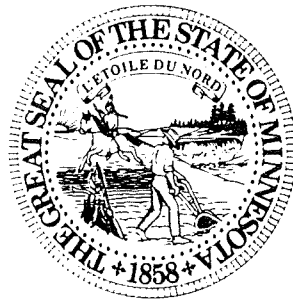

State of Minnesota

Summary of the
Comments on the
U.S. Department of Energy
Draft Area Recommendation Report
for the Crystalline Repository Project



March 1988

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Introduction

In May, 1986, the United States Department of Energy (DOE) indefinitely postponed the search for a second national nuclear waste repository. The second site program had narrowed the search to 20 sites in the midwestern and eastern states, including eight sites in Minnesota. In July, 1986, the State of Minnesota turned in detailed comments to DOE, challenging the federal government's rationale, data, and methodology for designating Minnesota sites, and recognizing that the indefinite postponement of siting could be revoked at any time. Those comments, submitted in response to DOE's Draft Area Recommendation Report, were prepared with the help of state agencies, consultants, and Minnesota citizens. The comments are summarized in this report.

In December, 1987, Congress overhauled the Nuclear Waste Policy Act of 1982, eliminating the requirement for a second repository. No communities in Minnesota, including the sites identified by DOE in 1986, are currently under consideration for nuclear waste disposal. We hope that the comments will provide a better understanding of Minnesota's experience with federal high-level radioactive waste siting in the 1980's.

Complete sets of comments are available at the regional libraries listed in the back of this report.

I. Geology

- A. Geologic discussions** - The Draft Area Recommendation Report (DARR) contain inadequate, incorrect, and misleading geologic discussions. DOE has also glossed over significant issues. The extent of glacial erosion, ground water discharge zones, water resource potential, and the presence of faults, fractures, and dike swarms deserve detailed discussions. Additionally, the DARR incorrectly states that most areas are well-drained and that all pertinent information has been considered in this document. DOE's attempt to use analogies comparing exposed rock to rock bodies covered by glacial drift is inaccurate and misleading.
- B. Area Assessment** - DOE has not accurately assessed well yields, mineral and natural resource potential, the number of wetlands, or the amount of cretaceous regolith in the candidate areas. Instead, DOE chose to focus the geologic discussions on irrelevant issues such as the dynamics which emplaced granitic bodies.
- C. Rock Characterization** - DOE's refusal to acknowledge the thick overburden covering potential host rocks in central and western Minnesota leads to many serious problems:
1. **Identifying Crystalline Rocks** - Since the presence of crystalline rock has been inferred based only on geophysical interpretations, it is not certain that crystalline rocks even exist beneath the candidate areas. In some places, no deep confirmatory boreholes exist.
 2. **Area Characterization** -
 - a) **Methodology** - DOE will have to rely on small samples obtained from drill holes to characterize unexposed rock. This method of characterization is costly, difficult, and unreliable since surveyors would have to rely on only a few holes to characterize a very large rock mass.
 - b) **Fracture Mapping** - By using only samples obtained from boreholes, DOE would not be able to accurately describe the fracture systems. Hence, any attempt to predict repository performance could be severely limited.
 - c) **Mineral Potential** - Since unexposed rock cannot be studied in detail, the mineral potential is currently unknown. DOE would like the public to believe that no information regarding mineral potential implies that no minerals are present.
- D. Area Characteristics** - The DARR favorably refers to many characteristics which, in reality, are adverse. In turn, DOE ignores several adverse conditions evident in the candidate areas such as:
1. flood potential
 2. extracting ground water resource from host rock
 3. significant potential for ground water discharge within and around the candidate area
 4. poorly drained area
 5. inhibiting amounts of overburden
- The following characteristics should *not have* been listed as favorable in most areas:
1. host rock configuration
 2. no resource extraction
 3. no deep drilling
 4. presence of well-drained terrain
 5. no potential for surface flooding
- E. Ground Water Flow System** - At repository depth, the deep ground water flow system is virtually unknown. Until DOE develops deep drill holes to describe the system, NRC cannot license construction of a repository.

- F. Water Resources** - DOE has downplayed the value of Minnesota's water resources. Minnesota contains the headwaters of several major watersheds and has an obligation to protect this resource from contamination. DOE has not acknowledged several water-related facts:
1. All candidate areas contain shallow high yield aquifers which provide the principal water supply to residents.
 2. Artesian conditions and upward groundwater flow characterize wells open to the host rock in many candidate areas.
 3. Numerous deep wells penetrating the host rock in several candidate areas could connect the ground water in the host rock and the upper aquifers. Since this condition would create adverse impacts upon the surface environment, DOE should disqualify areas containing these wells.
 4. The numerous wetlands and lakes overlooked by DOE are likely ground water discharge zones and should be considered as adverse when encountered.
- G. Tectonics** - The 1975 Morris earthquake, which occurred in the Great Lakes Tectonic zone, indicates the potential for renewed tectonic activity in this area. Consequently, increased local fracturing could markedly influence the deep ground water flow system.
- H. Glaciation** - DOE dismisses the effects renewed glaciation would have upon a repository in the North Central region. During glaciation, changes in the vertical flow of groundwater patterns may alter the surficial drainage and deep flow system. Renewed glacial advance and retreat could speed interaction between radionuclides and the groundwater leading to the surface environment.

II. Environmental

DOE's continued consideration of environmentally disqualified areas, significant state and federal protected lands, and areas containing population centers, indicates DOE did not adequately address many environmental consequences. Tourism and transportation concerns have also received inadequate attention.

- A. Environmentally sensitive lands** - DOE's failure to remove disqualified lands from the site selection process is unacceptable and inconsistent with the Screening Methodology Document (SMD). DOE has rationalized that disqualified areas can be considered as long as the chosen site is not within the boundaries of the repository surface facilities. This attitude shows little regard for environmental siting or characterization impacts on these areas.
- B. State and Federal Protected Lands** - Federal guidelines disqualify areas located in or around state and federal protected lands. However, DOE did not defer areas upstream of protected lands, thus increasing the potential for contamination.
- C. Environmental concerns** - DOE has glossed over or misrepresented many environmental concerns such as:
1. Environmental compliance.
 2. Climatic concerns. (i.e. severe winters, tornadoes, and glaciation.)
 3. Distribution of plant species.
 4. Indian treaty rights.
 5. Archeological sites.
 6. Population centers.
 7. Prime agricultural lands.
- D. Population** - By considering areas which include prime agricultural lands, DOE has not acknowledged that the produce from these lands benefits people outside of the area itself.
- E. Tourism** - DOE has deemphasized the negative effects a repository would place on tourism-oriented industries.

F. Definitions -

1. The definition of the controlled area and the accessible environment are highly dependent upon the direction of the deep ground water flow system, a fact DOE does not acknowledge in the DARR.
2. Disturbed Zone - As defined by the DOE, the disturbed zone stretched 50 meters beyond the boundary of the underground networks. According to NRC guidelines, this zone is dynamic and dependent on the spacing and temperature of the waste. Therefore, a static 50 meter zone would not accurately represent the area as defined by NRC.

G. Transportation - Transportation issues such as conditions of highways and rail lines, costs, weather related transportation problems, population along major routes, and weight restrictions were not addressed adequately. Despite the state's repeated attempts to have transportation considered in the screening methodology, DOE still did not address it.

III. Methodology

A. Inadequate Data

1. DOE has consistently considered the general lack of geologic data at the proposed sites a favorable indicator rather than an adverse condition. Consequently, the sites are relatively unknown, which makes claims of technical defensibility questionable. By deliberately choosing sites with obscure geology and hydrogeology, DOE has made the problem of finding a suitable site more difficult, expensive, and error-prone than necessary. Even basic statistics on the vertical and lateral extent of the rock body are unknown. Indeed, the thick glacial overburden present in Minnesota's candidate areas would unnecessarily hamper attempts to characterize the rock mass.
2. The DOE has interpreted the lack of data in such a way that sites in Minnesota appear more favorable. For example, the thickness of overburden was basically ignored in central and western Minnesota because the data could not be contoured. Even though there were not enough data to generate contours, adequate data points exist to show that the overburden is extremely thick. The lack of data strongly suggests the presence of thick overburden.

B. The methodology used in the DARR deviates from the original screening process on several counts:

1. **Back up sites -** The Screening Methodology Document (SMD) does not mention backup or reserve sites. The reserves are inconsistent with the SMD and should be dropped from consideration. Potentially, a reserve site could continue through the area characterization phase. If a primary site was found unsuitable, the reserve site could become the primary site without receiving thorough characterization.
2. **Deferral Analysis -** A deferral analysis step was not discussed in the SMD.
 - a. The DOE has undertaken a candidate area deferral process which is based on an incomplete and biased set of variables. Furthermore, due to an absence of information, DOE did not attribute many important adverse conditions to the candidate areas. As in the National Survey of Crystalline Rocks, DOE placed undue emphasis on the tectonic processes in the deferral analysis. Out of approximately 20 to 22 favorable conditions listed for each area, nine are simply variations on the tectonics guideline. DOE has used these additional variables to make the selected sites appear more favorable.
 - b. The DOE has made several arbitrary, inconsistent or unexplained decisions in deferring sites in the DARR. First of all, DOE used the concept of regionality to disqualify all western sites before initiating the regional phase of the crystalline program. Second, DOE deferred a rock body in Maine on the basis of its proximity to Canada; yet DOE has not deferred the Red River Valley sites in Minnesota. Since these sites are in a drainage basin which flows into Canada, selecting a Red River Valley site would directly violate the Boundary Waters Treaty of 1909. Third, DOE has determined that only the portion of the candidate area "directly affected" by

geology related disqualifiers would be excluded from consideration. However, DOE neglected to define "affected areas".

3. **Environmentally disqualified areas** - The decision to allow environmentally disqualified cells within a candidate area is not consistent with the SMD as reviewed by the states. Furthermore, permitting environmentally disqualified cells within potentially controlled areas is not prudent, since a federal or state protected area cannot be included in a controlled area due to ownership or other problems.
- C. **DOE Weighting Scenarios** - The DOE conducted a "weighting workshop" for states to develop a range of weighting scenarios for selecting candidate sites. In applying the suggested weights, the DOE failed to insert a wide range of values into the adopted scenarios, and entirely excluded affected Indian Tribes from the process. DOE has tried to create the aura of scientific defensibility around an approach which, in reality, is nothing more than a glorified opinion poll.

In an independent analysis, Minnesota compared the effect of using all CRP and State developed weighting scenarios using a wide spectrum of viewpoints. Not surprisingly, the study found the weighting methodology disproportionately sensitive to the weights used. DOE could have produced less biased results by selecting three or four representative weights and applying them to site selection, instead of using a scheme which tended to emphasize specific scenarios over others. Additionally, the quality of the database was not considered in developing weights.
- D. **Sensitivity Analyses** - The DOE did not perform a reliable sensitivity analysis on the results of the weighting application. Not only did DOE modify just three scales, but chose to apply the least penalizing scales to the North Central sites, rather than all regions.
- E. **Schedules** - DOE has continually shortened all federal agency and affected party review periods while habitually extending their own. The DOE wanted to abbreviate the Nuclear Regulatory Commission's (NRC) License Application review period to 26 months to compensate for time lost reviewing state comments. However, the NWPA gives the NRC three years, plus an optional one year extension, to review the License Application.
- F. **Monitored Retrievable Storage (MRS)** - The DOE failed to consider the MRS as a viable part of the repository program in the DARR. Despite the emphasis DOE headquarters placed upon the MRS, the impact of a successful MRS initiative was not included in the DARR contingency plan.
- G. **10 CFR 60 - NRC's rule guiding repository siting** - calls for a period of retrievability. DOE has not specified the site conditions required by this mandate (i.e. what plans for surface storage, mining activities, etc., have been developed to accommodate retrieved waste?).
- H. **DARR Review** - Incorporating new evidence received from comments requires a specific procedure. If the database changes because of state and tribal comments, DOE should reissue the ARR as a revised draft.
- I. **Methodology** - Several reviewers have revealed additional flaws in the DOE Site Screening process:
 1. DOE failed to list precise locations of candidate areas via the Townships and Range convention.
 2. The scores assigned in digitized maps of Major Discharge Zones, Surface Water bodies and Seismicity contain errors.
 3. DOE did not consider pertinent variables such as the degree of rock exposure, prime agricultural land and geologic dike swarms.

NC-A5

LOCATION: Marshall County in northern Minnesota.
AREA: 182 sq. km (70 sq. mi.)
STATUS: Back-Up Site

Disqualifying Factors

Environmental Disqualifiers

- Old Mill State Park lies adjacent to NC-A5, as do sensitive wetlands, and other flood-prone lowlands.
- Surface and ground water from this area drains into Canada. Polluting mutual water resources would violate the Boundary Waters Treaty of 1909.
- Shallow Quaternary aquifers** run through the groundwater system.

Natural Resource Disqualifier

- Mineral exploration boreholes and water wells are found throughout the area.
- Mineral resources have not been assessed.

Adverse Conditions

- The Minnesota Geologic Survey (MGS) has documented 95 wells within a five mile radius of the candidate area, six of which extend deeper than 100m.
- Artesian wells* and the configuration of the water table between the Tamarac and Middle Rivers indicate the presence of discharge sources. Radionuclides* from an underground repository could enter the ground water flow leading to the surface environment via these sources.
- A Lakehead Pipeline Company oil pipeline crosses NC-A5.
- The Tamarac and Middle Rivers are within boundaries of the Candidate Area.
- Pumpage data from local wells indicated extensive ground water use and unfavorable groundwater flow patterns.

Inadequate Discussions

- Ground Water Use
Water quality and quantity,
Well locations and yield
- Geologic Data
*Pre-Late Cretaceous regolith**
Thickness of batholiths under NC-A5*
Presence of diabase dike swarms, which could indicate weakness planes in the bedrock.*

Detracting Conditions

- Indian archeological sites scattered throughout the area would make land acquisition difficult.
- Since there is no exposed bedrock, geologic data are unreliable.
- The main arterial, Highway 29, parallels the Red River making the transportation of nuclear waste especially threatening in the event of an accident.

* The asterisks (*) denote terms defined in the glossary (page 14)

NC-6

LOCATION: Marshall, Pennington, Polk, and Red Lake Counties in northern Minnesota.
AREA: 780 sq. km (300 sq. mi.)
STATUS: Primary Site

Disqualifying Factors

Environmental Disqualifiers

- NC-6 contains the Pembina and Sunders Wildlife Management Areas.

Demographic Disqualifiers

- The town of Warren, located in NC-6, has a population density greater than 1,000 persons per square mile.

Natural Resources Disqualifiers

- Mineral exploration boreholes and water wells are found throughout the area.
- Mineral resources have not been assessed.

Adverse Conditions

- The MGS has documented 390 wells at or within a five mile radius of the candidate site, 28 of which extend deeper than 100m.
- The potential for severe flooding, suggested by very low topographical relief and slope, would jeopardize the safe operation of a repository.
- A thick overburden* covers the unexposed crystalline rock.
- Radionuclides migrating from a repository would threaten the shallow ground water resources characteristic of the candidate area.
- Polluting surface and groundwater which drain into Canada as well as Minnesota would violate the 1909 Boundary Waters Treaty.

Inadequate Discussions

- Ground Water Use
Water quality and quantity
Wells location and yield
- Tectonics
DOE does not assess the effects of Minnesota's four minor earthquakes with respect to faults and weakness planes located in NC-6.
Pre-Late Cretaceous regolith, Ordovician sedimentary rocks, and dike swarms in this area need further study.*

Detracting Conditions

- Indian archeological sites in the area would make land acquisition difficult.
- A Lakehead Company oil pipeline crosses NC-6.
- A major arterial, Interstate 29, parallels the Red River, making the transportation of nuclear waste especially threatening in the event of an accident.
- Inadequate Access: Trunk Highway 59 is not a 10 ton route, as cited in the DARR.

NC-7

LOCATION: Norman and Polk Counties in northern Minnesota.

AREA: 294 sq. km (113 sq. mi.)

STATUS: Primary Site

Disqualifying Factors

Natural Resources Disqualifiers

- Mineral exploration boreholes and water wells are found throughout the area.
- Mineral resources have not been assessed.

Environmental Disqualifiers

- The Ranum, Liberty, Agassiz-Nelson, and Agassiz-Olson WMAs, in addition to the Agassiz Dunes Scientific and Natural Area are contained in or near NC-7.

Adverse Conditions

- The MGS has documented 290 wells at or within 5 miles of the candidate area, 22 of which extend deeper than 100m.
- The United States Geological Survey (USGS) has identified NC-7, situated in the ancient lakebed of glacial Lake Agassiz, as a regional ground water discharge area.
- The deep ground water flow system, which travels upwards toward shallow aquifers and the land surface, would facilitate the migration of radionuclides from a repository.
- The potential for severe flooding, suggested by very low topographical relief and slope, would jeopardize the safe operation of a repository.
- The White Earth Indian Reservation is adjacent to NC-7. It is very unlikely the tribal council would agree to any plans to locate a repository in this area.

Inadequate Discussions

- Pre-Late Cretaceous rocks, dike swarms and the extent of faulting and fractures deserve more in-depth review.
- Ground Water Use
 - Well locations and yield*
 - Water quality and quantity*

Detracting Conditions

- This site is covered by a thick overburden which makes gathering accurate data very difficult.
- Inadequate transportation: Trunk Highways 9 and 32, north of Fertile are not 10 ton routes, which would hamper transporting large volumes of waste.

NC-9

LOCATION: Clearwater, Mahnomen, and Becker Counties in northern Minnesota.

AREA: 647 sq. km (249 sq. mi.)

STATUS: Back-Up Site

Disqualifying Factors

Natural Resources Disqualifiers

- Peat bogs scattered throughout NC-9 are potential energy sources.
- Mineral resources have not been unassessed.
- Mineral exploration boreholes and water wells are found throughout the area.

Environmental Disqualifiers

- Little Elbow Lake State Park, the adjacent Itasca State Park, Agassiz-Nelson, Upper Camp Lake, Roy Lake, Wapatus Lake, and McKenzie Lake WMAs, and a network of Grant-in-Aid Snowmobile Trails all indicate the presence of environmental disqualifying conditions, and the importance of tourism.

Adverse Conditions

- The MGS has identified diabase dike swarms within the crystalline bedrock of Candidate Area NC-9. Dike swarms represent weak structures that promote ground water movement. Canadian research teams consider these rock formations unsuitable for a repository.
- The MGS has also documented 290 wells at or within a five mile radius of the candidate site, five of which extend deeper than 100m.
- Thick overburden covers the unexposed crystalline rocks* thought to exist in NC-9.
- The large extent of surface water, swamps, and peat bogs, indicates particularly poor drainage and potential flooding in and around the area.
- Ground water from this area discharges into the headwaters of the Mississippi River.
- The White Earth Indian Reservation lies in NC-9. Inadequate attention was paid to tribal values in selecting this site. Since it is unlikely the tribe will forfeit or compromise existing treaties, land ownership would be especially difficult.

Inadequate Discussions

- In order to determine ground water flow patterns through crystalline rock, DOE should have gathered and evaluated more data.
- Ground Water Use
 - Well locations and yield*
 - Water quality and quantity*

DOE needs to expand upon the implications of faults, fractures, and dike swarms crossing the batholith beneath NC-9 would have upon a repository.

Detracting Conditions

- A repository would threaten prime agricultural lands farmed in this area.
- No exposed rock appears in the candidate site.
- A main arterial, Highway 29, parallels the Red River. Also, U.S. and State Highways 71, 92, 113, and 200 are less than 10 ton routes. Highways 113 and 200 are limited to 5 ton vehicles.
- Bemidji, a northern population center, is located only 20 miles beyond the perimeter of NC-9.

NC-10

LOCATION: Mille Lacs, Morrison, Benton, and Sherburne Counties in central Minnesota.
AREA: 1,032 sq. km (397 sq. mi.)
STATUS: Primary Site

Disqualifying Factors

Natural Resource Disqualifier

- Exploratory boreholes, from diamond and manganese investigations and quarries exist within the candidate area.

Environmental Disqualifiers

- NC-10 is situated near the Mississippi River, and includes the stretch of the river designated "Wild and Scenic."
- The Rum River, a State designated Canoe/Boating Route parallels the area's eastern boundary.
- Bibles and Ben Lacs WMAs, Sherburne National Wildlife Refuge, and a network of Grant-In-Aid Snowmobile Trails represent environmental disqualifiers and the importance of tourism.

Adverse Conditions

- High discharge of shallow wells means water resources could easily be polluted by radionuclides migrating to the surface.
- The MGS has documented 1,200 water wells at or within a five mile radius of the candidate site, 23 of which extend deeper than 100m.
- Surface lakes, wetlands, and rivers identify NC-10 as a potential source of ground water discharge.

Inadequate Discussions

- Ground water flow in crystalline rocks
- Ground water use
 - Water quality and quantity*
 - Well locations and yield*
- Topographic information concerning drumlins*, buried channels, and valleys present in NC-10.
- DARR lacks an appropriate description of the Stearns Granite Complex* and Pre-Late Cretaceous Regolith.
- The analogy relating NC-10 to the Minnesota River Valley is irrelevant.
- Milaca earthquake activities observed during 1977-81 warrant further attention.

Detracting Conditions

- Indian archeological sites scattered throughout this area would make land acquisition difficult.
- A repository would threaten prime agricultural lands farmed in NC-10.
- The highly-populated areas of St. Cloud, St. Paul, and Minneapolis lie downstream of NC-10.
- Tonnage limitations (less than 10 tons on Highway 25 south of Trunk Highway 95 and to 7 tons north of Foley) would severely restrict waste transportation throughout NC-10.
- Only 1% of the area's rock is exposed.

NC-12

LOCATION: *Stearns, Todd, and Pope Counties in central Minnesota.*
AREA: *445 sq. km (171 sq. mi.)*
STATUS: *Back-Up Site*

The problems presented by the thick, glacial overburden at all the sites in Minnesota are typified by the uncertainties regarding the bedrock at Candidate Area NC-12.

Recent drilling by the (MGS) in areas immediately adjacent to NC-12 identified sedimentary bedrock in areas previously thought to host crystalline rock*. It is possible that the bedrock at NC-12 is also sedimentary.

Disqualifying Factors

Tectonic* Disqualifier

- NC-12's proximity to the Great Lakes Tectonic Zone* suggests the bedrock is highly fractured and altered.

Demographic Disqualifier

- Inadequate attention to local population centers, such as Sauk Centre, Osakis, and Melrose, which have populations greater than 1,000 per square mile.

Natural Resource Disqualifiers

- Mineral exploration boreholes are found throughout the area.
- Mineral resources have not been assessed.

Environmental Disqualifiers

- Since Lake Carlos State Park, Padua, and Sauk River State Wildlife Management Areas located in this area, the site should have been removed from further consideration.

Adverse Conditions

- The MGS has documented 370 wells at or within a 5 mile radius of the candidate site, seven of which extend deeper than 100m.
- Local topography and water resources indicate that the area is not well-drained.

Inadequate Discussions

- Water Quality - The DARR includes a misleading correlation between NC-12 and the Minnesota River Valley
- Pre-Late Cretaceous regolith presents geomechanical difficulties.
- There is no support for DOE's claim that tectonic deformations will not affect ground water flow.
- The two outcrops* located in NC-12 comprise less than .001% of the area, rather than 1% as cited in the DARR.
- DOE incorrectly reported tonnage restrictions. U.S. Trunk Highway 71, only a minor arterial east of Interstate 94, has a 7 ton limit.
- Well pumpage data indicate upward, not downward or horizontal, gradients extending from Quaternary aquifers.

Detracting Conditions

- A repository would threaten prime agricultural lands farmed in this area.
- Indian archeological sites scattered about NC-12 would make land acquisition difficult.

NC-13

LOCATION: Stevens, Big Stone, and Swift Counties in west central Minnesota.
AREA: 156 sq. km (60 sq. mi.)
STATUS: Back-Up Site

Clear Lake, Lake Hattie, Dry Wood Lake, and Garden Lake mentioned in the DARR were not incorporated into the "surface water body" screening factor.

Disqualifying Factors

Tectonic Disqualifier

- DOE did not address the potential influence of the Great Lakes Tectonic Zone on the presence of fractures in the crystalline bedrock.
- The 1975 Morris Earthquake indicates that tectonic activity may again occur, which should disqualify this region from further consideration.

Environmental Disqualifiers

- The presence of state and federal protected lands, including five Wildlife Management Areas (WMA): Orville, Erickson, Robertson, Mathison, Chokio, and Alberta, is a disqualifying factor.

Natural Resources Disqualifier

- Mineral resources have not been assessed.
- Mineral exploration boreholes and water wells are found throughout the area.

Adverse Conditions

- According to the U.S. Geological Survey, ground water flows into Canada via the Red River drainage basin. Polluting this resource would violate the Boundary Waters Treaty of 1909.
- As documented by the MGS, 130 wells exist at or within a 5 mile radius of the site, five of which extend deeper than 100m.
- The multitude of surface water bodies located in NC-12 reflect great potential for ground water discharge and flooding.
- Thick overburden covers the proposed host rock.

Inadequate Discussions

- Pre-Late Cretaceous regolith
- Ground water use
 - Well locations and yield*
 - Water quality and quantity*
- DOE did not support their claim that tectonic deformations in the area will not affect ground water flow.
- DARR data on crystalline rock* ground water flow are inadequate.

Detracting Conditions

- Indian archeological sites found in NC-13 would make land acquisition difficult.
- Tonnage restrictions on State Trunk Highways 59, 12, and 28 limit available access to the proposed repository site. These roads also need extensive upgrading.
- Since there are no exposed rock bodies, geologic data are unreliable.
- A repository would threaten prime agricultural lands farmed in this area.

NC-14

LOCATION: *Renville, Sibley, McLeod, and Nicollet Counties in southern Minnesota.*

AREA: *746 sq. km (287 sq. mi.)*

STATUS: *Back-Up Site*

Disqualifying Factors

Environmental Disqualifier

- Fort Ridgely Creek and Little Rock Creek are proven discharge zones.
- Since there are no exposed rock bodies in this area, gathering accurate data is very difficult.
- Alfsborg and Grundmeyer WMAs located in the candidate zone are disqualifying factors.

Demographic Disqualifier

- Population centers in NC-14 with a population of more than 1,000 people per square mile include Fairfax, Hector, Bird Island, Gibbon, and Stewart.

Natural Resources Disqualifiers

- Mineral resources have not been assessed.
- Mineral exploration boreholes and water wells are found throughout the area.

Adverse Conditions

- A recent study by the Minnesota Geological Survey reveals that the NC-14 contains significant amount of sedimentary strata (marine clays and sands) at the bedrock surface.
- The sedimentary rocks and the remaining crystalline rocks are utilized extensively for ground water.
- The MGS has documented 580 wells at or within a 5 mile radius of the candidate site, 102 of which extend deeper than 100m.
- Surface Water covers 6% of NC-14.
- Wetlands and other flood-prone lowlands indicate poorly drained lands.

Inadequate Discussions

- A Pre-Late Cretaceous regolith with a thickness ranging from 20-100' has serious geomechanical implications.
- The archean thrust fault* in NC-14 is related to the Morris fault.
- There is no support in DARR that tectonic deformations would not affect regional ground water flow.
- Ground water use
 - Water quality and quantity*
 - Well locations and yields*

Detracting Conditions

- Inadequate Access: Trunk Highways U.S. 212, State 4,19, and 15 are not 10-ton routes. All are undivided 2-lane roads.

Glossary

Listed below are definitions for geologic terms which may be unfamiliar to the reader.

Aquifer, Quaternary

A rock body with sufficient porosity and permeability to transmit water to supply springs and wells. Quaternary refers to the geologic period, covering the last 2 million years, when the aquifers were formed.

Archean

Refers to the geologic period 2.6-3.8 billion years ago.

Artesian Wells

A well in which the groundwater tapped exerts enough vertical pressure to rise above the level of its aquifer.

Batholith

A very large (minimum 100 sq. km) intrusive igneous rock body of irregular shape.

Crystalline Rocks

Intrusive igneous (e.g., granite) and high-grade metamorphic rocks (e.g., gneiss) with a grain size sufficiently coarse that individual crystals can be detected with the unaided eye.

Diabase Dike Swarm

A discordant body of rock formed when hot magma or lava cools in the fractures of an igneous rock. Diabase refers to an altered basalt.

Drumlins

An elongate or oval hill of glacial drift.

Glaciation

The formation of ice sheets, specifically glaciers.

Great Lakes Tectonic Zone

This area stretches E-NE across central Minnesota, separating two different rock terrains. The DARR considered the granite gneiss terrain which lies to the south of the zone as a host for the proposed repository. Greenstone terrain lies north of this tectonic zone.

Igneous Rock

Rock formed by the cooling and solidification of magma or lava.

Outcrop

The part of a rock formation that appears at the surface of the ground.

Overburden

Loose or consolidated rock material overlying older, crystalline rocks.

Pre-late Cretaceous Regolith

Loose sand, rock, or other material overlying bedrock. Pre-Late Cretaceous refers to geologic activities which occurred before the Late Cretaceous period, 65-140 million years ago.

Radionuclides

Individual radioactive atoms.

Sedimentary Rocks, Ordovician

Rocks formed from the deposition of mud, till, clays, and sands. Ordovician refers to a geologic time period dating from 435-500 million years ago.

Stearns Granitic Complex

A geologic formation near St. Cloud in Stearns County.

Tectonic Processes

Refers to the broad, large scale structural features of the earth and how they originated.

Regional Libraries

Bemidji Public Library
Sixth and Beltrami
Bemidji, MN 56601

Chippewa County Library
224 South First Street
Montivideo, MN 56265

Crow River Regional Library
410 West Fifth
Willmar, MN 56201

Duluth Public Library
520 West Superior Street
Dulth, MN 55802

East Central Regional Library
240 Third Avenue S.W.
Cambridge, MN 55008

Environmental Conservation Library
300 Nicollet Mall
Minneapolis, MN 55401

Fergus Falls Public Library
205 East Hampden
Fergus Falls, MN 56537

Great River Regional Library
124 South Fifth Avenue
St. Cloud, MN 56301

Marshall-Lyon County Library
301 West Lyon Street
Marshall, MN 56258

Minnesota Valley Regional Library
120 South Broad Street
Mankato, MN 56001

Polk County-Crookston
120 North Ash Street
Crookston, MN 56716

Rochester Public Library
11 First Street
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