

THE MICHIGAN SITE SELECTION PROCESS FOR A LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY

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ABSTRACT

Michigan as the host state for the Midwest Compact is in the process of site selection of three potential candidate sites where detailed site characterization studies will be performed. The process consists of application of exclusionary criteria. An initial screening of the entire state by use of a geographic information system eliminated about 97 percent of the state. The remaining areas of over 2,250 acres in extent are being investigated using available data. Three have been eliminated to date and the remaining 79 continue under study.

INTRODUCTION

The Federal Low-Level Radioactive Waste Policy Act (Public Law 99-240) gave each state the responsibility to safely manage the low-level radioactive waste generated within its borders by 1993. In December, 1982, the Legislature passed and Governor Milliken signed into law Act 460 of 1982, an act for entering into the Midwest Interstate Low-Level Radioactive Waste Compact, whereby Michigan indicated its willingness to join with other midwestern states (Wisconsin, Minnesota, Ohio, Iowa, Indiana, and Missouri) in a regional compact to meet these responsibilities. This Compact was approved by the United States Congress in December, 1985 (Omnibus Compact Act of 1985). In July, 1987, the Midwest Compact selected Michigan as the Host State, since Michigan produced the most low-level radioactive waste of any of the other compact states, and made it responsible for constructing a facility to isolate low-level radioactive waste generated in member states. In December, 1987, Michigan enacted legislation creating the Michigan Low-Level Radioactive Waste Authority (Authority) to safely manage Michigan's waste (204 PA 1987) and created a regulatory framework in the Department of Public Health to ensure the safety of Michigan's citizens and the protection of its environment.

Among other responsibilities, the Authority was directed to develop final criteria for siting a low-level radioactive waste isolation facility in Michigan. To assist the Authority in carrying out its responsibilities, the Act required the establishment of a Siting Criteria Advisory Committee. Members of the Committee "...shall by education and experience be knowledgeable in a technical specialty related to the siting of a low-level radioactive waste disposal site."

The criteria developed by the Committee provided the basis for the final siting criteria adopted by the Authority as the standards by which areas of the State are to be judged for suitability as a location for a low-level radioactive waste isolation facility. The criteria are based on Federal Regulatory Guidelines and Michigan statute. Most of the criteria

are the same as those in Federal Regulation or State statute. In some instances, the criteria are more restrictive than legislation or regulatory guidelines. In other instances, the Committee and the Authority have interpreted guidelines which were unclear in such a manner as to provide criteria which are most protective of citizen health and the environment.

The final criteria can be divided into two categories: 1) Exclusionary criteria that omits an area from further consideration; and 2) Favorability criteria that distinguish the relative suitability of those areas not excluded from further consideration. The exclusionary criteria will be applied statewide and areas of the State which fail to meet each exclusionary criterion will be excluded from consideration. The remaining areas will be evaluated using the favorability criteria. The nine major categories that the criteria fall under are:

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| Objective I | Avoid Population Centers and Conflicts with Human Activities |
| Objective II | Avoid Areas Subject to Geologic and Flood Hazards |
| Objective III | Protect Surface and Groundwater Quality |
| Objective IV | Minimize Transportation Hazards |
| Objective V | Protect Air Quality |
| Objective VI | Avoid Resource Development Conflicts |
| Objective VII | Avoid Conflict with Areas of Special or Protected Land Use Including Environmentally Sensitive Areas |
| Objective VIII | Avoid Conflict with Community Social and Economic Goals |
| Objective IX | Comply with Federal and State Laws Which Protect Environmentally Sensitive Areas and Which Protect Cultural and Heritage Values. |

EXCLUSIONARY SCREEN

With the establishment of the siting criteria, the next stage in the site selection process was to evaluate Michigan on a statewide basis utilizing the exclusionary criteria. The Authority entered into a contract with Michigan State University to incorporate data into a Geographic Information System (GIS). The Comprehensive Resource Information Evaluation System (CRIES) was developed. This raster based system consists of dividing the State of Michigan into a 1 km grid to which information would be digitized, specific to each exclusionary factor. Data sources were then compiled for use in evaluation of the specific exclusionary criteria. Examples of the sources of data utilized were:

1. Regional soils maps
2. The Quaternary Map of Michigan
3. The Aquifer Vulnerability Map of Michigan
4. Bureau of Census Information
5. United States Geological Survey Maps and Michigan Department of Transportation Maps
6. Seismic Intensity Zone Map - (Fujita, 1988)
7. USGS surface water map, 1:500,000 scale map of Michigan
8. Public water well supply data
9. Land Cover Files -MSU
10. Exclusion of National Parks and Lakeshores, National Wild and Scenic River System, National Wildlife Areas, Wildlife Preservation System and State Parks and designated wilderness areas.

Sixteen of the exclusionary criteria were addressed either completely or partially in the initial exclusionary screen.

The exclusionary criteria that were addressed in their entirety in this screening were:

1. Objective I-A - Exclude areas within incorporated city limits as established on January 1, 1988.
2. Objective I-B - Exclude areas not sufficiently large to assure that an isolation distance of 3,000 feet or more from the disposal unit and adjacent property lines is available.
3. Objective II-A - Exclude areas located one mile or less from a fault where tectonic movement has occurred within the last 10,000 years.
4. Objective II-B - Exclude areas of significant earthquake intensity, defined as zones with a modified Mercalli index of VII or greater.
5. Objective II-C - Exclude areas within the 500 year floodplain, including areas designated under 245 PA 1929 (Sections 323.1 to 323.13 of the Michigan Compiled Laws).

6. Objective III-E - Exclude areas located over a designated sole source aquifer.
7. Objective III-H - Exclude areas located within 10 miles of Lake Michigan, Lake Superior, Lake Huron, Lake Erie, St. Mary's River, Detroit River, St. Clair River or Lake St. Clair. This criterion shall not apply to a site that is located at or adjacent to a nuclear power generating facility.
8. Objective IX-A - Exclude areas where siting will be inconsistent with the requirements of the following federal laws:
 - (iii) Costal Zone Management Act of 1972
 - (v) Wild and Scenic Rivers Act
 - (vi) Wilderness Act
 - (vii) National Wildlife Refuge System
8. Objective IX-B - Exclude areas where siting would be inconsistent with the requirements of the following state laws:
 - (i) State Parks, PA 218
 - (ii) Wilderness and Natural Areas Act, PA 241.

Many of the criteria were partially addressed in the exclusionary screen, but will require further site specific information before they are to be fully applied, due to limitations in the available data bases utilized in the CRIES system. These criteria are:

1. Objective III-A - Exclude areas where the water table associated with geologic deposits or formations is not sufficiently low to prevent the intrusion of ground water into the disposal unit or bottommost portions of the leak detection system, if one should be included in the design.
2. Objective III-B - Exclude areas where there is not 6 or more meters of soil with a maximum hydraulic conductivity of 1.0 times 10 to the minus 6 centimeters per second at all points below and lateral to the disposal unit and bottommost portions of the leak detection system, if one should be included in the design, or areas where there is not greater than 6 meters of relatively impervious soil that provides equivalent environmental protection to the public health, safety, and welfare, and the environment. This soil should extend laterally a sufficient distance to assure that it cannot be circumvented by ground water flow in 500 years.
3. Objective III-D - Exclude areas where the average ground water travel time from the water table beneath the bottom of the disposal unit to an aquifer is less than 500 years.
4. Objective III-F - Exclude areas located where the hydrogeology beneath the site discharges ground water to the land surface within 3,000 feet (915 m) of the boundaries of the disposal unit.

5. Objective III-G - Exclude areas not free of ponding or incapable of being drained in a manner that ensures the integrity of the disposal unit.
6. Objective III-L - Exclude areas located where the hydrogeology beneath the site discharges ground water to the land surface within 3,000 feet of the boundaries of the candidate site.
7. Objective VII-A - Exclude areas with wetlands as defined in the Goemaere-Anderson Wetland Protection Act, Act No.203 of the Public Acts of 1979, being sections 281.701 to 281.722 of the Michigan Compiled Laws.

The remaining criteria were not addressed in the exclusionary screen and will require detailed site specific information. Of these remaining criteria, there are two types, exclusionary and favorability. The exclusionary criteria are:

1. Objective II-D - Exclude areas where geological processes such as mass wasting, erosion, slumping, landsliding, or weathering precludes meeting the performance objectives in 10 CFR 61 Subpart C or precludes defensible modeling and prediction of the long term impact of such occurrences.
2. Objective III-C - Exclude areas where the average travel time of ground water along any 100 foot flow path from the water table beneath the bottom of the disposal unit is less than approximately 100 years.
3. Objective III-D - Exclude areas where the average ground water travel time from the water table beneath the bottom of the disposal unit to an aquifer is less than 500 years.
4. Objective III-M - Exclude areas located above an aquifer that is the primary source of drinking water for a municipality or county or for persons residing or doing business in the municipality or county where a candidate site is located.
5. Objective VII-B - Exclude areas with environmental areas or high risk areas as defined in the Shorelands Protection and Management Act of 1970, Act No. 245 of the Public Acts of 1970, being sections 281.631 to 281.644 of the Michigan Compiled Laws.
6. Objective IX-A - Exclude areas where siting will be inconsistent with the requirements of the following federal laws:
 - (i) Atomic Energy Act of 1954
 - (ii) Federal Water Pollution Control Act
 - (iv) Endangered Species Act of 1973
 - (ix) The National Historic Preservation Act

Favorability criteria will be utilized later in the site selection process. These criteria are:

1. Objective I-C - Seek areas where projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives of 10 CFR 61 Subpart C (10 CFR 61.50 (a)(3)) and are not likely to significantly interfere with an environmental monitoring program.
2. Objective III-I - Seek areas with simple hydrologic systems that can be characterized, modeled, analyzed, and monitored.
3. Objective III-J - Seek areas that do not overlie aquifers that produce potable water.
4. Objective III-K - Seek areas which do not include public water supply wells, well fields, high capacity production wells, and abandoned wells.
5. Objective IV-A - Seek areas which minimize the risk of transportation accidents.
6. Objective IV-B - Seek areas which minimize the risks of exposures to radiation associated with transportation accidents.
7. Objective V-A - Seek areas with simple meteorological systems that can be characterized, modeled, analyzed, and monitored.
8. Objective VI-A - Seek areas where natural resources do not exist on or significantly near to the candidate site that, if exploited, would result in failure to meet the performance objectives of Subpart C of 10 CFR 61.
9. Objective VII-D - Seek sites which do not cause visual intrusion on designated scenic highways so designated as on January 1, 1988.
10. Objective VII-E - Seek sites which will not require that prime farmland be removed from agricultural production.
11. Objective VIII-A - Seek areas which are not included in formally proposed or approved development plans as of January 1, 1988.
12. Objective VIII-B - If all other criteria are met, give preference to areas near communities desiring the facility.

This digitized information in the CRIES system permitted the creation of a series of maps that, when overlaid, produced the resultant suitable areas remaining after this initial broad based screening. As a result of this screening, 97% of the State of Michigan was omitted from further study. The remaining 3% proceeded into the next phase.

CANDIDATE AREA INFORMATION EVALUATION PROCESS

Of the remaining 3% of the potentially suitable land remaining from the exclusionary screen, the three largest parcels were selected as candidate areas for further evaluation to ultimately select candidate sites. The three areas

were: One in Ontonagon County in Michigan's Upper Peninsula, 16,750 acres, one in St. Clair County in the eastern lower peninsula, 16,750 acres, and one in Lenawee County on Michigan's southern border, 15,500 acres. This comprised a total of 49,000 acres total to evaluate in this phase.

Since the initial GIS system had resolution limitations (1 km), it was determined that another system would be needed for this more in-depth study phase. The Michigan Resource Information System, MIRIS, was accessible and available. However, the data base was at different levels of completion throughout the state. This vector-based or point-based system had the required resolution (i.e., down to a single point or line). The Michigan Department of Natural Resources is the agency in charge of the system. They were tasked to produce information for the three candidate areas. The necessary CRIES information was integrated into the MIRIS system.

The purpose of the candidate area evaluation phase of the siting process was to identify the potential candidate sites which appear to be most suitable for site characterization on the basis of available information. Potential candidate sites are those considered to have the highest likelihood of yielding a candidate site which meets the standards established by the Michigan Legislature and licensing requirements of the Nuclear Regulatory Commission (NRC) and Michigan Department of Public Health (DPH).

The following site resource elements were evaluated to determine if the three Candidate areas can meet the final siting criteria:

ECOLOGICAL RESOURCES - The evaluation process assessed the ecological, land use, and environmental impacts as they relate to wetlands, threatened and endangered species, important plants and wildlife species, and unique or sensitive ecosystems (special habitats).

LAND USE - The evaluation process provided input regarding current and potential land uses including, but not limited to, prime farm lands, mineral reserves, oil and gas reserves, and forest resources. Man-made features were also evaluated.

EARTH - The evaluation process assessed soil series and geologic/geomorphic processes with respect to erosion weathering, slope and drainage soil movement and so on. Available county soils maps and surveys, along with topographic data, will provide information to evaluate the susceptibility of certain soil types to these processes.

WATER - The evaluation process assessed hydrologic conditions and ground water characteristics with respect to specific siting requirements including

water supply wells, regional aquifer conditions, regional drainage patterns, and minor surface water features and their associated floodplains. Existing ground water data base systems and well logs will be consulted in this assessment.

CULTURAL RESOURCES - The evaluation process consulted state and local archives and recognized experts to determine potential impacts to important and sensitive sites of archaeological, cultural, and historical significance; sites sacred to Native Americans; and locations of significant folklife and other non-material resources; and sites of paleontological significance.

A Public Advisory Committee (PAC) was organized during this phase of the screening process. Through its wide representation of public organizations, the PAC provided public input to the evaluation of data available for the identification of candidate sites. The Authority established the PAC to bring an independent voice to the process, ensure a broad perspective, provide technical expertise, identify additional data sources, and provide an open evaluation of the data.

PAC members were appointed by public organizations that have a recognized interest and expertise with regard to a particular resource element. Each member addressed a specific resource element. The PAC members developed individual study plans describing how each member planned to evaluate data and identify additional data sources or needs. Each member then evaluated existing data bases in their area of technical expertise for each candidate area, identified data gaps or exclusionary factors, and recommended additional data sources and data needs.

The PAC members completed the process by producing individual "resource element" reports summarizing the evaluations and recommendations. These were incorporated into the Final Decision Report published by the Authority.

Based on this collective evaluation, the following conclusions were made:

1. The Ontonagon and St. Clair candidate areas were dropped from further consideration on February 16, 1990 due to the presence of protected wetlands and strong potential for ground water discharge within any 3,000-foot candidate site boundary configuration in either candidate area.
2. In the final review of the exclusionary criteria, the Authority determined that there is insufficient area within the Lenawee County candidate area to identify a potential candidate site for purposes of site characterization. This was due to a combination of exclusionary factors including wetlands, ground water discharge to the surface within 3,000 feet of the disposal unit, and a 3,000-

foot buffer drawn around all perennial streams and flood prone areas along Big Ravine Drain.

PLAN TO CONDUCT AN ANALYSIS OF THE POTENTIALLY SUITABLE AREAS

Over the next several months, the Authority staff and contractors plan to collect and evaluate available data on the remaining potentially suitable areas of Michigan to determine whether any of these areas will meet final siting criteria for the identification of potential candidate sites and be eligible for site characterization activities. Evaluation of the potentially suitable areas will include all areas 2,250 acres and larger in size.

The focus will be on the siting criteria that were demonstrated the most problematic as a result of the studies of the initial three areas and related studies by the Authority. These elements are: (1) wetlands defined under the Michigan Wetlands Protection Act, (2) ground water discharge within 3,000 feet of the disposal unit and within an additional 3,000 feet of the candidate site boundary, and (3) flood potential. In addition, man-made features of concern in the licensing process are planned to be addressed. Available data will also be used to evaluate additional siting elements such as the presence of aquifers and high water tables, ponding potential, impermeable soils, and protected species and unique natural areas.

The study approach adopted by the Authority will involve a two-phase process. Phase 1 will evaluate maps and data in the Michigan Resource Information System (MIRIS) covering land use/land cover, wetlands, threatened and endangered species, natural resources, and soils. In addition, well logs for the potentially suitable areas will be collected and analyzed. Floodplain maps and published geohydrological information will also be collected and analyzed. Data on major man-made features will be obtained from existing maps and records and from limited contacts with local officials.

Upon completion of this process, the Authority will determine whether sufficient areas which meet the screening elements remain to continue into Phase 2 studies. During Phase 2, the ground water data base will be evaluated

from automated and computer mapped well logs. Detailed data on any questionable man-made features will be obtained through field contacts and site visits. Satellite imagery of the remaining areas and appropriate land use and wetlands updates will also be obtained.

Following review of the Phase 2 data base, only those potentially suitable areas that meet all of these siting elements will be considered as candidate areas. At that time, the Authority may consider pre-characterization field studies of the remaining areas to study any potential fatal flaws before proceeding with the complete site characterization field effort.

This approach was established to meet the following requirements:

All potentially suitable areas must be equally evaluated using a defensible and comparable data base; at the end of the evaluation, this data base must be no less comprehensive than that obtained for the Lenawee, Ontonagon, and St. Clair candidate areas.

Exclusionary criteria that are most likely to eliminate potential candidate sites must be evaluated before proceeding into site characterization. The loss of one or more potential candidate sites during or after the detailed site characterization process would cost much more in time and budget than the current planned activities.

The data base and evaluation process must be sufficient to provide an objective critique of the siting criteria and to determine, from a technical standpoint, whether the criteria are too restrictive relative to the additional level of protection of health, safety, and the environment that is provided by such restrictions.

It must be demonstrated that each criterion was reviewed in sufficient depth and uniformly evaluated to have a technical basis for any requested change.

A defensible and comprehensive data base, comprising all currently available information, must be available to preclude, to the extent possible, extensive and costly additional work prior to selecting potential candidate sites.