. For example, in 1994 during Congressional hearings on the reauthorization of the SDWA, the USEPA testified that ”Compared to large systems, the 50,000 small community water systems in the U.S. face significantly higher costs per household in meeting SDWA regulatory requirements. The number of “non-viable” systems -- that is, those lacking the financial, managerial, and technical capacity to meet the requirements of the SDWA -- continue to grow”.

Many of the small community water systems that were present in the area now served by LPRW were finding themselves increasingly lacking in the financial and managerial resources and technical capacities necessary to meet SDWA regulatory requirements. Continuing the consolidation of the small water systems to the extent practicable will not only address the immediate water supply concerns, but will establish the viable managerial and facility infrastructure necessary to meet the long-term needs in the entire region.

The purpose of LPRW is, therefore, to provide a consistent and reliable supply of high-quality, affordable water to the residents of its service area. The availability of high-quality water has a direct impact on the quality-of-life and serves to stabilize and maintain the agriculture-based economy of the region. Without LPRW, more than 2,800 rural customers and 24 communities in southwest Minnesota would have a more difficult time maintaining a reliable and affordable source of high-quality potable water and, ultimately, a quality-of-life similar to that enjoyed by other areas of the State or Nation.

The purpose of this proposal is for the Agency to continue providing financial resources to the region through loans and grants to LPRW, thus helping to resolve immediate water supply and quality problems in the area but to meet longer-term technical and managerial capacity building objectives for rural water systems in general.

1.3 Background

1.3.1 System History and Summary

During the 1970's, drought conditions and rural water development in nearby South Dakota, Iowa, and Rock County, MN, prompted the initial interest in organizing a rural water system in Lincoln and Pipestone Counties of Minnesota. Through the dedicated efforts of a group of local individuals, LPRW was organized and completed its initial phase of construction in 1980. The project served Lincoln and Pipestone Counties as well as portions of Nobles, Rock, Lyon, Murray, and Yellow Medicine Counties (see Figure 1-1).

Continued interest in rural water service in the area prompted the development of a new service area in Yellow Medicine County in 1982, and in 1987 a major expansion of the original subsystem was completed. At the end of 1987, LPRW served 1,216 rural connections and the cities of Tyler, Lake Benton, Ivanhoe, Hendricks, Florence, Arco, Russell, Holland, Verdi, Kenneth, Trosky, Woodstock, and St. Leo.

In 1989 in response to continued interest in rural water service, LPRW initiated a signup campaign that resulted in the construction of two new water sources (Holland in 1991 and Burr in 1994) and the addition of 1,600 rural users and 7 communities. Service area boundaries grew to include additional portions of Nobles, Rock, Murray, Lyon, and Yellow Medicine Counties. This system expansion project extended over 5 years and consisted of three funding phases known as: Existing System South, Existing System North/Lyon County, and Nobles County phases. The system now provides service to approximately 2,800 rural customers and the cities of Arco, Ivanhoe, Lake Benton, Tyler, Verdi, Hendricks, Florence, Russell, Jasper, Ihlen, Trosky, Hardwick, Hatfield, Leota, Kenneth, Holland, Reading, Woodstock, Minneota, Ghent, Taunton, Porter, Green Valley, and St. Leo.

In addition to these municipalities and rural residents, LPRW is providing bulk water sales on a short-term contract basis to Marshall until its current water supply problems can be resolved. If system capacity is available, the City of Canby may be supplied water on a short-term contract basis, again until outstanding concerns with the its existing Water Treatment Plant can be resolved. For more information concerning LPRW’s relationship with Marshall and Canby see Section 1.3.2.

A service area in northeast Lyon County and south central Yellow Medicine County known as the “Northeast Phase,” consisting of 170 rural customers who have signed up for service and 2 communities (Hazel Run and Echo), is currently awaiting funding and will be an extension of the Existing System North/Lyon County phase of the project.

LPRW currently has three well fields that supply water to the system. Table 1-3 lists these well fields and Table 1-4 lists some common water quality parameters.

TABLE 1-3 LPRW WELL FIELDS

Well Field	No. of Wells/Water Quality/Treatment	Permit Volumes
Verdi Water Source	5 wells; hardness--375 mg/L; water is chlorinated and fluoride is added.	1,800 gpm; 683 million gallons year (Mgpy)
Holland Water Source	6 wells; hardness--375-410 mg/L; water is chlorinated, polyphosphate is added for iron and manganese sequestration, and fluoride is added.	500 Mgpy
Burr Water Source	3 wells in Burr Aquifer 1 well in Altamont Aquifer; water is treated; removal of iron and manganese; hardness is softened to 460 mg/L. Water is chlorinated and fluoride added.	750 gpm;400 Mgpy

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997

TABLE 1-4 PARTIAL SUMMARY OF WATER QUALITY PARAMETERS OF LPRW'S PRIMARY WATER SOURCES

Well Field	Total Dissolved Solids (mg/l)		Hardness (mg/l CaCO3)		Sulfates (mg/l)		Nitrates (mg/l)**
	Raw	Treated	Raw	Treated	Raw	Treated	
Verdi	395-510*	395-510*	360-450	360-450	50-145	50-145	2.6-8
Holland	310-570*	320-450	320-450	375-410	25-190	25-190	0.05-20
Burr	750-1530	480	590-670	360	380	380	0.05-7.7

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997; MNDNR (Berg, 1997a)
*Calculated using relationship: TDS = Specific Conductance x 0.06.
**MNDNR, Attachment 4, Comments on the LPRW Preliminary Draft Environmental Impact Statement, November 1997.

1.3.1.1 Regional Rural Water Development

Numerous questions at the public scoping meetings related to the intent of LPRW and how future development will affect the utilization of groundwater resources in the area. Because these questions relate to rural water development both from LPRW's perspective and from a regional perspective, the following brief discussion will include information regarding the regional development of rural water systems in South Dakota and Minnesota.

Rural water development in the region began in the early 1970's in South Dakota and Iowa in locations where groundwater was either difficult to obtain or of poor quality. The first rural water system in South Dakota began in the southeastern part of the State in Lincoln County in 1973. The first system in Iowa began service in 1975 in Sioux County which is located in the northwestern part of the State. South Dakota rural water systems closer to LPRW started providing service at this time, as well; Sioux Rural Water began service in 1976; Big Sioux, in 1976; and Brookings-Deuel, in 1977. Two other Minnesota systems adjacent to LPRW -- Rock County Rural Water in 1980 and Red Rock Rural Water in 1986 -- were also initiated during this period. Figure 1-5, shows the boundaries of the rural water systems in the region and the years in which initial construction was completed in each region.

FIGURE 1-5 RURAL WATER SYSTEM DEVELOPMENT IN THE REGION

Source: Dewild Grant Reckert and Associates Company, 1997

The growth of rural water systems in the region was a response to a general need for an improved water supply. Throughout most of the region, the lack of an adequate supply of potable water and the difficulties some individuals were having developing a reliable source of water were the driving forces behind the initial development of these systems. In much of this area, developing a source of water requires construction of a deep well at a cost of $4,000 to $20,000 or more. If water quality similar to that offered by LPRW is desired, the well owner must install sophisticated filtration or solids removal water treatment equipment at a further cost of $2,000 to $8,000. Annual operation and maintenance costs for these water treatment systems can exceed $500 per year depending on the chemicals used and the value placed on labor. Table 1-5 outlines some basic cost comparison data between individual point-of-use (POU) systems and actual average costs for an average household user served by LPRW (Madden, personal communication, 1997).

TABLE 1-5 COST COMPARISON OF CURRENT LPRW USER RATES VERSUS COST OF POINT-OF-USE SYSTEMS

	Capital Costs (dollars/1,000 gal)	Operation and Maintenance Costs (dollars/1,000 gal)	Totals (dollars/ 1000 gal)
LPRW			
Average User	2.79	1.30	4.09
Household User Only	6.78	1.35	8.13
POU Systems (Household User)	7.98[1]	Not computed[2]	7.98+

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997

[1] Capital costs were calculated as follows: Well and pump, construction cost ($4,000); water softener equipment ($600); TDS reduction equipment ($1,500). Annual costs were calculated assuming 7% interest and 15-year average life of facilities and equipment.

[2] Operation and maintenance costs for a POU system were not computed because of the variability in the amount of chemicals needed to maintain comparable water quality and because the value placed on an individual's labor is difficult to project. Costs may vary up to 50% based on initial water quality, volume of water used, users needs and level of automation desired.

As Table 1-5 shows, developing individual POU potable water systems is not likely to be competitive with the economies of scale offered by a rural water system like LPRW. All of the factors used to compute the capital costs for the POU system were on the low end of the range of costs mentioned above; therefore, the dollar amount computed represents the least potential cost for household users. It was assumed that this cost might represent the potential costs for a resident in the Northeast Phase, where based on test borings by the MNDNR and Leisch, groundwater accessibility and, therefore, well depths are likely to be shallower than in other parts of LPRW's service area (Berg, 1997b and Leisch, 1984). Requirements for deeper wells will increase capital costs increasing the cost difference between the POU system and LPRW. In addition, for agricultural interests, these costs do not represent the cost of providing the equipment necessary to provide water to livestock. Individual farmers using a

POU system generally do not treat their livestock water because the cost is prohibitive.

Even with the availability of POU systems, the fact that individuals in LPRW's service area continue to voluntarily sign up for service indicates that the reliability, quality, cost and convenience of a rural water system is the personal choice for many of the area's citizens.

1.3.1.2 LPRW Growth

Since operation began in 1980, LPRW has experienced increased demands for water as the system matured and more rural customers used the rural water supply to meet their needs. Drought conditions in the late 1980's added to the water demands of the system. Shallow farm wells in some areas were affected both by the drought, which severely restricted water availability, and, in some instances, by contamination of shallow surficial aquifers by nitrates and pesticides from agricultural operations.

Deep wells in the area are costly to construct and usually yield highly mineralized water with high levels of iron, manganese, sulfate, and total dissolved solids often exceeding SMCLs established under the SDWA. As a result, during the peak usage periods in 1988 and 1989, the system experienced difficulty in supplying the needs of its customers. During some periods, storage facilities fell to dangerously low levels and many of the municipalities on the system were required to turn to backup supplies. Significant delivery problems became apparent in some areas, and LPRW staff devoted much of its time to monitoring the status of the system and trying to balance the water demands throughout the system. Tables 1-6 and 1-7 illustrate the rapid growth in demand. Table 1-6 shows the growth in user numbers listed by year and by county. Table 1-7 list municipalities connecting to LPRW, the county of location, population, and year connected.

TABLE 1-6 LPRW SYSTEM GROWTH IN USER NUMBERS BY COUNTY

Expansion Project	Year Comp	Number of Rural Users by County								
		Lincoln	Pipestone	Rock	Murray	Nobles	Lac qui Parle	Yellow Medicine	Lyon	Total
LPRW Original Construction	**1980**	**357**	**350**	**23**						**730**
Yellow Medicine Phase	1982							110	4	114
1986 New Member Project	1987	128	27					210	7	372
Existing System South	1993	99	144	13					37	293
Existing System North/Lyon Co.	1994	125	26		44	38	37	229	453	952
Nobles County	1995				18	368				386
Total LPRW Users in Year 1995		**709**	**547**	**36**	**62**	**406**	**37**	**549**	**501**	**2,847**

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997

Table 1-6 is a typical example of user additions as a system matures. Becoming a rural water system member under Minnesota law represents a significant financial investment, about $7,000 estimated for the NE phase. Membership is voluntary. Therefore those with the greatest need and sufficient financial resources sign up first. Initial level of participation for Lincoln and Pipestone Counties in 1980 as shown in Table 1-6 was 350 and 357, respectively; by 1995 the number of users increased to 709 and 547, which represents approximately an increase of 50% and 36% in the level of participation. This participation has come about from increased membership along existing lines and smaller service expansions within those counties. The user numbers from 1995 represent 80-90% of the population in these counties; these numbers are not expected to increase significantly.

TABLE 1-7 LPRW MUNICIPALITIES
BY DATE AND COUNTY*

City	Date	County	1990 Pop
Arco	1980	Lincoln	104
Hendricks	1980	Lincoln	684
Ivanhoe	1980	Lincoln	751
Lake Benton	1980	Lincoln	693
Tyler	1980	Lincoln	1,257
Verdi	1980	Lincoln	52
Florence	1980	Lyon	53
Holland	1980	Pipestone	216
Trosky	1980	Pipestone	120
Woodstock	1980	Pipestone	159
Kenneth	1980	Rock	81
St. Leo	1982	Yellow Medicine	111
Russell	1987	Lyon	394
Hatfield	1990	Pipestone	57
Leota	1993	Nobles	198
Ihlen	1993	Pipestone	101
Hardwick	1993	Rock	234
Ghent	1994	Lyon	316
Green Valley	1994	Lyon	86
Minneota	1994	Lyon	1417
Taunton	1994	Lyon	175
Porter	1994	Yellow Medicine	210
Jasper	1995	Pipestone/Rock	599
Reading	1996	Nobles	98

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997

* All listed municipalities are unincorporated areas; population numbers included in township census data.

A major factor in the system expansion project undertaken by LPRW in 1991 was to secure another source of water; that source of water was the Burr Well Field. LPRW's other two well fields, the Holland and Verdi, were utilizing surficial aquifers of limited areal extent and were estimated to be unable to supply suitable volumes of water to the system as it expanded northward. One of the original design criteria for the Burr Well Field was that a portion of its water would be utilized in the northern portions of the Verdi Well Field's primary service area, thus reducing pumping pressure on the aquifer utilized at the Verdi Well Field. This issue has now become critical as the aquifer utilized at the Verdi Well Field has levels of nitrates that exceed the MCL for nitrates established in the SDWA. LPRW has submitted another application to the Agency to finance an upgrade of the Verdi Water Treatment Plant that will enable it to reduce nitrate levels to acceptable public health levels.

LPRW as a system has experienced steady growth since its inception but, as indicated by Figure 1-5, LPRW is largely surrounded by adjacent rural water systems which limits it's potential for growth. If and when construction of the Northeast Phase is completed, the LPRW Board of Directors' official policy with regard to future growth and priorities within the existing system will be as follows (Madden, personal communication, 1997):

- To maintain the continuity and improve the reliability of service to members presently served by the system.
- To extend service to potential members within LPRW's current service area and/or adjacent to existing LPRW pipelines.
- To extend its service area boundary where such extension improves the water quality and service reliability of the members to be served, is financially feasible, complements the present facilities and operations, does not increase the cost of service to existing members, and cannot be more economically served by another regional water supply facility.

In accordance with LPRW policy, it is highly unlikely that LPRW will extend service to the west, where it has a common boundary with the Brookings-Deuel and Big Sioux Rural Water systems; to the south, where it has a common boundary with the Rock and Osceola Rural Water systems; and to the east, where it is close to the Red Rock Rural Water system. The Minnesota River forms a natural geographic boundary to the north and northeast, and LPRW is unlikely to cross this boundary.

Therefore, within LPRW policy guidelines and depending on local interest, potential service area expansion exists to the north in Lac qui Parle County, to the northeast in Yellow Medicine County (beyond the proposed action), and to the east in Redwood County and eastern Nobles County. Currently, there are no expressions of interest and no plans to extend service to any of these areas.

1.3.2 Existing System North/Lyon County Phase History

On January 31, 1991, the Farmers Home Administration (FmHA) received a preapplication for the Existing System North/Lyon County (ESN/LC) Phase proposal from LPRW. On February 7, 1992, FmHA issued a Finding of No Significant Impact (FONSI) for an Environmental Assessment prepared for the loan/grant application pending for the ESN/LC Phase proposal. Notices of the FONSIs were published in local newspapers on February 12, 1992. FmHA then approved the loan/grant package on March 24, 1992, and FmHA approval of the construction contract was granted later in the month. As part of the project proposal, LPRW planned to develop a well field and construct a Water Treatment Plant near Burr, MN; build a ground storage tank and elevated storage tank; and connect a number of users in the communities of Porter, Tauton, Minneota, Ghent, and Green Valley.

On April 2, 1992, the MNDNR issued a Water Appropriation Permit (MNDNR, Permit 91-4159) for LPRW to appropriate water at a rate not to exceed 750 gpm or 400 Mgpy. The permit required a 7-day aquifer test and instituted additional conditions regarding well interference and with a calcareous fen (called the Sioux Nation Fen) located at the Sioux Nation Wildlife Management Area.

Construction of the Burr Treatment Plant, Burr Well Field, and other ESN/LC Phase activities began April 19, 1993. During construction of the Burr Treatment Plant, numerous inquiries continued to be made regarding potential environmental impacts to surface water resources in the area surrounding the treatment plant and well field. These inquiries resulted in FmHA amending its earlier Environmental Assessment. A draft amended Environmental Assessment was issued for public review and comment on October 14, 1994. Comments were received until November 15, 1994. Upon review of the comments, it was decided to prepare an EIS to address the outstanding issues from the earlier Environmental Assessment. In addition to these outstanding issues, the short-lived successor to FmHA's Water and Waste Program, the Rural Development Administration, had on record a preapplication from LPRW for the Northeast Phase Expansion proposal. It was determined that, because the activities of the two expansion phases (the ESN/LC Phase and the Northeast Phase Expansion) were so completely interrelated and interdependent, separating the phases into two environmental impact analyses would circumvent the letter and spirit of NEPA, as stated in 40 CFR § 1502.4, "Major Federal actions requiring the preparation of environmental impact statements". The regulation states: "Proposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement." Therefore, the impact analyses for both phases are included in this EIS.

Upon completion of the ESN/LC Phase, two issues have been repeatedly brought up and created concern among citizen and state regulatory agencies. These two issues are the supplying of water to the Minnesota Corn Processors in Marshall and LPRW and Rural Development/Rural Utilities Service's interactions with the City of Canby. The following discussion will briefly state the current status of these issues.

The City of Marshall is and has been searching for an additional source of water with better water quality to meet its municipal needs. This need predates the development of LPRW in the Marshall area. The Minnesota Corn Processors

(MCP) is an agricultural-based business located within the city limits of Marshall. MCP requires high-quality water for its corn processing activities; it now provides additional treatment on the water it now receives from Marshall and LPRW via the Marshall system. The plant began operation on July 15, 1983 using water purchased from the City of Marshall. Through the years MCP has made several plant expansions and has increased its water needs. The water purchase agreement between MCP and the City of Marshall provides for a maximum delivery of a given volume of water per day and deliveries may be restricted when the City cannot meet its internal demands. The City has restricted delivery of water to MCP in recent years.

LPRW completed an engineering report and feasibility study for the system expansion project initiated in January 1991. This study resulted in a system expansion proposal that is being built in numerous phases. As discussed, the Burr Well Field was developed in the last phase -- ESN/LC Phase project. The system expansion project will conclude with the Northeast Phase Expansion proposal, if it secures the appropriate funding and regulatory approvals. During the course of that study LPRW explored several water supply options for MCP with MCP representatives and representatives of the City of Marshall.

In completing plans for the various phases of the expansion project, it was determined that LPRW would not supply the total needs of MCP but would supplement their needs with a design capacity of 300,000 gallons per day. This represents 8.1% of the average day and 4.7% of the peak day needs for LPRW's Burr water source as summarized in Table 1-8. In the final design of providing service to the MCP, it was determined that the most practical method of water delivery was for LPRW to connect to the City of Marshall's existing water lines so as to supplement the 1.5 million gallons per day the City already provides to MCP. This configuration resulted in a contractual agreement, whereby, LPRW delivers water to the City of Marshall and the City delivers it and additional water to MCP.

LPRW constructed pipelines from facilities completed in the Existing System North expansion to MCP in April 1997 and began water delivery that same month via this connection. The construction consisted of about 3.5 miles of 10-inch pipeline and appurtenances and LPRW is to be repaid $229,000 for the construction costs over a five-year period of time. The water purchase contract between LPRW and Marshall is a five-year agreement to deliver 300,000 gallons per day and to provide additional capacity if it is available from LPRW. The agreement allows LPRW to reduce water deliveries to MCP if required by LPRW to meet its systems needs. The agreement is also renewable after the 5-year period if both parties agree. If LPRW chooses not to renew the agreement it will have been paid for all of its costs and will have no further obligation to the City of Marshall or MCP. It is safe to assume that LPRW will agree to renew the agreement at some level of service, if it has unused capacity available.

The other issue relates to the Rural Development/RUS' and LPRW's involvement with the City of Canby. A portion of the LPRW system, the Yellow Medicine Phase (see Figure 1-1), is adjacent to and was initially served by the City of Canby. The Yellow Medicine Phase was built in 1982 and provided service to 110 users and the City of St. Leo. It currently serves 161 rural users and the City of St. Leo.

In 1982 LPRW entered into a long-term agreement, whereby, LPRW purchased water from Canby for the Yellow Medicine Phase. The agreement included conditions that required LPRW to construct and own a water tower in Canby, water charges to LPRW would be based on actual costs, and that both utilities would share in the cost of Canby's facilities in proportion to their water use. In 1982 LPRW had no other facilities in the area of Canby or the Yellow Medicine Phase.

During subsequent LPRW system improvements including the development of the Burr water source, LPRW and the City of Canby had several discussions regarding various water source alternatives. Options explored included variations from using the City of Canby as a long-term source of water for the Yellow Medicine Phase to LPRW providing water to Canby and the Yellow Medicine Phase from the Burr source.

In late 1996/early 1997, based on concerns from state regulatory agencies of the City of Canby's Water Treatment Plant, the City of Canby determined that it was in their best interest to construct a new Water Treatment Plant. At the time LPRW was using about 32% of the total water produced and, therefore, under the terms of its agreement, LPRW was asked to share in 32% of the cost of the improvement. Upon review LPRW declined to participate in the proposal and decided to provide water to the Yellow Medicine Phase from the existing Burr source. In February 1997, LPRW advised the City of Canby of its intent to terminate their water purchase agreement.

During these discussions the City of Canby submitted an application to the Rural Development State Office for their Water Treatment Plant improvement proposal. This proposal is primarily designed to upgrade the water treatment plant's handling and disposal of treatment process residuals (initial estimate was $1,710,000). RD reviewed the application and declined to act on it at the time largely for economic considerations. The reasons stated and determinations made for not processing the application were 1) an economically feasible alternative for the City was to connect to LPRW (estimated cost was $1,04,519); 2) the preliminary engineering proposal did not meet the agency's regulatory determination that financed facilities be modest in size, design, and cost; and 3) other credit could be obtained that is comparable to the rates and terms offered by the Agency.

This decision was controversial and MNDNR, who voiced support for Canby's application, commented that this decision did not take into account the potential environmental concerns being evaluated as part of this EIS. MNDNR's comments focussed on LPRW and the Burr Well Field's ability, considering potential environmental concerns, to meet the long-term water supply needs of the City of Canby. In addition, MNDNR stated that the aquifer presently supplying Canby's needs is a reliable water source of reasonable water quality and that it is or could be a good backup source of water to LPRW should appropriations at the Burr Well Field be curtailed or reduced due to environmental constraints. Given these concerns MNDNR felt that the investment in Canby's Water Treatment Plant's upgrade could help alleviate potential effects on surface water resources caused by pumping at the Burr Well Field. These are valid concerns, however RD/RUS' decision was based largely on the economic realities of its limited funding. For example, in Fiscal Year 1998, the Minnesota RD State Office has on-hand applications for rural water and sewer projects totaling over $75 million dollars but has only $21 million dollars available. The decision-making process concerning which projects receive financial assistance must consider economic feasibilities and the realities of trying to best focus limited resources on those areas having the greatest needs.

1.4 System Needs

Before discussing the alternatives that will be evaluated as part of this EIS, it is necessary to establish LPRW's total needs, both actual, that is, as they now exist, and as projections for future needs. All the discussions and calculations of water requirements must revolve around the system's need. Without such an evaluation, it is difficult to ascertain the reasonableness of each alternative. Tables 1-8 and 1-9 provide data on LPRW's existing water needs and source capacity, as indicated by average day, peak day, and annual needs. The LPRW system has been designed to meet the needs of its average day and peak day needs, as well as projected total annual needs.

TABLE 1-8 SUMMARY OF WATER NEEDS AND SOURCE CAPACITY

LPRW Source Needs	Average Day Gpd	Peak Day gpd	Annual Use gal	Average Day kgpd	Peak Day Kgpd	Annual Use MGal	DNR Permitted Capacity Mgpy	DNR Permit Number	Total Water Pumped 1993 Mgpy	1994 Mgpy	1995 Mgpy	1996 Mgpy
System Demand												
Rural connections	1,693,855	2,879,554	618,257,153	1,694	2,880	618						
City Use	1,118,171	1,980,985	408,132,497	1,118	1,981	408						
Total Water Sold	2,812,026	4,860,539	1,026,389,650	2,812	4,861	1,026						
Estimated Unmetered	604,234	1,044,408	220,545,362	604	1,044	221						
Estimated Drought Demand	281,203	486,054	102,638,965	281	486	103						
Total Projected Water Needs	3,697,463	6,391,001	1,349,573,977	3,697	6,391	1,349						
Source of Supply (Primary)												
Verdi	1,371,073	2,529,791	500,441,801	1,371	2,530	500	683					
Holland	837,923	1,474,504	305,841,996	838	1,475	306	500					
Burr – Existing System	772,913	1,429,049	282,113,311	773	1,429	282	400					
Burr - NE Phase	575,135	709,467	209,924,365	575	709	210						
Canby (Now provided from Burr/part of Yellow Medicine Phase)	140,418	248,189	51,252,504	140	248	51	0					
Total Design Capacity	3,697,462	6,391,000	1,349,573,977	3,697	6,391	1,349	1,583					
Source Capacity (Primary and Secondary)												
Verdi	2,444,574	2,592,000	892,269,666	2,445	2,592	892	683	794114	402.51	402.64	425.11	424.50
Holland	947,065	1,686,080	345,678,703	947	1,686	346	500	904140	171.62	243.78	286.63	333.45
Edgerton Well								794195		0.14	0.00	0.00
Burr Burr Wells	1,719,861	2,804,695	627,749,326	1,720	2,805	628	400	914159		9.35	145.43	215.01
Altamont Wells								954171			27.33	2.40
Canby (Requires plant improvement)	140,418	248,189	51,252,504	140	248	51	0					
Total Design Capacity	5,251,918	7,330,964	N.A.	5,252	7,331	N.A.	1,583		574.13	655.92	884.50	975.36
Note: LPRW has a permit for 26.3 MG/year at Edgerton, however, they do not us that source.												

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1998.

TABLE 1-9 SUMMARY OF LPRW'S WATER NEEDS

Type of Use	Avg. Day (gal/day)	Peak Day (gal/day)	Annual (gal/yr)
Rural (2619)	1,693,855	2,879,554	618,257,153
Arco	8,734	21,836	3,188,000
Echo	26,720	50,100	9,752,800
Florence	3,173	7,932	1,158,000
Ghent	28,480	71,200	10,395,200
Green Valley	8,400	21,000	3,066,000
Hardwick	4,671	11,678	1,705,000
Hatfield	3,918	9,795	1,430,000
Hazel Run	7,440	13,950	2,715,600
Hendricks	77,945	155,890	28,450,000
Holland	14,419	28,838	5,263,000
Ihlen	12,627	25,255	4,609,000
Ivanhoe	62,411	124,822	22,780,000
Jasper	66,000	132,000	24,090,000
Kenneth	3,449	6,899	1,259,000
Lake Benton	74,019	148,038	27,017,000
Leota	763	1,527	278,667
Marshall	300,000	300,000	109,500,000
Minneota	124,102	248,204	45,297,230
Porter	13,000	32,500	4,745,000
Russell	45,740	91,479	16,695,000
St. Leo	9,011	22,527	3,289,000
Taunton	13,000	32,500	4,745,000
Trosky	6,679	13,359	2,438,000
Tyler	132,030	264,060	48,191,000
Verdi	5,438	13,596	1,985,000
Woodstock	66,000	132,000	24,090,000
Total Projected Water Sold	2,812,026	4,860,539	1,026,389,650
*Unmetered	604,234	1,044,408	220,545,362
Estimated Drought Demand	281,203	486,054	102,638,965
Total Projected Water Pumped	3,697,461	6,391,001	1,349,573,977
Average 20 Hr. Pumping Rate (gpm)	3,081	5,326	
Average 24 Hr. Pumping Rate (gpm)	2,568	4,438	

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997.
* LPRW estimates unmetered uses as water used to flush lines, treatment backwash and leaks. The difference in this value and metered water use is reported as unaccounted for water loss. Unaccounted for water loss is typically reported under 10%.

For planning purposes, peak day demand is estimated as 70% above average daily use and drought demand is estimated as 10% of average daily use. Each water source has a Primary service area on which its long-term annual use projections are based. In addition, the system is designed to permit the delivery of some water to adjoining service areas and they are called Secondary service areas. The reasons for the delivery of water to Secondary service areas will vary from short- term equipment maintenance to longer-term water shortages from adjacent sources.

For example, Table 1-10 lists several likely daily water needs for the Verdi source. If that need were supplied for a full year, the volume of water needed would result in the annual use summarized below.

TABLE 1-10 EXAMPLE OF SERVICE AREA DEMANDS

Verdi Service Area Demand	Daily (kgal/day)	Annual Use at Daily Rate (Mgpy)
Primary Service Area		
Average Day	1,371	500
Peak Day	2,530	923
Primary and Secondary Service Area		
Average Day	2,445	892
Peak Day	2,592	946

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997.

Using the above example, the total annual needs of the LPRW system – 1,349 Mgpy do not change, but LPRW is designed to meet its annual water needs from its several water sources. This is necessary not to meet service area needs but normal operational considerations and potential limitations on its water sources.

LPRW is a relatively new public water supply system and therefore the water use is expected to increase over time. A summary of LPRW water needs from Table 1-8, MNDNR permitted capacity and actual water use for the period of 1993 to 1997 is provided in Table 1-11. Water use has increased each year for the years shown and by 1997 was approximately 79% of the total design capacity of the system.

TABLE 1-11 SUMMARY OF LPRW WATER NEEDS AND RECENT ANNUAL WATER USE

LPRW Source Needs	Annual Use, Mgal		DNR Permitted Capacity (Mgpy)	DNR Permit Number	Total Water Pumped				
	Primary Area	Total Area			1993 Mgpy	1994 Mgpy	1995 Mgpy	1996 Mgpy	1997 Mgpy
Verdi	500	892	683	794114	403	403	425	424	383
Holland	306	346	500	904140	172	244	287	333	355
Edgerton Well				794195		0	0	0	0
Burr Burr Wells	492	628	400	914159		9	145	215	274
Altamont Wells				954171			27	2	55
Canby (Requires plant improvement)	51	51	0						
Total Design Capacity	**1,349**	N.A.	**1,583**	**Totals**	**574**	**656**	**884**	**975**	**1067**

Notes: 1. LPRW has a permit for 26.3 Mgal/year at Edgerton, however, they do not use that source.
2. Total annual needs are 1,349 Mgal; each source has the ability to deliver water outside of its Primary service area. The total delivery capability (Mgal) is shown in the Total Area column.

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1998.

For information purposes Table 1-12 provides information regarding LPRW's primary and secondary service areas for each of their well fields.

TABLE 1-12 LPRW WELL FIELDS WITH PRIMARY AND BACKUP (SECONDARY) SERVICE AREAS

Service Area	Primary	City Population	City Permit No.	Serves as Backup for
Verdi Well Field Permit 79-4114	934 Rural Connections			Rural Burr –187 Rural Holland – 972
	Arco	106	None	Harwick
	Florence	53	None	Hatfield
	Hendricks	684	79-4351	Holland
	Ivanhoe	751	79-4329	Ihlen
	Lake Benton	693	None	Kenneth
	Russell	392	94-4262	Leots
	Tyler	1,258	70-0367	Trosky
	Verdi	N.A.	None	Woodstock
	Jasper	599	85-4037	
Holland Well Field Permit No. 90-4140	864 Rural Connections			Rural Verdi – 28
	Hardwick	229	85-4037	Jasper
	Hatfield	61	None	
	Holland	213	None	
	Ihlen	95	84-4129	
	Kenneth	80	None	
	Leota	N.A.	84-4168	
	Troksy	121		
	Woodstock			
Burr Well Field Permit No. 91-4159	660 Rural Connections			Rural Verdi – 187 Rural Canby – 161
Altamont Backup Permit No. 95-4171	Ghent	312	79-2229	Ivanhoe
	Green Valley	N.A.	None	St.Leo
	Mineota	1,428	75-4219	
	Porter	212	84-4131	
	Taunton	174	84-4244	
City of Canby Permit No. 84-4157	161 Rural Connections			
	St. Leo	111	75-4172	
Edgerton Well Field Permit No. 79-4195	Serves as Emergency Backup Only			
Total System Connections	**Rural - 2,619** **City - 23**			

Source: MNDNR Permit No. 79-4114; Attachment B

In order to meet the existing and future projected needs of the Northeast Phase Expansion area and other parts of the system, LPRW requires 1,349 Mgpy. This need is defined within the context of LPRW's present well field configuration -- the Holland, Verdi and Burr Well Field. Because the yields of the aquifers utilized at the Holland and Verdi Well Fields are reported by LPRW to be at or nearing safe capacity, the minimum annual needs from the Burr Well Field as projected from an analysis of existing and long-term future needs are approximately 628 Mgpy. Present permitted amount is 400 Mgpy; LPRW's permit application with the MNDNR is for 800 Mgpy.

1.5 Summary of Scoping Process

the Agency announced its intent to prepare an EIS and hold public scoping meetings in a Notice of Intent in the *Federal Register* on June 8, 1995, and in public notices in local newspapers. Public scoping meetings were held on July 18, 1995, in Canby, MN, and July 19, 1995, in Brookings, SD. The purpose of the public scoping meetings was to receive public comments about the issues to be considered in the EIS.

The primary concern of most of the public comments was the effect that continued or increased groundwater appropriations may have on the surface water resources, such as Lake Cochrane and the numerous patterned calcareous fens, in the area surrounding the Burr Well Field. Because the Northeast Phase's activities would be limited primarily to expanding the existing water line distribution network, few comments were received relative to this activity, except those addressing how the activity related to overall water needs of the system and the Burr Well Field in particular.

Numerous comments suggested the types of studies that should be performed to determine or quantify the effects groundwater appropriations may have on the natural resources of the area. Most of the comments were concerned with determining the total water needs of LPRW in relation to the system's existing well fields and any future needs, determining the sustainability of the aquifers being used by the system, establishing a monitoring and management scheme that will allow regulatory agencies to determine "adverse" effects on sensitive natural resources from Burr Well Field appropriations, and evaluating alternative sources of water for contingency planning and meeting the long-term needs of the system.

Another issue that was of particular interest to numerous commenters was whether providing higher quality potable water in areas where water quality has been historically poor would in and of itself promote an influx of new large-scale confined animal operations and/or the expansion of current operations. These comments noted that an influx of these types of facilities and the animal wastes that would be produced would potentially contaminate groundwater resources in an area that was already affected, particularly if the waste-handling activities of these facilities were carelessly implemented or unregulated.

The significant issues, the analyses performed, and the conclusions drawn from these analyses are discussed in detail in subsequent sections of this EIS.

2 ALTERNATIVES

2.1 Identifying Reasonable Alternatives

It is required by law and is the policy of Federal agencies to identify and assess reasonable alternatives to a proposed action before making a decision regarding that action. Some of the alternatives that were brought out in public meetings were dismissed as unlikely or impractical, while others were found to be reasonable and warranted further evaluation. In addition, performing many of the studies requested for inclusion into this EIS were determined to be cost prohibitive or unfeasible because the information was incomplete or not readily available. An example of this issue was a recurring request to fully catalog or characterize all the calcareous fens in the area likely to be influenced by groundwater appropriations from the Burr Well Field. Although this information would be highly desirable, it simply is not readily available at a reasonable cost. the Agency consulted with the United States Geologic Survey, USDA Natural Resource Conservation Service, and Foreign Agricultural Service regarding the feasibility of using remotely sensed satellite imagery to help catalog these unique ecological features. Even though there are numerous flight lines over the general area around the Burr Well Field in black and white, color, and color infrared imagery, the scale of these images was inadequate to meet the requirements of the proposal. Existing soil survey maps prepared by the Natural Resources Conservation Service using aerial photography, although at the smallest scale available, are still at a scale that is too large for discerning fens that are typically less than 0.5 acre in size.

It should be mentioned that the environmental impact analyses and discussion of alternatives presented in this EIS, particularly as they relate to the Burr Well Field, are being performed subsequent to a decision made in 1992 to fund the Existing System North/Lyon County Phase. This situation presents the Agency with a procedural dilemma as to the ultimate purpose of the analyses to be presented in the EIS. The dilemma is that NEPA, as a procedural law, requires consideration of environmental consequences of a proposed action before a decision is made. Even though decisions have already been made and significant public funds committed to the development and construction of the Existing System North/Lyon County Phase which included the Burr Well Field and Water Treatment Plant, the Agency decided, based on subsequent information and evidence presented, that the letter and spirit of NEPA would be advanced by taking a “harder” look at the outstanding issues from its earlier Environmental Assessment. This was particularly relevant, because the Agency received a subsequent application from LPRW to complete the original system expansion project -- the Northeast Phase Expansion -- and that the Burr Well Field was originally designed and built to serve as a source of water for the Existing System North/Lyon County Phase, Northeast Phase Expansion, Yellow Medicine Phase, and other areas of LPRW’s service area (see Figure 1-1). In addition, any information gathered and analyzed by this EIS could assist the natural resource management agencies in both Minnesota and South Dakota to evaluate, monitor, and manage any appropriations at the Burr Well Field.

The decision to take a harder look at the environmental issues left unresolved from the amended Environmental Assessment did not include, as has been suggested by numerous parties during scoping meetings, an evaluation of the environmental issues as though the well field and Water Treatment Plant had never been built. When the FONSI was issued in 1992, there were no indications, nor could it be substantiated, that appropriations from the Prairie Coteau aquifer would irreversibly or irretrievably destroy the resources that were of concern. In all likelihood, the aquifer was being recharged and a yet undetermined volume of water could be safely withdrawn from the aquifer. This is not to say that the Agency or LPRW was not made aware of the presence of surface water resources in the area of the Burr Well Field, but due to the lack of baseline data the level or significance of environmental impacts to these resources could not be quantified and were generally unknown.

On the other hand, the unique geologic conditions that created the circumstances for the fens to exist raised enough concerns that the aquifer may not be able to sustain an unlimited withdrawal of groundwater without adversely affecting these resources, particularly during the periodic droughts the area invariably experiences. These concerns are real and require that resource management agencies closely examine and monitor the situation for adverse impacts. However, the Agency, with concurrence from USEPA, Region 8 as a cooperating agency for the EIS, has decided that to evaluate the environmental conditions at the Burr Well Field as though the well field and Water Treatment Plant had never been built is not a reasonable alternative and will not be considered further in the EIS.

An alternative was raised during the review of an internal draft of this document concerning the use of surface water as a source of water supply. The most feasible watershed of sufficient size in this part of the state would be the Minnesota River. In previous years, the City of Granite Falls was using the Minnesota River a source of drinking water for its citizens and because of reliability and public health concerns related to water quality Minnesota State officials required the City to switch to a groundwater source. LPRW considered the surface water alternative in early planning phases of the rural water system, but the alternative was not seriously considered because the cost of treating surface waters to SDWA standards is significantly more expensive than for groundwater and because of regulatory barriers by Minnesota State public health professionals. This alternative, therefore, is not a reasonable alternative and will not be considered further in the EIS.

The alternatives that were determined by the Agency to be reasonable are discussed and compared in the following sections.

2.2 Description of the Alternatives Considered

The National Environmental Policy Act requires that when Federal agencies evaluate a proposed action the agency must identify and assess reasonable alternatives to the proposal that will avoid or minimize adverse environmental effects of the action on the environment. The actions the Agency must evaluate are the proposed action, all alternatives determined by the Agency to be reasonable, and the No-Action alternative. In addition, the Agency should describe its preferred alternative.

As stated earlier, this EIS evaluated: 1) outstanding concerns from the Existing System North/Lyon County Phase Environmental Assessment and 2) the environmental effects of funding the construction of the Northeast Phase Expansion. Upon reviewing and considering the input received from Federal and State agencies and citizens during the scoping process, the Agency determined that the alternatives described in Table 2-1 are reasonable; therefore, these are the alternatives that are explored in-depth in the EIS.

In addition to evaluating outstanding concerns at the Burr Well Field, the proposed action that the Agency is responding to is an application submitted by LPRW to fund the Northeast Phase Expansion and LPRW's application to the MNDNR for an increase in groundwater appropriations at the Burr Well Field from the current rate of 750 gpm/400 Mgpy to 1500 gpm/800 Mgpy. LPRW's application to the MNDNR is being considered because the Burr Well Field is the proposed source of water for the Northeast Phase Expansion and a significant portion of LPRW's northern service area. The only issue that is subject to an Agency decision at this time is whether or not to provide financial assistance to LPRW for the construction of the Northeast Phase Expansion. All decisions regarding the disposition of LPRW's Water Appropriation Permit at the Burr Well Field are subject to the approval of the MNDNR, Division of Water. Based on analyses performed in this EIS the Agency will make recommendations to the MNDNR, but all decisions regarding LPRW's permit are subject to MNDNR's regulatory authority.

TABLE 2-1 LIST OF ALTERNATIVES CONSIDERED

Alternative	Northeast Phase Expansion Status	Burr Well Field Status
Current Status	LPRW submitted application to RUS to fund construction of the Northeast Phase Expansion	LPRW is authorized under their current Water Appropriation Permit to appropriate groundwater at the rate of 750 gpm/400 Mgpy. LPRW submitted an application to the MNDNR to increase groundwater appropriations 1,500 gpm/800 Mgpy.
Proposed Action	Fund the Northeast Phase Expansion	Increase groundwater appropriations at the Burr Well Field to 1,500 gpm/800 Mgpy.
Alternative 1	Fund the Northeast Phase Expansion	Discontinue use of Burr Well Field
Alternative 2	Fund the Northeast Phase Expansion	Discontinue use of Burr Well Field Supplement water needs from other sources: Adjacent Rural Water Systems Lewis and Clark System Altamont Aquifer Canby Aquifer Other Aquifers
Alternative 3	Fund the Northeast Phase Expansion	Maintain current appropriations at Burr Well Field
Alternative 4	Fund the Northeast Phase Expansion	Maintain current or reduce appropriations at Burr Well Field Fund and construct new well field and Water Treatment Plant in the Wood Lake area.
Alternative 5	Do not fund the Northeast Phase Expansion; Finance Point-of-Use systems in Northeast Phase Expansion area.	Maintain current appropriations at Burr Well Field
Alternative 6 – No Action Alternative	Do Not Fund the Northeast Phase Expansion	Maintain current appropriations at Burr Well Field

Table 2-2 provides a convenient summary of the analyses for each the alternatives considered in the EIS. For narrative discussion on these analyses see Section 2.2.

TABLE 2-2 SUMMARY COMPARISON TABLE FOR THE ALTERNATIVES ANALYSIS

Alternative	Groundwater Source			Environmental Effects			
	Burr	Altamont	Other	Fens	Lake Cochrane	Biological	Comments
Proposed Action	Y	Y	N	PS	PS	N - FED PS-ST	At pumping at 1,500 gpm/800 Mgpy there is a potential for significant adverse impacts to surface water resources, particularly during drought. Not enough data to predict impacts with certainty. User rates increase - 17%.
Alternative 1	N	N	N	N	N	N	LPRW unable to meet the needs of the system without third well field. Potential for significant adverse economic impacts for rural businesses.
Alternative 2	N	N	Y	N			Only source that would be feasible at this time would be the Altamont aquifer. At Burr Well Field the Altamont would be unable to sustain high levels of appropriations. Water from Altamont would require treatment, could use Burr Water Treatment Plant. Not enough information available to determine if Canby aquifer is large enough to be a significant source of water supply.
Lewis and Clark	N	N	Y	N	N	N	
Altamont	N	Y	Y	N	N	N	
Canby	N	N	Y	N	N	N	
Alternative 3	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 gpm there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty.
Alternative 4 **Wood Lake Alt.**	Y	Y	y	M	M	N-FED M-ST	At 750 gpm/400 Mgpy there would be minimal potential for adverse impacts to surface water resources because a well field and treatment plant would be built decreasing reliance on Burr Well Field. Very expensive, user rate increases - 31%. MNDNR's preferred alternative.
Alternative 5	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 Mgpy there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty. Point-of-use systems more expensive than rural water system and labor intensive.
Alternative 6 – No Action Alternative	Y	Y	N	P	P	N-FED P-ST	At 750 gpm/400 gpm there is a potential for adverse impacts to surface water resources. Not enough data to predict impacts with certainty. Users in Northeast Phase Expansion would not be served. User rate increases - 11%
Y - Yes; N - No; M – Minimal Effects; P - Potential Effects; PS - Potentially Significant Effects; FED - Federal List for Threatened/Endangered Species; ST - State List of Threatened/Special Concern/Rare Species							

The following tables provide cost data for analyzing the economic impact of the alternatives being considered. Only those alternatives determined to be technically or economically feasible based on information evaluated in the EIS were subjected to this cost analysis. They will be referred to periodically in the following alternative analyses, and will serve as documentation when references are made to specific or system needs.

TABLE 2-3 SUMMARY OF NORTHEAST PHASE EXPANSION COSTS FOR SELECTED ALTERNATIVES

Item	Total Cost	Proposed Action	Preferred Alternative	Wood Lake Alternate	
				WTP – 500 gpm 140 Mgpy	WTP – 750 gpm 210 Mgpy
Construction Costs					
NE Phase Distribution System	$4,330,000	$4,330,000	$4,330,000	$4,330,000	$4,330,000
LPRW EIS Participation Costs	$476,000	$476,000	$476,000	$476,000	$476,000
Burr EIS Well Field Expansion	$1,420,000		$1,420,000		
Wood Lake Aquifer Source					
3 half capacity wells	$90,000			$90,000	$90,000
500 gpm WTP	$3,304,000			$3,304,000	
750 gpm WTP	$4,171,000				$4,171,000
500 gpm Transmission Pipeline	$290,000			$290,000	
750 gpm Transmission Pipeline	$632,000				$632,000
Total Construction Costs		$4,806,000	$6,226,000	$8,490,000	$9,699,000
Northeast Phase Expansion Proposed Funding					
Loan Funds		$2,643,300	$3,424,300	$4,669,500	$5,334,450
Grant Funds		$2,162,700	$2,801,700	$3,820,500	$4,364,550
Annual Costs					
Burr WTP Capital Costs		$130,000	$130,000	$130,000	$130,000
NE Phase Capital Costs @ 5%, 30 years		$172,000	$223,000	$304,000	$347,000
NE Phase Plant O&M Costs/1,000 gal.		$0.2500	$0.2700	$0.3500	$0.2875
O&M Costs for 210 MG/year		$52,500	$56,700	$66,500	$60,375
Total Annual Costs		$354,500	$409,700	$500,500	$537,375
Cost per 1,000 gallons		$1.69	$1.95	$2.38	$2.56

NOTE: Cost projections and analyses developed for this table are based on a 55%/45% loan/grant share calculated at 5% interest over a 30 year period of time. All costs were developed for economic evaluation and comparison purposes only; actual loan/grant ratios are subject to change. These estimates and calculations do not represent any financial commitment from the Rural Utilities Service.
Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1998.

TABLE 2-4 SUMMARY OF FUNDING FOR SELECTED ALTERNATIVES AND ITS IMPACT ON USER RATES FOR LPRW CUSTOMERS

Item	Total Cost	No Action Alternative		Proposed Action		Preferred Alternative		Northeast Phase Expansion and Wood Lake Alternative WTP - 500 gpm		Northeast Phase Expansion and Wood Lake Alternative WTP - 750 gpm	
Projects and Funding											
Existing System North Bond Retirement	$1,500,000	$1,500,000		$1,500,000		$1,500,000		$1,500,000		$1,500,000	
Burr EIS Well Field Expansion	$1,420,000					$1,420,000					
LPRW EIS Participation Costs	$476,000	$476,000		$476,000		$476,000		$476,000		$476,000	
Holland Water Treatment	$3,056,000	$3,056,000		$3,056,000		$3,056,000		$3,056,000		$3,056,000	
NE Phase	$4,330,000			$4,330,000		$4,330,000		$4,330,000		$4,330,000	
Wood Lake Alternate @ 500 gpm	$3,684,000							$3,684,000			
Wood Lake Alternate @ 750 gpm	$4,893,000									$4,893,000	
Total Cost		$5,032,000		$9,362,000		$10,782,000		$13,046,000		$14,255,000	
Estimated Loan		$2,767,600		$5,149,100		$5,930,100		$7,175,300		$7,840,250	
Estimated Grant		$2,264,400		$4,212,900		$4,851,900		$5,870,700		$6,414,750	
Debt Service Financial Impact											
Total Loan		$2,767,600		$5,149,100		$5,930,100		$7,175,300		$7,840,250	
NE Phase Assessment (170 users @ $7,500)				$1,275,000		$1,275,000		$1,275,000		$1,275,000	
Net Revenue Financed Loan		$2,767,600		$3,874,100		$4,655,100		$5,900,300		$6,565,250	
Annual Debt Service, 4.875%, 28 yrs		$185,760		$260,029		$308,214		$390,659		$434,685	
Less Payment on Retired Bonds		$150,015		$150,015		$150,015		$150,015		$150,015	
Net Annual Payment Financed by Revenue		$35,745		$110,014		$158,199		$240,644		$284,670	
Impact on Water Rates ($ per 1,000 gallons)		**Added Cost**	**% Increase**	**Added Cost**	**% Increase**	**Added Cost**	**% Increase**	**Added Cost**	**% Increase**	**Added Cost**	**% Increase**
At 800 million gallons per year		$0.045	3.31%	$0.138	10.19%	$0.198	14.65%	$0.301	22.28%	$0.356	26.36%
At 900 million gallons per year		$0.040	2.94%	$0.122	9.05%	$0.176	13.02%	$0.267	19.81%	$0.316	23.43%
At 1,000 million gallons per year		$0.036	2.65%	$0.110	8.15%	$0.158	11.72%	$0.241	17.83%	$0.285	21.09%

Holland Nitrate Treatment O&M Financial Impact											
Holland Well Field O&M Annual Nitrate Removal Costs of $91,800 per year											
At 800 million gallons per year		$0.115	8.50%	$0.115	8.50%	$0.115	8.50%	$0.115	8.50%	$0.115	8.50%
At 900 million gallons per year		$0.102	7.56%	$0.102	7.56%	$0.102	7.56%	$0.102	7.56%	$0.102	7.56%
At 1,000 million gallons per year		$0.092	6.80%	$0.092	6.80%	$0.092	6.80%	$0.092	6.80%	$0.092	6.80%
Combined Debt Service and O&M Financial Impact											
At 800 million gallons per year		$0.160	11.85%	$0.253	18.74%	$0.31	23.15%	$0.42	30.78%	$0.47	34.86%
At 900 million gallons per year		$0.142	10.52%	$0.224	16.59%	$0.28	20.58%	$0.37	27.36%	$0.42	30.99%
At 1,000 million gallons per year		$0.128	9.48%	$0.202	14.96%	$0.25	18.52%	$0.33	24.63%	$0.38	27.89%
Impact on Water LPRW Water Rates											
Current Water Rate ($/1,000 gal) - $1.35											
Projected Water Rate for all LPRW Rural and Municipal Users ($/1,000 gal)											
At 800 million gallons per year		$1.51		$1.60		$1.66		$1.77		$1.82	
At 900 million gallons per year		$1.49		$1.57		$1.63		$1.72		$1.77	
At 1,000 million gallons per year		$1.48		$1.55		$1.60		$1.68		$1.73	
NOTE: Cost projections and analyses developed for this table are based on a 55%/45% loan/grant share calculated at 5% interest over a 30 year period of time. All costs were developed for economic evaluation and comparison purposes only; actual loan grant ratios are subject to change. These estimates and calculations do not represent any financial commitment from the Rural Utilities Service.											

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1998.

TABLE 2-5 SUMMARY OF THE TOTAL PROJECT COSTS FOR SELECTED ALTERNATIVES

Alternative	Total Project Cost ($000)	Cost/1,000 gallons (dollars)	Impact on User Rates (dollars) (Current rate - $1.35)	Percent User Rate Increase
No Action Alternative	$5,032	N.A.	$1.49	10.5%
Proposed Action	$9,362	$1.69	$1.57	16.6%
Preferred Alternative	$10,782	$1.95	$1.63	20.6%
Wood Lake Alternative **Option 1** – 500 gpm/140 Mgpy	$13,046	$2.38	$1.72	27.4%
Option 2 – 750 gpm/210 Mgpy	$14,225	$2.56	$1.77	31.1%

* Includes total project financing requirements (includes cost of Holland Water Treatment Plant upgrade for nitrate problems) and overall debt burden facing LPRW at the present time.

2.2.1 Proposed Action

The proposed action is to fund the Northeast Phase Expansion and to continue to appropriate groundwater at the Burr Well Field at a higher rate than is now permitted. This action is partly based on LPRW's formal submittal of a permit request to the MNDNR to increase the Burr Well Field capacity to 1,500 gpm/800 Mgpy; the current rate is 750 gpm/400Mgpy.

The Agency has concluded, based on a systematic and objective evaluation of the environmental and economic issues related to the proposed action and the alternatives analyzed as part of the EIS, that the proposed action poses unreasonable environmental risks to surface water resources of the area. Because of the uncertainty of and potential for long-term environmental impacts on surface water resources in the area around the Burr Well Field, the Agency has concluded that under drought conditions, pumping at the proposed appropriation rate from the Burr Well Field is likely to cause significant adverse environmental impacts to these resources.

A summary of the important points that were considered in the above conclusion include:

Sustainable Yield of the Burr Unit

- Sustainable yield of the aquifer is unknown.
- Recharge mechanics are not clearly understood.
- All pump tests and monitoring completed to date have occurred during periods of high precipitation.

Significant Data Gaps/Uncertainties

- Long-term impacts to surface water resources from groundwater appropriations are unknown.
- Magnitude of existing or future impacts are not accurately known or understood.
- Recharge and discharge conditions for the Burr Unit are not well understood.
- Significant uncertainties related to the water budget and groundwater contributions or discharges from the Burr Unit to Lake Cochrane exist.
- The gathering of data on the effects of pumping from the Burr Unit on surface water resources is technically difficult, time consuming, and expensive.
- Determining the relationship between groundwater appropriations from the Burr Unit and natural-occurring climatic fluctuations and how these effects impact surface water resources in the area is not well understood or quantified.

Potential Impacts to Surface Water Resources of the Area.

- Pump tests have demonstrated that the Burr Unit is hydraulically connected to groundwater discharges at the fens.
- Multiple lines of evidence indicate that groundwater contributions or discharges from the Burr Unit to Lake Cochrane are likely.
- Pumping from the Burr Unit at the Burr Well Field reduces the potentiometric surface in the aquifer and would cause proportional reductions in discharges to fens and Lake Cochrane.
- The ecological integrity of a fen is sensitive to changes in groundwater flow.

Even though pumping at the proposed rate of 1,500 gpm/800 Mgpy from wells screened in the Burr Unit represents in the Agency's opinion an unreasonable risk to surface water resources, the Agency has concluded that at current appropriation rates (400-525 gpm from the Burr Unit) it is unlikely surface water resources will be significantly impacted (see Section 3.0). The Agency has concluded that adverse environmental effects to surface water resources in the area of the Burr Well Field can be avoided or minimized if mitigation measures developed as part of the agency's preferred alternative are implemented (see Section 3.2.3).

As mentioned earlier, the Northeast Phase Expansion project is the culmination of a system expansion proposal that began in 1991. In the engineering and planning efforts that have supported the various phases of the project, the Burr Well Field was developed to contribute a significant portion of the water supply needs to the system's northern service area. It is generally accepted by technical experts consulted that the Burr Unit of the Prairie Coteau aquifer is physically able or capable of providing adequate yields in the volumes desired by LPRW, but the critical limiting factor relates to the environmental effects of such withdrawals.

The potential environmental consequences of groundwater withdrawals at the proposed rate of 1,500 gpm/800 Mgpy are not well understood. While it is accepted that because the fens are totally dependent on groundwater discharges, it is critical to maintain hydraulic gradients above the surface elevation of the fen dome for the fens to remain ecologically viable. What has not been established is at what rate can groundwater be withdrawn from the Burr Unit before adverse environmental impacts would occur. Even though LPRW is permitted to appropriate groundwater at 750 gpm/400 Mgpy, the maximum they have used on an annual basis was in 1997. In that year, LPRW withdrew groundwater from the Burr Unit at rates between 400-525 gpm (average rate 521 gpm) which totals 274 Mgpy. Based on an evaluation of the hydraulic gradients measured by piezometers installed in the fen's peat mass at the above rates and during previous pump tests, the Agency concludes that at rate of 400-525 gpm no significant environmental impacts to the fens have become apparent to date (see Section 3.2.2.1.1). At these rates all of the conditions used by the MNDNR to establish thresholds of impacts -- subsidence of the peat dome and maintenance of sufficient hydraulic gradients and water tables within the peat dome so as to keep the peat saturated -- were met.

Analyzing system-wide water supply needs, it is readily apparent that LPRW needs a third source of water in addition to the Holland and Verdi Well Field to supply its existing and future customer needs. It was suggested that the Agency should revisit the feasibilities of reusing some of the smaller communities' water systems that were incorporated through consolidation in the LPRW system. While it is true some of the small communities that have been incorporated into the LPRW system may have well fields that have reasonable water quality, it is not know if it would economically or technically feasible to revisit all previous decisions made by LPRW and MNDNR officials as to why these fields were abandoned. It is likely that these small communities' well fields were abandoned due to inadequate water supply, poor water quality, or the economic realities related to, as was discussed in Section 1.0, small communities lacking the financial, managerial, and technical capacity or wherewithal to meet the requirements of the SDWA. The consolidation of small communities into larger water systems is one of the tools used by many state and federal agencies concerned with increasing the public health status of the nation's drinking water supply and LPRW's past management activities are entirely consistent with this goal. This information was not explored in great depth because it was felt that if these sources had been economically viable alternatives in the past they would been pursued as appropriate.

As presented in Table 2-3 the proposed action is a lower cost alternative than either the preferred alternative or the Wood Lake alternative. This is because additional wells or Water Treatment Plants would be required.

The proposed action would supply LPRW with enough water for the system to meet the needs of its customers for the foreseeable future. In addition, it is estimated that, if the Burr Well Field was operating at its design capacity, LPRW would not need to develop another well field, even if it were to expand to the north in response to customer demand. Absent the potential for potential adverse environmental impacts to surface water resources, the Burr Well Field could most likely serve as a reliable source of water, however, due to concerns for these resources and without an approved fen mitigation plan from the MNDNR it is unlikely the LPRW would be allowed to appropriate at such high rates.

Based on the above evaluation and the level of uncertainty of environmental impacts to surface water resources of the area, the Agency believes that the proposed action poses an unreasonable environmental risk particularly during drought conditions. However as discussed in Section 2.2.3, the Agency has developed a preferred alternative that incorporates mitigation measures that could serve to avoid or minimize any significant adverse environmental impacts to the area's surface water resources but still meet the needs of the system as discussed above.

2.2.2 Alternatives to the Proposed Action

The next two alternatives are to fund the Northeast Phase Expansion and discontinue use of the Burr Well Field and Water Treatment Plant and use existing production and treatment capacities from the Verdi and Holland Well Fields by themselves or to supplement the well fields with an additional source from within or outside LPRW's service area.

2.2.2.1 Alternative 1

The first alternative is to fund the Northeast Phase Expansion and discontinue use of the Burr Well Field and Water Treatment Plant; use Verdi and Holland Well Fields to make up for the loss of the Burr Well Field to meet the system's needs.

Based on Table 1-9, the current annual water demands on the LPRW system, including the Existing System North/Lyon County phase, are approximately 1,349 Mgpy. The current annual water use from the Verdi and Holland Well Fields is approximately 806 Mgpy, with permitted appropriations at 1,183 Mgpy. Based on these estimates alone, this alternative would not meet the existing or future projected needs of the system. From the standpoint of system reliability and safety factors, it is clear LPRW would not be able to meet the needs of its customers under this alternative. Based on recent analyses, it has been projected that both of these well fields are operating at near capacity (Madden, personal communication 1997) and additional geologic exploration efforts near the Holland Well Field has not produced any formations of sufficient thickness that would be able to supplement supplies to the Holland field (Berg, 1997b).

LPRW is currently providing bulk water sales to the city of Marshall. LPRW also has present capacity and existing pipeline facilities to provide bulk water sales to the city of Canby; however, Canby is meeting its needs by using its existing facilities. The City of Marshall has water supply and quality limitations and is and has been performing geologic exploration efforts to locate an additional source of water. The City of Canby has having problems with its Water Treatment Plant and handling its treatment process residuals. Both of these municipalities are attempting to resolve these problems expeditiously, but Marshall, for example, is having difficulty in locating an adequate supply of water. In the meantime, because the Northeast Phase Expansion is not yet constructed and present users have not reached LPRW's design projections, the existing facilities at the Burr Well Field have unused capacity for short-term supplies. LPRW is providing or can provide these two municipalities with water from the Burr Well Field to meet or supplement their needs. The volume of water currently being supplied to Marshall is estimated at approximately 200 Mgpy. If bulk water sales to Marshall were immediately discontinued, LPRW's annual water supply needs would remain at 1,150 Mgpy. This need is slightly less than LPRW's permitted appropriations for the Verdi and Holland Well Fields (1,183 Mgpy) and less than the primary and secondary design capacities (1,238 Mgpy). In addition if the City of Canby were to again supply the rural residents in the Yellow Medicine Phase that would potentially decrease the LPRW needs by another 39 Mgpy. For safety and reliability, it is not feasible to depend on secondary design capacities to supply the system's long-term needs. To date the maximum withdrawal from the two well fields has been 737 Mgpy, significantly less than their permitted capacities of 1,183 Mgpy, and, as stated earlier, the two well fields are operating at near capacity. Therefore, it does not appear to be feasible to use these well fields alone to meet LPRW long-term needs.

As stated earlier, LPRW has in the past purchased water from the city of Canby to serve some rural users and the village of St. Leo in that area (the Yellow Medicine Phase). Total needs of those users are 39 Mgpy. LPRW could again purchase water from Canby; however, purchase of that amount of water is not enough to fulfill LPRW's overall supply needs.

Therefore, relying on the Verdi and Holland Well Fields alone is not a feasible option and will not be given further consideration in this EIS.

2.2.2.2 Alternative 2

The second alternative is to fund the Northeast Phase Expansion and discontinue use of the Burr Well Field and Water Treatment Plant; use the Verdi and Holland Well Fields and supplement this supply with water from other sources to meet the system's needs. Based on the analyses in Section 2.2.2.1 LPRW cannot safely or reliably meet the needs of its current customer base with only two well fields. It is clear that the system needs, at minimum, a third source of water. This alternative evaluates other sources of water that have the potential to be economically and reasonably available within LPRW's service area.

Evaluations of alternative sources of water will be presented in greater detail in the following subsections. In addition to those sources, other options that were considered within each alternative will be explored in this section.

2.2.2.2.1 Lewis and Clark Project

Wide-ranging preliminary discussions are being conducted related to the development of a multi-state regional water system that proposes to install large production well fields in the alluvial aquifer of the Missouri River and provide this water as bulk water sales through interconnections to municipalities and rural water systems in South Dakota, Minnesota, and Iowa. This proposal is called the Lewis and Clark project and is being proposed through discussions with the U. S. Department of Interior, Bureau of Reclamation (Jacobson, V., 1996). Funding for the project is proposed to come from 80% federal sources and 10% state grants. The primary purpose of the proposal is to improve the economic well-being of the region by developing and providing residential, commercial, and industrial customers a more reliable water supply for short- and long-term emergencies and offering better service for the entire region on a daily basis, as well as during drought conditions.

It is possible that LPRW would benefit from this proposal by the ability to import treated water from interconnections with the Lewis and Clark system. This water could be provided to the extreme southern tier of LPRW's customers, as supplemental and emergency water needs, thus potentially decreasing the demands on the system's existing well fields.

In the preliminary discussions related to this proposal, concerns have been raised as to the overall cost of this proposal as well as concerns related to interbasin transfers of water that, in this case, would be between the Missouri and Mississippi River basins. At the present time, LPRW is transferring water from the Verdi Well Field located in the Missouri River basin to the Mississippi River basin. This issue has major potential legal implications for the Minnesota State legislature. While the issue is being debated, Minnesota's current policy is to discourage and minimize such interbasin transfers of water.

Because the decisions necessary to address all the issues related to the funding and feasibility of the Lewis and Clark system and interbasin transfers of water will likely require many years to resolve, it is not reasonable for the Agency and LPRW to postpone resolution of the proposed action. If the Lewis and Clark system is eventually funded, the Agency and LPRW can revisit their previous decisions regarding any future water supply development in the region. If the project is funded, then LPRW would benefit from an additional source of water for its service area which would relieve some of the appropriation burdens on existing well fields further north. The entire area, not just LPRW, would likely benefit from the Lewis and Clark plan.

2.2.2.2.2 Adjacent Rural Water Systems

One alternative to supplementing the Holland and Verdi sources with outside sources would be for LPRW to interconnect to one or more of the adjacent rural water systems and purchase bulk water.   The surrounding rural water systems in Minnesota include the Rock County to the south and Red Rock to the east, and in South Dakota, the Big Sioux and Brookings-Deuel to the west. None of these systems have any excess capacity that could be utilized by LPRW (Madden, personal communication, 1997). This is not unusual because the cost of developing water sources, treatment facilities, and distribution networks is so great that rural water systems rarely develop excess capacities above their existing or foreseeable future needs. Inasmuch as none of these systems has excess water capacity from which to sell to LPRW, this alternative will not be considered further.

2.2.2.2.3 Altamont Aquifer

The Altamont aquifer is a widespread layer of outwash directly overlying Cretaceous shale in western Yellow Medicine and Lyon Counties, MN, and eastern Deuel County, SD. The materials that form the Altamont were deposited by meltwater that flowed away from the advancing front of glaciers during the initial advance of the last great ice sheet. The well that tested the Altamont at the Burr Well Field penetrated beds of densely packed silt and sand in which the water was under artesian conditions. The fine-grained nature of the aquifer materials, coupled with a thickness of only 15 to 20 ft, limit the yield of this aquifer at the Burr Well Field to levels well below that of the Burr Unit at this same location.

According to Kume (Kume, 1985) the Altamont aquifer is more than 80 ft thick in the southwestern corner of T. 114 N., R. 47 W., Yellow Medicine County, MN. Recent geophysical and geological investigations by B.A. Liesch and Associates and MNDNR (Berg, 1997a) indicate that this aquifer is present in the area southeast of the Burr Well Field. Thicknesses of this water-bearing formation in this area are greater than in the Burr Well Field area. It is thought that this aquifer could potentially serve as a primary source of water to LPRW (see Section 3). In that this aquifer shows great promise, it also is considered in the Agency' preferred alternative.

2.2.2.2.4 Canby Aquifer

The Canby aquifer is an unconfined, or water table, aquifer in outwash deposits that are associated with the surface drainage pattern of the Canby Creek in Yellow Medicine County. This aquifer is being used as a source of water by the City of Canby. As late as 1944, the City of Canby obtained its water supply from the aquifer in a combination well that consisted of a dug pit 30 feet deep with five holes drilled into the bottom of the pit to depths of about 70 ft. Water would rise up into the pit to a depth of approximately 15 feet where the water was subsequently pumped out at a rate of 50 gallons per minute with little drawdown.

In the 1960's the City utilized a series of surficial sand and gravel wells finished at depths ranging from 68 to 100 feet (Wells 3 and 4) (Cotter and Bidwell, 1968). These shallower wells currently serve as a standby water source due to better yields and more favorable water quality in the buried drift source. Two well (Wells 7 and 8) had been developed in a buried drift aquifer

Based on records supplied by the MNDNR (MNDNR, 1997, attachments 24, 25, and 26) the Canby aquifer has been a consistently reliable source of water for the City from a recorded period since 1962. Available water quality data suggest that the shallower aquifer is excessively high in iron (3.2 to 4.5 mg/l) and manganese (0.42 to 0.51 mg/l) when compared to the buried drift aquifer with iron and manganese at 2.9 and 0.14 mg/l, respectively (MDH, 1989). Table 2-6 summarizes some of the pertinent information from the City of Canby's wells.

TABLE 2-6 SUMMARY OF CANBY PRODUCTION WELLS AND WATER QUALITY DATA

City of Canby Well Numbers	Depth (feet)	Permit Rate (gpm)	Hardness (mg/l)	Total Dissolved Solids (mg/l)	Sulfates (mg/l)
Well No. 3 and 4	94-97	250	870	1400-1500	720
Well No. 7 and 8	155-170	500-600	870	1100-1400	330-740

The USGS Hydrologic Investigation Atlas HA-269 shows the shallow aquifer as a limited area of surficial sand and gravel occurring at the base of the Prairie Coteau near Canby. The buried drift aquifer has not been mapped and its extent is unknown.

Even though the aquifer appears to be providing the City of Canby with a reliable source of water and several of the bore logs provided by the MNDNR indicate that the aquifer has some potentially thick sequences of loose coarse sand and sand and gravel layers, little or no information is available that indicates the areal extent of the aquifer. Based on this limited information, it is difficult to project how extensive the aquifer is or what types of specific yields could be produced from the aquifer. Little more can be said other than it appears to be a promising source of water.

At the present time Canby is appropriating about 50 Mgpy. For more information about Canby's involvement with LPRW see Section 2.3.2. Because of limited information as to the areal extent of the Canby aquifer, the EIS will not provide any further discussion concerning this aquifer.

2.2.2.2.5 Other Aquifers in the Region

Specific detailed information on the availability of other aquifers within the service area of LPRW is limited. Specific geologic exploration efforts focusing on groundwater resources in the area of southwestern Minnesota, as discussed in Section 1, have been limited primarily to individual municipalities seeking to locate additional water supplies or one of better quality. Specific exploration efforts undertaken by local municipalities, various units of Minnesota State Government and the USGS are not comprehensive nor specific enough for the Agency to evaluate conclusively other alternative aquifers that could potentially serve LPRW's needs.

Because of the geologic history of the area, it is and has been historically difficult to locate and delineate specific formations that can provide reliable sources of water (Berg, 1997 a and b). Discussions in Section 1 documented the difficulties the region has experienced in securing adequate supplies and quality of water. Because of the expense necessary to conduct a regional comprehensive groundwater exploratory program and the difficulties in locating specific aquifers, the Agency is not in a position to conduct those types of studies specifically for this EIS. Where these studies do exist, for example, the recent geologic explorations performed by the MNDNR (Berg, 1997a and b), the information has been incorporated as applicable and has greatly helped in developing the Agency' preferred alternative. Therefore, all of the Agency's evaluation efforts were confined to the aquifers where information is readily available. These aquifers include the Prairie Coteau (Burr Unit), Altamont, and the Wood Lake aquifers.

2.2.2.3 Alternative 3

The third alternative is to fund the Northeast Phase Expansion and continue utilizing the Burr Well Field at current permitted appropriations (750 gpm/400 Mgpy) and supplement with sources other than the Burr Unit aquifer.

This alternative, like Alternative 2, involves discussing the feasibility of using other aquifers in the region to assist LPRW in meeting the needs of its customers. In order to minimize duplication of analyses and discussions, readers are referred to the discussions of the other aquifers in the above sections.

As noted above, no other aquifer within LPRW's service area was found to be reasonably accessible given the current knowledge of the region's groundwater resources except for the Altamont aquifer and the Wood Lake aquifer. As was discussed in Sections 1 and the sections above, groundwater exploration is costly, and because of the region's geologic history, finding suitable aquifers can be difficult. The only aquifer in the area other than the Burr Unit that is likely to provide a reliable source of water was the Altamont aquifer and Wood Lake. Based on the exploration efforts of Berg (Berg, 1997a), the Altamont aquifer offers a promising potential to provide an additional source of water. This aquifer is discussed in the Agency' preferred alternative (see Section 2.2.3).

For a discussion concerning the Wood Lake aquifer, see Section 2.2.2.4.

In addition, the last option considered under this alternative is for LPRW to maintain its current appropriation rate and its existing well fields to meet its customers' demands. This option will be explored in the following paragraphs; however based on the conclusions and discussions in Section 2.2.2.2, the alternatives of evaluating aquifers in areas other than the Burr Unit will not be considered further,

The potential for using the Altamont aquifer as either a primary or secondary source of water is promising. As discussed in Sections 3, recent exploration efforts completed by Berg (Berg,1997a) indicate that the characteristics of the

Altamont aquifer in the area southeast of the Burr Well Field have a very good potential for supplying water in municipal quantities. This option would require an additional well field and pipelines to transport the raw water to the Burr Water Treatment Plant. In addition, the Altamont aquifer and the Burr Unit appear to be hydraulically isolated (Berg, 1997a), which would minimize potential adverse effects to fens and surface water resources from potentiometric surface drawdowns in the Burr Unit. Additional exploration efforts will be necessary to define the thickest portions and extent of this aquifer (Berg, 1997a).

Another option of this alternative is for LPRW to maintain it's existing well field configuration and permit conditions. It would be potentially feasible for LPRW to meet its current customer needs plus the Northeast Phase Expansion by maintaining its current permit conditions at the Burr Well Field and eliminating any water supplies to the Minnesota Corn Processors (MCP) and the City of Canby could again provide water to the Yellow Medicine Phase. These two changes could reduce the annual appropriations by a range of 78-160 Mgpy. These reductions would reduce LPRW minimum needs from 628 to 468 Mgpy. Given that LPRW has a permitted rate of 400 Mgpy plus the what ever the Altamont could provide, the option could be feasible. This option would not, however, address the system's foreseeable needs for meeting future customer demands and allowing the option of building system capability for meeting emergency needs and secondary service area demand. This option would also have a potential for a significant adverse economic impact on the MCP who is a major employer in the area and also serves as a market for the area's grain production.

If the groundwater exploration efforts performed by Berg (Berg,1997a) had been unsuccessful in locating other potential sources of water, this option would be attractive, considering the uncertainty surrounding the potential impact to surface water resources in the area. However, it appears that Berg's exploration efforts identify a probable source of good quality water in the Altamont (and Burr Unit) within a reasonable distance to the Burr Water Treatment Plant.

2.2.2.4 Alternative 4

A fourth option is fund the Northeast Phase Expansion, maintain current permit conditions at Burr Well Field and develop a new well field and treatment facility in the Northeast Phase Expansion area to supply water to Northeast Phase Expansion customers.

This alternative maintains current appropriation status at the Burr Well Field and evaluates the potential for developing another well field within the Northeast Phase Expansion area. Consideration was given to the feasibility and likelihood or potential for locating a well field in this area. Only two localities in this area have been identified as having aquifers that might be suitable sources of water. The Canby aquifer in and around the city of Canby was discussed earlier, as well as a water-filled outwash bed of coarse sand-sized materials near the City of Cottonwood and Wood Lake.

This area around Wood Lake was the subject of additional geologic exploration efforts performed by the MNDNR as part of their Southwestern Minnesota Groundwater Exploration Project. (Berg 1997b). As part of this project a limited number of test borings were drilled in an area mapped from available well logs as a buried valley, incised into the pre-Quaternary surface. Three of six test holes bored in this valley penetrated 32-60 ft of fine to very coarse sand at a depth of approximately 150 ft below the ground surface (Berg, 1997b). This aquifer is believed to be part of a 1-2 mile wide aquifer called the Wood Lake aquifer. The aquifer crosses the eastern portion of Yellow Medicine County in a northwest-southeasterly direction. Selected cross sections and a sand thickness maps can be found in Appendix D.

B. A. Leisch and Associates completed the only pump test that has been performed in this aquifer. This test was performed in1985; the well was pumped at a rate of 840 gpm for 48 hours. A transmissivity value was calculated in an adjacent observation well as 73,430 gallons/day/ft; hydraulic conductivity was calculated assuming an aquifer thickness of 60 ft as 1,200 gallons/day/ft^2 (Berg, 1997b).

This aquifer is considered as a potentially feasible alternative so costs were developed relative to developing a new well field and, based on the water quality from the aquifer, a new Water Treatment Plant. In general, the water quality in the Wood Lake aquifer is not as good as the water in the Burr Unit or the Altamont and would require greater treatment than the other sources. Water quality data from the Wood Lake indicates that total hardness ranges from 370 mg/l – 770 mg/l; TDS 1,074 mg/l – 2000 mg/l; and sulfates 470 mg/l – 820 mg/l (MNDNR, 1997, Attachment 30; Berg, 1997b; and Liesch, 1984).

In addition to developing construction costs for a new well field and Water Treatment Plant, costs estimates were developed to show what effect this alternative and other selected alternative would have on LPRW's debt service and, ultimately, the users rates for the entire system. Two options were evaluated in this alternative – a 500 gpm/140 Mgpy and a 750 gpm/210 Mgpy well field/treatment plant. See Table 2-3 for a cost analysis summary.

Even though this alternative looks promising, evaluating the construction costs of both options and their cost impact on user rates, this alternative was determined to be cost prohibitive. Utilizing the Wood Lake aquifer and its technical and cost feasibility factors, however, would be more promising if LPRW were to expand beyond north and west of the proposed Northeast Phase Expansion. See additional discussions in Section 1.3.1.2.

This alternative is the alternative preferred by the MNDNR. They believe an additional well field in the Northeast Phase Expansion will give LPRW an additional source of water in the area that LPRW seeks to expand and will minimize adverse impacts on surface water resources in the Burr Well Field area. While it is true this alternative offers a potentially better solution environmentally it would increase user rates 27-31% and would put LPRW is a position that exceeds its ability to service its debt. In addition user rate increases of this magnitude would create potential affordability factors for the citizens of this area. It is likely that if this is the only alternative available to LPRW then the Northeast Phase Expansion would not be built nor would funding be pursued for the well field and water treatment plant proposed at this location.

2.2.2.5 Alternative 5

This alternative evaluates the feasibility of financing point-of-use (POU) systems for potential customers in the Northeast Phase Expansion rather than financing the Expansion project. Section 1.3 evaluated the costs of providing individual POU systems versus the cost of LPRW supplying potable water to customers in its service area. The cost data in Table 1-5 represents actual cost data from LPRW and an estimate for POU systems. As the discussion on estimating costs indicated, a range exists for all of the factors that need to be considered when establishing capital and operations and maintenance costs for the POU systems, e.g., costs of drilling and developing a well can range from $4,000 to $20,000, depending on the depth necessary to locate a source of water. In order for the comparison to be as objective as possible, all the factors used to compute total costs used the low end of each of the ranges. In addition, because LPRW has a variety of users (residential, commercial, and industrial) figures were supplied for an average cost per user per 1,000 gal plus a cost per 1,000 gal for household use only. The cost per 1,000 gal for household use was used to compare with the POU system costs, because it was thought that these comparisons best represented comparable types of systems and potential costs.

The average cost for household use only for LPRW was $8.08/1,000 gal, whereas the capital cost alone for the POU systems was $7.98/1,000 gal. The annual operation and maintenance cost for the POU system was not computed, because it was clear that a POU system is not competitive with the economies of scale that a rural water system like LPRW can offer. Even though POU systems are currently available, individuals continue to sign up for LPRW service where it is available. This continued support of LPRW is evidence that a public water supply that, in most cases, is cheaper and more reliable in its delivery of better quality water is the preferred and personal choice of the majority of residents in LPRW's service area.

One issue could be relevant in that it is occurring within the LPRW service area. This issue relates to aquifer contamination. If, for example, an area or particular source of water became contaminated with nitrates, as is happening in the Verdi aquifer, the potential to provide treatment in a larger rural water system, while expensive, would be more economical on a cost per gallon basis versus the cost for treating the contaminated water for individual rural users utilizing the same aquifer. The cost of providing point-of-use treatment for certain contaminants is very expensive.

This alternative would be more desirable if adverse environmental effects were occurring as a result of the Burr Well Field's appropriations. Based on the analyses performed as part of this EIS, it appears unlikely that at current Burr Well Field appropriation rates, the fens or surface water resources will be adversely affected. In addition, the Agency is only able to provide loan/grants to public bodies and non-profit entities. Unless LPRW were to administer a management program to manage the development, installation, and operation and maintenance activities of a large scale POU program, the Agency could not provide financial support for a proposal such as this. Given these factors the Agency has concluded that this alternative is too expensive and would require a management program that is very time and labor extensive, therefore, this alternative will no longer be considered in this EIS.

2.2.2.6 Alternative 6

The final alternative is the no-action alternative, an evaluation required by NEPA. As stated earlier, the Agency is facing a procedural dilemma with regard to performing environmental impact analyses on decisions that have already been made. Because the only decision facing the Agency at this time is whether or not to provide financial assistance for the Northeast Phase Expansion, the no-action alternative will be to not fund the Northeast Phase Expansion. Part of the proposed action is to construct an elevated storage tank near Minneota and a booster station near Green Valley. Because the Northeast Phase Expansion proposal is the culmination of a multi-phase system expansion project, certain engineering decisions regarding the design and operation of the system as a whole have been made earlier in the design phase of the system expansion project. For example, of the proposed facilities to be added as part of this expansion phase, the proposed storage tank is critical to meet the hydraulic needs of not only the proposed Northeast Phase Expansion but all of the East and most of the West Phase of the Existing System North/Lyon County Phase (Krause, 1993, 3). One of the shortcomings of the LPRW system is a lack of sufficient water storage capacity to meet its peak daily demands (Jacobsen, 1996, 4); therefore, this storage facility is critical to maintain the proper hydraulic integrity and storage capacity of the system. Certainly if this project were not to be built it would create system-wide management problems but these would not be insurmountable.

Based on the outcome of recent geologic explorations performed by Berg (Berg, 1997a), the Agency has concluded that the no-action alternative is not reasonable. As stated earlier, analyses of well logs and electrical resistivity surveys in northwestern Lincoln County and southwestern Yellow Medicine County indicate that the areal extent of the Burr Unit aquifer is larger than previously thought. If the preferred alternative is implemented, the Agency believes that any adverse impacts to the fens or surface water resources in the area could be avoided or minimized.

For years, the rural residents of the Northeast Phase Expansion have expressed a desire to be serviced by LPRW. the Agency believes that the need to maintain hydraulic integrity of the system, improve storage capacity, and supply a reliable source of good quality potable water is an achievable goal, particularly given the implementation of mitigation measures proposed in the Agency' preferred alternative. If a comprehensive groundwater management approach were implemented by incorporating a supplemental well field into the Burr Water Treatment Plant's capacity, it would be unlikely that there would be significant adverse impacts to surface water resources in the area.

Based on the above analyses, the Agency has concluded that it would be unreasonable to not fund the Northeast Phase Expansion proposal. It appears likely that given regulatory oversight and a willingness of LPRW to closely monitor and manage groundwater appropriations in such a fashion that minimizes the drawdown or reduction in the potentiometric surface of the Burr Unit, meeting the water supply needs of rural residents in this area in a cost effective manner could be achieved while at the same time protecting surface water resources from significant adverse impacts.

2.2.3 Preferred Alternative

As stated in the Section 2.2.1 (Proposed Action), the Agency has concluded that because of the level of uncertainty regarding the long-term environmental effects of the proposed action, the Agency believes that the proposal as submitted is not a reasonable alternative as it represents too great of a risk for adverse environmental impacts. Studies performed before and during the EIS indicate that the Burr Unit aquifer and surface water resources of the area are hydraulically connected, and pumping at the Burr Well Field causes reductions in the potentiometric surface and proportional reductions in the hydraulic head supplying recharge to these resources. The data gathered to date, however, has not indicated any significant adverse environmental impacts on surface water resources at groundwater appropriations rates of 400-525 gpm (see Section 3).

The Agency believes that a significant portion of the risk posed by the proposed action is to place too much reliance on the Burr Well Field as a single point of appropriation from the Burr Unit and by doing so creates a potentially unreliable source of water for the system. As such, the Agency proposes that a supplemental well field be developed in either the southwestern portion of Yellow Medicine County or northwestern portion of Lincoln County where test borings collected in previous and recent groundwater exploration efforts by the SDDENR, MNDNR, USGS, and LPRW indicate that the aquifers utilized at the Burr Well Field extend in a south - southeasterly direction. This data indicates a strong potential for both the Burr Unit and Altamont aquifers to be capable of supplying municipal quantities of water with good water quality characteristics.

In order to avoid or minimize any significant adverse environmental impacts the Agency has developed the following actions as mitigation measures:

- Continue to maintain the Burr Well Field as a primary water source. The Agency supports reducing or limiting ground water appropriations at the Burr Well Field from **each** of the two aquifers -- the Burr Unit and Altamont aquifer -- to 400-525 gpm with a corresponding annual appropriation rate.

- Supplement existing wells at the Burr Well Field with a new well field in an area south-southeast of the current Burr Well Field. This new well field could utilize both the Burr Unit and Altamont aquifers in a configuration similar to that at the Burr Well Field. Water from the new wells could be transported to the Burr Water Treatment Plant for treatment and distribution to LPRW customers.

- The Agency recommends that the appropriation rates of the supplemental wells be similar to those permitted at the Burr Well Field or higher in the case of the Altamont aquifer. This configuration would give LPRW two well fields and enable it to continue utilizing the existing treatment capacity at the Burr Water Treatment Plant to meet the primary and secondary needs in the northern portion of its service area. This recommendation would likely “spread out” the effects or reductions in the potentiometric surface of the Burr Unit caused by production pumping, thus potentially avoiding or minimizing any adverse effects to surface water resources in the area.

- The Agency recommends that MNDNR establish, as part of its permitting requirements for LPRW, protocols and standard operating procedures for well field operations that are designed to minimize drawdowns in the potentiometric surface in the Burr Unit. These protocols could include regulating pumping rates and annual withdrawals for each well and aquifer.

- Formalize a water resource management plan that will continue to use existing monitoring points at fen locations and observation wells in the Burr Unit in Minnesota and South Dakota. This monitoring plan would enable LPRW and natural resource management agencies in both Minnesota and South Dakota to monitor and develop a long-term strategy for evaluating groundwater appropriations and their effects on surface water features in the area.

Provided these mitigation measures are implemented and LPRW meets the conditions specified in Section 3.2.3, the Agency is prepared to approve LPRW's application for construction of the Northeast Phase Expansion proposal subject the availability of funds. For more detailed discussions regarding the proposed mitigation measures see Section 3.2.3.

3 ENVIRONMENTAL EVALUATION

3.1 Approach

In an attempt to improve the readability of this EIS, this section will consolidate two sections that are typically found in Environmental Impact Statements – Affected Environment and Environmental Consequences. Those sections follow a format recommended by the Council on Environmental Quality's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* at 40 CFR 1502.10, Recommended Format. The purpose of the sections is to first, "succinctly describe the environment of the area(s); and secondly, discuss and describe the environmental effects that could result from the proposed action or the alternative being considered.

To minimize duplications of discussions and to improve accessibility of this document, Section 3 is organized so that discussions and analyses relative to a particular issue are presented together. Each section or issue is discussed as follows:

Affected Environment

This section describes the current condition of a particular resource. This discussion is meant to give readers the necessary information to understand the impact that is predicted on that resource.

Environmental Consequences

For both the construction and operation phase, these sections describe the impact on the particular environmental resource that would stem from activities at that site. These sections will also discuss the importance of each impact.

The indirect effects of the proposed project are also described in the environmental consequences subsections.

Mitigation

These sections, where appropriate, describe the measures that would be or could be taken to prevent, avoid, lessen, or compensate for the impacts.

the Agency worked with interested stakeholders and Federal and State Government staff in identifying and determining the direct and indirect impacts of specific actions that could come about as a result of the proposed action. For each of the activities the Agency and its study team identified, attempts were made to identify the various kinds of direct and resulting indirect effects on the environment that could be caused by the activity and that are reasonably foreseeable. The discussions in the following section are the result of these evaluations.

ACTIVITY

Soil Excavations: Can lead to →

Direct Effects: Soil erosion
Which can lead to→

Indirect Effects: Muddy streams
Which can lead to→

Indirect Effects: Fish kills and water quality degradation

This section is also organized to cover the areas or issues of concerns determined by the Agency to be of relative importance in supporting a reasoned analyses for its decision-making process. The determination of which issues to focus on for in-depth analyses is based on the scoping process. The issues to be analyzed in this EIS encompass the impacts from the previously constructed Existing System North/Lyon County Phase project, including: the effects of groundwater appropriations at the Burr Well Field on surface water resources; impacts from the construction of the Northeast Phase Expansion project; and an socio-economic evaluation of specific agri-business concerns with regard to whether the availability of rural water systems affects or promotes such interests.

Based on analyses presented in Section 2, the Agency concluded that the most reasonable alternatives considering all of the environmental and economic factors involve continuing to utilize the Burr Unit and Altamont aquifers. Therefore the in-depth analyses and discussions in Section 3.2, Existing System North/Lyon County Phase, will be confined to these aquifers, their continued utilization, and how such activity affects the surface water resources in the area surrounding the Burr Well Field.

3.2 Existing System North/Lyon County Phase

3.2.1 Geology and Groundwater

3.2.1.1 Burr Unit

Affected Environment

Portions of following discussion are taken almost verbatim from a report prepared by MNDNR, *Burr Well Field Aquifer Test Analysis*, April 1995; the report summarizes the geologic conditions surrounding the Burr Well Field.

The Burr Well Field lies at the intersection of two major geographic features; the Coteau des Prairie (Coteau), a flat-iron shaped upland plateau that trends from the northwest to the southeast from South Dakota through Minnesota into Iowa. It further extends eastward to the lowland plains of the Minnesota River valley.

The Coteau forms the regional drainage boundary between the Big Sioux River to the west and the Minnesota River on the east. The elevational differences between the Coteau uplands, approximately 2000 ft above mean sea level or the National Geodetic Vertical Datum (NGVD) at the Deuel-Hamlin County, South Dakota border and the Minnesota River lowlands (890 NGVD) at Granite Falls, Minnesota, provide a significant driving force for groundwater movement to the east (see Figure 1-6). Ground level elevations at the wells within the Burr Well Field range from 1709 to 1728 NGVD. Locally, the groundwater gradient is generally from west to east.

FIGURE 3-1 WEST TO EAST GEOLOGIC CROSS-SECTIONAL VIEW IN YELLOW MEDICINE COUNTY

Source: USDA, Soil Conservation Service
Yellow Medicine Soil Survey, 1981

In Minnesota, two prominent hilly features along the eastern slope of the Coteau mark the presence of sediments deposited in the last glacial advance of the Des Moines Lobe – the Bemis and Altamont Moraines. The Altamont Moraine upon which the Burr Well Field is located marks a recessional position of the Des Moines Lobe ice. The Altamont Moraine is a rugged, poorly drained complex of knobs, kettles, ice-block basins, and disintegration ridges. Locally, a stagnation moraine lies in contact along the eastern edge of the Altamont Moraine (see Figure 3-2).

FIGURE 3-2 LOCAL GLACIAL GEOLOGY

Source: MNDNR, Burr Well Field
Aquifer Test Analysis, April 1994

The Altamont Moraine is a northwest-southeast trending geomorphic feature that extends from the southeast corner of Lac qui Parle County across western Yellow Medicine County into western Lyon County. A prominent feature, the step-like slope, is bordered on the northeast by a glacial lake plain that is crossed by the Canby outwash plain, which extends from section 9 of Norman Township northward across central Hammer Township into Lac qui Parle County. An extensive till plain, termed the lowland plain by Hokanson and others (SCS, 1981), extends from this lake plain northeast about 18 to 24 miles to the broad, Glacial Lake Benson Plain which ranges up 10 miles wide.

The glacial deposits at the Burr Well Field site overlie Cretaceous-aged siltstones or silty marlstone bedrock (Berg, 1997a) and are locally up to 500 ft thick. The glacial sediments include both tills and outwash. The tills consist of silty, sandy, pebbly, calcareous clays (shaley at depth). Locally, individual strata of tills that are interspersed with outwash sediments range in thickness from 50 to 200 ft thick. The outwash sediments consist of sands and gravels ranging from several ft to over 100 ft thick. These outwash sands and gravels were deposited along the flank of the Coteau by swift running, high-energy meltwaters flowing from the margins of the ice flow (see Figure 3-3). As the ice continued to advance southward, the sand and gravel deposits were overridden and buried under a thick layer of till. Tills are characteristically low in permeability and therefore not major sources of groundwater; instead they act as aquitards or confining layers, confining the water of these underlying outwash deposits.

1) Advancing glacier
Arrows show southwestern and lateral ice movement

2) Receding glacier
Arrows show meltwater drainage from the glacial forming an outwash channel between the lateral glacial edge and the higher southwestern land surface

FIGURE 3-3 DEPOSITION OF NORTHWEST-SOUTHEAST ORIENTED BURIED GLACIAL OUTWASH CHANNEL (BURR UNIT)

Source, MNDNR, Southwestern Minnesota Groundwater Exploration Project, 1996-97, Progress Report 1

Stratified glacial deposits of sand and gravel form the principal aquifers in much of the study area. Water-bearing glacial drift deposits consisting of permeable deposits of sands and gravel can be classified in two categories, buried outwash and surficial outwash. Buried outwash deposits appear to be a significant source of groundwater within the area. Many domestic wells draw water from these sources. Buried outwash deposits are overlain by less permeable glacial till, which acts as an aquitard or confining layer and provides for hydraulic separation between surface water and deeper waters contained in the buried outwash deposits.

In the study area, all commercially developable groundwater sources are located in either buried outwash deposits or surface deposits of sand and gravel associated with ancient or present-day drainage channels. Within the area around the Burr Well Field, there are two major aquifers. The deepest formation is known as the Altamont aquifer and the other is the Prairie Coteau aquifer.

The Altamont is a sand and gravel layer directly overlying the Cretaceous age bedrock. It is known to range from 10 to 100 ft thick in South Dakota test wells and 35 to 38 ft thick in Minnesota (Berg, 1997a) and is estimated to cover 500,000 acres. This aquifer appears to be hydraulically isolated from the overlying Prairie Coteau aquifer (Berg, 1997a) by relatively impermeable till layer.

A pump test was performed on the Altamont aquifer at the Burr Well Field in November/December 1994 by B. A. Leisch. This pump test consisted of a 6-day test at approximately 465 gpm. The average tranmissivity was approximately 8,700 gallons/day/ft. Using an aquifer thickness of 30 ft, the Altamont aquifer has a hydraulic conductivity of 290 gallons/day/ft^2 (Berg, 1997a).

The Prairie Coteau aquifer is named after the dominant geological feature in the area, the Coteau des Prairie. As stated earlier, the Coteau is a large area of uplift composed of Precambrian crystalline rock underlying thick beds of Mesozoic and Cenozoic shales. The Prairie Coteau aquifer is reported by the USGS to occur at depths ranging from 3 to 364 ft (the average depth was reported to be 94 ft below grade) (Kume 1985). The Prairie Coteau aquifer is not a continuous water-bearing formation; it is made up of numerous discrete lenticular units of sand and gravel that are reported to range from 1 to 144 ft thick with no consistency in areal size. These units are generally discontinuous and have varying degrees of hydraulic connectivity between one another. A nearly continuous confining layer of glacial till overlies the Prairie Coteau aquifer.

In the study area, glacial drift is as much as 500 ft thick along the Altamont Moraine thinning to less than 200 ft east of Canby, and is less than 50 ft thick over local bedrock highs (Hokanson et al., 1981). Well DTH-3-94, a test hole bored into the Altamont aquifer at the Burr Well Field, penetrated 453 ft of glacial sediment and bottomed 20 ft into a clay layer that may be weathered Cretaceous shale, although no materials with the characteristics of basal till were penetrated. This clay is overlain by 31 ft of fine-to-coarse sand with a 6-ft bed of clay near the top and a 1-ft bed of clay at about the midpoint of the sand unit. This water-bearing unit is confined by 159 ft of clay and sandy clay interspersed with sand beds ranging up to 10 ft thick. A 95-ft-thick sand sequence, referred to herein as the Burr Unit of the Prairie Coteau aquifer, is present from 113 to 208 ft . It is this strata or formation that the 3 production wells are screened in at the Burr Well Field. A till sequence consisting mostly of sandy clay with a rocky zone from 82 to 102 ft overlies and confines the Burr Unit.

At the Burr Well Field, the Burr Unit consists of three hydraulically connected layers of outwash composed predominantly of sand (Berg, 1997a) (see Appendix C). The Burr Unit is a widespread unit that ranges in thickness from 0 ft in southwestern Deuel County, SD, to more than 140 ft in T.115 N., R. 48 W., and T.116 N. R. 49 W. Wells, test borings, and geophysical (electrical) methods indicate that the Burr Unit is present in southwestern Yellow Medicine County and northwestern Lincoln County. The thickest portion of this body of outwash extends from northwest of section 35, T. 115 N., R. 48 W., Deuel County, SD, southeast to section 6, T. 114 N., R. 46 W., Lincoln County, MN. Parallel to the axis of this trend, it is more than 50 thick in a band that is about 4.5 miles wide.

Three 7-day pump tests of the Burr Unit have been conducted at the Burr Well Field. Pumping rates for the tests were 818 gpm, 750 gpm, and 1,500 gpm. Analyses of the drawdown curves generated by these tests indicate that the effective transmissivity of the Burr Unit is in excess of 50,000 gal/day/ft. Using this transmissivity value and assuming an aquifer thickness of 160 ft., the Burr Unit in this area has a hydraulic conductivity on 350 gal/day/ft^2 (Berg, 1977a).

Test drilling performed in South Dakota by the SDDENR indicates that the Burr Unit is overlain by approximately 100 ft of till however it thins to less than 50 ft on the west edge of Lake Cochrane (see Figure 3-4).

FIGURE 3-4 GENERALIZED GEOLOGIC WEST TO EAST CROSS-SECTION OF GLACIAL TILL AND OUTWASH ALONG CANBY-LAKE COCHRANE ROAD

Source: Pence, South Dakota Geologic Survey
Hydrologic Study of the lake Cochrane Area, 1995

The Burr Well Field consists of 3 wells that are screened in the Burr Unit and one well screened in the Altamont aquifer. Water quality in both aquifers is suitable for use with minimal treatment. Water from the Burr Unit contains small quantities of iron and manganese and is moderately hard. Table 3-1 summarizes the quality of the water typically found in the Burr Unit and the Altamont aquifer.

TABLE 3-1 TYPICAL WATER QUALITY DATA FROM AQUIFERS AT THE BURR WELL FIELD

Analyte	Burr Unit Aquifer	Altamont Aquifer	Drinking Water Standards	Units
Alkalinity	277	326	--	mg/L
Calcium	156.6	159	--	mg/L
TDS	1,532	1,442	(500)	mg/L
Fluoride	0.3	N.A.	4.0	mg/L
Hardness (Total as $CaCO_3$)	512	594	--	mg/L
Hardness (Total)	30	N.A.	--	gpg
Iron	1.7	1.4	(0.3)	mg/L
Magnesium	29.5	48	--	mg/L
Manganese	0.5	0.5	(0.05)	mg/L
Nitrate/Nitrite (as N)	< 0.2	0.02	10	mg/L
pH	7.9	7.3	(6.5-8.5)	units
Potassium	3.4	6	--	mg/L
Sodium	8.7	24	20	mg/L
Sulfate	370	284	250	mg/L

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1997; Berg, 1997a

As mentioned above a portion of the Burr Unit of the Prairie Coteau aquifer is overlain and confined by relatively impermeable glacial till. Because of the elevational position and downward trend of the aquifer relative to the land surface, the water in the eastern portion of the aquifer is under pressure (see Figure 3-4). When a well is drilled through the overlying impervious layer into a confined aquifer, such as the Burr Unit, water rises in the well to some level above the top of the aquifer. The water level in that well represents the confining pressure at the top of the aquifer. This is equivalent to the hydraulic head, expressed in ft of water and is defined as the vertical distance between the water level in the well and the top of the aquifer. The elevation to which water rises in the well is its potentiometric level. Under confined conditions, the potentiometric surface is an imaginary surface representing the confined pressures throughout all or part of a confined aquifer (Driscoll, 1986). This upward hydraulic head or gradient creates artesian or free-flowing wells, groundwater-fed fens, springs and seeps along the eastern edge of the Coteau (see discussion in Section 3.2.2.1.1).

> Potentiometric Surface--Refers to the following concept: If an aquifer is confined, and if water levels in wells screened in that aquifer were plotted on a map and contoured, the resulting surface would represent the hydraulic head in the aquifer. In this case, the pressure (head) in the Burr Unit is higher than the surface elevation of the land and results in springs, often referred to as artesian springs.

One of the long-term concerns of utilizing the Burr Unit at the Burr Well Field is the issue of sustainable yield from and recharge of the aquifer. In the study area, most groundwater recharge occurs during the period that coincides with snowmelt and spring rainfall. Occurrence of groundwater recharge during the growing season is rare. Most groundwater levels decline throughout the summer and early fall unless occasional heavy precipitation causes small increments of recharge and its attendant rising water levels. This pattern continues throughout the fall until freezing temperatures prevent any further recharge from entering the soil zone.

According to Pence (Pence, 1995) recharge to the Burr Unit apparently occurs in the area of Cobb Creek, which is located south and east of Lake Cochrane. Cobb Creek flows north in clockwise-circular fashion around Lake Cochrane to a point about 4 miles west of Lake Cochrane, continuing on in a northeasterly direction before it empties into Florida Creek about 3 miles north-northwest of the lake. Florida Creek then flows in an easterly direction down the face of the Coteau and Altamont Moraine draining off into the lowlands below.

Depths of surficial till in this area range from approximately 57 ft on the west edge of Lake Cochrane to 124 ft at the Burr Well Field. Since the end of the period of glaciation, Cobb Creek has eroded approximately 60 ft down through the surficial till sequence and is now in contact with the permeable outwash sediments that are connected to the Burr Unit. In the vicinity of Cobb Creek the Burr Unit is an unconfined aquifer with a water table that slopes eastward. According to Pence (Pence, 1995) the Burr Unit aquifer functions as an unconfined aquifer system from the midpoint of section 6, T.114 N., R.47 W. -- the section west of Lake Cochrane -- to west of Cobb Creek. East of section 6, the aquifer is confined and the potentiometric surface slopes to the east at a rate of less than 1 ft/mile to the South Dakota/Minnesota State line and beyond.

Cross sections of the Burr Unit prepared by Pence (Pence, 1995) indicate water levels in observations wells screened in the Burr Unit range from 1695.9 to 1692.8 ft NGVD. Table 3-2 lists the water level and potentiometric surface elevations from selected observation wells. The water levels in the Burr Unit drop off sharply near its northwestern boundary along Cobb Creek.

TABLE 3-2 WATER AND POTENTIOMETRIC SURFACE ELEVATIONS FROM SELECT WELLS IN BURR UNIT

Observation Well	Elevation (ft. NGVD)
94-33	1695.9
94-18	1695.1
94-26	1694.8
93-14	1693.8
93-11	1693.2
93-9	1692.8

Source: Pence (1995); See Appendix A for locations of Observation Wells

The configuration of the water table and analysis of well data from the area west of Lake Cochrane are strongly indicative of recharge in the area of Cobb Creek as suggested by Pence (1995). The very low slope that exists on the potentiometric surface from section 6 eastward indicates that natural water losses from the confined portion of this aquifer system are relatively small and that recharge to and discharge from the aquifer are closely balanced. Recharge into the Burr Unit from Cobb Creek is apparently insufficient to fill the western portion of the aquifer where it is under water table conditions or the aquifer is discharging at about the water table elevation to other areas, most likely to area north of Lake Cochrane. Thick surficial till and the positive hydraulic head in the area where the aquifer is confined effectively prevent aquifer recharge from the surface into that portion of the aquifer.

Environmental Consequences

In order to determine basic characteristics of the aquifers being utilized at the Burr Well Field it is customary engineering/geologic practice and often required by regulatory or permitting agencies to perform pump tests. Pump tests have been performed on both the Burr Unit and the Altamont aquifers at the Burr Well Field. These tests were performed at various withdrawal rates to estimate the magnitude and extent of drawdown caused by the production wells at the well field. Table 3-3 summarizes these tests.

TABLE 3-3 SUMMARY OF PUMP TESTS PERFORMED AT THE BURR WELL FIELD

Water Source	Date of Pump test	Pumping Rate (gpm)	Test Duration (days)	Effective Transmissity (gal/day/ft)	Estimated Hydraulic Conductivity (gal/day/ft^2)
Altamont	November 1994	465	6	8,700	290
Burr Unit	January 1991	750	3	51,000	
Burr Unit	July 1993	818	7	56,000	350
Burr Unit	September 1995	750	7		
Burr Unit	June 1996	1,500	7	50,000	

Source: Madden, J., Dewild, Grant, and Reckert and Associates Company, personal communication, 1998; Berg 1997a

In evaluating pump tests on confined aquifers valuable information regarding an aquifer's characteristics can be gathered by observing maximum drawdown levels and the amount of time it takes the aquifer to recover to levels measured at the start of the test. Table 3-4 describes this information for selected observation wells.

TABLE 3-4 SUMMARY OF DRAWDOWNS AND RECOVERIES OF SELECTED OBSERVATION WELLS FROM THE JUNE 1996 PUMP TESTS

Observation Well Number/Identifier*	Distance from Test Well (ft)**	Maximum Drawdown (ft)	Date Test Completed	Date of 100% Recovery
PW No. 1	650	15.92	7/2/96	7/5/96
OW 3-90	800	15.28	7/2/96	7/5/96
Christenson	5,200	3.24	7/2/96	7/5/96
Deep Steel	6,400	4.73	7/2/96	7/4/96
SD-94-27	11,888	0.97	7/2/96	7/5/96
SD-94-18	14,600	0.45	7/2/96	7/5/96

* See Appendix A for Observation Well Locations
** Measurements are estimated as linear distances measured directly off of USGS Quad Sheet from PW No.3.

The information presented in Table 3-4 is remarkable in that the aquifer recovered to pre-pump test levels in a very short time -- 2-3 days, demonstrating the good transmissive character and elasticity of the Burr Unit.

Although pump tests are a valuable tool in determining aquifer characteristics, they do not emulate the normal operation of production pumping. That is to say, pump tests typically require production well pumps to run continuously at a given pumping rate for a certain period of time, such as 7 days. Production wells at water treatment facilities typically cycle on and off several times each day, depending on the demands placed on the system. For an aquifer with the “elasticity” of the Burr Unit these on-off production cycles allow the aquifer to partially recover which prevents the lowering of the potentiometric surface without pause as in the case of a pump test. For example, during the June 1996 7-day 1,500 gpm test the water level or potentiometric surface decline in OW-90 was 15.28 ft whereas during production pumping during the later portion at 1997 where pump rates approached 650 gpm the decline was less than 8 ft. Therefore, it is difficult to use the results of pump tests to predict the effects that groundwater withdrawal will have on surface water resources, though they do provide insight into basic aquifer characteristics and production potential.

The effect on the potentiometric surface in the Burr Unit from the June 1996 pump test is depicted graphically in Appendix A. This graphic was developed from observations collected from numerous observation wells at a given point on the land surface during this pump test and indicates the maximum drawdown in the potentiometric surface that occurred during the 1996 pump test. The graphic clearly shows that the drawdown contours of equal pressure emanating from the Burr Well Field resemble an inverted cone. This cone is termed a “cone of depression” and is typical of the hydraulic conditions surrounding production wells.

The environmental resources of the area that could be affected by a reduction in the potentiometric surface are those resources that are dependent on groundwater recharge from the Burr Unit and that are within the effect of this “cone of depression.” The resources that are dependent on groundwater recharge in the area are the calcareous fens and other surface water features, such as Lake Cochrane. The evaluation and determination of the environmental consequences of the effects on these resources can be found in Section 3.2.2.1.

The environmental consequences of the long-term withdrawal of groundwater from the Burr Unit or the Altamont aquifer are not completely understood at this time. In addition, recharge mechanisms to the Burr Unit are not well understood, so it is not possible to quantify with any degree of certainty what is the recharge or discharge characteristics of this aquifer. It is likely, however, given the areal extent, transmissive nature and favorable hydraulic characteristics of both aquifers, that these aquifers are physically able to produce municipal levels of water supply. Whether higher rates of withdrawals than LPRW’s current rates of between 400-525 gpm will produce significant adverse effects on surface water resources in the area will be discussed later in this EIS.

Because of the hydraulic connectivity between the Burr Unit and surface water resources it is likely that if the Burr Unit is pumped at high levels, particularly during drought conditions, these resources could be affected. As is discussed in Section 3.2.2.1 pumping to date at levels averaging around 400-525 appear to be having little or minimal effects on any surface water resources. Because the Burr Unit has not been pumped in a production mode at rates consistently above 525 gpm, direct data has not been collected that could be used to analyze the effects of pumping at higher rates. It is therefore difficult to predict what effect pumping at higher rates would be. Even though the nature and magnitude of impacts to surface water resources and their relationship with pumping at the Burr Well Field are not clearly understood or quantified, predicting impacts from reductions in the volume of groundwater being supplied to these resources is reasonably straightforward (see Section 3.2.2.1). Predicting if and under what conditions these reductions will occur is more difficult given the limited baseline data collected to date.

Both the Burr Unit and Altamont aquifers are buried outwash sediments and have the advantage of being relatively safe from surface contamination such as that affecting the Verdi Well Field in the form of nitrates.

3.2.1.2 Other Portions of the Burr Unit

Affected Environment

In 1995 the Minnesota legislature funded a proposal from the Minnesota Water Well Contractors Association to characterize the geologic and hydrologic conditions of southwestern Minnesota where water supplies are hard to find (Berg, 1997a). This effort was termed the *Southwestern Minnesota Groundwater Exploration Project 1996-1997*. State funds were matched from non-state sources including LPRW. Analysis of well logs and electrical resistivity surveys collected by the MNDNR and B. A. Leisch in the area around the Burr Well Field in northwestern Lincoln County, MN, indicates that the Burr Unit is present in the southwestern corner of T.114 N., R.46 W., and the northwestern corner of T. 13 N., R.46 W. According to Berg (Berg, 1997a), Well #87-7 (NW ¼, SW ¼, SW ¼, section 28, T. 114 N., R. 46 W.) penetrated 139 ft of fine to very coarse sand (from a drilling depth of 68 ft to 204 ft). In addition, Well #41-1 (section 6, T. 113 N., R. 46 W.) drilled 35 ft of medium sand (277 ft to 312 ft). Further to the southeast, Well #42-2 (SE ¼, SE ¼, NE ¼, section 27, T.111 N., R. 43 W.) penetrated coarse to very coarse sand and gravel with beds of cobbles from a drilling depth of about 58 to 109 ft. Sample descriptions of the materials penetrated by Berg suggest that they would likely have very good aquifer characteristics. This well and Well #87-7 lie along a general northwest-southeast trend that conforms with the configuration of thick Prairie Coteau aquifer reported in north-central Deuel County, SD, by Kume (1985). Although additional drilling would be required to confirm the presence of similar outwash deposits between wells 87-7 and 42-2, it seems likely that the Burr Unit is present there.

Environmental Consequences

Even though geologic borings of the Burr Unit indicate that there is a stacking of outwash sediments of varying grain-size distributions, it is likely that these sediments are hydraulically connected and that the formation acts as one hydrological unit (Berg, 1997a). A proposal being explored in this EIS is whether the aquifers in the area south of the Burr Well Field (Burr Unit and the Altamont) could support a supplemental well field that could provide raw water for transport to the Burr Water Treatment Plant for treatment and distribution to LPRW customers. If an additional well field is developed in this area, then the cone of depression that would develop around this well field could affect any fens in that area by reducing the potentiometric surface. Because the geologic and hydraulic conditions found at the Burr Well Field extend south-southeast along the face of the Coteau it is likely that fens could exist in this area as well. MNDNR performed some initial field screening for fens in this area and found areas in sections 21 and 22, T.114 N., R. 46 W. in Yellow Medicine County along Canby Creek that may be upon further study be classified as calcareous fens or seepage fens (MNDNR, 1997, Attachment 15). Evaluations further south and west in sections 20, 28, 29, 30 did not locate any areas that could be potential fens.

If a well field was developed in section 28 in southwestern Yellow Medicine County, it is thought that the overlap between the cone of depression that would develop from the new well field and the Burr Well Field's cone of depression, as projected from the June 1996 1,500-gpm, 7-day pump test, would be small. If the well field were developed in the southern portions of either section 32 or 33, or the western half of section 34, it is unlikely there would be overlap between these cones of depression.

Development of another well field in the Burr Unit could be advantageous to the overall aquifer systems by "spreading out" the effects from the cones of depression produced by production wells. It is these cones of depression that directly affect groundwater discharges to surface water resources. By minimizing the drawdown effects of these cones, potential adverse effects to surface water resources could be minimized or potentially avoided. The areal extent of the cones would be larger, because multiple well fields are being pumped, but the potentiometric surface would not be drawn down as much. By managing aquifer appropriations from multiple well fields and multiple aquifers, it would be possible to withdraw greater volumes of water (than currently permitted at the Burr Well Field) from the aquifer system as a whole. This could potentially meet LPRW's long-term water supply needs and at the same time minimizing the potential for adverse environmental effects to surface water resources in the area. This is particularly feasible if, as is discussed in Section 3.2.1.3, the Altamont aquifer is utilized in this new area in greater volumes than it is now at the Burr Well Field.

The direct effects of establishing another well field in this area would require test drilling and well development activities. Because of invasive well exploration activities and the need to create access roads, test drilling would affect the drill sites and the access routes to those sites. Soil and vegetative renovation of these sites would likely be complete after 1 or 2 years. Test borings not developed into production wells would be plugged so that the borings do not become conduits for contamination from the land surface into the aquifer. The production well and two observation wells that would be needed to test the aquifer could be removed if the tests do not lead to a production well field. In the event that a well field is developed, the test well could be developed into a production well, and the observation wells could be retained for monitoring drawdowns in the potentiometric surface at the new site. If the well field is not developed the borings could be plugged in a few days, and the sites completely renovated in 1 or 2 years.

Development of a well field would require construction of infrastructure. Two or more production wells would be completed, well heads and pumps would be installed, and roads, pipelines, and power lines would be constructed. In addition, a small service building and a perimeter fence would be located at the site.

3.2.1.3 Altamont Aquifer

Affected Environment

The Altamont aquifer (basal Quaternary unit of Berg, 1997a) is a widespread sheet of outwash materials directly overlying Cretaceous-aged bedrock in southwestern Minnesota (Berg, 1997a) and southeastern South Dakota (Kume, 1985, Fig. 15). The materials that form the Altamont were deposited by meltwater that flowed away from the advancing glaciers during the initial advance of the last great ice sheet. The well that tested the Altamont at the Burr Well Field penetrated beds of densely packed silt and sand and the groundwater was under artesian conditions. The fine-grained nature of the aquifer materials coupled with a thickness of only 15 to 20 ft limit the yield of this aquifer at the Burr Well Field to levels well below that of the Burr Unit at this same location.

According to Kume (1985), the Altamont aquifer is more than 80 ft thick in the southwestern corner of T. 114 N., R. 46 W., Yellow Medicine County, MN. The sample log from a USGS observation well, DU-73A, (NE¼, NE ¼, NE ¼, Section 32, T.114 N., R.47 W. (Leisch, 1996)) indicates that outwash sediments described in the log as gravel, medium to coarse and coarse sand in the Altamont aquifer are 101 ft thick starting at 459 ft.

LPRW is currently producing more than 400 gpm from this unit at the Burr Well Field where it is about 18 ft thick. Sand thicknesses range from 0 to more than 100 ft in adjacent areas of Deuel County, SD (Kume, 1985). Well 41-1 (section 6, T. 113N., R. 46 W.) (Berg, 1997a) penetrated 35 ft of this unit (from 461 ft to 496 ft), and Well 87-7 (section 28, T. 114 N., R. 46 W.) drilled through 38 ft (355 ft to 393 ft) of silty, very fine to coarse sand. Information from these wells and Well 87-8 (section 34, T. 114 N., R. 46 W.) coupled with data from South Dakota (Kume, plate 15) show that the basal Quaternary sand (Altamont aquifer) is a widespread unit that ranges up to 100 ft in thickness. Based on production data from the Burr Well Field (R. Rassmussen, personal communication, 1997), where the Altamont consists of 18 ft of densely packed silt and fine sand, indications are that, in areas where the aquifer is thicker and composed of coarser-grained sediments, it would be capable of producing significant volumes of water.

Environmental Consequences

Even though the Altamont aquifer is under similarly confined conditions as the Burr Unit, there is no indication that this aquifer contributes to surface water discharges that occur from the Burr Unit. This fact is critical in that surface water resources that are affected by discharges from the Burr Unit would be unaffected by withdrawals of groundwater from the Altamont aquifer. If appropriation rates from the Burr Unit were reduced for some reason, LPRW would still be able to withdraw water from the Altamont aquifer. Although the Altamont aquifer at the Burr Well Field has smaller values of transmissivity than the Burr Unit (based primarily on aquifer materials - silty sands versus coarser sand and gravel materials) and is not considered capable of sustained high yields, the characteristics of the Altamont aquifer further south are much different. Sample logs indicate that the Altamont consists of coarser-grained materials and because of its greater thickness it could potentially be capable of supplying greater volumes of water than it does at the Burr Well Field. Therefore, instead of serving as a backup supply of water as it does at the Burr Well Field, the Altamont could in a supplemental well field scenario potentially serve as a primary source of water.

While the recharge mechanism is not well understood for the Altamont aquifer, its areal and vertical extent in the borings cited above indicate that this aquifer is an attractive target (Berg, 1997a) and offers promising potential to being able to supply municipal quantities of water.

Because of the apparent hydraulic isolation of the Altamont from the Burr Unit, its depth and overburden of relatively impermeable glacial till, no environmental impacts from the Altamont aquifer are expected from current or additional appropriations from a new field. The direct environmental effects of establishing another well field in this area will require test drilling and well development activities. As discussed above, these site disturbance activities would be minimal, of short duration and subject to additional environmental review requirements.

3.2.2 Surface Water and Biological Resources

Based on hydrological studies and a records search, the Agency has identified the following biological resources that could be affected by the continued appropriation of groundwater at the Burr Well Field and proposed expansion of LPRW:

- Lake Cochrane in South Dakota
- Calcareous fens in the vicinity of the Burr Well Field and
- Rare, threatened, and endangered species and their habitats in the vicinity of the proposed pipeline construction area, in Lake Cochrane,

and in the calcareous fens.

The study addressed whether Lake Cochrane, the calcareous fens, or habitats of rare, threatened, and endangered species would be affected by the continued or increased withdrawal of groundwater from the Burr Well Field. Also studied was the potential for changes in Lake Cochrane and the calcareous fens.

3.2.2.1 Burr Unit

3.2.2.1.1 Fens

Affected Environment

The Burr Well Field withdraws groundwater from the Burr Unit, a buried sand and gravel unit of the Prairie Coteau aquifer and, as a result of topographic settings and geologic conditions, the well field is located within an area that is under artesian conditions. Zones of varying permeability exist throughout the surficial till layer and, if sufficient hydraulic gradients exist between the land surface and the aquifer, groundwater discharges onto the land surface creating numerous groundwater-fed wetlands, springs, and sideslope seep areas. A group of these groundwater-fed wetland areas exhibits characteristics that are within the classification criteria of calcareous fens, as defined in the MNDNR's *Technical Criteria for Identifying and Delineating Calcareous Fens in Minnesota*, (MNDNRa, 1995).

Calcareous fens are listed as "Outstanding Resource Value Waters" in Minnesota's Rules 7050 and are protected under the Minnesota Wetland Conservation Act of 1991 (Minn. Stat. 103G). This act states, "Calcareous fens may not be drained or filled or otherwise altered or degraded except as provided for in a management plan approved by the [MNDNR] commissioner" (Minn. Rules 7050.0180). As of 1991, 72 areas in 27 Minnesota counties have been identified by the Minnesota Pollution Control Agency as calcareous fens under the Outstanding Resource Value Waters definition (USACE/MPCA Section 404/401, Enclosure 1, Administration Manual for Minnesota Wetland Conservation Act).

The calcareous fens in the study area are characterized by a partially mineralized peat mass through which a groundwater discharge (a "spring head") occurs in numerous areas throughout the peat mass. This peat mass is referred to as a fen dome. Because of the hydraulic gradient that exists between the Burr Unit and land surface, groundwater typically discharges diffusely through out the fen. In some cases, water exits through channels in the dome, flows over the side slopes of the dome, or flows through diffuse lateral flow outward through the peat mass. Figure 3-5 is a schematic of a generalized calcareous fen (Peterson, 1995).

FIGURE 3-5 GENERALIZED SCHEMATIC OF CALCAREOUS FENS

Source: Peterson, Field Evaluation of Known and Proposed
Calcareous Fens, Yellow Medicine County, Minnesota., 1995

When plants growing in the fen shed leaves or die, their remains contribute to a deposit of peat. This is organic matter that is partially decayed and continues to decay very slowly because of a lack of oxygen. This occurs in a fen, because the groundwater that saturates the fen soil is very low in oxygen. Thus, the elevation of a fen will tend to rise in two ways: minerals are carried to the surface in the water, precipitated, and are deposited as solids at the surface, and the remains of plants accumulate as peat. For a discussion of the specific geochemical relationships that occur at the fens see the report prepared by Peterson Environmental Consulting, Inc. (Peterson, 1995). Some fens have a distinct form of a 5- to 10-ft-high mound, with one or more springs of water emerging at the top of or various locations within the mound. However, other processes act to control the buildup of a fen, including:

- Fresh mineral deposits are not rock-like, but are relatively soft and can be washed away by the spring water or by rainstorms or snowmelt.

- The mineral deposits will be compressed as new material is deposited on top and older deposits solidify becoming hard.

- The peat deposits also compress under the weight of new material on top. Peat further diminishes in size as it slowly decays.

- Hydraulic head available at the base of the peat.

A fen exists only where groundwater is discharging onto the land surface and where water is able to ultimately flow away from the fen, e.g., water must not be able to inundate or pond in the area where the discharge is occurring. The surface elevation of the fen dome and the amount of groundwater available to a fen are intimately linked together. If the top surface of the fen becomes higher than the level to which the groundwater can well up, then conditions exist whereby minerals are no longer being deposited and plant materials are no longer under saturated conditions. Both of these conditions must exist for a calcareous fen to survive and thrive. If these conditions cease to exist, the plant materials would no longer be saturated and as a consequence they would decomposed more rapidly and not form peat. Thus, the size and height of a fen represents a state of equilibrium between the hydraulic head available at the points of discharge and the mass of decaying plants at the site. A fen can be described as akin to a “wet blanket” lying on the landscape without a recognizable spring head. A state of equilibrium between the volume of groundwater discharge and the height or size of the peat mass has evolved over many years and fluctuates in response to the set of environmental conditions that has allowed the fens to exist.

This unique set of conditions of groundwater flow and chemistry creates a distinct habitat for plants. Only plant species that can survive saturated conditions, low oxygen content in the soil, and alkaline conditions will grow here. It is, however, an excellent habitat for species that are calcium loving, i.e., calciphiles. Therefore, a calcareous fen tends to have a distinctive group of plant species growing on it. The MNDNR has established a list of 27 statewide calciphiles that are indicative of and used to classify calcareous fens (see Table 3-5).

TABLE 3-5 CALCAREOUS FEN INDICATOR SPECIES

Scientific Name	Common Name	Indicator Status
Carex prairea	Prairie Sedge	FACW+
Carex sterilis	Dioecious Sedge	OBL
Eleocharis rostellata	Beaked Spikerush	OBL
Rhynchospora capillacea	Needle Beakrush	OBL
Sclera verticillata	Low Nut-rush	OBL
Triglochin palustris	Marsh Arrow-grass	OBL
Carex viridula	Little Green Sedge	OBL
Caladium mariscoides	Smooth Sawgrass	OBL
Juncus alpino-articulatus	Jointed Rush	OBL
Juncus brevicaudatus	Narrow-panicle Rush	OBL
Parnassia glauca	Waxy Grass of Parnassus	OBL
Primula mistassinica	Mitassini Primrose	FACW
Salix candida	Hoary Willow	OBL
Saxifraga pennsylvanica	Swamp Saxifrage	OBL
Scirpus cespitosus	Tufted Bullrush	OBL
Tofieldia glutinosa	Sticky False Asphodel	OBL
Valriana edulis var. ciliata	Edible Valerian	FACW+
Cardamine bulbosa	Bulbous Bitter Cress	OBL
Carex granularis	Meadow Sedge	FACW+
Carex hystericina	Porcupine Sedge	OBL
Carex interior	Inland Sedge	OBL
Carex stricta	Uptight Sedge	OBL
Liparis loeselii	Fen Orchid	FACW+
Lobelia kalmii	Brook Lobelia	OBL
Oxypolis rigidior	Stiff Cowbane	OBL
Parnassia palustris	Northern Grass of Parnassus	OBL
Potentilla fruticosa	Shrubby Cinquefoil	FACW
Triglochin maritima	Seaside Arrow-grass	OBL

Artesian conditions necessary to produce settings conducive for calcareous fens exist throughout the eastern portion of the areal extent of the Burr Unit. Six distinct fen complexes have been identified and four (Sioux Nation, Fairchild, South Dakota #2 and #5 fens) were monitored during previously performed pump tests. The Cleveland Fen is located 0.2 miles north of the Burr Well Field.

The Fairchild Fen is located 0.5 miles east of the Burr Well Field. The Sioux Nation Fen is located in the northwest quarter of section 17, T.114 N., R.46 W. (Fortier Township, MN). The Livermore Fen is located 0.3 miles north of the Sioux Nation Fen in section 8 of Fortier Township. The South Slough Fen is located on the shore of South Slough in the southeast corner of section 9, T.114 N., R. 47 W. (Norden Township, SD). The Lynch Fen is located in the southeast corner of section 8 (Norden Township, SD).

The Fairchild, Sioux Nation, Livermore, and South Slough Fens are located in level to nearly level ground and exhibit well-developed domes. The Lynch Fen is located at the top of a swale and has been somewhat degraded by livestock and past attempts to drain it. The Cleveland Fen has been significantly affected by drain tiles that were installed to drain it and by livestock that have broken down the side slopes of the fen dome. The Fairchild fen has also been minimally affected by past agricultural activities (installation of a livestock watering device). Drain tile records previously maintained by the USDA, Natural Resource Conservation Service indicate that a subsurface drainage tile exists at this fen location. Despite these disturbances, the fen is apparently not being adversely affected.

Sioux Nation, Livermore, Fairchild, and Cleveland Fens

As mentioned above, four calcareous fens have been identified near the Burr Well Field: the Sioux Nation, Livermore, Fairchild, and Cleveland Fens. Baseline vegetation surveys of the four fens were conducted from 1994 to 1995. A total of 93 plant species were identified at the Sioux Nation Fen, 47 species at the Livermore Fen, 49 species at the Fairchild Fen, and 35 species at the Cleveland Fen. The Minnesota calcareous fen indicators that were identified at the four fens are in Table 3-6.

TABLE 3-6 MINNESOTA CALCAREOUS FEN INDICATOR SPECIES IDENTIFIED

Scientific Name	Common Name	SN[1]	L[2]	F[3]	C[4]
Cardamine bulbosa	Bulbous Bitter-cress	✓	✓	✓	✓
Carex interior	Inland Sedge	✓	✓	✓	✓
Carex prairea	Prairie Sedge	✓	✓	✓	✓
Juncus brevicaudatus	Narrow-panicle Rush				✓
Liparis loeselii	Fen Orchid	✓		✓	
Lobelia kalmii	Brook Lobelia	✓	✓	✓	✓
Parnassia glauca	Waxy Grass-of-parnassus	✓	✓	✓	✓
Rhynchospora capillacea	Needle Beakrush	✓	✓	✓	✓
Salix candida	Hoary Willow	✓	✓	✓	✓
Triglochin maritima	Seaside Arrow-grass	✓	✓	✓	✓
Triglochin palustris	Marsh Arrow-grass	✓	✓	✓	✓

Source: Janssens and Noble, 1996.
1. SN = Sioux Nation Fen
2. L = Livermore Fen
3. F = Fairchild Fen
4. C = Cleveland Fen

For the Sioux Nation Fen, eight ecotypes, e.g., habitats, were classified according to the predominant fen species identified from the survey. Permanent survey areas were established within these ecotypes, including a permanent area to monitor unique plant assemblages. The data from the permanent survey areas will provide a baseline for future surveys to assess any changes in the fen vegetation.

Rare, Threatened, and Endangered Species

No federally listed rare, threatened, or endangered species have been identified at or associated with the fens. However, several plant species have been identified and listed by Minnesota on State lists as either rare, threatened or species of special concern. Although important these species are not regulated or afforded protection under the federal Endangered Species Act. Table 3-7 lists the species that have been identified in the fens and their status on the State's list.

TABLE 3-7 STATUS OF PLANT SPECIES FOUND IN FENS LISTED ON STATE LISTS

Plant	Family	Classification on MN State Lists
Carex Stricta	Cyperaceae	Threatened
Cladium mariscoides	Cyperaceae	Special Concern
Cyprpedium candidum	Cyperaceae	Special Concern
Eleocharis rostellata	Cyperaceae	Threatened
Rhynchospora capillacea	Cyperaceae	Threatened
Rhynchospora fusca	Cyperaceae	Special Concern
Scleria verticillata	Cyperaceae	Threatened
Triglochin palustris	Juncaginaceae	Rare
Valeriena edulis var. ciliata	Valerianaceae	Threatened

Source: MNDNR, 1997; Attachment 34

Environmental Consequences

In the vicinity of the LPRW well field, the Burr Unit is under artesian conditions. The potentiometric surface of this system ranges from about 1,690 ft east of the well field to about 1,695 ft 2 miles west of Lake Cochrane. Detailed investigations of water chemistry, changes in hydraulic head during pump tests, tritium content of aquifer water and water being discharged at the Fairchild and Sioux Nation Fens, and age dating of aquifer water and water from these fens are evidence that they are maintained by groundwater discharges from by the Burr Unit. Moreover, the potentiometric surface of this aquifer stands about 10 ft above the ordinary high water mark (OHWM) of Lake Cochrane and a variable distance above other lakes and wetlands in the area.

Even though only the Fairchild, Sioux Nation and South Dakota #5 Fens have been shown through studies to be hydraulically connected to the Burr Unit, it is likely that the other fens in the area overlying the Burr Unit are similarly supported and that they could be affected if the potentiometric surface is reduced, at a minimum, below the surface elevation of the fen dome by pumping at the Burr Well Field

If the groundwater inflow into a calcareous fen were to change significantly, then the fen's structure and character could change significantly. As discussed above, the groundwater brings to the surface dissolved minerals that add to the mass of the fen. If the amount of water flowing into the fen changes, then the amount of minerals deposited will change. In addition, if the pressure that causes the water to rise were to decrease via a reduction in the potentiometric surface, then it might not rise above or to the surface of the fen. The top layer of the fen would no longer be saturated with oxygen-poor groundwater. The decay of plant material in this layer could then proceed more quickly, and the mechanisms of producing peat would be altered, potentially causing a reduction in the size and height of the peat dome structure.

These effects would tend to halt the buildup processes of the fen. Compaction, erosion, and decay would still occur, however, at an accelerated rate, so the net result could be a subsidence in the level of the fen surface. The fen could, therefore, get lower. Depending on how much the groundwater level has decreased, the fen surface might or might not ever reach a new level at which the buildup processes equaled the compaction, erosion, and decay processes.

The change might, however, be more profound than "merely" lowering the level of the fen. As the top portion of the fen "dries out," i.e., the groundwater no longer reaches a high enough level to saturate it; the plant community may change. The species that grow there because they are adapted to saturated and calcium-rich soil materials may be replaced by other species better adapted to drier conditions. The unique mix of plant species that characterizes a calcareous fen could be replaced by a much less distinctive or diverse mix of plants, perhaps more typical of the surrounding drier land. However, if the level of the fen dome and groundwater were to reach and stabilize at a new level of equilibrium, species that invaded the portions of the fens that were no longer saturated would then again be outcompeted by the species that are able to survive the chemical and saturated conditions that presently exist at the fens.

The cone of depression that developed on the potentiometric surface of the Burr Unit during a 7-day pump test at a pumping rate of 1,500 gpm in June 1996 clearly indicated that the Burr Unit functions as an interrelated aquifer system in an area of at least 15 mi^2 with the Burr Well Field on the eastern edge of the aquifer. Although long-term continuous pumping at this rate would cause this cone to deepen and the area affected would expand, the expansion would not likely be dramatic. Because production well fields, such as the LPRW field at Burr, pump in response to demand, it is unlikely that the well field would pump at a sustained maximum rate 24 hours a day, 7 days a week, 52 weeks each year. Rather, the field would likely be pumped hardest during periods of intense use, such as during crop spraying in the spring and early summer. It should be noted that, the period of peak demand for water from the Burr Well Field coincides with the time when the water requirements of the plants in the fens are at their maximum. From fall through early spring, the system would operate with much lower average pumping rates.

The area of the most intense drawdown on the potentiometric surface during the 1996 aquifer test was at Production Well #3 where it was 27.82 ft. In the Deep Steel Well, that is located approximately 6,400 ft southeast of the Burr Well Field and close to the Sioux Nation Fen, drawdown was 4.74 ft; and at the

Christenson well on the eastern margin of Lake Cochrane, 5,200 ft west-northwest of the center of the cone, drawdown was 3.24 ft. The cone of depression is somewhat asymmetrical with relatively steep slopes on the north and northeast flanks and a lower slope to the west (see Appendix A). This configuration fits with the current understanding of the distribution of the aquifer, which, based on available well data, trends northwest-southeast across north-central Deuel County, SD, into southwestern Yellow Medicine and northwestern Lincoln Counties, MN.

Drawdown of the Burr Unit potentiometric surface across Lake Cochrane ranges from 3.74 ft at the Christenson well at the eastern margin of the lake to about 1 ft at the western end of the lake. Before pumping, the potentiometric surface stood about 10 ft above the OHWM of this lake. After pumping the Burr Well Field at 1,500 gpm continuously for 7 days, the potentiometric surface was still 6 ft above the lake surface along the eastern margin and more than 8 ft above the lake surface at the western margin of the lake.

Production pumping toward the end of a protracted drought could be expected to cause the most extreme lowering of this surface. Because no data are available for either recharge rates into the aquifer or aquifer performance during protracted droughts, it is not possible to predict with certainty how the aquifer will respond to long-term production pumping combined with drought conditions. The size of the hydraulically connected portions of the Burr Unit and its response to extended pump tests indicate, however, that based on the limited data available, withdrawal rates similar to current production pumping (400 – 525 gpm) should not cause the aquifer to be excessively dewatered. In addition, the thickness and areal extent of the aquifer suggest that sufficient water would be present within it to sustain pumping for the duration of a limited drought.

Long-term monitoring of the fens will be required before the impact of pumping on these features can be established. Because the Fairchild and Sioux Nation Fens are situated more than 30 ft below the potentiometric surface at Burr Well Field, it seems unlikely that production pumping at current rates of 400-525 gpm will have other than minimal effects on these resources. Fen #5 near the southern shore of South Slough is also situated well below the potentiometric surface and minimal effects would be expected from such pumping rates. Fen #2 is located at an elevation of about 1,680 to1,690 ft some 50 to 60 ft below the top of a hill composed of glacial materials. Because of this physical setting, it is possible that Fen #2 is fed from groundwater that accumulates in this hill, rather than by discharge from the Burr Unit of the Prairie Coteau aquifer.

As part of the conditions for the water appropriation permit for the Burr Well Field, MNDNR established impact thresholds for the Sioux Nation and Fairchild Fens. The thresholds comprise limits on hydraulic gradients, fen dome subsidence, and water table elevations (MNDNR, 1995b). MNDNR established these thresholds with the objective to ensure that upward hydraulic gradients were maintained at the fens; no subsidence in the peat dome occurred; and monitoring wells installed in the fens indicated the hydraulic head and water tables in the fens remained above the surface elevations of the fen dome. Thresholds have not yet been established for the Cleveland or Livermore Fens.

The only threshold that was exceeded during any of the pump tests was a shallow water table monitoring well in the Fairchild Fen. MNDNR did not consider this occurrence to have exceeded the established thresholds. The thresholds in the wells used to monitor water tables are set to ensure that water levels in the fen domes exceed the surface elevation of the dome. Over the last few years the surface elevation at the fen dome has decreased slightly. This change in elevation in the dome meant that water levels in the water table well could be lowered by a corresponding amount without causing the top of the dome to dry out. As long as the objective of keeping the fen dome saturated and that the water table exceeded the surface elevation of the dome, MNDNR did not consider that the threshold was exceeded (MNDNR, 1996).

The most important factor that has created conditions necessary for fen formation is the discharge of groundwater from the Burr Unit onto the land surface. Groundwater discharges are dependent on two factors:

- the potentiometric surface of the Burr Unit must be above the land surface; and
- A permeable conduit between the aquifer and land surface must be present.

Generally speaking, where these two conditions exist, fens have formed. As discussed, the most crucial issue necessary for ensuring the ecological integrity of fens is that sufficient hydraulic head is maintained within the peat dome mass. This material must remain saturated in order to preserve and allow the unique assemblages of plants that exist on the domes to remain viable.

The various pump tests that have been performed have clearly demonstrated and established that a hydraulic connection exists between the Burr Unit and the fens; furthermore, reductions in the potentiometric surface caused by pumping at the Burr Well Field causes reciprocal responses in the hydraulic head measured in observation wells and piezometers installed in and adjacent to selected fens.

Monitoring wells and piezometers have been installed adjacent to and in the Sioux Nation Fen. Figure 3-6 shows the locations of three piezometers installed directly in the top of the Sioux Nation Fen dome. These piezometers are numbered as Sioux Nation Fen Dome 1 (water table); Sioux Nation Fen Dome 2 (intermediate); and USGS Dome (deep). These piezometers have been installed at various depths in the fen dome in order to evaluate changes in the hydraulic gradients within the peat mass. Data has been collected using both data loggers and hand measurements. Figure 3-7 is a plot collected in all three piezometers from the Spring - Summer, 1991 to April 1994.the Fall, 1996. Dates vary because the installation dates of the piezometers differed. Figures 3- 8 to10 show individual plots of the data from each of the piezometers; the period of observation extend from Spring – Summer, 1991 and Summer 1992 - Fall 1997. The dates of the three most recent pump tests and surface elevations of the fen dome at the piezometer locations have been plotted on the Figures.

FIGURE 3-6 SIOUX NATION FEN DOME WELL AND PIEZOMETER LOCATIONS

Source: MNDNR, Burr Well Field
Aquifer Test Analysis, 1994

FIGURE 3-7 SIOUX NATION FEN HISTORIC WATER LEVELS IN PIEZOMETERS

Source: MNDNR, Burr Well Field
Aquifer Test Analysis, 1994

FIGURE 3-8 SIOUX NATION FEN DOME 1 PIEZOMETER (WATER TABLE)

Source: MNDNR, 1997, Attachment 39

FIGURE 3-9 SIOUX NATION FEN DOME 2 PIEZOMETER (INTERMEDIATE)

Source: MNDNR, 1997, Attachment 39

FIGURE 3-10 SIOUX NATION FEN USGS DOME PIEZOMETER (DEEP)

Source: MNDNR, 1997, Attachment 39

The plots created from the data collected from all three piezometers indicate the magnitude of responses from the three pump tests. Table 3-8 summarizes this information from the June 1996 1,500 gallon per minute pump test.

TABLE 3-8 RESPONSES OF HYDRAULIC HEADS AT FENS IN PIEZOMETERS DURING 1996 PUMP TEST

Piezometer	Surface Elevation of Fen Dome (ft)	Head Elevation at Start of Test (ft)	Decline in Head During Test (ft)	Head Elevation above Dome at Maximum Drawdown (ft)
Sioux Nation Fen Dome 1 (water table)	1659.30	1659.94	-0.05	+0.59
Sioux Nation Fen Dome 2 (intermediate)	1659.50	1660.41	-0.03	+0.88
Sioux Nation USGS Deep	1659.40	1661.09	-0.14	+1.55

Source: MNDNR, 1996; Attachment 39 and 1994.

The data shown in Figure 3-7 and Table 3-8 clearly illustrate that the Sioux Nation Fen is in an area of groundwater discharge with a strong upward gradient that diminishes from the deep (USGS Dome Well) to the shallowest well (Dome 1). During the 1993 pump test the water level in the Dome 1 well remained between 0.5 – 0.6 ft above the surface of the fen dome; this is consistent with the 1996 test. The head decline in the 1993 pump test at the USGS Deep well was 0.06 ft; even during the maximum drawdown from the test, the head elevation above the surface of the dome was 1.19 ft. This compares with 1.55 ft during maximum drawdown at during the 1996 test. The implication of this information is clear. During the last three pump tests and production pumping for at least the last 3 years, the effects or impacts from pumping at the Burr Well Field at the Sioux Nation Fen have been extremely minor measured largely in hundredths of an foot. At no time did the hydraulic head or water table elevations fall close to or below the surface elevations of the peat domes.

During the June 1996 pump test, the MNDNR reported in field notes taken on July 2 (the day the 7-day test ended) that areas on the west side of the Sioux Nation Fen that are reported to normally have standing pools of water were dry but yet on July 5 these pools returned. Data collected at the Sioux Nation Fen during this test indicated that declines in the three piezometers ranged from 0.03 – 0.15 ft and the water levels in the piezometers remained 0.59 – 1.55 ft above the surface of the fen dome at all times. The information provided concerning the pools is not consistent with the measured hydraulic conditions during the test. In order for this type of information to be scientifically valid, the information needs to be gathered and reported in a more scientifically rigorous manner, e.g., the pools should be identified and measured before, during, and after the test. In addition during the pump test period, rainfall data reported by Al Bender, South Dakota State Climatologist's office in Brookings, SD indicated that the Canby area received 0.72 inches of rain. Rainfall was measured in 5 out of 7 days during the test. Based on the measured hydraulic conditions in the piezometers in the fen dome and the rainfall data, the Agency can offer no explanation or response to the reported drying of pools in the dome except to say that it appears unlikely that pumping from the Burr Well Field during the pump test could have caused the pools to dry up. If the MNDNR feels that this anecdotal information is significant, then a more controlled and systematic sampling and data gathering mechanism should be implemented to verify these observations.

Mitigation

In the Agency's opinion, piezometer nests such, as the one installed in the Sioux Nation Fen, are the best tool available for directly measuring effects to the fens from production pumping at the Burr Well Field or any other well field that might be developed. Because of the complexity of analyzing effects on the fens, the fact that piezometers provide direct measurements of the hydraulic gradients in the fen dome (which appear to be the most important factor in determining the ecological sustainability of a fen) suggests that this type of monitoring is highly desirable.

Data collected from these piezometers could be compared and correlated with the potentiometric surface levels as monitored in observation wells screened in the Burr Unit and LPRW pump logs. This information could form the basis for a long-term monitoring effort designed to comprehensively manage groundwater withdrawals from the Burr Unit aquifer.

To determine the natural variations of a fen ecosystem, it is recommended that a relatively undisturbed fen located outside the area of influence of a cone of depression be selected to serve as a "control" fen. A piezometer nest could be installed in this fen and data collected from this fen could be used to compare and correlate data collected from fens within the Burr Well Field's cone of depression.

Previous vegetation studies performed by Janssens and Noble (1996) and others at the Sioux Nation Fen have established an excellent baseline data set for evaluating whether any changes in plant species over time are induced by production pumping at the Burr Well Field or by naturally occurring conditions. It is assumed that the MNDNR will continue to monitor and update the evaluations based on this study to assess any changes in the calciphile populations at the fens. Should changes occur in the plant communities and if these changes were determined to be caused by pumping, then the MNDNR would be able to modify LPRW's permit conditions.

Monitoring of the Sioux Nation and Fairchild Fens needs to continue within the context of a comprehensive water resources management plan. The management plan, which should include monitoring well data and weather data, would enable LPRW and the Minnesota and South Dakota natural resource agencies to assess on a real-time basis, immediate and long-term affects of withdrawals from the Burr Well Field. See section 3.2.3 for a discussion of this plan.

3.2.2.1.2 Lake Cochrane

Affected Environment

Lake Cochrane is a public recreational fishing lake owned by the State of South Dakota and managed by the South Dakota Department of Game, Fish, and Parks (SDDGFP). The primary fish species in the lake are walleyes (*Stizostedion*), hybrid sunfish, largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescnes*), and northern pike (*Esox lucius*). Other species include green sunfish (*Lepomis cyanellus*), fathead minnow (*Pimephales promelas*), banded killifish (*Fundulus diaphanus*), white sucker (*Catostomus commersoni*), black bullhead (*Ictalurus melas*), muskellunge (*Esox masquinongy*), and carp (*Cyprinus carpio*) (SDGFP, 1994).

During the height of vegetation coverage in mid-summer, about 50% of the lake bottom is covered by submerged plants, such as wigeon grass, stoneworts, and muskgrass. Emergent vegetation covers less than 5% of the shoreline. The large amount of submergent plants provides abundant cover for panfish, e.g., hybrid sunfish, bluegill, green sunfish, and yellow perch. This protects them from predators that would otherwise control the panfish populations and results in an overabundance of these smaller fish. To improve the populations of sport fish, the State has been removing panfish from Lake Cochrane since 1994. Under the current State of South Dakota management plan, the State will remove about 40% of the panfish biomass, by weight, annually until 1999 (SDSU, 1993).

Since 1983, South Dakota has stocked Lake Cochrane at various times with northern pike, walleye, muskellunge, and largemouth bass (SDDGFP, 1995). Under the current management plan, the lake is and will be stocked with about 9,000 walleye and 18,000 largemouth bass annually until 1999 (SDDGFP, 1994).

Since 1993, Lake Oliver has overflowed into Lake Cochrane. Lake Cochrane overflows to a wetland and then into Culver Lake. The nearby South Slough also flows into Lazarus Creek via a separate stream channel.

During the period from the early 1950's until 1993, Lake Oliver did not overflow into Lake Cochrane. In the intervening years prior to 1993, the natural waterway between Oliver and Cochrane was filled in. In 1993, in response to high water levels in Lake Oliver from high levels of precipitation and in the absence of the natural waterway that was filled in, a 12-inch plastic culvert was installed to help drain Lake Oliver into Lake Cochrane.

In 1972, a 2-ft diameter metal culvert, drop structure was constructed as the Lake Cochrane outlet. Because of flooding problems, construction of a new Lake Cochrane outlet was completed during March 1996. A new Lake Oliver outlet is scheduled to be constructed during September to November 1997. The new outlets are sized to release flood water from a 100-year, 24-hour storm within 5 days (Hatch, personnel communication, 1997).

The environmental concerns at Lake Cochrane include, in order of priority, a large amount of submergent vegetation, some septic leachate from shoreline residences, moderate siltation problems, and algal blooms, which are sudden, overabundant growths of microscopic floating plants (SDDGFP, 1994).

Rare, Threatened, and Endangered Species

No federally listed threatened or endangered species have been identified in Lake Cochrane. Two fish species listed as endangered in South Dakota on state lists have been found in Lake Cochrane: the banded killifish (*Fundulus diaphanus*) and the central mudminnow (*Umbra limi*) (SDDGFP, 1996). The banded killifish was last sighted in the lake in 1991, and its population has been fluctuating since 1989. Its reproduction, population potential, and condition are rated as poor in Lake Cochrane (SDDGFP, 1994). The central mudminnow was last sighted in 1978, and its current status is unknown.

The banded killifish attains a maximum length of about 3 in. It is found from South Carolina north to the Maritime Provinces and Newfoundland, west through New York, Pennsylvania, and southern Canada within the Great Lakes Basin, to the Yellowstone River in eastern Montana. It has been reported in Charles Mix, Day, Deuel, Fall River, Roberts, and Union Counties in South Dakota. Habitat for the banded killifish ranges from quiet waters of lakes and ponds with lots of vegetation to muddy streams without vegetation. This species spawns in late spring and summer, with egg clusters attaching to plants by filaments. Where abundant, it may be a significant prey for northern pike and fish-eating birds, such as the kingfishers. The banded killifish has experienced reduced habitat due to wetland drainage (Ashton and Dowd, 1991).

The size of the mature central mudminnow ranges from 2 to 7 in. It is found throughout central North America; South Dakota is on the western edge of its range. It has been reported in Brookings, Day, Deuel, and Roberts Counties in eastern South Dakota. The central mudminnow is found in heavily vegetated parts of small creek pools, where the bottom has a thick layer of muck. It is very tolerant of harsh conditions, such as low oxygen levels and high water temperatures. The central mudminnows are eaten by pickerel, northern pike, and sunfishes, as well as birds and foxes. The amount of suitable habitat for the central mudminnow has been reduced by drainage and alteration of densely vegetated streams and creeks (Ashton and Dowd, 1991).

Environmental Consequences

Concern has been expressed that production pumping of the Burr Unit at the Burr Well Field may affect Lake Cochrane as well as the fens in the area. The impact of production pumping at the Burr Well Field can be assessed by considering the changes in the hydraulic head that were imposed on the potentiometric surface during the 1,500-gpm, 7-day aquifer test conducted in the summer of 1996. Before pumping was started at the Burr Well Field, the potentiometric surface of the Burr Unit (as recorded in observation wells around Lake Cochrane) stood 10 to 12 ft above the OHWM of Lake Cochrane. Drawdown at Lake Cochrane during this test ranged from over 3 ft at the Christenson well on the eastern margin of the lake to about 1 ft in Well 94-15 at its western margin. For the sake of calculation, assume that the potentiometric surface was 10 ft above Lake Cochrane prior to the test, if the potentiometric surface declined 1 ft in the western portion of the lake the reduction in the head is 10% and if the lake were receiving groundwater from the Burr Unit, this would correspond to a 10% reduction in the volume of water discharging into the lake. Likewise, if the potentiometric surface declined 3 ft in the eastern portion of the lake this would correspond to a 33% reduction in head and, again, if the lake were receiving groundwater it would represent a 33% reduction in the amount of groundwater the lake would receive.

In an attempt to estimate a groundwater contribution to Lake Cochrane, staff from the SDDENR, Geologic Survey developed a basic water budget analysis for Lake Cochrane. Calculating water budgets for lakes is a very imprecise art. The factors used to calculate this budget are natural phenomena that vary spatially and as a function of time. Moreover, these factors are commonly not measured in many localities and, as a consequence, must be estimated across broad areas.

Due to the variability of estimated parameters there are inherent risks involved in relying on data inputs in calculations that are based on data points estimated across large areas and not measured directly. For example in determining a value to use for the “runoff” parameter in the water budget equation, SDDENR used values ranging from 0.8 in/yr – 1.5 in/yr. This range included the value of 0.55 in/yr estimated and provided by the USDA, Natural Resource Conservation Service. The range of values for runoff used in these calculations are such that the 1.5 in/yr value is more than 93% greater than the 0.8 in/yr. Each of the factors included in the water budget calculations have similar magnitudes of variability. While not meant to be a criticism of SDDENR, the concern on using data inputs in calculations that are based on data points estimated across large areas and not measured directly is a common concern in the modeling of natural phenomena. The point to make is that until the parameters used in a water budget calculation are more directly measured an accurate assessment of the role groundwater plays in the budget is limited.   It should be noted that even using a wide range of data values for the parameters used in their water budget analysis, SDDENR was unable to calculate a scenario whereby Lake Cochrane's water budget was able to balance without a groundwater contribution. This information is certainly valuable in that it assists in making a reasoned analysis where limited data and evidence is available on Lake Cochrane and what effect pumping at the Burr Well Field could have on the water budget of the lake.

In addition to their water budget analysis, SDDENR analyzed and calculated the drainage area to lake surface ratios of 110 public lakes in South Dakota (Pence, 1995). The comparisons of these lakes indicated that 99 of the 110 lakes have ratios that are greater than 10:1 and the remaining 11 have ratios less than 10:1. Of those with ratios less than 10:1, 9 were greater than 4:1 – Lake Cochrane's ratio was the lowest at 2.4:1. Of the 11 lakes that had ratios less than 10:1, 9 lakes were located in glacial outwash with known hydraulic connections to shallow groundwater. The remaining two lakes consisted of one lake that was reported to be receiving groundwater contributions through flowing wells and the last one was Lake Cochrane.   Based on this analysis, SDDENR concluded that the limited drainage area of Lake Cochrane is insufficient to maintain lake levels from surface water runoff alone and, therefore, the lake's water budget was unable to be balanced without a groundwater contribution.

Ostracods are minute arthropods (joint-legged organisms akin to insects, crabs, and spiders) that have two shells or "valves" that enclose their bodies and give them the appearance of tiny clams.

Although it is not possible to quantify flow from groundwater sources without extensive data gathering, according to Dr. Allison Smith of Kent State University (personal communication, 1997), the assemblage of ostracods found at Lake Cochrane is consistent with a lake-wetland setting that is receiving groundwater. These organisms can be very sensitive environmental indicators and respond to natural changes in water quality. According to Dr. Smith, some of the Lake Cochrane ostracods are a variety that is known to thrive in groundwater seeps and springs along the shoreline of lakes. She suggests that the "lake may be a through-flow lake and perhaps if there are no other shallow unconfined aquifers in the area, it is likely there are fractures through which the water in the artesian aquifer reaches the lake" (December 16, 1993 letter to SDDENR).

The above information summarizes SDDENR's analyses supporting their conclusion that Lake Cochrane's water budget does not balance without a groundwater contribution. The Agency does not dispute that it is likely that Lake Cochrane is receiving contributions to the lake's water budget from groundwater sources. It is likely that Lake Cochrane is receiving groundwater from both shallow and deeper (Burr Unit) sources. In general, while agreeing with the general conclusions drawn from SDDENR's water budget analysis, the Agency believes that SDDENR could provide greater weight to the contributions offered as runoff from the variable source areas associated with the streams at the western and southwestern margins of the lake and any adjacent wetland areas. Simplified calculations of surface water runoff often downplay the contributions these areas can add to an overall water budget.

In addition as Figure 3-4 portrays and test borings indicate (Pence, 1995), the eastern portion of Lake Cochrane and areas eastward formed within a stagnation moraine. Evidence that localized, permeable zones exist within the stagnation moraine can be found by the numerous groundwater-fed wetland areas (fens), springs and seeps located in the area including and east of Lake Cochrane and in areas continuing south-southeastward along the flank of the Coteau. Because these conditions exist it would also be logical to assume that numerous laterally positioned permeable zones could exist in these same areas. The presence of these zones around Lake Cochrane could and likely do provide additional groundwater contributions separate from the Burr Unit to the lake.

Another line of evidence that supports the position that Lake Cochrane is receiving some groundwater flow from a deeper source is numerous reports that Lake Cochrane turns a reddish cast after ice melt in the spring. This phenomenon could be due to the accumulation of iron-rich waters from groundwater sources in the lake during the winter months and during the spring turnover of the lake's waters the iron oxidizes causing the water to temporarily turn a reddish cast.

All of the above information, analyses and conclusions indicate that Lake Cochrane is likely receiving a portion of its water budget from groundwater. The groundwater could be from both shallow and deep sources.

The following discussion describes the biological effects that could occur to Lake Cochrane from a reduction of groundwater flow into the lake caused by production pumping at the Burr Well Field from the Burr Unit.   In addition, a general discussion of the ecological effects of man-induced changes to the lake is included.

If less groundwater were to enter the lake, a greater portion of the lake's standing water would come from surface sources, such as developed areas around the lake, runoff from surrounding agricultural areas, and, in times of high precipitation, Lake Oliver. This could change the chemical and physical characteristics of the lake water. The typical water quality of the Burr Unit is very different from that of Lake Cochrane. The water quality of both is presented in Table 3-9.

TABLE 3-9 TYPICAL WATER QUALITY OF THE BURR UNIT AND LAKE COCHRANE

	pH	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Sulfate (mg/L)
Burr Unit	7.9	157	30	9	3	389
Lake Cochrane	8.4	83	228	58	30	973

Source: Vista Technology, Inc.; water samples drawn in 1996.

A change in water chemistry, such as the concentration of dissolved solids like calcium, magnesium, iron, carbonate, and sulfate, could change the suitability of the lake for various plant and animal species. A shift in pH; a change in the temperature; the turbidity, i.e., cloudiness; or the dissolved oxygen concentration could all produce a change in the ability of various plant and animal species to grow and compete with one another. For example, submerged aquatic plants cannot grow as well in turbid water as in clear water because more sunlight can reach them. However, floating plants and algae can thrive, especially if they do not have to compete for nutrients with the shaded-out submerged plants. Changes in plant communities lead to changes in the abundance of the different species of fish and other animals that rely on algae for food or on the submerged plants for food or habitat.

Thus, a change in the "mix" of waters flowing into Lake Cochrane could change its ecological structure. However, the surface water inflows to the lake have themselves changed significantly over recent years without regard to any induced effects from the Burr Well Field. The inflow from Lake Oliver during the past 3 to 5 years, for example, has introduced water with potentially different chemical and physical characteristics into Lake Cochrane. The inflows from Lake Oliver have occurred and may continue to occur independently from any change in the groundwater inflow.

In addition, other human-induced changes in water characteristics continue to occur. Nutrients and other pollutants are apparently flowing into the lake in increasing amounts from surface runoff and from leaching of septic fields surrounding the lake. These factors are themselves sufficient to induce potentially dramatic changes in the biological communities of the lake. Excess nutrients from agricultural fertilizer runoff, for example, can cause excessive algae growth. Such "algal blooms" make the water turbid and sometimes give it a musty odor. When a bloom of algae exhausts the available nutrients, the algae die and begin to decompose. This can use up the dissolved oxygen in the lake water, resulting in harm or death to the fish.

The State's stocking and removal of fish represents a major human intervention in the functioning of the lake's ecological system. Large numbers of sport fish of various species are inserted into the lake each year; many of them are more or less promptly removed by fishermen.

Lake Cochrane's ecological system is today a product of several natural factors and many human activities that affect it either intentionally or unintentionally. And these activities are themselves changing, e.g., changes are and have been frequently made in the natural inflow and the outflow characteristics of the lake either through engineering structures or by the filling in of the natural drainage channel between Lake Oliver and Lake Cochrane. Therefore, it is not possible, nor would it be meaningful, to predict specific potential effects on the lake caused by a decrease in groundwater inflow.

Furthermore, even if it were certain that Burr Well Field pumping would cause a decrease in the groundwater inflow into Lake Cochrane, the ecological effects of that cannot be reliably distinguished from the ecological effects of human management actions or activities.

Rare, Threatened, and Endangered Species

The two State-listed endangered fish species in Lake Cochrane are both prey to other fish species in the lake, such as northern pike and sunfish. The State has stocked northern pike in Lake Cochrane in the past. Sunfish are now overly abundant in the lake. The state of the banded killifish in the lake is rated as poor. The central mudminnow has not been sighted in the lake since 1978, and its current condition is unknown. The two species are affected by both the natural conditions of the lake and human interventions through past and present management practices. The magnitude of these impacts is so large that it is not possible to evaluate the effects a potential decrease in groundwater inflow may have on these species of fish.

Given that it is likely Lake Cochrane is receiving a groundwater contribution to its water budget and that a portion of that contribution likely comes from the Burr Unit, the critical factor that would assess the potential effect from pumping at the Burr Well Field would be to quantify the percentage of groundwater in relation to the overall budget of the lake. In an attempt to evaluate reasonably foreseeable effects to Lake Cochrane from long-term pumping at the Burr Well Field, the Agency has concluded that information determining or quantifying the percentage of groundwater contribution can not be obtained because the cost involved in gathering this information with any level of certainty or precision is prohibitive. In addition, obtaining this information would be scientifically demanding and beyond the mission of the Agency. Therefore in accordance with 40 CFR 1502.22, Incomplete or Unavailable Information, the Agency states the following:

- Any and all decisions or statements regarding any impact to Lake Cochrane from the Burr Well Field is being made on incomplete or unavailable information.
- The information necessary to determine reasonably foreseeable impacts is relevant to any decision being made regarding this project.
- All discussions in this subsection summarize currently available information regarding Lake Cochrane and the potential effects from pumping at the Burr Well Field.

The Agency has concluded based on its evaluation of available information that there could be effects to Lake Cochrane from long-term pumping at the Burr Well Field. In addition based on analyses of the information provided to it from the various pump tests and in consultation with experts in the field of hydrology and geology it is the Agency' opinion that effects to Lake Cochrane from the continuation of pumping from wells screened in the Burr Unit at the Burr Well Field at the rate of 400-525 gpm would not have significant environmental impacts. That is not to say that Lake Cochrane could not be affected, but that any effects from the range of appropriations listed above would not likely have catastrophic or significant effects.
Lake Cochrane is only one of the surface water resources in the area that is of concern. The Agency has developed a series of mitigation measures and recommendations that if implemented comprehensively could avoid or minimize any adverse impacts to all surface water resources of the area (see section 3.2.3 and Section 3.2.2.1.1).

It is the opinion of some of the experts consulted as part of this EIS, that to be protective of the fens will also be protective of Lake Cochrane. In other words, minimizing the reduction in the potentiometric surface in the Burr Unit and establishing critical elevations where if these elevations are exceeded actions would be taken to modify pumping from the Burr Unit. These thresholds, will have to be established as part of the regulatory conditions implemented as part of the LPRW's Water Appropriation Permit with MNDNR at the Burr Well Field. Certainly the most critical elevation for Lake Cochrane would be the OHWM and its relationship to the potentiometric surface. As long as the potentiometric surface remains above the OHWM, groundwater contributions from the Burr Unit will continue. Based on standard principles of hydrology, however, reductions in the potentiometric surface will cause proportional reductions in groundwater inflow to the lake. If the potentiometric surface were to be lowered below the OHWM, surface water flow from Lake Cochrane to the Burr could happen.

3.2.2.2 Other Portions of the Burr Unit

All of the environmental issues for the Burr Unit are discussed in Section 3.2.1.2.

3.2.2.3 Altamont Aquifer

Because of its depth and overlying stratigraphy, the Altamont aquifer is not hydraulically connected to the surface water resources in the area of concern; therefore, any additional withdrawals from this aquifer will have no effect on surface or biological resources.

3.2.3 Mitigation

This section will provide a comprehensive discussion of the Agency' proposed mitigation measures. Mitigation measures as defined in 40 CFR 1508.20, Mitigation, includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.
(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(e) Compensating for the impact by replacing or providing substitute resources or environments.

As discussed in Section 3.2, the issues to be addressed in the EIS are 1) outstanding concerns from the Existing System North/Lyon County Phase Environmental Assessment and 2) the Northeast Phase Expansion. The proposed action that the Agency is responding to is an application submitted by LPRW to fund the Northeast Phase Expansion within the context of LPRW's application to the MNDNR for an increase in groundwater appropriations at the Burr Well Field from the current rate of 750 gpm/400 Mgpy to 1500 gpm/800 Mgpy.

The only issue that is subject to an Agency decision at this time is whether or not to provide financial assistance to LPRW for the construction of the Northeast Phase Expansion. All decisions regarding the disposition of LPRW's Water Appropriation Permit at the Burr Well Field are to subject to approval by the

MNDNR, Division of Water. The Agency will make, based on analyses performed in this EIS, recommendations to the MNDNR but all decisions regarding LPRW's permit fall under MNDNR's regulatory authority.

The primary issue evaluated in Section 3, has been -- What is the effect on surface water resources from pumping at the Burr Well Field? The analyses and conclusions developed in Section 3 indicate that the Burr Unit aquifer being utilized at the Burr Well Field is hydraulically connected to calcareous fens located in the vicinity of the Burr Well Field and likely to Lake Cochrane, as well. Pumping from the Burr Unit at the Burr Well Field causes reductions in the potentiometric surface. These reductions can effect those resources that are dependent on the potentiometric surface being maintained at levels above the land surface.

Evaluating effects to surface water resources can be fairly straightforward. This can be accomplished by measuring and monitoring the level and status of the potentiometric surface and hydraulic gradients at and within the fen domes and to monitor the potentiometric surface adjacent to and around Lake Cochrane. Determining whether or not an effect is adverse is less clear. Clearly the most critical factor for the fens is to maintain the hydraulic head above the surface elevation of the peat domes so as to ensure that the fens remain completely saturated. It is reasonably logical to state that as long as the fens remain saturated, minimal impacts to their ecological integrity would be expected even if the hydraulic head in the peat dome fluctuating but did not drop below the surface of the dome. On the other hand, determining adverse effects on Lake Cochrane is more difficult. Because the level and magnitude of groundwater contribution is difficult to determine with any precision, all that can be stated is that reductions in the potentiometric surface below the lake's OHWM will reduce groundwater input into the lake and in the event that the potentiometric surface drops below the OHWM flow would be reversed. Lake Cochrane's ecological character is already affected by significant human interventions, therefore the ecological effects of a reduction of groundwater flow cannot be reliably distinguished from the ecological effects of past and present human management actions and other activities.

Because the interdependence and commonality between the Burr Unit and the area's surface water resources is the potentiometric surface, mitigation measures are proposed that attempt to minimize drawdowns in the potentiometric surface but yet meet LPRW's present and future water supply needs. The Agency will condition approval on LPRW's application for financing the Northeast Phase Expansion and other associated costs with the following elements. This approval is subject to LPRW's being able to obtain the appropriate water appropriation permit(s) from the MNDNR.

- Explore the development of a supplemental well field in the area south of the Burr Well Field determined by various geologic exploration efforts as containing aquifer materials that would be capable of supplying municipal levels of water. The new well field should utilize both the Burr Unit and the Altamont aquifer providing for more reliance on the Altamont than it does at the Burr Well Field. Raw water from this well field could be transported to the Burr Water Treatment Plant to take advantage of the facilities existing water treatment capacity.

- LPRW shall formalize a water resource management plan with the MNDNR to establish monitoring procedures and protocols to evaluate the effects of pumping the Burr Unit on surface water resources in Minnesota. Included within this plan LPRW shall develop standard operating procedures to manage and implement groundwater appropriations from the Burr Unit at both the new well field and Burr Well Field to minimize drawdown of the potentiometric surface.

- LPRW shall formalize an agreement with SDDENR to establish monitoring procedures and protocols to evaluate the effects of pumping the Burr Unit on surface water resources in South Dakota.

the Agency offers the following recommendations to the Minnesota and South Dakota natural resources management agencies for their consideration:

- Develop and formalize a comprehensive Water Resource Management Plan that includes locations of all monitoring wells and fen monitoring points in Minnesota and South Dakota; sampling and analytical protocols for each monitoring points; Burr Well Field pumping data requirements; and a data management plan for all the collected data sets. No additional observation wells and monitoring points appear to be necessary beyond existing monitoring activities.

- If economically possible locate a fen that could serve as a “control” fen that would be located outside the areas by production pumping. Install a nest of piezometers similar to the Sioux Nation Fen. Critical issue will be to establish natural variability within the fen ecosystem.

- the Agency concurs with the goals, objectives, and implementation of MNDNR’s threshold program at the fens. Use of these thresholds to establish regulatory guidelines by which water appropriations are managed would afford protection to the fen.

- Recommend that South Dakota either implement or continue monitoring the biological aspects of Lake Cochrane.

All the monitoring activities developed pursuant to a water resources management plan have attendant costs. These costs could be significant; therefore, it would be prudent to ensure that each monitoring point chosen provides data that contributes to the understanding of the hydrogeologic relationships of the area. To maximize the technical appropriateness and cost effectiveness of this data-gathering effort, the Agency recommends that consideration be given to dividing up the costs between LPRW and both State regulatory agencies. By distributing these costs among the involved parties, each party has an obligation to develop a cooperative working relationship and establish reasonable monitoring requirements. the Agency is willing to contribute and assist, through LPRW, the cost for environmental monitoring.

3.3 Northeast Phase Expansion

The proposed Northeast Phase consists of approximately 170 miles of pipe, an elevated tank near Minneota, and a booster station near Green Valley (see Figure 3-11).

FIGURE 3-11 NORTHEAST PHASE EXPANSION PROPOSED PIPELINE ROUTES

3.3.1 Geology and Soils

Affected Environment

The geology and soil types in the proposed service area for the Northeast Phase are generally very uniform. The entire service area is proposed to be constructed in a relatively uniform geologic area that is classified as ground moraine and locally characterized as a “lowland plain” (SCS, 1978). Ground moraines have low relief (less than 10 ft in the service area [SCS, 1978]) marked by gently sloping swells, swales, and depressions (closed or not) with an apparently random pattern (Flint, 1971). The major soil types that occur in the service area are developed in generally homogeneous loamy glacial till with numerous fragments of shale. General soil map units include the Ves-Canisteo soil unit in the lowland till plain and the Lamoure-La Prairie soil unit in floodplain areas adjacent to the areas’ surface drainage channels. The Ves-Canisteo soil unit consists of the well-drained Ves soil on short, irregular, convex slopes, and the poorly drained Canisteo soils occur on flats and edges of depressions. Minor soils within these areas include the poorly drained Glencoe soils that occur in closed depressions and other low areas. As mentioned above, the poorly drained Lamoure soil and the moderately well-drained La Prairie soils developed in alluvial deposits associated with drainageways.

All the major soil types in the service area are classified as important farmland by the Natural Resources Conservation Service (formally the Soil Conservation Service) and are, generally speaking, highly productive soils, if proper soil management practices are used.

Environmental Consequences

The primary objective of the proposed Northeast Phase is to provide rural water service to rural residents (240 rural users) who have requested service and to 2 rural communities, Hazel Run and Echo. The facility construction of this phase is 170 miles of pipe, including 2- to 8-in lines, an elevated tank near Minneota, and a booster station near Green Valley.

Because the primary construction activity of the Northeast Phase is to install pipeline to the rural residents who have requested service, the impact on the soils in the area will be short-term. Soil disturbance will occur when trenching and excavating equipment is used to install water distribution lines.

More extensive soil disturbance will occur at sites where clean out valves, the booster station, and the water tank will be installed. Because of the small number of clean out valves and pump stations required, this impact, which has the potential to be locally significant, but is minor when considered as a portion of the whole project. In order to periodically flush the system and provide access for fire protection activities, the Minnesota State Board of Health requires the installation of clean out valves/fire hydrants at specified intervals. Similarly, the booster station must be installed to provide adequate pressure maintenance in the system. Where hydrants and other facilities are installed, soil erosion and sediment control best management practices will be applied to minimize soil loss. Best management practices for this type of construction may include silt fences, sediment traps, temporary mulching, and revegetation.

The construction of the distribution network will require installation of pipe through small wetland areas and minor stream crossings. All distribution system network construction will be in or adjacent to existing road right-of-ways and effects will be minor and of limited areal extent. Construction practices and mitigation measures for the installation of utility lines in wetland areas and stream crossings are covered under the authority of Section 404 of the Clean Water Act and regulated by the U.S. Army Corps of Engineers (USACE).   Based on the recent promulgation of regulatory requirements for activities in wetlands or other aquatic environments, the USACE has reissued regulatory requirements for activities in wetland areas.

Disturbance in or proposed construction affecting wetlands or aquatic environments requires consultation with the USACE. Because the installation of utility lines is a routine activity, USACE has developed a Nationwide Permit that stipulates that, if specific mitigation and construction practices are followed then construction is allowed to proceed with minimal oversight by USACE. The Nationwide Permit issued to regulate utility line construction activities was reissued in the December 13, 1996, Federal Register, Volume 61, Number 24, pages 65,873-65,922, Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits (see Appendix B).

As long as the general conditions of the Nationwide Permit program are met with regard to construction activities (e.g., all soil disturbances shall be returned to pre-construction contours), LPRW will submit a Pre-Construction Notice to the USACE, St. Paul District. Upon completion of the construction, LPRW shall notify USACE.

Elevated Water Tank

The Northeast Phase Expansion proposes to construct an elevated water tank and two booster stations. The elevated water tank is proposed to be built south of Minneota within the SW ¼, NW ¼ of Section 36, T. 113 N., R. 43 W. This land is already owned by LPRW. The exact site of the water tank has not yet been determined. Wetland soils occur on the parcel. As a condition of financing, LPRW would be required to avoid wetland areas when the tank is built.

The entire area around the water tank site consists of either wetland soils or soil types classified as important farmland soils by the Natural Resources Conservation Service. Provided the tank construction does not affect wetland areas, the area affected by the construction will be converting important farmland. Because the entire area is important farmland and is within a quarter mile of the town limits of Minneota, the conversion will not be significant.

Booster Stations

Two booster stations are proposed for the Northeast Phase Expansion. One will be located at the elevated water tank site and the other one in the vicinity of SE ¼, SE ¼, Section 8, T. 112 N., R. 41 W. The latter booster station will be built along either the southern or eastern portion of this quarter section adjacent to the road right-of-way. The siting of this booster is important to the system hydraulically and will be located along a 10-in main. The exact location of this booster station has not yet been chosen; however, the stretch of road along the south and east portion of this quarter section does not contain any wetland soils. The soil types in the entire area are classified as important farmland. For this reason, the construction of a booster station and the small land area that will be impacted will have a minimal effect on important farmland in the area.

3.3.2 Biological Resources

Affected Environment

The construction of additional water distribution lines will occur in parts of Yellow Medicine and Lyon Counties (see Figure 3-11). The pipelines will be buried below the surface and for the most part will be located on or adjacent to existing road rights-of-way. However, pipelines will be constructed across several streams, including Yellow Medicine River, Spring Creek, and Boiling Spring Creek in Yellow Medicine County and Redwood River and Threemile Creek in Lyon County.

Based on the review of the Minnesota Natural Heritage Information System data base (MNDNR, 1996), no federally or State-listed rare, threatened, or endangered species or rare natural communities have been found directly on the routes of the proposed pipeline expansion. Table 4-6 presents a list of protected species and sensitive biological communities that have been found within 2 miles of the proposed expansion routes in Yellow Medicine and Lyon Counties.

Environmental Consequences

Inasmuch as most of the pipeline construction will occur on or adjacent to existing road rights-of-way, no significant impact on the biological resources in those areas is expected. However, construction of pipelines across creeks and wetland areas may increase erosion and sedimentation, which may harm the biological communities in the water bodies. Temporary and unavoidable minor effects from wetland disturbance for construction of utility crossings include soil erosion and temporary degradation of aquatic habitat at and downstream of the construction site. These effects will be minimized by standard construction best management practices as required by the Clean Water Act, Section 404, and the

USACE, Nationwide Permit conditions.

TABLE 3-10 RARE, THREATENED, AND ENDANGERED SPECIES IN PIPELINE EXPANSION AREA

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	STATE STATUS	HABITAT[1]	LAST YEAR[2]	TOWNSHIP SECTION
ANIMALS						
Northern Grasshopper Mouse	*Onychomys leucogaster*	N/A	NON[3]	Open country; grass, sagebrush, greasewood; sandy or gravelly soil. Mostly in burrows of other animals, such as ground squirrels, prairie dogs, and pocket gophers.	1966	T112N R40W 14
PLANTS						
Water-Hyssop	*Bacopa rotundifolia*	N/A	SPC[4]	Usually in water 7 to 15 cm deep, but seems to survive well in mud at margins of receding ponds.	1945	T111N R41W 26
OTHER RARE AND SENSITIVE COMMUNITIES						
N/A	N/A	N/A	N/A	Colonial waterbird nesting site.	1984 1994	T113N R39W 34 T112N R40W 17
N/A	N/A	N/A	N/A	Mesic Prairie (southwest).	1977	T111N R41W 23 T113N R41W 31

Source: SDGFP, 1996.

1. Source: Coffin and Pfannmuller, 1988.
2. Date that the element was last collected or observed at this location
3. NON=rare (no legal status)
4. SPC=special concern

Mitigation

A Section 404, Clean Water Act, permit will be obtained from the USACE for each stream crossing in the proposed expansion area. The permitting process is similar to an Environmental Assessment in which alternative locations and methods, beneficial and adverse effects, and cumulative impact are considered. Because the pipeline construction will comply with the State and USACE permitting requirements, impact on the aquatic environment will be minimized during design and construction. The Corps of Engineers and the State of Minnesota typically require these effects to be mitigated by minimizing disturbance through the implementation of erosion and sedimentation control best management practices and restoration and revegetation of disturbed areas.

Because no federally or State-listed rare, threatened, or endangered species have been found on the pipeline expansion routes, no direct impact to threatened or endangered species is expected to occur. However, the Minnesota County Biological Survey, a county-by-county inventory of rare natural features, has not been performed for Yellow Medicine or Lyon County. Therefore, the information on their biological resources is incomplete. It is probable that there are ecologically significant features in these counties for which no record exists.

If the Minnesota County Biological Surveys for Yellow Medicine and Lyon Counties are completed before the start of the pipeline construction, Minnesota law requires that LPRW check its proposed pipeline routes against the survey findings. If any proposed route should be within a quarter mile of a protected species' habitat or other sensitive habitats, LPRW will be required to confer with MNDNR to determine if rerouting or other mitigation is warranted.

3.3.3 Cultural Resources

Affected Environment

A preliminary plan of the proposed Northeast Phase area expansion was submitted to the Minnesota Historical Society with a request to identify any portions of the proposed service area expansion that may contain historical, archaeological, or cultural resources of significance that may be affected by the proposed project. In response to the request, the Minnesota Historical Society recommended that a Phase I Archaeological Reconnaissance Survey be conducted before the installation of five waterline hookups located in Yellow Medicine, Lincoln, and Lyon Counties in Minnesota. The five areas of review are designated as corridors and are defined in Table 3-11.

TABLE 3-11 LOCATION OF PHASE I ARCHEOLOGICAL INVESTIGATION CORRIDORS

Corridor	County	Location	Distance (miles)	Area
1	Yellow Medicine	R39T113	3.75	22.5
2	Yellow Medicine	R45T114	0.75	4.5
3	Lyon	R41T111	2.00	12.0
4	Lincoln	R46T111	0.75	4.5
5	Lincoln	R44T111	1.5	9.0
TOTALS			**8.75**	**52.5**

The corridor areas consist of a ribbon of land adjacent to a designated roadside, which is 50 ft from the road right-of-way lines or ditch back slope into agricultural land where construction easements are acquired. The pipeline installation will affect a very small horizontal land surface area, but the vertical cut (approximately 18 in wide by 6 ft deep) could be damaging to existing cultural resources.

The objective of the Phase I Survey was to obtain data sufficient only to determine within reason:

- The presence or absence of any prehistoric, historic, or architectural resources within the designated proposed development area.
- The location of any prehistoric, historic, or architectural sites within the proposed development area.
- A preliminary evaluation of the site's condition.
- Recommendations for more detailed work.

Before the field survey, a background check was conducted of the documented prehistoric and historic cultural resources within the project areas. The Minnesota Historic Society stated in a letter dated July 3, 1994, to DeWild Grant Reckert Company, that there are no reported historical properties or archaeological resources in the project's area of potential impact. A further check was conducted using previous investigations or cultural resource management reports, USGS Quad Sheets, DNR maps showing updated locations of sites, early State and county maps, county soil maps, and 19th and 20th century plat maps.

A pedestrian survey was conducted in August 1994 and achieved total coverage of the corridor lengths. The survey was spaced at 5-m and 10-m intervals, then reduced to 2-m intervals where artifact scatters were encountered. Areas excluded from the surface survey were observable regions altered by construction, farmyards, cattle yards, areas around manmade drainage ditches, and residential homes surrounding lakes. Limited subsurface tests were generally conducted and placed within the survey corridor and spaced 15 m apart for a representative sample of landforms.

Environmental Consequences

The Phase I Reconnaissance Survey found no prehistoric, historic, or architectural resources along the proposed waterline routes. Therefore, no cultural resources will be affected by the pipe installation in the five corridor areas surveyed.

Mitigation Measures

It is possible that archeological sites of significance could be located in areas not surveyed and could be disturbed by the proposed project. To mitigate the possible impact on unknown cultural resources, construction contractors will be required to monitor excavations. Should archeological evidence be observed, they will be required to stop work immediately and contact the Minnesota Historical Society and the State Historic Preservation Officer.

3.4 Systemwide Socio-economic Effects

As part of the public scoping phase, concerns were raised about whether the availability of potable water as supplied by a rural water system promotes the proliferation of large-scale animal confinement operations.   Based on the analyses performed for this EIS, the study team concluded that the availability of potable water supplied by LPRW has and will not, by itself, cause an increase in these types of livestock operations. Market forces, for example, demand created by national consumption patterns, availability of suitable land, and the proximity to slaughterhouses are the primary factors that influence the number of livestock production facilities. The supply of potable water appears to have no bearing on whether large-scale animal confinement operations will locate within the study area. In addition, this EIS has concluded that the availability of potable water in the LPRW service area will have minimal effects on the socio-economic conditions in the study area, except for increasing the quality-of-life with regard to accessibility to a consistent, reliable source of good quality potable water and helping to stabilizing the agricultural economy in the area by allowing farmers the option to diversify their operations should other market conditions warrant such commodities. The bases for these conclusions are presented below.

3.4.1 Study Methodology

3.4.1.1 Public Concerns

As discussed above, during public scoping meetings, concerns were raised about the effect the availability of potable water has and will have on encouraging the proliferation of large-scale animal confined operations, most notably hog operations. Concerns have also been raised about whether integrated (corporate) farming will dominate the market at the expense of family farms once LPRW has completed the expansion.

Therefore, the premise of the socio-economic analysis was -- does the supply of potable water make a difference in the agricultural conditions of the Minnesota study area?

3.4.1.2 Study Region

For the purposes of the analysis, this socio-economic study has focused on two study areas, one in Minnesota and one in South Dakota. The study team chose the eight counties that were serviced by the LPRW, and three counties to the east and four to the west that abutted the LPRW-supplied counties for comparison purposes. The Minnesota study area included 11 counties, Lincoln, Lyon, Yellow Medicine, Lac qui Parle, Redwood, Pipestone, Murray, Cottonwood, Rock, Nobles, and Jackson Counties (see Figure 3-12). The South Dakota study area contained four counties, Brookings, Deuel, Minnehana, and Moody (see Figure 3-13). Redwood, Cottonwood, and Jackson are the three counties to the east of the LPRW service area.

The South Dakota counties were also chosen because they are closest in proximity to the Burr Well Field and occur in a similar physiographic setting -- that is, with similar environmental and climatic conditions. The South Dakota study area was included to confirm that the agricultural trends evident in the Minnesota study area were regional in nature and not unique to the Minnesota portion of the study area. Similarity of the South Dakota trends to the Minnesota trends is particularly relevant, in that South Dakota has different laws and regulations that could affect the agricultural industry in that State.

FIGURE 3-12 MINNESOTA STUDY AREA

FIGURE 3-13 SOUTH DAKOTA STUDY AREA

Potable water is supplied to many of the counties in the study area. As of 1980, 95% of Lincoln County was supplied with potable water by LPRW. Parts of Nobles, Pipestone, Lyon, Rock, and Murray Counties are also serviced. By 1982, parts of Yellow Medicine County were served. LPRW continued to expand its system throughout these counties and, by 1994, additional users were supplied in Lincoln, Pipestone, Rock, Murray, Nobles, Lac qui Parle, Yellow Medicine, and Lyon Counties. The Rock County Rural Water System was servicing the Rock County users by December 1979. In 1980, LPRW extended its service area into Rock County to serve users that were not served by the Rock County Rural Water System.

The study area also included the service area of the Red Rock Rural Water System. In November 1985, this system began to provide service to 230 customers in Cottonwood, Lyon, Redwood, and Murray Counties, although not all townships were serviced. By 1990-1991, parts of Jackson County were serviced and, by 1993, additional customers in parts of Murray County were added to the system.

The Brookings-Deuel rural water service supplies customers in the Brookings, Deuel, and Moody Counties in South Dakota. This operation has been serving customers since 1979.

3.4.1.3 Study Parameters

The socio-economic factors analyzed include the population, local economy, and agricultural aspects of the study area. The agricultural aspects studied include the number of farms, total farm acreage, average farm size, number of cattle and/or calf farms, number of cattle and calves, number of beef cow farms, number of beef cows, number of hog and/or pig farms, number of hogs and pigs, number of farms with irrigated land, and acres of irrigated land.

Information about the socio-economic issues within Minnesota and South Dakota was obtained by direct contact with State of Minnesota personnel and through the use of census information from the 1992 Census of Agriculture and USA Counties. The population and economic statistics are displayed in Tables 3-13, 3-14, and 3-15. The population and agricultural statistics were reported for a 10-year interval by using two 5-year time periods. The first time period was from 1982 to 1987, and the second was from 1987 to 1992. The information was compiled and the data used for the analysis are displayed in Tables 3-16 and 3-17 of this section. Hog and pig population census data are also shown in graphic form in Figures 3-14 and 3-15 of this section.

The study team did not identify any mechanism through which the proposed action could create the need for major additions to the existing agricultural workforce and no new demand for housing, facilities, or services. Therefore, these factors of the socio-economic environment are not discussed. Also, a change in the population resulting from the proposed project is not anticipated. Educational services are not discussed because, without a change in the population, this factor will not be affected by the proposed project.

3.4.1.4 Comparison of Hog-Farming Practices

The public was concerned that the new potable water supply would attract large-scale hog farming and that corporate farming practices would dominate the market once the service area was expanded. With this premise in mind and because there has been media focus on the hog industry in the United States, the study team investigated hog farming in other areas of the country.

North Carolina has been the focus of attention concerning large-scale corporate hog farming operation; therefore, the study team compared farming methods within North Carolina and Minnesota. The purpose of the comparison was to ascertain if the reported problems experienced in North Carolina were likely to occur in Minnesota. The team contacted the National Pork Producers Council (NPPC), Minnesota and North Carolina State Pork Producers Councils, and State of Minnesota and North Carolina personnel to obtain data for this analysis.

Minnesota law requires permits for new operations that have 25 or more adult hogs and for existing operations that have 125 or more hogs. Hogs and pigs are typically kept indoors in buildings where the temperature, humidity, and other environmental factors can be controlled. These houses usually contain machinery to automatically feed and water the hogs. In each housing unit, hogs are kept on slatted floors that allow waste to drop to a pit below. A number of collection, storage, and treatment options are available to handle the accumulated waste. The decision of which system to use depends on both economics and State law. These systems will be discussed below.

The hog houses vary in size, depending on the number of animals housed and the type of building, i.e., a farrowing house, nursery, or finishing house. A typical finishing floor for 100 hogs is approximately 42 ft wide and 200 ft long (Bottcher, 1996). This infrastructure can be expensive, with capital investments upwards of $1 million. The number of hogs per facility varies greatly, from the hundreds into the thousands. The majority of Minnesota pork producers raise hogs on farms with greater than 1,000 head (Minnesota, 1996). Neither the State of Minnesota nor its counties provide tax incentives to encourage the development or expansion of pork production facilities (Jacobson, L., 1996).

According to Minnesota hog producers, land is a key factor in siting a hog farm in the State. Land requirements vary with the number of animals on a farm and the crop grown on the land. The hog producers apply hog waste as fertilizer to crops used for hog feed. Minnesota farmers raise their own feed or purchase it locally. Hog feed is typically a mixture of corn and soybeans. A pig requires approximately 10.5 to 11 bushels of corn and 2.5 bushels of soybeans from birth to finishing. Under Minnesota conditions, one acre of corn can support about 11 to 12 pigs per year, while one acre of soybeans can support about 14 to 15 pigs per year (Hawton, 1996). Feed accounts for about 50% to 60% of operational costs on a hog farm (Zering, 1996). Other feed additives are provided to ensure an animal gets balanced amounts of protein, essential fatty acids, minerals, and vitamins. Feed efficiencies can vary greatly from farm to farm (NPPC, 1996).

Farmers simply need adequate land to grow feed for their animals and to apply (dispose of) the waste from their operations. A ton of hogs will generate approximately 32 tons of waste per year, approximately twice the rate of human waste production (Satchell, 1996). In North Carolina, pork producers use waste lagoon systems on their farms. The choice of this type of system is a result of a shortage of land for applying hog manure. Water is flushed through collection pits in the barns, and the slurry is drained into a waste storage lagoon for both treatment and storage. In the lagoon, bacteria stabilize organic matter and reduce nitrogen concentrations. The lagoon slurry with a lowered nitrogen content is then applied to crops, usually through a spray mechanism. By allowing denitrification to occur in the lagoon slurry, less land is needed to assimilate the nitrogen (Williams, 1996). Hog growers in North Carolina use their land by growing crops, usually Bermuda grass, that will maximize nutrient uptake. Approximately 80 acres of Bermuda grass are needed to utilize the nutrients from a 1,000-hog operation (Stocker, 1996).

Midwestern farmers typically use either deep-pit or gravity-drained waste collection systems, where waste storage pits hold the waste until it is applied to the land. Deep-pit systems under the hog house floor are approximately 8 ft deep and serve as both a collection and storage area. Alternatively, a shallow pit under the hog house floor can be gravity-drained to a separate storage area, typically outside the hog house. Most farmers using these systems apply the waste to the land by a method that injects the manure a few inches below the land surface to maximize crop nutrient uptake (Jacobson, L., 1996).

Most Minnesota pork producers do not operate a lagoon system for three reasons. First, deep-pit and gravity-drained systems do not require a permit, while lagoon structures must be certified by an engineer (Brynildson, 1996). Second, lagoons are often cost prohibitive for Minnesota farmers, due in part to the fact that Minnesota law requires that lagoons be fitted with liners (LAW, 1996). The cost of design, purchase, and installation of liner systems, whether clay or synthetic, is expensive. In addition, because bacterial activity decreases at lower temperatures, lagoons work best in areas without cold winters (Barker, 1995). To compensate for lower bacterial activity, lagoons would have to be two to three times larger than the ones used in North Carolina (Jacobson, L., 1996). A 20-ft-deep lagoon for a 1,000-hog operation in North Carolina would cover approximately 6 acres (Whitall, 1996). This same lagoon would cover approximately 18 acres of surface area in Minnesota or, for 70,000 hogs and pigs, approximately 1,260 acres. Third, Minnesota farmers are more interested in making the nutrients in hog manure available to their crops. Because they are using the waste as fertilizer for crops, they want the nitrogen in the waste and do not need to employ a denitrifying system (Williams, 1996).

Water on a hog farm is used for animal consumption, regular washdowns, and waste systems. Typical water consumption by hogs is shown in Table 3-12

TABLE 3-12 WATER CONSUMPTION BY HOGS

Type of Animal	Weight (lb)	Gallons per Day
Nursery Pig	Birth to 50	1
Finisher	50 to 240	3 to 5
Gestating Sow	300 to 375	6
Lactating Sow and Pig Litter	350 to 400	8

Source: Private Water Systems Handbook, Midwest Plan Service, MWPS-14.

The water from the washdowns usually enters the floor drains in the hog buildings and ends up in the waste pits. The washdown water, and any other water required for waste treatment, is used to properly liquefy the waste for underground injection.

Most growers in Minnesota are still independent farmers who own their own hogs and raise them from "farrow-to-finish." "Farmer-to-farmer" arrangements are also relatively common, accounting for approximately 10% of all hog farms. With these arrangements, farmers in a community contract with one another, rather than a corporation. Typically, a hog farmer will contract with another for the finishing phase of production. Minnesota State Statute §500.24 limits the growth in contract farming by prohibiting corporations, pension or investment funds, and limited partnerships from engaging in farming or acquiring an interest in any title to real estate used in farming. This rule only discourages, but does not prevent, large-scale or contract farming in Minnesota, because family farm corporations may still participate in these practices (Strandburg, 1996). The State also has contracting laws that might discourage corporations from recruiting growers. For example, if a farmer invests in farming infrastructure and the contracting corporation pulls out of the contractual agreement, the farmer is entitled to damages (Priesler, 1996).

A secondary consideration in siting a farm is the proximity to a slaughterhouse. Transporting hogs long distances at a slaughter weight of about 250 lb can be cost prohibitive. The Minnesota study area is relatively close to three slaughtering facilities: the Swift plant in Worthington, MN; the Iowa Beef Processing plant in Storm Lake, IA; and the John Murrell plant in Sioux Falls, SD. With only the one large hog-slaughtering facility in the Minnesota study area, many producers ship their animals across the border into Iowa and South Dakota. Because of Minnesota's stringent workers' compensation laws, it is highly unlikely that new slaughtering facilities will be built in the State (Clanton, 1996).

3.4.2 Demographic and Economic Factors

3.4.2.1 Population

The Minnesota study area is agriculturally oriented. There is little industry in the counties of the Minnesota study area that is not related, in some aspect, to the agricultural industry. The resident population for the Minnesota study area decreased over the 10-year period from 1982 to 1992. The percent decreases in population for all counties in the Minnesota study area are listed in Table 3-13. The actual population figures are in Table 3-14.

TABLE 3-13 MINNESOTA STUDY AREA POPULATION

County	Percent Decrease 1982 to 1987	Percent Decrease 1987 to 1992
Lincoln	10.6	5.2
Yellow Medicine	8.4	5.8
Lyon	2.2	1.4
Lac qui Parle	6.4	5.5
Redwood	6.4	5.5
Pipestone	7.3	2.6
Murray	9.2	5.1
Cottonwood	7.4	7.6
Rock	6.4	0.4
Nobles	5.8	0.8
Jackson	37.7	4.7

3.4.2.2 Economy

In 1990, the unemployment rate within the 11 counties of the Minnesota study area ranged from 3.0% to 6.9%. Market data were not available for 4 of the 11 counties in the Minnesota study area. In the other remaining 7 study area counties, data analysis indicated that wholesale and agricultural sales primarily led the market. Retail sales and service business receipts followed this pattern, although retail sales were slightly higher than agricultural sales for 2 counties. The unemployment percentages and actual dollar figures for the various sales categories may be found in Tables 3-14 and 3-15.

TABLE 3-14 MINNESOTA AND SOUTH DAKOTA RESIDENT POPULATION BY COUNTY

County	1982	1987	1992	Change ('82-'87)	Change ('87-'92)	Change ('82-'92)	Unemployment Rate (%)
Minnesota							
Lincoln	7,996	7,152	6,778	-844	-374	-1,218	5.9
Yellow Medicine	13,342	12,223	11,518	-1,119	-705	-1,824	6.3
Lyon	25,442	24,873	24,524	-569	-349	-918	5.6
Lac qui Parle	10,370	9,434	8,636	-936	-798	-1,734	3.9
Redwood	19,224	18,002	17,010	-1,222	-992	-2,214	3.0
Pipestone	11,509	10,674	10,393	-835	-281	-1,116	4.3
Murray	11,209	10,173	9,652	-1,036	-521	-1,557	6.9
Cottonwood	14,483	13,417	12,396	-1,066	-1,021	-2,087	3.7
Rock	10,510	9,837	9,800	-673	-37	-710	4.4
Nobles	21,542	20,292	20,124	-1,250	-168	-1,418	5.4
Jackson	19,487	12,141	11,565	-7,346	-576	-7,922	4.7
South Dakota							
Brookings	24,954	24,621	25,688	-333	1,067	734	6.8
Deuel	5,209	4,621	4,481	-588	-140	-728	7.8
Minnehana	111,434	119,548	129,985	8,114	10,437	18,551	4.1
Moody	6,693	6,511	6,664	-182	153	-29	5.8

Source: USA Counties Minnesota Home Page--Population, Total and Selected Characteristics, U.S. Census Data and USA Counties South Dakota Home Page--Population, Total and Selected Characteristics, U.S. Census Data.

TABLE 3-15 MINNESOTA AND SOUTH DAKOTA ECONOMIC INDICATORS BY COUNTY

County	Sales in Thousands			
	Agricultural	Wholesale	Retail	Service Business
Minnesota				
Lincoln	$47,823	$39,484	$22,271	$5,731
Yellow Medicine	$77,545	$103,330	$46,333	$8,960
Lyon	$93,381	$233,095	$148,618	$35,032
Lac qui Parle	N.A.[1]	N.A.	N.A.	N.A.
Redwood	N.A.	N.A.	N.A.	N.A.
Pipestone	$52,886	$98,041	$48,035	$11,456
Murray	$87,232	$91,573	$31,237	$11,208
Cottonwood	N.A.	N.A.	N.A.	N.A.
Rock	$87,789	$75,578	$34,474	$10,275
Nobles	$115,008	$186,998	$115,741	$29,729
Jackson	N.A.	N.A.	N.A.	N.A.
South Dakota				
Brookings	$69,870	N.A.	$108,520	$26,999
Deuel	$41,703	$10,046	$13,689	$2,151
Minnehana	$95,482	$1,439,798	$976,956	$384,626
Moody	$58,652	$29,991	$13,616	$9,104

Source: USA Counties Minnesota Home Page, U.S. Census Data and USA Counties South Dakota Home Page, U.S. Census Data.

[1] N.A. = Not Available

In 1990, the unemployment rate within the four counties of the South Dakota study area ranged from 4.1% to 7.8% (see Table 3-14). The dominance of the agricultural, wholesale, retail, and service business markets differed from county to county (see Table 3-15).

3.4.3 Agricultural Factors

Analysis of the agricultural factors for the study area was done as part of a more general effort to ascertain if any discernible differences exist between the counties in that area.

Livestock farming in the Minnesota study area is dominated by cattle and/or calf farms, beef cow farms, and hog and/or pig farms. Data concerning poultry farming indicated that this was not a significant factor in the Minnesota agricultural market (Minnesota, 1992). There was no information in the data base concerning turkey farming. Please refer to Tables 3-16 and 3-17 for the complete statistical data concerning the agricultural factors analyzed in the Minnesota and South Dakota study areas.

3.4.3.1 Background

Number of farms--The number of farms decreased for all Minnesota study area counties from 1982 to 1992 (see Table 3-16). In the South Dakota study area, the number of farms also decreased in all counties for both time periods (see Table 3-17).

Total Farm Acreage--In the Minnesota study area, total farm acreage declined for nine of the Minnesota study area counties from 1982-1987 and increased for the other two counties. During 1987-1992, the farm acreage dropped in four of the counties and increased in the other seven counties; however, the net result was still a loss of approximately 106,000 acres of farmland over the reported 10 year period.

During the same 10-year period, the total farm acreage dropped in three South Dakota counties, while it increased in one county. On the whole, there was a decrease of approximately 13,000 acres of farmland in the entire South Dakota study area.

Average Farm Size in Acres--The average farm acreage increased for all the Minnesota study area counties over the 10-year period. In the South Dakota study area, the average farm size rose for all four counties during the same 10-year period.

Number of Cattle and/or Calf Farms--In all Minnesota study area counties, the number of cattle and/or calf farms decreased during the 10-year time frame.[1] In the South Dakota study area, the number of cattle and/or calf farms decreased for the same 10-year period.

Number of Cattle and Calves--In all Minnesota study area counties, there was a net decrease in the number of cattle and calves over the 10 years from 1982 to 1992. In the South Dakota study area, the number of cattle and calves had a net decrease in all four counties for the same 10-year period.

Number of Beef Cow Farms--In the Minnesota study area, the number of beef cow farms decreased during 1982-1987 for all counties. The number increased in three counties and decreased for five counties during 1987-1992. However, for the 10-year reporting period, the net result was a loss of the number of beef cow farms in the Minnesota study area.

The number of beef cow farms decreased in the South Dakota study area during the 10-year period.

Number of Beef Cows--In the Minnesota study area, the number of beef cows decreased for all counties during 1982-1992. In the South Dakota study area, there was a net loss in the beef cow population.

Number of Hog and/or Pig Farms--In the Minnesota study area, the number of hog and/or pig farms decreased for all counties during both time periods. In the South Dakota study area, the number of hog and pig farms decreased during both time periods for all four counties.

Number of Hogs and Pigs--The number of hogs and pigs decreased in nine counties and increased in two counties during 1982-1987 for the Minnesota study area. All 11 counties experienced an increase in the hog and pig populations during 1987-1992. For the entire study area, the increases in the latter time period exceeded the previous decreases (see Figure 3-14).

The number of hogs and pigs in South Dakota decreased in three counties and increased in one county during 1982-1987. The population increased in three counties and decreased in one county during 1987-1992 (see Figure3-15).

[1]The changes in the number of a specific type of farm, e.g., beef cow farms, do not necessarily correlate with or reflect an increase or decrease in the total number of farms for the study area. These data only indicate that the number of farmers participating in this type of farming has changed.

TABLE 3-16 MINNESOTA AGRICULTURE CENSUS (1982, 1987, 1992)

Category and Data by Survey Year		Lincoln		Yellow Medicine		Lyon		Lac Qui Parle		Redwood		Pipestone		Murray		Cottonwood		Rock		Nobles		Jackson	
		Amount[1]	Change[2]	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change
Number of Farms	82	823	-	1,211	-	1,175	-	1,082	-	1,544	-	828	-	1,150	-	1,053	-	953	-	1,413	-	1,253	-
	87	748	-75	1,027	-184	1,036	-139	972	-110	1,435	-109	785	-43	995	-155	970	-83	843	-110	1,269	-144	1,074	-179
	92	696	-52	923	-104	947	-89	866	-106	1,259	-176	778	-7	903	-92	876	-94	791	-52	1,199	-70	1,027	-47
Total Farm Acreage	82	267,033	-	440,591	-	407,677	-	418,749	-	511,596	-	250,996	-	371,868	-	378,608	-	273,959	-	420,113	-	411,488	-
	87	253,044	-13,989	412,568	-28,023	368,115	-39,562	411,194	-7,555	514,462	2,866	246,804	-4,192	372,454	586	377,506	-1,102	260,092	-13,867	413,816	-6,297	394,000	-17,488
	92	255,453	2,409	407,953	-4,615	395,023	26,908	405,029	-6,165	491,726	-22,736	252,658	5,854	375,628	3,174	374,920	-2,586	270,332	10,240	416,570	2,754	401,039	7,039
Average Farm Size (Acres)	82	324	-	364	-	347	-	387	-	331	-	303	-	323	-	360	-	287	-	297	-	328	-
	87	338	14	402	38	355	8	423	36	359	28	314	11	374	51	389	29	309	22	326	29	367	39
	92	367	29	442	40	417	62	468	45	391	32	325	11	416	42	428	39	342	33	347	21	390	23
Number of Cattle and/or Calf Farms	82	518	-	409	-	553	-	390	-	556	-	538	-	564	-	408	-	578	-	679	-	390	-
	87	393	-125	254	-155	368	-185	295	-95	418	-138	427	-111	410	-154	316	-92	405	-173	443	-236	249	-141
	92	336	-57	227	-27	347	-21	253	-42	352	-66	430	3	362	-48	284	-32	388	-17	400	-43	233	-16
Number of Cattle and Calves	82	46,029	-	33,565	-	58,353	-	32,634	-	48,081	-	50,247	-	51,698	-	45,784	-	65,421	-	63,969	-	41,425	-
	87	33,302	-12,727	22,722	-10,843	39,267	-19,086	21,040	-11,594	35,522	-12,559	33,982	-16,265	37,886	-13,812	32,828	-12,956	49,695	-15,726	42,273	-21,696	23,255	-18,170
	92	27,765	-5,537	21,552	-1,170	40,032	765	24,947	3,907	34,011	-1,511	35,710	1,728	39,089	1,203	35,194	2,366	42,242	-7,453	43,665	1,392	22,048	-1,207
Number of Beef Cow Farms	82	251	-	190	-	246	-	227	-	204	-	214	-	218	-	204	-	277	-	279	-	184	-
	87	168	-83	120	-70	150	-96	150	-77	129	-75	185	-29	143	-75	158	-46	196	-81	193	-86	111	-73
	92	171	3	107	-13	156	6	144	-6	123	-6	217	32	162	19	131	-27	213	17	174	-19	97	-14

TABLE 3-16
AGRICULTURAL CENSUS MINNESOTA (1982, 1987, 1992) (cont.)

Category and Data by Survey Year		Lincoln		Yellow Medicine		Lyon		Lac Qui Parle		Redwood		Pipestone		Murray		Cottonwood		Rock		Nobles		Jackson	
		Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change	Amount	Change
Number of Beef Cows	82	9,360	-	5,826	-	9,110	-	6,474	-	7,052	-	7,346	-	7,063	-	6,398	-	10,348	-	8,192	-	6,155	-
	87	5,424	-3,936	4,611	-1,215	5,898	-3,212	3,854	-2,620	4,632	-2,420	5,759	-1,587	4,738	-2,325	4,393	-2,005	7,080	-3,268	5,247	-2,945	3,575	-2,580
	92	5,431	7	4,019	-592	5,915	17	4,278	424	4,192	-440	6,708	949	5,313	575	3,943	-450	7,279	199	6,134	887	2,603	-972
Number of Hog and/or Pig Farms	82	294	-	307	-	389	-	319	-	526	-	286	-	410	-	336	-	402	-	555	-	391	-
	87	217	-77	223	-84	334	-55	225	-94	479	-47	257	-29	335	-75	287	-49	316	-86	446	-109	301	-90
	92	178	-39	204	-19	306	-28	205	-20	416	-63	189	-68	288	-47	255	-32	288	-28	420	-26	289	-12

Source: Agricultural Census, Minnesota Home Page, 1992 Census of Agriculture, U.S. Census Data.
[1]The reported number of farms, animals, or acreage recorded during survey years 1982, 1987, and 1992, respectively.
[2]The increase or decrease in the number of farms, animals, or acreage compared to the previous survey year, i.e., 1987 vs. 1982 and 1992 vs. 1987.

TABLE 3-17 AGRICULTURAL CENSUS SOUTH DAKOTA (1982, 1987, 1992)

Category and Data by Survey Year		Brookings County		Deuel County		Minnehaha County		Moody County	
		Amount[1]	Change[2]	Amount	Change	Amount	Change	Amount	Change
Number of Farms	82	1,060	-	705	-	1,490	-	732	-
	87	1,004	-56	690	-15	1,382	-108	662	-70
	92	959	-45	634	-56	1,262	-120	640	-22
Total Farm Acreage	82	442,974	-	346,566	-	425,971	-	293,153	-
	87	432,552	-10,422	351,278	4,712	432,472	6,501	280,774	-12,379
	92	444,440	11,888	341,131	-10,147	425,288	-7,184	284,888	4,114
Average Farm Size (Acres)	82	418	-	492	-	286	-	400	-
	87	431	13	509	17	313	27	424	24
	92	463	32	538	29	337	24	445	21
Number of Cattle and/or Calf Farms	82	740	-	537	-	922	-	470	-
	87	582	-158	489	-48	728	-194	335	-135
	92	524	-58	444	-45	695	-33	341	6
Number of Cattle and Calves	82	76,657	-	51,646	-	80,726	-	49,215	-
	87	63,057	-13,600	48,532	-3,114	64,578	-16,148	38,929	-10,286
	92	61,962	-1,095	49,731	1,199	64,198	-380	36,776	-2,153
Number of Beef Cow Farms	82	517	-	332	-	572	-	343	-
	87	405	-112	283	-49	448	-124	231	-112
	92	379	-26	280	-3	455	7	266	35
Number of Beef Cows	82	23,345	-	14,145	-	22,288	-	14,537	-
	87	17,734	-5,611	12,431	-1,714	16,025	-6,263	9,114	-5,423
	92	20,129	2,395	14,290	1,859	18,410	2,385	11,994	2,880
Number of Hog and/or Pig Farms	82	316	-	121	-	427	-	246	-
	87	244	-72	116	-5	312	-115	193	-53
	92	212	-32	97	-19	301	-11	175	-18
Number of Hogs and Pigs	82	69,223	-	16,295	-	79,817	-	50,813	-
	87	64,601	-4,622	17,241	946	78,587	-1,230	50,110	-703
	92	70,832	6,231	15,772	-1,469	103,713	25,126	52,127	2,017

TABLE 3-17 AGRICULTURAL CENSUS SOUTH DAKOTA (1982, 1987, 1992) (cont.)

Category and Data by Survey Year		Brookings County		Deuel County		Minnehana County		Moody County	
		Amount[1]	Change[2]	Amount	Change	Amount	Change	Amount	Change
Number of Farms With Irrigated Land	82	85	-	13	-	22	-	18	-
	87	94	9	15	2	24	2	25	7
	92	79	-15	15	0	25	1	16	-9
Acres of Irrigated Land	82	16,074	-	1,591	-	1,589	-	2,681	-
	87	15,257	-817	2,097	506	2,376	787	2,036	-645
	92	14,666	82	2,048	-49	1,112	-1,264	1,601	-435

Source: Agricultural Census, South Dakota Home Page, 1992 Census of Agriculture, U.S. Census Data.
[1]The reported number of farms, animals, or acreage during survey years 1982, 1987, and 1992, respectively.
[2]The increase or decrease in the number of farms, animals, or acreage compared to the previous survey year, i.e., 1987 vs. 1982 and 1992 vs. 1987.

FIGURE 3-14 COMPARISON OF HOG AND PIG CENSUS FOR YEARS 1982, 1987, 1992

FIGURE 3-15 COMPARISON OF HOG AND PIG CENSUS FOR YEARS 1982, 1987, 1992

Number of Farms With Irrigated Land and Acres of Irrigation--In 1992, a few farms in the Minnesota study area were reported to use irrigation. This meant that an extremely small portion of the over 4 million farm acres in this study area was irrigated.

In the South Dakota study area, in 1992, a few farms used irrigation; again, a very small portion of the total acreage in the study area was irrigated.

Pesticides and Herbicides--The study team sought to determine if supplying water to farms could lead to increased use of agricultural chemicals. The premise was that farmers who are dependent on their own well water have a strong incentive to avoid overuse of agricultural chemicals to prevent the contamination of their own groundwater. The concerns were:

- If farmers received potable water from a rural water system, would they no longer be concerned about groundwater contamination?
- Would they be more likely to use greater quantities of agricultural chemicals?
- Would this, in turn, result in increased groundwater contamination?

Relevant data to answer these questions were not available. For example, information was sought regarding the total number of pounds per acre of agricultural chemicals used or the total volume of pesticides applied as a liquid. Data relative to any of these issues could indicate if there was an increase or decrease of water use. However, because these data are not available, no reliable comparison could be made about agricultural chemical use or overuse in the study areas.

The cost of agricultural chemicals has risen sharply in recent years. This cost has become much more of a constraint on overuse than may have been the case in the past.

3.4.3.2 Agricultural Trends

For the Minnesota and South Dakota study area, all the agricultural trends followed a similar pattern. For the study region, and hence the two study areas, over the 10-year reporting period, the number of farms, total farm acreage, number of cattle and/or calf farms, number of cattle and calves, number of beef cow farms, number of beef cows, and number of hog and/or pig farms all declined, while the average farm size and the number of hogs and pigs were the only two factors that showed a gain. No unusual growth in the size of the farms or the population of hogs and pigs occurred in the study region.

The total number of farms decreased in the study region along with the total farmed acreage, while farm size increased slightly. These trends are probably due to some farmers who left farming altogether and to Federal programs that place agricultural land in conservation or other programs. Thus, farmland is not lost, but just taken out of production; an item not reported in the agricultural census data. It is apparent from the trend toward increased farm size that some of the farmland is being purchased by other farmers. There is no evidence that any farms in the region are being combined by any one entity or entities into large-scale corporate agricultural operations.

During the 10-year period, the trend in 12 regional counties was that the hog and pig populations decreased during the first 5 years then increased for the second 5 years with the gains generally exceeding earlier losses. Of the three counties that were the exception, two had a steady slow increase and one increased then decreased in hog and pig population. The trend of the decrease and then increase in the hog population in the study region mirrored the consumption of pork in the United States for the same period (World Almanac Book, 1996). The percentage of increases in hog and pig population for the Minnesota study area may be found in Figure 3-16. The percentage of increases in hog and pig population were quite different; Lincoln County had a 52% increase compared to an average increase of 22% throughout the Minnesota study area. However, it should be noted that this apparently large percentage increase occurred in a county that had a relatively small hog and pig population to start with in 1987. Lincoln County started the 1987-1992 period with approximately 43,500 hogs and pigs, compared to the area-wide average of 97,000. The county's hog population grew by 52%, but that only represented an actual increase of 23,000 hogs. For comparison, the other counties added, on the average, 21,000 hogs. The range of the increases was from 2,500 to 52,500 (see Table 3-18). It is interesting to note that the counties with the highest increases in hogs and pigs were Rock, Jackson, and Nobles, the counties closest to the slaughtering facilities in Worthington located in Nobles County, MN.

TABLE 3-18 GROWTH IN NUMBER OF HOGS IN THE MINNESOTA STUDY AREA FROM 1987 TO 1992

County	1987	1992	Change	Percent Change
Lincoln	43,565	66,435	22,870	52.5
Yellow Medicine	64,525	76,557	12,032	18.6
Lyon	110,551	136,032	25,481	23.0
Lac qui Parle	59,143	66,387	7,244	12.2
Redwood	141,878	154,445	12,567	8.9
Pipestone	60,433	70,506	10,073	16.7
Murray	93,047	105,165	12,118	13.0
Cottonwood	100,534	103,092	2,558	2.5
Rock	103,460	146,838	43,378	41.9
Nobles	149,301	201,797	52,496	35.2
Jackson	141,608	169,201	27,593	19.5
Totals	**1,068,045**	**1,296,455**	**228,410**	**244.0**
Mean	**97,095**	**117,860**	**20,765**	**22.2**

FIGURE 3-16 PERCENTAGE INCREASES IN HOG POPULATIONS IN MINNESOTA COUNTIES DURING STUDY PERIOD

3.4.3.3 Socio-economic Consequences

Population trends are not anticipated to be affected by the continued expansion of the LPRW system. Even though much of the study area was being supplied with potable water, the population still declined over the 10-year period. The availability of a potable water supply did not diminish or arrest the population decrease. The entire Minnesota study area has shown a population decrease in both the areas supplied by LPRW and existing water supplies. The population has not been affected and is not projected to be affected either positively or negatively by the expansion of the LPRW system.

In the Minnesota and South Dakota study areas, the increase of the number of people on the unemployment rolls correlates with the decrease in the number of farms over the 10-year time frame. As the number of farms decreases, the number of agricultural jobs also decreases.

The availability of land is the single most important factor in siting a hog farm, and the proximity to a slaughterhouse is second. The supply of potable water appears to have no bearing on the expansion of hog farming. In such counties as Lincoln and Rock, if availability of potable water was a significant factor, then it would be expected that the number of hog farms would have increased rather than declined in these counties. When the number of farms did decline, it might also have been expected that would have been no loss in total farm acreage and the average acreage per farm would have risen sharply. This would indicate that the vacated farms were bought up to form larger farms and large-scale hog-farming operations. In addition, it would be expected that the numbers of hogs and pigs would have risen sharply with continuous growth. None of this has occurred and, in fact, these and all counties in the study followed the same general trends. Potable water does not, therefore, appear to be a parameter that will by itself cause an increase in hog and/or pig farming. Continued expansion of LPRW will not cause an increase in the hog and/or pig population, nor an increase in hog and/or pig farms.

There are not enough specific data available to ascertain if supplying potable water will have a positive or negative effect on the economy. The supply of potable water should improve human health and livestock quality. Improved livestock quality would make the farm animals more marketable. Consumers would benefit also, because the animal products would be of better quality. However, since all the counties in the study area have a complete or partially complete potable water service area, and the quality of the groundwater is not known throughout the study area, no conclusions can be drawn about whether the availability of potable water has an effect on agricultural, wholesale, retail, or service business sales.

3.4.4 Land Use Considerations

Of primary concern to the U.S. Department of Agriculture is the impact its programs have on the unwarranted conversion of important farmland and other important land resources, defined in the area of southwestern Minnesota as wetlands and floodplains. The Agency, in accordance with USDA Departmental Regulation 9500-3, Land Use Policies, encourages and promotes wise land use policies with the recipients of its program. As such, the Agency has considered the indirect and cumulative effects of the proposed action and its potential effect on important farmland, wetlands, and floodplains. As a condition of the loan, the Agency will require LPRW to consider requests for service connections and how they may affect the unwarranted conversion of floodplains and wetlands. the Agency' letter of conditions with LPRW will include the stipulations or mitigation measures described below.

Important Farmland--After analysis of the demographic patterns and trends of LPRW's service area, it was concluded that there will be minimal developmental pressures in the area and, therefore, little potential for unwarranted conversions of important farmlands. No mitigation measures related to important farmland will be developed.

Floodplains--There are floodplains in LPRW's service area. the Agency' letter of conditions will stipulate that LPRW shall not provide service connections to any existing user within a flood hazard zone in any municipality unless that municipality is participating in the Flood Insurance Program as administered by the Federal Emergency Management Agency. No new service connections will be provided to any proposal in any designated flood hazard zones. Because there is limited coverage of flood hazard determinations in the area, floodplains may also be identified as alluvial soils on NRCS Soil Surveys. The delineation of alluvial soils in these soil surveys does not constitute regulatory limits; therefore, LPRW is only encouraged to be aware of their existence.

Wetlands--There are numerous wetland areas in LPRW's service area. LPRW will be required to inform service connection applicants that pursuant to Section 404, Clean Water Act, individuals must contact the USACE if their proposed development will affect any wetland or other aquatic environment. Failure to do otherwise is a violation of Federal law, and violators will be subject to legal action by USACE.

3.4.5 Environmental Justice Concerns

In accordance with Executive Order 12898, Environmental Justice, the Agency evaluated whether or not the proposed action will have a disproportionate impact on low-income or minority populations. Because the project will involve minimal construction activities and will be supplying potable water to all who request it, provided the community requesting such service is an eligible program participant, the Agency concludes that the proposed action will not have a disproportionate impact on low-income or minority populations. The proposed action, by providing better quality of water to the area's residents, will improve the quality-of-life for those residents currently using individual wells and POU systems.

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7 APPENDICES

7.1 Appendix A - Maximum Drawdown in the Potentiometric Surface from the June 1996 Pump Test

7.2 Appendix B - Nationwide Permit 12, Utility Line Discharges

Discharges of dredged or fill material associated with excavation, backfill or bedding for utility lines, including outfall and intake structures, provided there is no change in preconstruction contours. A “utility line” is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquefiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. The term “utility line” does not include activities which drain a water of the United States, such as drainage tile; however, it does apply to pipes conveying drainage from another area. This NWP authorizes mechanized landclearing necessary for the installation of utility lines, including overhead utility lines, provided the cleared area is kept to the minimum necessary and preconstruction contours are maintained. However, access roads, temporary or permanent, or foundations associated with overhead utility lines are not authorized by this NWP. Material resulting from trench excavation may be temporarily sidecast (up to three months) into waters of the United States, provided that the material is not placed in such a manner that it is dispersed by currents or other forces. The DE may extend the period of temporary side-casting not to exceed a total of 180 days, where appropriate. The area of waters of the United States that is disturbed must be limited to the minimum necessary to construct the utility line. In wetlands, the top 6" to 12" of the trench should generally be backfilled with topsoil from the trench. Excess material must be removed to upland areas immediately upon completion of construction. Any exposed slopes and stream banks must be stabilized immediately upon completion of the utility line. (See 33 CFR part 322.)

Notification: The permittee must notify the district engineer in accordance with the “Notification” general condition, if any of the following criteria are met:

(a) Mechanized land clearing in a forested wetland;

(b) A Section 10 permit is required for the utility line;

(c) The utility line in waters of the United States exceeds 500 ft; or,

(d) The utility line is placed within a jurisdictional area (i.e., a water of the United States), and it runs parallel to a stream bed that is within that jurisdictional area. (Sections 10 and 404)

Notification Requirements:

(a) Timing: Where required by the terms of the NWP, the prospective permittee must notify the District Engineer with a Pre-Construction Notification (PCN) as early as possible and shall not begin the activity:

(1) Until notified by the District Engineer that the activity may proceed under the NWP with any special conditions imposed by the District or Division Engineer; or

(2) If notified by the District or Division Engineer that an individual permit is required; or

(3) Unless 30 days (or 45 days for NWP 26 only) have passed from the District Engineer's receipt of the notification and the prospective permittee has not received notice from the District or Division Engineer. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Notification: The notification must be in writing and include the following information:

(1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) Brief description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s) or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity.

7.3 Appendix C - Burr Unit/Altamont Aquifer Cross Sections and Sand Thickness Maps

The reference for information in this appendix is the Southwestern Minnesota Groundwater Exploration Project, 1996-97, Minnesota Department of Natural Resources, February 1997. Chapter 4 of this reference documents exploration efforts of the aquifers utilized at LPRW's Burr Well Field. The following information describes water-bear formations attributed to the Prairie Coteau (Burr Unit) and Altamont Aquifers. The information is presented in order of depth from the shallowest to the deepest (see Figures 7-4 to 7-7).

Aquifer	Formation Designation
Prairie Coteau (Burr Unit) Aquifer	Unit 2 Unit 3 Unit 4, 4a Unit 5
Altamont Aquifer	Basal Quaternary (BQ)

FIGURE 7-1 BURR WELL FIELD/LAKE COCHRANE, UNIT 2 SAND THICKNESS

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-97, Progress Report

FIGURE 7-2 BURR WELL FIELD/LAKE COCHRANE, UNIT 3 SAND THICKNESS

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-97, Progress Report

FIGURE 7-3 BURR WELL FIELD/LAKE COCHRANE, UNIT 4A SAND THICKNESS AND CROSS SECTION LOCATIONS

Source, MNDNR, Southwestern Minnesota Groundwater Exploration Project, 1996-97, Progress Report

FIGURE 7-4 BURR WELL FIELD/LAKE COCHRANE AREA, CROSS SECTION A-A'

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-97, Progress Report

FIGURE 7-5 BURR WELL FIELD/LAKE COCHRANE AREA, CROSS SECTION B-B'

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-977, Progress Report

FIGURE 7-6 BURR WELL FIELD/LAKE COCHRANE AREA, CROSS SECTION C-C'

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-97, Progress Report

FIGURE 7-7 BURR WELL FIELD/LAKE COCHRANE AREA, CROSS SECTION D-D'

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1996-97, Progress Report

7.4 Appendix D - Wood Lake Aquifer Cross Sections and Sand Thickness Maps

FIGURE 7-8 WOOD LAKE AQUIFER SAND THICKNESS, YELLOW MEDICINE COUNTY

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1997, Final Report

FIGURE 7-9 WOOD LAKE AQUIFER CROSS SECTION LOCATIONS, YELLOW MEDICINE COUNTY

Source, MNDNR, Southwestern Minnesota Groundwater
Exploration Project, 1997, Final Report 1

FIGURE 7-10 WOOD LAKE AQUIFER, CROSS SECTION A-A'

Source, MNDNR, Southwestern Minnesota Groundwater Exploration Project, 1997, Final Report 1

FIGURE 7-11 WOOD LAKE AQUIFER, CROSS SECTION B-B'

Source, MNDNR, Southwestern Minnesota Groundwater Exploration Project, 1997, Final Report 1

FIGURE 7-12 WOOD LAKE AQUIFER, CROSS SECTION C-C'

Source, MNDNR, Southwestern Minnesota Groundwater Exploration Project, 1997, Final Report 1

7.5 Appendix E - Comments from the Minnesota Department of Natural Resources on the Preliminary Draft Environmental Impact Statement

Preliminary Draft Environmental Impact Statement (PDEIS)
Lincoln Pipestone Rural Water (LPRW)

1.0 INTRODUCTION

This section states that the purpose for the EIS is to ensure that environmental information is available to decision makers and citizens before decisions are made and actions taken. Unfortunately much of the document provides only general information that is not useful for specific resource decisions. However, MNDNR agrees with RUS's conclusion in the PDEIS that pumping rates at the Burr Well Field should not be increased and that another well field should be developed. The proposed action by LPRW poses environmentally unacceptable risks to unique and valuable resources that cannot be replaced. The MNDNR's preferred alternative is to develop a new well field within the proposed NE Expansion area. Water sources within the proposed NE Expansion area have been identified and should provide reliability and flexibility to the system.

2.1 Purpose and Need

This section states that eligible loan purposes include providing services to rural residents, rural businesses, and other rural users. In Section 2.3.1 on page 17, the PDEIS states that LPRW is providing water to Marshall Municipal Utilities on a short-term basis until its water supply problems can be resolved. Section 3.3.3.1 on page 44, states the volume of water currently provided to City of Marshall is estimated at approximately 200 MGY or about 550,000 gallons per day. This is 20% of the total water withdrawals for the entire system and over 50% of the water pumped from the Burr Well Field. Information from LPRW's consultant DGR (Attachments 1 & 2) show the design capacity for the Burr Well Field is based on providing water service to the City of Marshall and that water volumes could increase to two million gallons per day for this purpose. The purpose and need section of the EIS should discuss short and long-term intentions to provide water service to the City of Marshall and whether this is an eligible loan purpose that meets population, income and other RUS funding criteria. We do not deny the importance of the water supply to the City of Marshall, but question whether this increased demand should be putting additional pressure on the aquifer and limiting the supply for rural water users in the total system.

2.2 Groundwater Availability and Quality in Southwestern Minnesota

The information on water availability and quality information provided in this section is very general and may not apply to the proposed expansion area. Water quality data on page 13, are based on samples taken between 1958 and 1970 for communities on the very south end of the LPRW service area or outside the LPRW service area. The PDEIS should include water quality data for the communities and farmsteads in the proposed NE Expansion area. Customer sign up forms are readily available and should be a good source of information on water quality and quantity problems for people interested in receiving rural water service in the proposed NE Expansion area. Copies of sign up forms and a summary of water needs identified in the customer sign up forms should be added to the EIS.

Attached is a 1996 news article (Attachment 3), in which the clerk and water superintendent for the City of Echo state the city's water source has a dependable history, but the water has some hardness that causes some household appliances to wear out faster. Water resources within the area of use should not be dismissed in the PDEIS as unacceptable water source alternatives just because treatment is needed to address water hardness and quality problems that do not exceed MCL's.
Page 15 describes general nitrate water quality problems and on page 16 the PDEIS states "The purpose of LPRW is, therefore, to provide a consistent and reliable supply of high-quality, affordable water to the residents of its service area." The PDEIS provides no data that indicate water quality for LPRW is better than existing individual or community water systems. Attached (Attachment 4) is a list of nitrate data for communities in southwestern Minnesota that indicate many of the systems now served by LPRW have lower nitrate levels than the Holland or Verdi Well Fields. Water at the Holland Well Field exceeds the MCL for nitrate and LPRW is required to take corrective actions under a compliance agreement (Attachment 5) with the Minnesota Department of Health. High nitrates in the Holland Well Field impacts approximately 864 rural customers and 8 community (Attachment 6) water systems and nitrate levels in the Verdi Well Field are close to exceeding the nitrate MCL.

Page 16, states "sulfates are commonly found in the area and in high concentrations may cause particular problems with livestock operations (MPCA, 1997). Sulfates in the concentrations . . . prior to the availability of treated water, many farmers were not able to diversify their farming operations to include the raising of livestock." This statement contradicts the statement made on page 102. "Based on the analyses performed for this EIS, the study team concluded that the availability of potable water supplied by LPRW has not and will not, by itself, cause an increase in these types (large scale animal confinement) of livestock operations."

Page 17, states LPRW is providing water to the City of Marshall on a short-term basis until Marshall's current water supply problems can be resolved. A lot of money was spent to provide a high capacity supply line to the City of Marshall and it is very doubtful that this was done only for a short-term solution. Information submitted by DGR to Rural Development clearly indicates interest in a long-term agreement to provide water to Marshall and this was confirmed by Marshall's consultant and LPRW at a meeting on 11/8/97. Again, providing water to the City of Marshall appears to be part of the design capacity at the Burr Well Field and treatment plant.

This section concludes (page 17) with a statement that the purpose of this proposal is for RUS to continue providing financial resources to the region through loans and grants to LPRW, thus helping to resolve the water supply and quality problems in the area. The City of Canby submitted an application for funding to Rural Development for water treatment plant improvements. At a meeting with the City of Canby Rural Development representatives stated their general policy is to encourage participation in regional water systems and that it is unlikely that a loan would be approved for Canby when a new water treatment plant with adequate capacity is located less than 10 miles away (Attachment 7). The City of Canby has a proven water source and water treatment plant improvements would provide a contingency source of water for the region and help minimize adverse impacts caused by pumping at the Burr Well Field. Rural Development's position on the City of Canby application appears to be based solely on economics and encourages increased water demands on a resource that cannot sustain higher pumping rates without adverse environmental impacts. Rural Development's position on having the City of Canby connect to LPRW prior to the completion of the EIS does not appear to be appropriate. We are also concerned about federal funding policies that impact state water management decisions and the need for better coordination. MNDNR supports regional water systems that spread water demands over multiple sources of water that can serve as backup supplies to other service areas and prevent situations like the high nitrate problems at the Holland Well Field that has affected hundreds of customers dependent this resource. A discussion of Rural Development's funding policies and the impact of these policies on natural resources and state water management should be included in the EIS.

2.3.1 System History and Summary

Nitrate levels should be added to the table on page 19 that describes general water quality at each well field and the EIS should discuss the need for treatment plants at the Holland and Verdi Well Fields to address nitrate levels that are close to or exceed MCL's. The PDEIS includes many references to the Holland and Verdi service areas and any relationship between this EIS and the environmental assessment currently being completed for the proposed Holland Water Treatment Plant should be discussed.

Attached is a more recent map from DGR with more detail on primary and secondary service areas that could be used for Figure 2-4.

2.3.1.1 Regional Rural Water Development

This section states that a well owner would be required to pay $2,000 to $8,000 to obtain water quality similar to that offered by LPRW. No water quality data for rural farmstead wells in the proposed NE Expansion are provided in the PDEIS to support this statement. Many customers in the Holland and Verdi service areas are actually receiving water with higher nitrate levels than their previous supply.

Costs for point of use water treatment systems in Table 2-1 that were provided by LPRW's consultant should be verified by RUS or balanced with price quotes from equipment manufacturers. All or most of the farmsteads in the proposed NE Expansion area currently have wells and the water from the Burr Water Treatment Plant is classified as hard water that would require further water softening. Eliminating costs for existing items or equipment that would be needed for rural water would reduce cost estimates significantly. Use of home water softeners would also help reduce TDS and the purpose and need for rural customers to have special TDS reduction equipment should be discussed in the EIS. The LPRW user costs in Table 2-1 need to indicate how costs are calculated and if user costs include federal grant money, which would distort cost comparisons.

Actual capital costs for large users and the City of Marshall should be added to the EIS. Table 2-1 indicates that average or larger water users pay about half the amount of money that household or smaller users pay. This difference appears to be based on large and small water users paying the same connection fee regardless of the amount of water used or the actual cost for construction of the connection. Reliability, quality, and convenience are cited as reasons for preferring rural water systems over point of use systems. Flat rate connection fees that benefit larger water users and federal grant money to subsidize rural water costs are also major factors that encourage use of LPRW.

The PDEIS states that ground water accessibility and, therefore, well depths are likely to be shallower in the proposed NE Expansion area than in other parts of the LPRW's service area. The basis for this statement and supporting data should be added to the EIS because the PDEIS has very little data on water quality and availability in the proposed NE Expansion.

2.3.1.2 LPRW Growth

The LPRW Board of Directors' official policy does not define any limits on the ultimate size of the system. According to the PDEIS potential areas for expanding the system includes Lac Qui Parle and Redwood Counties and the northeastern part of Yellow Medicine County. This potential expansion area is very large and supports the need for an additional well field in the proposed NE Expansion area to help reduce environmental impacts and improve system reliability.

LPRW also stated at a meeting on 11/8/97 that about half of the potential users in the Burr Well Field service area are connected to the system and that they expect more people within the service area to sign up in the future. Reserved capacity within currently authorized limits should be maintained for expansion of service to new customers within the existing Burr Well Field service area.

2.3.2 Existing System North/Lyon County Phase History

The EIS should include the history of the St. Leo service area and provide additional information on water service to the City of Marshall. These service connections increased water demands at the Burr Well Field by approximately 239 MGY in the last year.

The PDEIS provides limited information in Section 3.3.3.1 on the recent change in water service to the 161 customers in the St. Leo service area that was previously served by the City of Canby under an agreement with LPRW. The City of Canby has a proven source of supply, which provided reliability and flexibility to LPRW. The City of Canby and LPRW agreement does not terminate until the year 2012 (Attachment 8), but LPRW stopped using this source of water in 1996 and now supplies 39 MGY to this area from the Burr Well Field. LPRW's action increased water use at the Burr Well Field, eliminated part of LPRW's contingency plan and reduced the storage capacity for the system because LPRW and Canby shared a water tower. Impacts from increased pumping at Burr Well Field and reductions in storage capacity should be discussed in the EIS.

The history of plans to provide water to the City of Marshall should be discussed in more detail. There are indications (Attachments 1& 2) as early as 1991 that the Burr Treatment Plant was being designed to provide up to 2 MGD of water to Marshall and more than half of the water produced at the Burr Well Field is currently supplied (PDEIS page 44) to Marshall. LPRW's attorney and Marshall's consultant at a meeting on 11/8/97 stated that the City of Marshall is interested in a long-term agreement for water service. This arrangement appears to be part of the original design capacity for the Burr Well Field and is therefore important to the history of this expansion area. A copy of the short-term agreement with the City of Marshall should be added to the EIS along with other available information submitted by LPRW to RUS and Rural Development.

2.4 Summary of Scoping Process

3.0 Alternatives

3.1 Identifying Reasonable Alternatives

The last sentence in the first paragraph of this section (page 28) is not clearly worded.

This section states (page 29) that the Burr Well Field was built to serve as a significant source of water not only for the Northeast Phase but for a significant portion of LPRW's service area. Information used to determine the design capacity of the Burr Treatment Plant should be included in the EIS.

Page 29, includes a statement that when the FONSI was issued in 1992 (for the original EA), there were no indications, nor could it be substantiated that appropriations from the Prairie Coteau aquifer would irreversibly or irretrievably destroy the resources that were of concern. MNDNR notified LPRW (Attachment 9) regarding concerns about potential impacts to natural resources, but these concerns were not disclosed in the environmental assessment. RD/FmHA sent MNDNR a request for information that included very limited and inaccurate information (Attachment 10) about the project and also sent notice of the FONSI, but MNDNR was never provided a copy of the actual environmental assessment for review or comments. Rural Development should provide copies of the actual environmental assessments for public review prior to issuance of a final decision regarding impacts. This process would allow an evaluation of information collected during the development of the environmental assessment and the opportunity to provide current information.

MNDNR agrees with the statement in the PDEIS that the aquifer may not be able to sustain an unlimited withdrawal of groundwater without adversely affecting fens and local surface water resources.

3.2 System Needs

This section is very confusing and does not provide a clear understanding of actual water use or system demands. The actual and projected needs also do not consider conservation measures to improve long-term efficiencies, demand reduction measures for emergencies, environmental impacts at projected demands or the capability of the resource to supply projected volumes. As indicated in the previous section the potential for adverse environmental impacts exists and, therefore, projections based on demand reduction measures and contingency actions should also be included in the EIS.

Attached is a map (Attachment 11) from DGR and an attachment to LPRW’s permits (Attachment 6) that identifies primary and secondary service areas for each well field. Secondary service area on the map and LPRW’s water appropriation permits refers to the ability of a well field to provide a backup supply to other service areas in the event there is a problem with the primary well field for that service area. The PDEIS states “secondary sources reflect the limited amount of flexibility LPRW has at its three primary sources of water and how modifications in permitted appropriations could allow the utility to meet system water needs in a crisis.” The example provided in the PDEIS to support this statement is based on a theoretical assumption that there is a problem with the authorized volume of water at the Verdi Well Field and that it should be increased from 683 MGY to 892 MGY. However, the volume of water reported by LPRW for the Verdi Well Field in 1996 was 424.5 MGY and the highest volume reported was 521 MGY in 1988. The Verdi Well Field was not able to supply additional water to the Holland Well Field service area during the current nitrate water quality problems and the ability to pump 683 MGY let alone 892 MGY is questionable at best. It is clear from these statements that RUS does not understand that the MNDNR Waters permitting process is meant to consider the long-term capability of the resource not just the short-term needs of emergency pumping. The statement about the lack of flexibility is not supported by the source capacity figures in Table 3-1 and the purpose and use of these numbers needs to be justified in the EIS. Also attached (Attachment 12) is a copy of the permit for the Verdi Well Field, which reflects that the pumping rate requested by LPRW is authorized by the permit.

The EIS should include information on actual water demands as stated at the beginning of this section. Attached are pumping records for the Burr Well Field and a summary of reported data for the Verdi and Holland Well Fields (Attachments 13 & 14). In 1996, water withdrawals reported by LPRW totaled 975.3 MGY for the entire system and this compares to a total system demand of 1,247 MGY (1,026 MGY sold and estimated unmetered 221 MGY) listed in Table 3-1.

The following items in Tables 3-1 and 3-2 should be defined and addressed.

- System demand includes all of the well fields, but source capacity is listed by well field. It would be appropriate to list the demand by well field.
- The source capacity of the Burr-existing system is listed as an “Average Day (kgalday)” of 773. This value is already too low-the current average is approximately 900,000+ gallons per day.
- How is “estimated unmetered” calculated and why is it estimated rather than determined by subtracting water sold from total water withdrawals. Unaccounted-for water volumes (water withdrawals minus water sold) appears to be 17.7% on Table 3-1 and 21.4% on Table 3-2. Unaccounted water exceeds the 10% volume recommended by the American Water Works Association and there is no discussion in the PDEIS about goals or measures to reduce this volume of water.
- How is “total firm design capacity” defined and how does it relate to firm capacity (total capacity with the largest pump out of service)?
- The DGR peak day is 248,000 gallons for Canby, which is lower than the Canby estimate of 465,000 gallons (Attachment 7).
- The DGR total design capacity of 1,917 MGY is higher than the 1,583 MGY

permitted capacity, but almost a billion gallons higher than the maximum reported usage by LPRW. As stated on page 32, the absolute maximum yields cannot be sustained and using annual total design capacity volumes to justify an alleged lack of flexibility due to lower permitted authorizations that have never been exceeded is questionable.

- Table 3-1 states the annual use for the proposed NE Expansion is 210 MGY and in Table 3-2 the total annual use for Echo and Hazel Run is 12,468,400 gallons. This leaves approximately 197 MGY for the 170 rural customers in the proposed NE Expansion or 1,270 gallons per capita per day based on 2.5 persons per household. A total of 210 MGY is obviously a very high projection for water use in the proposed NE Expansion and shows the need to provide justification for the numbers used in Table 3-1.

- Total storage capacity should for each service area should be listed along with a discussion on how storage capacity relates to the average day demands. Storage for the system is less than the average daily demand recommended in the *Recommended Standards for Water Works* (Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers) and the impact of inadequate storage on pumping rates required for average and peak demands should be discussed.

- The annual use for Marshall Municipal Utilities is listed as 109.5 MGY, but page 44 states 200 MGY is currently being provided.

3.3 Description of the Alternatives Considered

3.3.1 Preferred Alternative

The PDEIS states the preferred alternative is to continue to maintain the Burr Well Field as the primary water source, but it is not clear if this statement refers to currently authorized pumping rates and volumes or some other level of pumping. How can the PDEIS state that minimal impacts to sensitive natural resources are anticipated and then recommend continued use of the Burr Well Field as a primary water source without recommending a pumping rate?

"RUS believes that sufficient evidence exists to conclude that the Burr Unit of the Prairie Coteau aquifer will be able to serve as a primary source of water for the foreseeable future." What is the basis for this statement? Since there is almost no record of water levels collected at the permitted pumping rate, much less the requested rate, it is premature to state that the resource can sustain long-term pumping.

The preferred alternative states (page 34) "This does not . . . discount the potential for adverse effects to fens and surface water features in the general area" and recommends development of another well field. MNDNR's preferred alternative is to develop a well field and treatment plant in the proposed NE Expansion area. Development of a well field in the proposed NE Expansion area would reduce the potential for adverse environmental impacts and improve system reliability and flexibility.

The PDEIS preferred alternative includes a recommendation for a new well field in the Burr Unit of the Prairie Coteau Aquifer and to evaluate the Altamont aquifer as a source of additional water. These potential water sources were identified by the recent MNDNR grid drilling program, however, this is an area where calcareous fens would be expected to be present and have been identified (Attachment 15). Placing a well field at a location that is away from calcareous fens or in an aquifer that would not impact calcareous fens could provide a supplemental water source for the Burr Well Field. MNDNR supports development of a supplemental water source that would allow for a reduction in current pumping levels at the Burr Well Field. However, the proposed NE Expansion is fifty miles from the current well field and the MNDNR preferred alternative is to develop a source of water in that area to supply water requirements for a new service area.

The preferred alternative also recommends development of a fen management plan. The term fen management plan is not defined in the PDEIS, but has a specific purpose and meaning under Minnesota Statutes. Minnesota Statute 103G.223, states that calcareous fens as identified by the commissioner, may not be filled, drained, or otherwise degraded, wholly or partially, by any activity, unless the commissioner, under an approved management plan, decides some alteration is necessary. LPRW received an exemption from developing a fen management plan for appropriations within the existing permit authorizations. Increasing appropriations above the currently permitted levels will require an approved management plan. However, the commissioner must determine that there are no other feasible alternatives before deciding that a fen management plan is required to allow increased pumping and further impacts to calcareous fens near the Burr Well Field. The MNDNR believes a water source closer to or within the proposed NE Expansion area can be developed to serve the needs of that area and provide greater flexibility and reliability for the system. Development of a fen monitoring plan would be worthwhile, but development of a fen management plan to allow further degradation of calcareous fens should not be considered for this purpose because other water resources are available within the region to satisfy demands for the proposed NE Expansion area.

3.3.3.1 Fund the Northeast Phase Expansion

The purpose and need for the booster stations near Minneota and Green Valley should be stated in the PDEIS. The booster stations will allow water to be distributed greater distances from the well field (fifty miles or more) and would have a related environmental impact by increasing pumping rates at the Burr Well Field.

3.3.1.2 Continue to Maintain the Burr Well Field as a Primary Water Source

Page 35: Correction. SDGS 93-18 is a boring not a well.

The first paragraph on page 35 states " . . . Available data on the water table, potentiometric surface, and the response of the aquifer to the three previous pump tests . . . the Burr Unit functions as a single hydrologic unit that would be capable of sustaining production pumping at rates exceeding those currently permitted." This statement appears to project the long-term sustainability of the aquifer when the well field has not even pumped for more than six months at an average rate of approximately 625 gpm. It should be noted that water levels never stabilized at this rate (Attachment 16) and never stabilized during any of the pump tests.

The PDEIS (page 34) states "RUS believes that sufficient evidence exists to conclude that the Burr unit . . . will be able to serve as a primary source of water . . . now and for the foreseeable future. This does not . . . discount the potential for adverse effects to fens or surface water features in the general area.", (page 35) and "Until a more extensive data base has been collected . . . RUS is not in a position to conclusively state or project what effect increased appropriation may have on fens or surface water features." The last two statements contradict the first statement. The PDEIS draws conclusions on the unlikelihood of adverse impacts, while at the same time pointing out the uncertainty regarding potential impacts and the lack of data to support any conclusions.

The last paragraph on page 35 states that at *existing* (existing rate needs to be defined in the EIS) appropriation rates it appears unlikely that the fens or surface water features will be adversely effected. According to the PDEIS this statement is based on minimal observable effects on fens or surface water features during the three previous pump tests. This statement dismisses the drying out of pools on the dome of the Sioux Nation Calcareous fen during the 1,500 gpm pump test and the water level declines at the Fairchild fen. A definition of "observable impact" would be useful in the EIS along with an explanation about why drying of the fen is not considered an impact. There is another statement (page 36) that during the 1,500 gpm test there were no observable adverse impacts to the fens that were monitored. Again the drying of the pools on the Sioux Nation Calcareous fen is an observable impact that is not even mentioned in the PDEIS despite statements by MNDNR to the RUS contractor and LPRW's consultant during the test and information sent (Attachment 17) to RUS and LPRW (Attachment 18) after the test. The EIS should state the observable and reported fact that the pools dried up during the pumping test and returned after pumping ceased. The pools returned two days after pumping ceased which appears to indicate a cause and effect relationship.

The PDEIS states (page 36) that well fields pump in response to demand (especially true if there is inadequate storage) and it is highly unlikely that the well field would pump at a sustained maximum rate 24 hours a day, 7 days a week, 52 weeks each year. LPRW is currently withdrawing water at or close to the 750 gpm authorized pumping rate approximately 20 hours per day. LPRW has discussed providing up to 2 MGD to the City of Marshall and there is no reason to believe that LPRW will not continue to pump in response to demand at maximum allowable rates. This paragraph also states that pumping would be hardest during crop spraying and much lower pumping rates would be used from fall through early spring. The crop spraying period coincides with times when calcareous fen plants have their highest needs for water in the late spring and summer.

Water demands for the current Burr Well Field service area and projected water demands for the proposed NE Expansion are defined (PDEIS page 38) as 282 MGY and 210 MGY respectively. In 1996, LPRW reported a total of 217.4 million gallons for the current Burr Well Field service area, which includes 680 rural customers and 5 towns. The proposed NE Expansion includes 170 rural customers and the towns of Echo and Hazel Run. In Table 3-2 the total annual use for Echo and Hazel Run is 12,468,400 gallons so this leaves approximately 197 MGY for the 170 rural customers in the proposed NE Expansion or 1,270 gallons per capita per day based on 2.5 persons per household. The DGR projection of 210 MGY appears very high for the proposed NE Expansion and is high even compared to the volume of water required for the larger number of users on the existing Burr Well Field service area. The projected demand for the proposed NE Expansion needs to be verified and documented for the EIS.

3.3.1.3 Develop Additional Wells in the Burr Unit of the Prairie Coteau Aquifer

MNDNR supports the development of an additional well field at a location or in an aquifer that will not impact calcareous fens and that will allow a reduction in pumping at the Burr Well Field. It should be noted that this section states additional geologic exploration efforts are needed to obtain an additional water source from the Burr Unit and the Altamont aquifer systems. The aquifer near Cottonwood is dismissed (Section 3.3.3.4) as an alternative because of the need for a similar exploration program. We would like to see the EIS explain why different criteria are being used for different alternatives.

3.3.1.4 Formalize a Fen Management Plan and Establish Additional Monitoring Points

This section refers to development of a **fen monitoring plan**, which is different from a **fen management plan** referred to in Minnesota Statutes 103G.223 (See 3.3.1 comments). Reasonably available alternative water sources exist closer to and in the proposed NE Expansion area that would minimize avoidable harm caused by increased pumping at the Burr Well Field.

Page 40, paragraph 2, states “Because no data were compiled before the construction of the Burr Well Field and Water Treatment Facility, it is not possible at this time to establish or predict long-term trends with any degree of accuracy.” While it is true that only a limited amount of pre-pumping data does exist, it is possible to use this data to make some educated summations about what the water levels were doing from 1990 to 1994. Clearly during that period water levels rose, whether this rise was part of a long-term cycle is unclear. Additionally, while much has been said about the difference in water levels between Lake Cochrane and the Burr Unit, the document does not acknowledge that this water level difference was much less in 1990 than it was in 1994.

Page 40, paragraph 3, states “It is clear that additional long-term monitoring data must be gathered and analyzed before definitive predictions can be made or regulatory impact thresholds established that reflect or take into account the natural variability that the aquifer system and fens invariably experience . . . “ What is it that should be monitored? LPRW's pumping rate has not been consistent so far, so it has been virtually impossible to (except during pumping tests) separate natural water level fluctuations and well field fluctuations and well field pumping impacts. We would appreciate RUS's comments on this dilemma.

Page 40, paragraph 4, states “ . . . Although it may seem intuitive that pumping at the Burr Well Field could exacerbate “impacts” at the fens during drought conditions, no data currently exists that substantiates this hypothesis . . . “ MNDNR provided documentation to RUS concerning the drying of the pools at Sioux Nation fen during the 1996 pump test. This data clearly shows a cause and effect. MNDNR also provided documentation of peat subsidence at the Fairchild fen following the first full year of pumping from the Burr Unit. While it is unclear whether this subsidence was an “adverse impact,” it is clear that this was an impact from pumping.

MNDNR has spent a considerable amount of time and money developing the existing monitoring network and would welcome additional assistance with monitoring activities and costs. The PDEIS infers that existing monitoring program is not adequate and it would be useful to define the additional monitoring needs in the EIS.

Attached is a letter (Attachment 19) from Minnesota Governor Carlson to former Governor Miller of South Dakota that states Minnesota MNDNR will coordinate permit actions with South Dakota DENR. However, LPRW's attorneys have repeatedly questioned Minnesota's legal authority to protect resources in South Dakota on numerous occasions.

The PDEIS (page 42) states that the preferred alternative recommends a collective pumping rate above 750 gpm, but does not indicate a specific pumping rate. It should be noted that the total combined pumping rate at the Burr Well field is 1,215 gpm (750 gpm Burr and 465 gpm Altamont) which is 19% less than the 1,500 gpm requested in LPRW's proposed action. The Altamont well is authorized as a supplemental water source for peak demands and emergencies. It was pumped from June until October of 1997 and it appears to show better potential for use over extended periods of time. Attached is a hydrograph of water levels for the Altamont well (Attachment 20).

The last paragraph on page 42, makes recommendations for a monitoring plan, but does not state what should be monitored at each of the data collection points. The EIS should include the items to be monitored.

Page 43, paragraph 1. Correction: The existing weather station is at the Sioux Nation fen (not Fairchild). The weather station is within a couple miles of Lake Cochrane and the purpose for moving it to the lake should be explained in the EIS.

3.3.2 Proposed Action

It may be helpful for the EIS to clarify that this is LPRW's proposed action because the public could get the impression that this is the action proposed by RUS.

The proposed action is not allowable under Minnesota Statutes because it will adversely impact calcareous fens and alternative sources of water exist that will avoid harm to calcareous fens near the Burr Well Field.

The ability of the Verdi and Holland well fields to supply larger service areas by looping the system does not appear to be feasible based on actual operations during this last summer. As stated in Section 3.3.3.2 rural water systems rarely develop excess capacities above existing and foreseeable future needs. Differences between theory and reality need to be considered because the Verdi Well Field was not able to supply the Holland Well Field service area after nitrate levels exceeded the MCL.

The PDEIS on page 43 states that “it appears unlikely that the fens or surface water features will be affected by the 1,500 gal/min appropriation rate.” This statement should be deleted from the EIS. No where in this document is there a strong case made to support this statement, but the PDEIS (page 76) does state the need to maintain the top portion of the fen saturated with water (note Attachment 21). There is no discussion in the PDEIS about the pools on the Sioux Nation Calcareous Fen becoming dry during the 1,500 gpm test and this issue appears to be ignored in order to form a conclusion that there were no effects. Hydrographs (Attachments 22 & 23) also illustrate that water levels declined dramatically near the Fortier (Livermore) and Cleveland fens.

3.3.3 Alternatives to the Proposed Action

3.3.3.1 Alternative 1

The secondary source designs in Table 3-2 should not be used to define actual annual water use projections because these pumping levels could not be maintained for an entire year. Primary and secondary design capacities also need to be defined better in the EIS.

Page 44, last paragraph. Correction: The City of Canby does not have a water supply problem, it has a need to upgrade its treatment plant. This point should be clarified along with any intentions by Canby to utilize LPRW on a short-term basis.

Why would annual water supply needs remain at 1,350 MGY if the 200 MGY supplied to the City of Marshall was discontinued? Please clarify this statement.

The St. Leo service area is about the same size as the proposed NE Expansion, but there is a big difference in projected demands (39 MGY vs. 210 MGY). The EIS should include documentation on the 210 MGY projected for the proposed NE Expansion. It is true that the 39 MGY previously provided by Canby is not enough to supply LPRW's overall needs, but it should be considered as part of a solution to a purported regional problem. RUS should include a statement addressing the appropriateness of Canby as a small but a vital alternate/additional supplier.

3.3.3.2 Alternative 2

This section states that at a minimum three sources of water are required for the system. Potential economically available alternatives include the proposed Lewis and Clark Rural Water System, which requests 80% federal and 10% state grants to fund the project. This is an attractive potential alternative water source for supplemental and emergency purposes.

Several corrections are needed in the first paragraph on page 46. Minnesota Statutes regarding interbasin diversions refer to waters of the state and provide no distinction between surface and ground waters. Secondly LPRW is transferring water from Verdi Well Field located in the Missouri River basin to the Mississippi River basin. Finally, Minnesota participants have testified that this project would only provide supplemental and emergency water needs and is not intended to replace existing sources of water.

Altamont Aquifer

On page 47, the PDEIS states " . . . the chemistry of the water in this aquifer differs from that of the water in the Burr Unit and is generally regarded as being of lower water quality." This statement implies that the water quality may be unusable. It may be more appropriate to state that while the quality of the Altamont is lower than the Burr Unit, it is treatable and therefore a viable source.

LPRW has previously indicated that changing from use of the Burr Unit to the Altamont aquifer caused water quality problems for customers that use medications for livestock and human purposes. We have been unable to find anyone that can confirm this problem, but if this is an issue it should be addressed in the EIS.

Canby Aquifer

Apparently there was a misunderstanding with the information attributed to Mr. Frischman. There have not been any "recent evaluations" that Mr. Frischman has reviewed from which to make any comments about the aquifer's capacity to supply water. MNDNR provided water level information to RUS (11/97 meeting) from MNDNR observation well 87002 and Canby wells 7 and 8, which indicate that the Canby aquifer has been a reliable source of water for the last 30+ years-including several drought cycles. The aquifer also supplied approximately 39 MGY to the LPRW St. Leo service area from the early 1980's until 1996. This section should be revised to reflect the data provided by MNDNR. Included as Attachments 24, 25 and 26 are hydrographs for MNDNR observation well 87-002, water level and chemistry data for Canby wells 7 and 8, and several well logs from wells completed in the aquifer.

The January 1991 B.A. Liesch Water Supply Exploration Work Plan (Attachment 27) states this aquifer "appears to be related to a significant surficial outwash deposit. . . the potential for buried water bearing formations in this area should not be ruled out."

Other Aquifers in the Region

The Burr Well Field replaced the water source for the City of Minneota, which supplied 45 MGY and met safe drinking water MCL's. This resource provided water for more than 1,400 people and is much closer to the proposed NE Expansion area than the Burr Well Field. Water resources in the proposed NE Expansion area that should be evaluated include sources utilized or near Echo, Hanley Falls and Cottonwood. The Hanley Falls source is referenced in a 1991 DGR report (Attachment 1) and the MNDNR grid drilling information previously provided to RUS shows good potential for the Cottonwood source. The PDEIS states that RUS is not in a position to conduct ground water studies, but RUS's alternative also requires additional exploration work for another Altamont well. The PDEIS dismisses water source alternatives in the NE Expansion area in favor of alternatives located fifty miles from the area of use. A water source in the proposed NE Expansion area should be able to supply water requirements for the area and strengthen the ability of the system to provide a reliable water service. RUS water resource development decisions based on economic benefits of large scale systems increase the potential for adverse environmental impacts. Smaller capacity well fields and treatment systems located near the area of use would reduce the potential for environmental impacts and help prevent the type of large scale water quality problem that is affecting hundreds of customers in the Holland and Verdi Well Fields. We recommend that RUS require applicants to work with MNDNR to identify appropriate water resources to satisfy regional water needs prior to submitting RUS funding applications.

Page 48, paragraph 4, states " . . . no other aquifer within LPRW's service area was found to be reasonably accessible given the current knowledge of the region's groundwater resources." Please see discussion of Cottonwood below.

Page 49, paragraph 2, states "This option would not, however, address the system's foreseeable needs for meeting future customer demands and allowing the option of building system capability for meeting emergency needs and stabilizing the water supply for the region's citizens." The PDEIS has not clearly defined foreseeable needs other than indicating there is a large number of potential customers within the existing service area and an even larger potential for expansion of the system. It is also not clear what stabilizing the water supply for the region means. MNDNR's preferred alternative of developing a water source within the proposed NE Expansion would certainly help stabilize a regional supply.

The RUS second choice alternative is not clear. Is the second choice the section 3.3.3.3 Alternative 3, or maintaining the existing well field configuration and permit conditions? It would help the EIS if RUS clarified if they are supporting the development of an alternative source or supporting the maintenance of the existing structure.

3.3.3.4 Alternative 4

Development of a well field in the proposed expansion area is MNDNR's preferred alternative. The PDEIS states that consideration was given to the feasibility and likelihood or potential for locating a well field in the proposed NE Expansion area, but the lack of resource information in this section indicates that very little consideration was given to these alternatives. Ground water investigations for development of the Burr Well Field were required and funded by RUS and a similar exploration process should be pursued for water resources in the proposed NE Expansion area. The EIS should include a cost estimate for construction of a water treatment plant in the proposed NE Expansion area.

This section states "The aquifer near Cottonwood has not been the subject of an intensive exploration and testing program." MNDNR provided information to RUS (11/97 meeting) that includes exploration test hole logs and pump test data for the aquifer north of Cottonwood (Attachment 28). Attached (Attachment 29) are water level data collected in the aquifer. RUS should comment on use of this aquifer, located within the proposed NE Expansion area based upon the data provided by MNDNR.

Attached are data sheets (Attachment 30) from the Minnesota Department of Health for community water sources within or near the Burr Well Field service area and proposed NE Expansion area.

3.3.3.5 Alternative 5

The point of use information in Table 2-1 needs to be verified before conclusions can be made on this alternative.

3.3.3.4 Alternative 6

We appreciate RUS's desire to help Minnesota natural resource managers to better understand and manage state ground and surface water resources.

This section identifies the need for additional storage. The storage capacity for each service area should be included in the EIS along with an evaluation of reduced pumping rates that could be achieved with additional storage capacity. The reasons for replacing the water tower near Minneota with a booster pump during the original development of the Burr Well Field service area should also be stated in the EIS.

On page 51 the PDEIS states " . . . it appears unlikely that at current Burr Well Field appropriation rates, the fens or surface water features will be adversely affected . . . " In terms of ground water levels, the last few years have appeared to have been "on the rising limb". This fact most likely keeps us from being able to see the impacts which would have occurred had our monitoring begun in a normal or dry regime. Even at the current Burr Well Field appropriation rates, heads are changed beneath the fens and springs of the area, especially close to the well field (for example the Fairchild fen and springs on the Tol farm). No one can measure how mineral deposition in the peat might be responding to changing rates of ground water discharge or measure how many seeds don't thrive that should and how many seeds of exotics thrive that shouldn't at all due to changes in the rate of ground water discharge relative to evapotranspiration. No one is able to assess how the permeability of the peat mass will respond to the fluctuations in pumping rates which will change the groundwater discharge volume, which in turn will change the height of the peat mound slightly, stretching, perhaps tearing the cell structures of the plant material. Also, because LPRW has only recently increased pumping rates from an average daily rate of approximately 400 gpm to 625 gpm, therefore, any statements RUS makes about impacts seen to date are due to LPRW's pumping at a lower rate, which is far below the rate requested by LPRW.

Page 52, paragraph 1, " . . . Even considering a protracted drought scenario, based on existing needs of the system, RUS believes that the thickness and areal extent of the Burr Unit and Altamont aquifers suggest sufficient water is present within them to sustain pumping for the duration of such a drought. If a long-term monitoring program indicates that fens or surface water features are experiencing adverse effects, then MNDNR could take action to temporarily reduce appropriations at the well field until the aquifer is receiving additional input through recharge." The EIS should evaluate alternatives to avoid adverse environmental impacts instead of promoting increased pumping and waiting until long-term monitoring shows impacts and then mitigate these impacts with temporary reductions in pumping during a period when water demands are highest. RUS repeatedly states that monitoring to date is inadequate to determine the difference between manmade and climate-induced effects, and yet expects MNDNR to be able to know the difference in time to shut down the well field before damage occurs. If long term pumping is seen to have impacts, how could short-term pumping restrictions solve the problem? RUS needs to clarify what should be monitored and how this data can help manage the resource.

"RUS believes that by funding the Northeast Phase Expansion, minimal adverse impact to the fens and surface water features will be experienced and that, if such impact is experienced, action by MNDNR will be sufficient to prevent irreversible or irretrievable consequences." It is not clear from this statement which alternative RUS is supporting and this should be clarified. Increased pumping from the Burr Unit will reduce heads in the Burr Unit beneath the fens. This is an impact. It is not possible to say that this impact will cause no harm nor can it be said that changes in vegetation large enough to be observable over environmental noise will be reversible. We can't tell if a given year's plants are healthy enough to produce seed; we can't tell if rootstocks are going into winter with as much stored energy as they used to. Before people see enough change in the plant life, the fens could be on an unstoppable down slide.

The beginning of the PDEIS refers to LPRW's broad authority "to do all things necessary," which has included an expensive campaign to obtain a statutory exemption from developing a fen management plan. LPRW also sued MNDNR for a temporary restraining order to prevent stoppage of unauthorized pumping for line testing before customers were even being served by the system. The willingness of LPRW to manage water demands to protect these resources after further expansion of the service area is questionable. The PDEIS does not provide a feasible contingency plan so the ability of LPRW to reduce demands is also questionable.

Page 54, paragraph 2. RUS: "Analyses presented in Section 3.0 have concluded that the only viable alternatives related to the proposed action involve the Burr Unit of the Prairie Coteau and Altamont aquifers...."

Comment: We disagree. This artificial constraint on the scope of the hydrogeologic investigation of alternative water sources. There are promising areas within the NE expansion and near Canby. MNDNR completed additional test drilling during the summer of 1997 in an area near Cottonwood previously explored by Bruce A. Liesch and Assoc. We are transmitting the data developed this summer along with the long-term monitoring data which show the Canby aquifer to be capable of sustaining long term pumping. RUS should discuss the data referenced above for both the Canby aquifer and the aquifer located north of Cottonwood.

Page 54, paragraph 3. RUS: "...Glacial till deposits occur at the surface and range in thickness from 50 to 100 ft;..."

Comment: While the glacial tills at the well field do appear to be this thick, it must be noted that drilling by the SDGS shows that the till thins appreciably on the west side of Lake Cochrane. RUS should clarify this point in their document to avoid misleading the reader.

Page 55, Figure 4-2. Incomplete reference. Spelling.

Page 56, Figure 4-12. Source?

Page 57, RUS "The water levels in the Burr Unit drop off sharply near its northwestern boundary along Cobb Creek"

Comment: Figure 4-2 shows rising water levels (the only legible # is 1700.8) toward Cobb Creek. If the information about declining water levels by Cobb Creek and the implication of flow toward the northwest from some ground water divide between Cobb Creek and Lake Cochrane is significant, then include another cross section from the relevant area which backs this up.

Page 57, paragraph 1. RUS "...The USGS has estimated groundwater storage in the entire Prairie Coteau aquifer system to be 5 million acre-feet or approximately 1.6 trillion gal of stored groundwater..."

Comment: Include reference with date. This statement has very little bearing on the Burr well field since the Prairie Coteau aquifer system is an assemblage of sand and gravel lenses which are not interconnected, are not laterally extensive and therefore cannot be counted on to provide water to the Burr well field as one large aquifer. Indeed, the Prairie Coteau system is most ideally suited to be a reliable source for an area served by individual wells because small water supplies can successfully tap the sand lenses and don't have to rely on extensive interconnectedness.

Page 57, paragraph . RUS "The USGS [no date] report...indicated that the aquifer could support a major amount of additional development.

The USGS did not evaluate impacts on surface features and the report does not state that development could occur without causing impacts.

Page 57, paragraph 2. Correction: "Well DTH-3-94, an Altamont ~~aquifer test~~ test hole at the Burr Well Field,..."

Page 59, paragraph 1. RUS "...indicates that the transmissivity of the Burr Well..."

Comment: This should read indicates that the effective transmissivity of the Burr Well...' The transmissivity referenced in the document is actually one calculated after pumping has intercepted a barrier boundary.

Page 59, paragraph 1. RUS "transmissivity .gal/day per foot of drawdown"

Comment: Transmissivity is the permeability of the aquifer (gallons per day per unit cross sectional area of the aquifer) multiplied by the thickness of the aquifer. This means that transmissivity represents the rate of flow of water through a vertical strip of the aquifer. The per foot' here is aquifer width, not drawdown.

Page 59, paragraph 1. RUS "...the Burr Well Field has been pumping from the Burr Unit at 750 gal/ min during much of late June and early July 1997 showing that it is capable of sustained yield at this rate."

Comment: Attachment 31 is a hydrograph illustrating how water levels have responded at the Burr Well field in response to the increased pumping starting this summer.

Page 59, paragraph 1. RUS: "The groundwater elevation at Production Well #1 before the September 1993 pumping test was 1,694.3 feet. Historical groundwater elevation data are limited to the measurements after the construction of Well #1 in January 1990, when the static water level was recorded at 1,690.06 ft."

Comment: This period of record, though short, does give an indication of which direction the groundwater levels were heading following the drought of 1988-89 (up approximately 4.3 feet). It is of interest to note that water levels collected in OW3-90 apparently never rose over 1,694 feet during this period 32. What is the source of the water level measurements at PW-1?

Page 65, Table 4-1. "Typical Water Quality Parameters at the Burr Well Field"

Comment: Identify the data source.

Page 65, paragraph 1. RUS: “In the study area, most groundwater recharge occurs during the period that coincides with snowmelt and spring rainfall...The available general water-level data indicate that groundwater storage increases to a maximum during the period from April through June of each year and is reflected by rising groundwater levels....”

Comment: In general it is assumed that in the upper Midwest, the greatest period of recharge coincides with snowmelt and spring rainfall, however, RUS implies “The available general water-level data...” that they have reviewed specific water level data that illustrates these recharge events. RUS should include one or more hydrographs supporting this statement or at least reference their data source.

Page 65, paragraph 2. RUS: “...Attempts to estimate the sustainable yield, ..., were unsuccessful,...”

Comment: MNDNR would like to see the calculations, or at least the assumptions applied to the calculations.

Page 66, paragraph 1. RUS.   “...As a result, the sustainable yield of the Burr Unit is not known nor can it be computed until a data set has been compiled that is based on long-term observations of the responses of the Burr Unit to production pumping....”

Comment: This statement seems to contradict earlier RUS statements: “...RUS believes that sufficient evidence exists to conclude that the Burr Unit of the Prairie Coteau aquifer will be able to serve as a primary source of water for LPRW now and for the foreseeable future....” (p34), and “...Even considering a protracted drought scenario, based on existing needs of the system, RUS believes that the thickness and areal extent of the Burr Unit and Altamont aquifers suggest that sufficient water is present within them to sustain pumping for the duration of such a drought....” (p52). It is known that the first source of water discharging from wells is from reductions in natural discharge. The natural discharges in this area are to Lake Cochrane, the fens, the springs and streams of this part of the Coteau. In this case acting in the face of uncertainty about sustainable yield puts these resources at risk. These resources belong to the people of Minnesota and South Dakota and are of regional if not statewide significance. Calcareous fens are globally rare. None of these resources should be put in peril under uncertainty.

Page 66, Table 4-2 This would be more useful if maximum drawdowns and percent recovery on day 14 were included for selected observation wells.

Page 67, paragraph 3. RUS: Change in hydraulic head...Burr Unit to the surface....”

Comment: This paragraph will be very difficult for the layman to understand. RUS should rewrite to clarify the description- a diagram may be useful.

Page 67, paragraph 4. RUS: “...Zones of higher permeability in the till allow water from the Burr Unit to reach the land surface at discrete locations. It is at these points of discharge that fens form.”

Comment: Note these discharge points are also in the form of springs and side slope seeps along the streams and creeks of the Coteau.

Page 68, figure 4-8. “Map of Maximum Drawdown from Sept. 1995 750 GPM Pumping Test”

Comment: The location of well 94-18 is wrong, it belongs between 94-33 and 93-17. The drawdown at 94-19 appears too high (2.5 ft vs. 1.5 ft) and the drawdown at the Fairchild Barn well appears too small (0.7 ft vs. 2.2 ft). Values are missing from many of the points.

Page 69, figure 4-9. “Map of Maximum Drawdown from 1996 1500 GPM Pumping Test”

Comment: Again the location of well 94-18 is wrong. Well CO-03 is assigned a drawdown of 0.3 feet. This implies that the small shallow aquifers around Lake Cochrane are susceptible to impacts of pumping the Burr Unit. The drawdown assigned to the Fairchild Barn well (1.4 ft) is actually that measured in the Fairchild Fen Deep well. The drawdown observed in the Barn well was approximately 5.35 feet. Well 94-31 is actually on the west side of the road and something covered the Sioux Nation area completely when the map was photocopied. Again values are missing from some of the points.

Page 70, paragraph 1. RUS; “Monitoring well data collected from wells inside the Sioux Nation Fen and the Fairchild Fen indicate that water levels in those fen domes respond to changes in the gradient between the Burr Unit and the land surface caused by production pumping at the Burr Well Field...The impact of the reduction in the hydraulic head under the two fens monitored in South Dakota was too small to be practically quantified....”

Comment: Water levels in South Dakota fen #5, declined and then recovered along with the pumping at the well field during the 1500 gpm test (Attachment 33). Since the amount of decline in the water level at SD fen #5 was similar to that in the Sioux Nation fen USGS Dome well, it would be fair to say that SD Fen #5 also responds to the pumping. The author is using changes in water levels in wells that are screened in the subpeat (hand pounded wells, it isn't really possible to know exactly what is screened) to indicate in an absolute way whether there will be an impact at a fen. Though an immediate indicator that something is happening, and perhaps the only way we could prove the link between pumping and anything that happens in a fen, these water level changes in sub peat wells are not the true measure of the sum of the impacts. The change that really matters is the change in head difference between the Burr Unit and the base of the fen. That change is estimated by extrapolating the drawdowns measured in the closest Burr Unit observation wells. That is the change that will result in the delivery of different rates of ground water flow to the base of the fen.

Page 70, paragraph, continued top of page 71. RUS, "..the cone of depression that will develop around this [additional] well field could affect any fens in the area .. As discussed in Section 3.3.1, spreading out the effects of these cones of depression from the well fields will likely minimize any adverse effects on fens.

Comment: We agree that if pumping were to be spread out over several adequately separated wells, effects at any give point would be lessened. However, this will only reduce impacts at the fens currently under discussion if pumping from the current well field were reduced. Drawdowns at any other fens now in very peripheral areas of the cone of depression will increase. This line of reasoning only has merit if LPRW can be expected to develop a system with excess capacity and not sell all of that excess capacity within a few years, thus needing to pump all of the wells at full capacity for several weeks during spraying and in the case of drought.

Page 72, paragraph 3. RUS: "...because of the depth of the overburden acting as an aquitard, it is unlikely that there are any discharges to the land surface as there are from the Burr Unit. Therefore, no environmental impact is expected from any additional appropriations from the Altamont aquifer."

Comment: Just as the depth of the overburden limits the potential for surface discharges, (as well as the fact that the potentiometric surface doesn't intersect the ground most places) it also limits the recharge potential of the aquifer. RUS should include a discussion of the recharge potential of the Altamont. A hydrograph of the record of the closest relevant monitoring well could be presented and reviewed.

Page 73, citation of PCA rules. Specific location is 7050.0180. It should be noted that the rules specifically protect any unlisted Outstanding Resource Value Waters in the same way that the listed ones are protected (7050.0180 Subpart

7). This means that the PCA will accept the MNDNR Commissioner's opinion about whether an area is a fen to determine if it is to be protected.

Page 73, last paragraph. RUS a "discharge pipe or vent"

Comment: The use of this term leads to misconceptions. In the literature (Moore and Bellamy, 1974) the term spring head is used. It gets the point across without letting people think that pipes lead to the ground surface from the aquifer.

Page 74, Bulleted list. RUS: ..mineral deposits are not rock-like..

Comment: In most cases the older mineral deposits are hard enough to stand on and are difficult to cut through when cables must be trenched through them. Freshly deposited material may be vulnerable as described.
Comment: Add new bullet: "Head available at the base of the peat".

Page 75, Figure 4-10.

Comment: This depiction leads to misconceptions about the nature of the connection to the aquifer, which is by no means comparable to a pipe, nor should it be suggested that there really is a pocket of free water within the dome. I believe that peat-water slurry is what one sees after the disturbance and liquefaction of the peat by sampling. It shouldn't be thought of as the natural condition.

Page 76, paragraph 1: RUS: .."a fen exists only where ground water is discharging onto the surface"

Comment: Should note that the surface must be one that cannot flood (water must be able to flow away from the fen).

Page 76, paragraph 1: RUS: .."as the level of the peat dome rises, the ground water may or may not be able to keep pace with it."

Comment: The peat dome cannot grow above its water supply. Ground water by definition keeps up in a living calcareous fen.

Page 76, paragraph 3. RUS: "Artesian conditions necessary to produce the central vent"

Comment: Very few fens (albeit many located in this region) exhibit what you would call a vent. There are many fens which would be more aptly described as "wet blankets" on the topography without a recognizable spring head, or perhaps with a line of spring-seeps which defy description as central vents.

Page 76, paragraph 3. RUS. "...Six distinct fen complexes have been identified and monitored during previously performed pumping tests...."

Comment: Data have been collected at six fen complexes in the process of their identification, but only four have been monitored during pump tests (Sioux Nation fen, Fairchild fen, South Dakota fen #2 and South Dakota fen #5).

Page 76, paragraph 4. RUS "...The Fairchild fen is also in a degraded condition from previous agricultural activities and the existence of subsurface drainage tile."

Comment: We do not agree that the Fairchild fen should be called "degraded." The existence of the drain tile has reduced the amount of water which remains at the surface near the Fairchild fen. The fen dome at this location has been fenced for years to keep Mr. Fairchild's cows from getting dirty (said Mr. Fairchild). Because the cows were entering the fen to get to water, Mr. Fairchild placed a barrel in the peat and routed a hose (approx. 3/8" ID) to a livestock watering pool. These interventions have apparently served the fen well because it currently has the typical vegetation, peat dome, ground water upwelling, and water chemistry to meet the technical criteria for a calcareous fen. The drain tile may have kept the fen from being flooded by ponded surface water as the road network in the area has been built and improved. The elimination of trampling by livestock has allowed the peat dome to grow without being cut and channeled by livestock trails. The dome might be a bit higher now had the water that is diverted to the livestock not been taken, but the fen is not degraded in its current condition. Care should be taken by the humans who walk there that they not create the equivalent of livestock trails.

Page 77, Table 4-3.

Triglochin palustris
Cladium mariscoides
Saxifraga pennsylvanica
Valeriana edulis var. ciliata
Cardamine bulbosa
Lobelia kalmii
Beaked Spikerush

Page 78, Table 4-4.

Comment: The work done by Janssens & Noble isn't the only vegetation work recorded for Sioux Nation fen. We enclose a table which lists the rest of the species which have been identified at the site. (Attachment 34). Note that Salix candida has been found, an additional indicator species.

Page 79, first paragraph. RUS “The Sioux Nation and the other fens in the area can be an important source of plants for other prairie fens to be restored in the future (Janssens and Noble, 1996)”

This wording should be changed to remove the possibility that a reader might assume that one could go to one of these fens and dig up plants for a project. In a scientific sense it is true that these fens are sources of seeds and plant material, but it is unlikely that a calcareous fen would be used as a source for anything more than seed.

Page 79, paragraph 2. RUS: “two plant species are considered rare in Minnesota”

Cypripedium candidum has also been found at Sioux Nation fen. Occurrences have been frequent and numerous in our field notes. It is listed in Minnesota as a species of special concern. See the species list attachment referenced above. Federal candidate listed species of butterflies include the Dakota Skipper and the Regal Frittilary (Attachment 21).

Page 80, paragraph 2. RUS “Although only the Fairchild and Sioux Nation Fens have been shown to be hydrologically connected to the Burr Unit,...”

Comment: Data collected at South Dakota Fen #5 during the 1996 pump test, clearly shows a response to the pumping at the well field (Attachment 33). RUS should include this data in document. There is no reason to doubt that the Burr unit is the likely source of water to fens which exist below the potentiometric surface of the Burr unit. Fens develop where there is a reliable source of water. Shallower water sources in this area are not likely to be consistent enough to have nursed fens through the dust bowls and drought years of many centuries. It is not responsible to try to study all fens to prove the interconnection. We don’t have the money, people or time and the studies themselves damage the fens.

Page 80 paragraph 4. RUS: “ .so the net result could be a subsidence in the level of the fen.”

Comment: It is important to note that disturbances of the sort predicted here are likely to provide a foothold for invading species. In this location seed sources of leafy spurge, thistle, and buckthorn are found adjacent to the fens. Changes in the balance between the species typically found in undisturbed fens can also cause certain species, especially shrubs, Phragmites, and Typha, to begin to dominate to the exclusion of the lower-growing fen species, resulting in a decrease in diversity within the fen.

Page 81, paragraph 1. RUS “...Because production well fields, ..., pump in response to demand, it is highly unlikely that the well field would pump at a sustained maximum rate 24 hours a day, 7 days a week, 52 weeks each year. Rather, the field would likely be pumped hardest during periods of intense use, such as during crop spraying....”

Comment: Unfortunately the peak demand period for the well field is also the period when the fen plants’ water requirements are at their maximum, therefore the fen plants have to deal with both the stress from maximum annual ET and the peak pumping requirements of the well field. If pumping reduced the ground water discharge at a fen to below that needed to supply an excess of water over potential evapotranspiration, the surface of the peat will possibly dry out, causing the negative impacts on fen vegetation discussed above. It should be noted that with the additional daily water needs of the City of Marshall, the well field will have much higher daily averages than if the system were serving the farms and small rural communities it was purportedly built to serve.

Page 81, paragraph 2. RUS: “...In the Burr Unit observation well at the Fairchild Fen some 3,000 ft to the east-southeast, drawdown was 4.35 ft,...”

Comment: MNDNR assumes this well is actually the Fairchild Barn well which is located several hundred feet east of the Fairchild Fen. It should be noted that the Barn well is not directly connected to the Burr Unit, the water elevation in the well is approximately 40 feet below the potentiometric surface of the aquifer, however, the reported depth of the well has an elevation that is well within the known boundaries of the aquifer at the well field. Drawdown during the 1996 pump test in the Barn well was actually 5.35 ft. The well at the Fairchild fen is a subpeat well, it does not penetrate the Burr Unit either.

Page 81, paragraph 3. RUS: “...Before pumping, the potentiometric surface stood about 10 ft above the OHWM of this lake. After pumping the Burr Well Field at 1,500 gal/min continuously for 7 days, the potentiometric surface was still 6 ft above the lake surface along the eastern margin (proximal side) and more than 8 ft above the lake surface at the western (distal) margin of the lake....”

Comment: If the 4 feet of rise in static water level measured from 1990 to 1993 is removed from these values, the potentiometric surface would be only 2 and 4 feet above the OHWM.

Page 81, paragraph 3. RUS: “...It is unlikely that production pumping of the Burr Well Field at 750 gal/min would lower the level of the potentiometric surface below the level imposed by the 1996 7-day pump test.”

Comment: Pumping over a short term period (such as 7 days), at 1500 gpm will cause the potentiometric surface to drop lower than that caused by pumping at 750 gpm, however, it is not appropriate to state that the long term drawdown caused by 750 gpm is less than that caused by a 7 day pump test. In any case, water levels were still declining as each of the tests were terminated.

Page 82, paragraph 2. RUS: "...Because the Fairchild and Sioux Nation Fens are situated more than 30 ft below the potentiometric surface at Burr Well field, it seems unlikely that production pumping at 750 gal/min will adversely affect these features. Fen #5 near the southern shore of South Slough is also situated well below the potentiometric surface and is unlikely to be changed significantly by such pumping...."

Comment: It is a misconception that the ground water discharge at a fen would behave as if from a pipe. The water elevations at any fen or spring is a function of the hydraulic gradient between the potentiometric surface and the discharge point and the conductivity of the materials through which the water must pass from the aquifer to the land surface. If the conduit through which the water must pass were a simple cased well, it would be easy to relate the change in hydraulic gradient caused by a lowering of the head due to pumping and a potential decrease in discharge at a fen. Flow may indeed cease before the head difference between the aquifer and the fen equals 0. That amount of head would represent head loss in the "conduit". This head loss would have to be removed from consideration before the impacts of head loss can be evaluated. For example, if a head difference of, say, 24 of a total 30 feet to move water through the conduit, then a drop of 3 feet in head would result in decrease in discharge of 50% (3 ft vs. 6 ft). RUS should consider this relationship when estimating any decline in discharge at the fens or any springs in the area.

Page 82, paragraph 3. RUS: Discusses the thresholds established to protect the Fairchild and Sioux Nation fens.

Comment: Due to all of the uncertainties, the thresholds are no guarantee that no harm would occur to the fens. They were set to make sure that upward gradients would still exist, that the peat would not subside, and that water table wells would show water levels above ground surface. These thresholds only serve to keep the peat wet and perhaps they are inadequate to do even that. During the 1996 pump test the thresholds at Sioux Nation were not violated, yet the surface pools on the dome's side dried up. MNDNR is reevaluating how thresholds are set and is considering tying them to water levels measured in wells screened in the Burr Unit.. It has not been considered possible to monitor discharge, so no discharge standards were set. This conclusion is being reexamined.

Page 82, paragraph 3: RUS: Discussion of threshold exceedance at Fairchild fen.

Comment: The threshhold at water table wells is set to ensure that water levels remain at or above the ground surface. This was described in the threshhold document as an elevation. Over the years that Fairchild fen has been monitored, its surface has subsided a small amount. This change in the elevation of the surface of the dome meant that water levels in the water table well could be a small amount lower without causing the top of the dome to dry out. This is why the MNDNR did not act on the “threshold exceedance”: the spirit of the threshold was not violated. Survey control at these fens is excellent and surveys are repeated regularly so that MNDNR can detect changes and adapt the monitoring and enforcement appropriately to those changes.

Page 82, paragraph 3. RUS: “Fairchild Fen is being actively drained by subsurface drain tile, which further brings into question the validity of monitoring the water table in the fen itself.

Comment: Fairchild fen exists with both a subsurface drain and a small diversion for livestock watering. The fen is healthy. Both diversions were preexisting and are considered to be constants during monitoring and test pumping. The drain tile may be keeping the fen dome from being an island in the middle of a surface water pond after snowmelt and large rainfall events, but whatever, the tiling was luckily not very effective.

Page 82, paragraph 4. Grammar error. “...relationship to established thresholds **is** changes in the ...”

Page 83, paragraph 1. RUS: “...The threshold established for these monitoring points in both the Fairchild or the Sioux Nation Fen was not exceeded during any of the pump tests. The other thresholds for the Sioux Nation Fen were not exceeded at either 750 or 1,500 gal/min....”

Comment: Which thresholds? There are thresholds for subsidence, water elevation and gradient at both fens. RUS should clarify their statement. MNDNR’s thresholds do not guarantee that no damage to fens will occur or that all damage to fens can be prevented by making sure that thresholds are not violated. They merely represented a quantitative description of conditions which are deemed necessary for the fens to exist: Water table at or above ground surface; upwelling ground water; and no subsidence.

Page 83, paragraph 1. RUS: “...Based on this data it appears unlikely that pumping at rates of 750 gal/min or higher would cause adverse impacts to the fens....”

Comment: See Attachment 17 describing the drying of pools on Sioux Nation fen during the 1500 gpm pump test and discussing the subsidence of Fairchild fen. RUS should either incorporate or rebuff this data in document.

Page 83, paragraph 3. RUS: “ Additional monitoring points need to be established, particularly in South Dakota a “control” fen..”

On the face of it, a control fen is a good idea. Other monitoring points merely to add to the database are not. Fens are fragile and monitoring is expensive. We have monitoring in place on fens close to the well field, thus we will see impacts where they are most likely to occur. The issue of the control fen is worth further discussion, but implementation will depend on what resources can be brought to bear on the problem and whether a suitable fen can be found within the same climatic regime and in a suitable undisturbed, and likely to remain undisturbed, condition. LPRW should fund this effort.

Page 83, paragraph 3. RUS: “...It is assumed the MNDNR will continue to monitor and update the evaluations based on this study to assess any changes in the unique calciphile populations at the fens.”

Comment: This is a very expensive undertaking, the costs of which have been primarily born by the state resource agencies. MNDNR will continue to provide expertise as part of its role in managing the state’s resources for the people of the state, but more of the financial burden must be shifted to those who benefit from the use of the water.

Page 83, paragraph 4. RUS: “...If changes in the plant communities are noted in the future, and if these changes are determined to be caused by pumping, then the MDNR (sp) may modify LPRW’s permit conditions.”

Comment: If vegetative changes are used as a trigger for modification of LPRW’s pumping permit, it is likely that permanent damage would occur to the fens’ calciphile populations. The fen communities are “well buffered” from impacts due to the ability of plants to grow even when they are not thriving. By the time changes are reflected in any quantitative vegetation index, the system may be overwhelmed and change irreversible.

Page 86, paragraph 1. RUS: “...If it is assumed that the Burr Unit is discharging to Lake Cochrane, then these reductions in head would have resulted in a change of less than 3% in the discharge at the west end of the lake and a reduction of less than 5% at the east end....”

Comment: It appears that RUS believes that the hydraulic gradient between the Burr Unit and Lake Cochrane’s OHWM is the difference between the height of the potentiometric surface above the top of the aquifer (on the proximal side of the lake) and the OHWM. The hydraulic gradient between the Burr Unit and Lake Cochrane’s OHWM is actually the difference between the OHWM and the potentiometric surface. Thus, when the 1,500 gpm test resulted in a 4 ft reduction in head at the Christenson well, the potential reduction in discharge was 40%, not the mere 3% to 5% stated by RUS. Attachment 35 is a letter from Jay Gilbertson to John Hatch describing the relationship between hydraulic gradient and discharge. RUS should reconsider their definition of hydraulic gradient as it applies to Lake Cochrane.

Page 86, paragraph 2. RUS: "In an attempt to determine potential impact from pumping at the Burr Well Field on Lake Cochrane, staff from the South Dakota Department of Environment and Natural Resources (SDDENR), Geological Survey, developed a basic water budget analysis for Lake Cochrane...."

Comment: The calculation was not intended to determine potential pumping impact', instead it was meant to estimate the groundwater contribution to the lake.

Page 86, paragraph 2. RUS: "...Calculating water budgets for lakes is a very imprecise art....The latter value is more than 93% greater than the former...."

Comment: See Pence, 1995, Attachment 36.

Page 87, paragraph 3. RUS: "...according to Dr. Allison Smith of Kent State University (personal communication, 1997), elements of the Lake Cochrane ostracod fauna suggest that this body of water receives groundwater discharge from the shallow groundwater system...."

Comment: Attachment 37 is a letter from Dr. Smith to Assad Barari where she states that the ostracod's require groundwater, not shallow groundwater' to exist.

Page 87, paragraph 3. RUS: "...According to Dr. Smith, some of the Lake Cochrane ostracods are a variety that is known to thrive in the hard water discharging in seeps along the shoreline of lakes. This combination of shallow water habitat in hard water suggests that the seeps are fed by the shallow groundwater aquifer system."

Comment: The waters from shallow groundwater systems are generally relatively soft, while groundwater from deeper aquifers is usually higher in dissolved solids. There is no reason to believe that it is not possible to have a shallow water habitat with springs providing water from the deep groundwater aquifer systems.

Page 88, Table 4-5. "Typical Water Quality of the Burr Unit and Lake Cochrane"

Comment: The water sample collected in Lake Cochrane was a mix of Lake Cochrane and Lake Oliver water. RUS should include either Lake Oliver water quality data or Lake Cochrane data from a period when Lake Oliver was not discharging into Cochrane.

Page 89, paragraph 2. RUS: "...The inflow from Lake Oliver during the past 3 to 5 years, for example, has introduced water with potentially different chemical and physical characteristics into Lake Cochrane. The inflows from Lake Oliver have occurred and may continue to occur independently from any change in the groundwater inflow."

Comment: RUS should attempt to define the water quality of Lake Oliver for comparison to that of Lake Cochrane. The fact that Lake Oliver has been flowing into Lake Cochrane for the past several years is just an indicator that the groundwater levels in the area are quite high compared to the past several decades.

Page 89, paragraph 3. RUS: "...Nutrients and other pollutants are apparently flowing into the lake in increasing amounts from surface runoff and from leaching of septic fields surrounding the lake...."

Comment: Is there a community septic system serving the Lake Cochrane residents?

Page 91, paragraph 1. RUS: "...it should be possible to calculate evaporation, the principal loss to Lake Cochrane and most of the fens...."

Comment: Groundwater discharge and evapotranspiration are the key losses from the fens.

4.4 Systemwide Socioenconomic Effects

Page 102, paragraph 4. RUS: "...Based on the analyses performed for this EIS, the study team concluded that the availability of potable water supplied by LPRW has and will not, by itself, cause an increase in these (large-scale animal confinement operations) types of livestock operations....The supply of potable water appears to have no bearing on whether large-scale animal confinement operations will locate within the study area...."

Comment: Members of LPRW's Board of Directors have commented in the past, that but for the availability of rural water, they themselves could not raise livestock in the numbers that they now can (personal communications, 1994-1997).

6.0 IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES AND LONG-TERM VS SHORT-TERM TRADEOFFS

Page 128, paragraph 3. RUS: “...at a minimum, the present permit conditions at the Burr Well Field are continued, it is unlikely that any adverse impact to natural resources will occur. As was discussed this interpretation is based on limited information....the Burr Unit of the Prairie Coteau aquifer and the Altamont aquifer in combination appear to be capable of providing the volumes of groundwater needed for LPRW present and future foreseeable needs with minimal impacts to surface water features in the general area surrounding the Burr Well Field, even considering the potential for a protracted drought.”

Comment: The bottom line is this, until LPRW’s pumping rate stabilizes for enough time to allow the water levels in the Burr Unit to reach a new dynamic equilibrium from which to predict long-term effects, any statement that impacts will be minimal is premature and should be struck from the document.