BLM LIBRARY
88066687

U.S. Department of the Interior
Bureau of Land Management

Eastern States
Milwaukee Field Office

April 1998

Mosquito Creek Lake
Draft Planning Analysis/ Environmental Assessment

In cooperation and coordination with
U.S. Army Corps of Engineers,
Pittsburgh District,
and Ohio Department of Natural Resources

HD
243
.O3
M67
1998

#39477184 ID 88066687 HD 243 .03 M67 1998

TABLE OF CONTENTS

TABLE OF CONTENTS

Table of Contents

Table of Contents

TABLE OF CONTENTS

Acronyms

AAQS	Ambient Air Quality Standards
ACEC	areas of critical environmental concern
ADT	average daily traffic
ALS	aquatic life standard
APD	Application for Permit to Drill
bbl	barrel
BCF	Billion cubic feet (natural gas)
BEA	(U.S. Department of Commerce) Bureau of Economic Analysis
BLM	Bureau of Land Management
BOP	blowout preventer
CA	Communitization Agreement
CAA	Clean Air Act
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
CRA	Compensatory Royalty Agreement
CWA	Clean Water Act
dB	decibels
dB(A)	decibels of the A-weighted scale
DOG	Division of Oil and Gas (Ohio Department of Natural Resources)
DOI	U.S. Department of the Interior
DOT	Department of Transportation
E and P	exploration and production
E.O.	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act of 1976
FR	Federal Register
gpd/ft	gallons per day per foot
gpm	gallons per minute
HAZCOM	Hazard Communication Standard
HazMat	hazardous materials
INC	Incidence of Non-compliance
IOGCC	Interstate Oil and Gas Compact Commission
L_{dn}	day-night sound level
LEPC	Local Emergency Planning Committee
LLSD	Lakeview Local School District
Mcf/d or mcf/d	thousand cubic feet per day
MFO	Milwaukee Field Office (formerly Milwaukee District Office)
mg/l	milligrams per liter

MMcf or mmcf	million cubic feet
MMS	Minerals Management Service
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service (formerly Soil Conservation Service)
NRHP	National Register of Historic Places
NPDES	National Pollutant Discharge Elimination System
NSO	No Surface Occupancy
NTL	Notice to Lessees
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OPUC	Public Utility Commission
OSERP	Oil Spill Emergency Response Plan
OSHA	Occupational Safety and Health Administration
OUPS	Ohio Utility Protection Service
PA/EA	Planning Analysis/Environmental Assessment
PM	particulate matter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFDS	Reasonably Foreseeable Development Scenario
RQs	Reportable Quantities
RUSLE	Revised Universal Soil Loss Equation
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SMCL	Secondary Maximum Contaminant Level
SPCC	Spill Prevention, Containment, and Countermeasure (plan)
TDS	total dissolved solids
TSP	total suspended particulates
μg/l	micrograms per liter
μs/l	microSiemens per centimeter
UIC	underground injection control
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

VOC	Volatile Organic Compounds
VRM	Visual Resource Management
WO	Washington Office
YSU	Youngstown State University

MMcf or mmcf	million cubic feet
MMS	Minerals Management Service
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service (formerly Soil Conservation Service)
NRHP	National Register of Historic Places
NPDES	National Pollutant Discharge Elimination System
NSO	No Surface Occupancy
NTL	Notice to Lessees
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OPUC	Public Utility Commission
OSERP	Oil Spill Emergency Response Plan
OSHA	Occupational Safety and Health Administration
OUPS	Ohio Utility Protection Service
PA/EA	Planning Analysis/Environmental Assessment
PM	particulate matter
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RFDS	Reasonably Foreseeable Development Scenario
RQs	Reportable Quantities
RUSLE	Revised Universal Soil Loss Equation
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SMCL	Secondary Maximum Contaminant Level
SPCC	Spill Prevention, Containment, and Countermeasure [illegible]
TDS	total dissolved solids
TSP	total suspended particulates
ug/l	micrograms per liter
µs/l	microSiemens per [illegible]
UIC	underground injection control
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey.

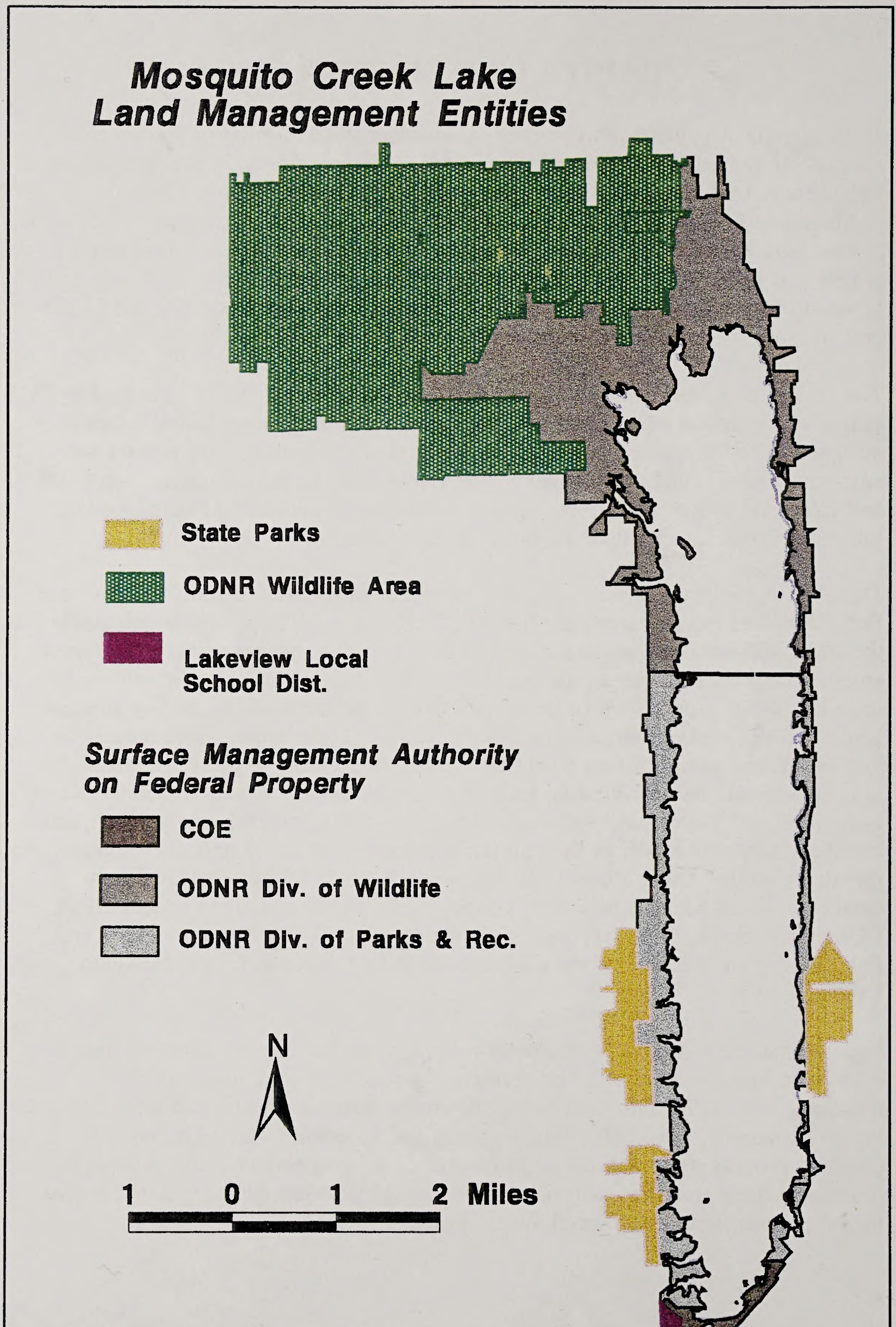
CHAPTER ONE - INTRODUCTION

This Planning Analysis/Environmental Assessment (PA/EA) reviews management alternatives for leasing of Federal oil and gas resources underlying the Army Corps of Engineers (COE) Mosquito Creek Lake project in Trumbull County, Ohio. In addition, one 32-acre non-COE tract will be addressed in this document. This tract is located adjacent to the COE property boundary in the southwestern corner of the project and is owned by the Lakeview Local School District (LLSD) (see Map 1, Mosquito Creek Lake Land Management Entities). The combined COE and LLSD properties are hereafter referred to as the "project area."

The project area lies within the Bureau of Land Management (BLM), Milwaukee Field Office's jurisdiction. The BLM's primary mission in the Eastern United States is to manage mineral resources owned by the Federal government through orderly and environmentally sound development. The environmental, socioeconomic, and health and safety impacts of leasing the oil and gas resources underlying Federal lands at Mosquito Creek Lake will be analyzed in this document.

This PA/EA reviews the following two management alternatives for development of Federal oil and gas resources at Mosquito Creek Lake: (1) no action, which means that the BLM will not issue any leases to extract Federal oil and gas resources, but may enter into agreements that would pool unleased Federal oil and gas with private minerals, which would then be developed through private wells located on adjacent lands; and (2) leasing with a "no surface occupancy" stipulation, which means that Federal oil and gas resources would be leased, but no wells or other permanent structures would be permitted on Federal property. Lessees would be able to extract Federal oil and gas resources through directional drilling methods from wells located on adjacent private lands, or through pooling leased Federal oil and gas resources with private minerals. Other alternatives were considered, but were eliminated from detailed analysis because they were contingent on allowing wells to be located on COE surface lands. (See Section 1.5, "Relationship to Other Plans, Programs and Policies" for a discussion of the COE's management direction for the Mosquito Creek Lake project.)

Issues considered in the assessment of the environmental impacts resulting from each alternative include: water quality, aesthetics, wetlands, special status species, recreation, cultural/historic and Native American resources, health and safety, and liability concerns. Two other issues—roads and economics—raised during the planning process were determined to be outside the scope of analysis. Although impacts to these resources will be analyzed, BLM lacks the authority to implement measures specific to lessen or eliminate impacts.


Mosquito Creek Lake
Land Management Entities
State Parks
ODNR Wildlife Area
Lakeview Local School Dist.
Surface Management Authority on Federal Property
COE
ODNR Div. of Wildlife
ODNR Div. of Parks & Rec.
N
1 0 1 2 Miles

Map 1

Organization of this Document

This document is divided into five chapters, with supporting documentation found in several appendices. This chapter describes the need for the PA/EA, and contains descriptions of the planning area, BLM's planning process, issues selected for analysis, the relationship to other plans, programs and policies, and resource objectives for the area. Chapter Two contains a description of the proposed action and management alternatives considered and not considered for analysis, and the reasonably foreseeable development scenario. Chapter Three describes the resources that may be affected by the development of oil and gas resources at Mosquito Creek Lake given either alternative. Chapter Four provides the analysis of the environmental impacts under the two alternatives. Chapter Five summarizes BLM's consultations and coordination during the planning process, including the involvement of the public in developing the PA/EA. It also contains a listing of the staff members who contributed to the document. Following Chapter Five are five appendices, glossary, and a list of sources and references. A list of acronyms precedes this chapter.

1.1 Purpose and Need

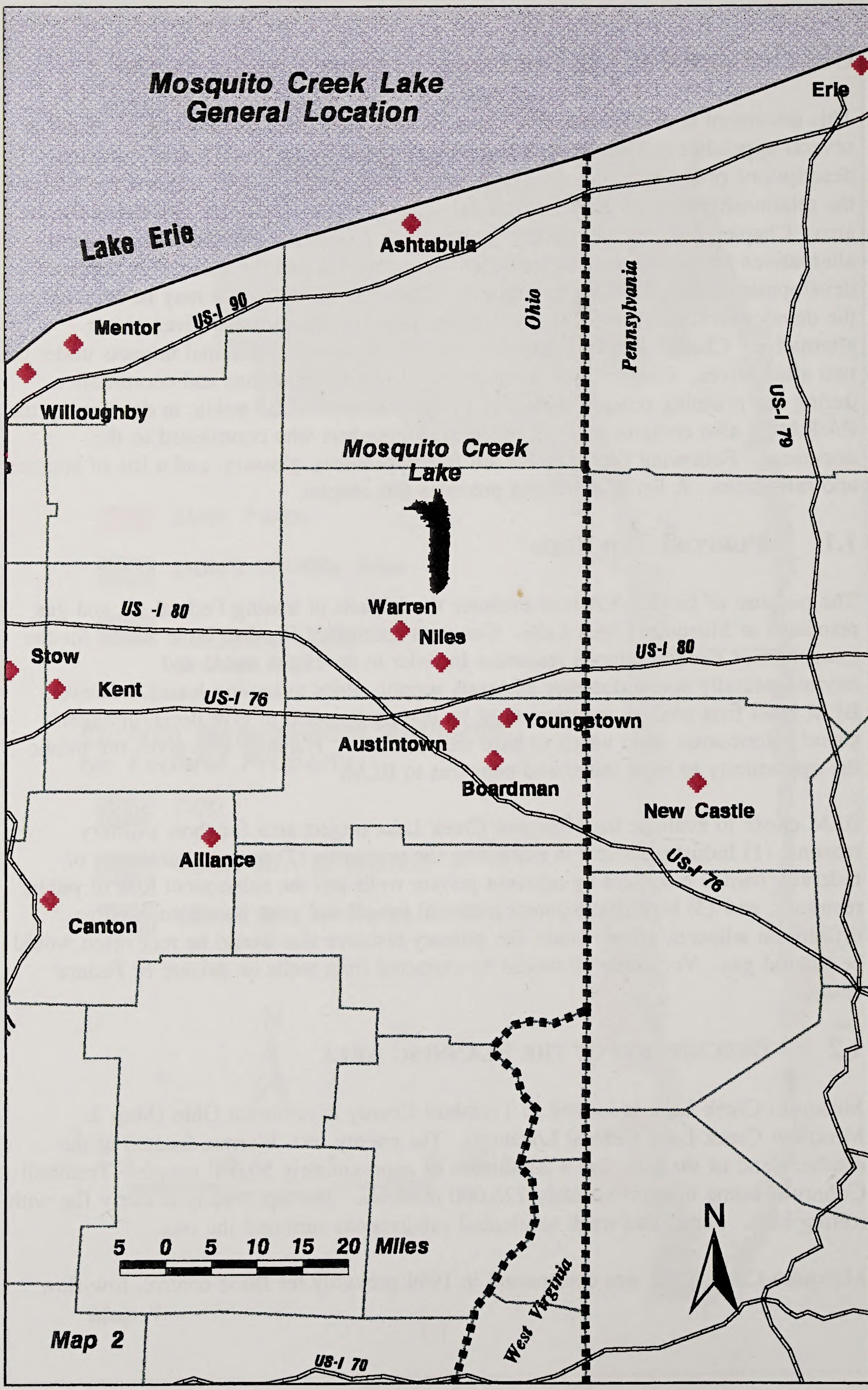
The purpose of this PA/EA is to evaluate the impacts of leasing Federal oil and gas resources at Mosquito Creek Lake. Congress authorized BLM to issue leases for the extraction of Federal mineral resources in order to develop a stable and environmentally sound domestic minerals supply. Prior to issuing leases, however, BLM must first analyze the impacts of its leasing proposal to give decisionmakers sound information upon which to base their decision. Planning also gives the public the opportunity to raise issues and concerns to BLM.

BLM chose to evaluate the Mosquito Creek Lake project area for three primary reasons: (1) industry interest in extracting the resources; (2) potential drainage of federally owned resources by adjacent private wells and the subsequent loss of public revenues; and (3) high development potential for oil and gas. Based on existing drilling on adjacent private lands, the primary resource that would be recovered would be natural gas. Very little oil would be extracted from wells on private or Federal leases.

1.2 Description of the Planning Area

Mosquito Creek Lake is located in Trumbull County in northeast Ohio (Map 2, Mosquito Creek Lake General Location). The county seat, Warren, located at the southern end of the lake, has a population of approximately 50,000 people. Trumbull County is home to approximately 225,000 residents. The topography is fairly flat with rolling hills. Farms and small residential subdivisions surround the lake.

Mosquito Creek Lake was constructed in 1944 primarily for flood control, low-flow


Mosquito Creek Lake
General Location
Lake Erie
Erie
Ashtabula
Mentor
US-I 90
Willoughby
Ohio
Pennsylvania
US-I 79
Mosquito Creek
Lake
US -I 80
Warren
Niles
US-I 80
Stow
Kent
US-I 76
Youngstown
Austintown
Boardman
New Castle
Alliance
US-I 76
Canton
N
5 0 5 10 15 20 Miles
West Virginia
Map 2
US-I 70

augmentation, municipal water supply, and water quality control. The project also provides other benefits and uses, such as land conservation and fish and wildlife preservation. The earthen dam at the south end of the lake impounds Mosquito Creek and controls a drainage area of 97.4 square miles. The City of Warren obtains its drinking water directly from the waters of the lake. The City of Cortland is served by municipal water wells which are drilled into aquifers that are recharged partly by waters from the lake.

The lake and most of its surrounding surface lands are leased or licensed by COE to the Ohio Department of Natural Resources (ODNR) for parks, recreation and wildlife purposes. COE manages approximately 176 acres at the south end of Mosquito Creek Lake near the dam and administration area.

For the purposes of analysis, the planning area is defined as all of the COE's land, the LLSD tract and land up to one-half mile from the boundaries of these tracts. The one-half mile buffer around the administrative boundary of the project area was chosen as a reasonable estimate of the extent of direct impacts that could occur from potential well locations given current directional drilling technology and existing land use. By setting this buffer, the planning team was able to focus its data collection efforts. Resource values were analyzed within a larger context or geographic area when appropriate.

1.3 Planning Process

This PA/EA has been prepared under the authority of Section 202 of Federal Land Policy and Management Act (FLPMA) (43 U.S.C. 1711-1712) and the National Environmental Policy Act (NEPA) (42 U.S.C. 4321, *et seq.*) by an interdisciplinary team of resource specialists (see Chapter Five, List of Preparers). The document has been developed following procedures approved by the BLM, Eastern States Office, State Director (Manual Section 1611.2, Guidance for Resource Management Planning). The general process is described below:

- Notify the public
  - Public scoping
- Conduct the analysis
  - Identify issues
  - Collect and analyze information
  - Formulate management alternatives
  - Estimate effects of management alternatives
- Document the analysis
  - Prepare Draft PA/EA
  - 60-day public review/Governor consistency review
- Make decision
  - Prepare Proposed PA/EA

30-day protest period
Resolve protests, if applicable
Prepare Approved PA/Decision Record

1.4 Issues Selected for Analysis

The management alternatives outlined in this PA/EA are based upon issues that were identified during the initial public scoping phase of the planning effort. These issues have guided BLM's data gathering for analyzing the impacts of developing Federal resources. A description of public involvement is found in Chapter Five, Consultation and Coordination.

In developing issues to be analyzed in the PA/EA, BLM and the COE acknowledged the concern raised by certain members of the public that oil and gas leasing and development may lead to psychological distress. This concern was echoed by the authors of the Youngstown State University study (Peterson, et al., 1997). Several members of the public stated that the impacts from increased oil and gas activity were unknowable or that catastrophic events may occur which might result in the loss of the lake as a public water source for a period of time. Individually, these concerns have been addressed and mitigation measures have been identified to minimize or avoid potential impacts.

The psychological impact of oil and gas development, however, was not specifically addressed because it was determined to be outside the scope of an analysis prepared under NEPA. This finding has been supported by the U.S. Supreme Court in *Metropolitan Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766 (1983). In that case, the Court ruled that NEPA does not require agencies "to consider psychological effects of the existence of a risk before the risk had materialized" (Tabb and Malone 1992, p. 288). The Court ruled that "fear arising from a risk of a nuclear accident (in that case, the reopening of the Three Mile Island reactor) did not constitute an "effect" requiring consideration under NEPA" (ibid.) Given this ruling, BLM did not evaluate the psychological fear of leasing and development of Federal oil and gas resources, but rather concentrated its efforts on analyzing the environmental impacts as required by NEPA.

The following eight issues were identified and addressed in alternative development and impact assessment:

Issue #1 - Water Quality: Oil and gas leasing and subsequent operations may affect surface and groundwater quality in the watersheds of Mosquito Creek Lake. Decisions will be made to address the following questions:

- How will the quality of the municipal drinking water supplies be maintained?
- How will existing groundwater quality and quantity be maintained?

- How will quality outdoor recreational experiences be maintained?

ISSUE #2 - AESTHETICS: Oil and gas leasing and subsequent operations may influence the aesthetic qualities of Mosquito Creek Lake area for residents and users. Decisions will be made to address the following questions:

- How will the scenic qualities of Mosquito Creek Lake be managed and maintained?
- How will noise levels be minimized?
- How will odors be minimized?

ISSUE #3 - WETLANDS: Oil and gas leasing and subsequent operations may affect wetland and associated resources. Decisions will be made to address the following questions:

- How will wetland hydrologic and biological functions be protected?
- How will waterfowl habitat be protected?

ISSUE #4 - SPECIAL STATUS SPECIES: There are known Special Status Species in the Mosquito Creek Lake planning area. Decisions will be made to address the following question:

- How will Special Status Species and their suitable habitat be protected?

ISSUE #5 - RECREATION: Oil and gas leasing and subsequent operations may have impacts on outdoor recreation opportunities available on the Mosquito Creek Lake project area. Decisions will be made to address the following questions:

- How may impacts to recreational users and facilities be minimized?
- How might duck hunting occur concurrently with oil and gas operations?
- How will recreational fishing opportunities be maintained?

ISSUE #6 - CULTURAL/HISTORIC, NATIVE AMERICAN RESOURCES: Oil and gas leasing and subsequent operations may affect historic, archaeological and traditional cultural properties. Decisions will be made to address the following questions:

- How will National Register of Historic Places (NRHP) eligible resources be identified, evaluated and appropriately treated?
- How will non-NRHP eligible resources be identified, evaluated and appropriately treated?

ISSUE #7 - HEALTH AND SAFETY: Oil and gas leasing and subsequent operations may create health and safety concerns for recreational users and residents in the immediate Mosquito Creek Lake area. Decisions will be made to address the *following question:*

- What actions may be taken to ensure safe operations?

ISSUE #8 - LIABILITY: Oil and gas leasing and subsequent drilling, production and plugging operations may pose a liability problem if operators do not properly drill and maintain wells/facilities through a well's productive life or do not properly abandon wells/facilities at the time oil and gas resources are depleted. Decisions will be made to address the following question:

- How will BLM ensure that wells and other facilities are operated in a manner that minimizes environmental, economic, or public health and safety risk during the life of the wells and after they are plugged and abandoned?

Two issues were identified as being beyond the scope of the document. Although these issues are addressed in this document and potential impacts are described, there are no special mitigation measures developed specifically to address these issues. These two issues are:

ECONOMIC CONCERNS - Oil and gas leasing and subsequent operations may affect property values in the Mosquito Creek Lake planning area.

Analysis of property values during the past ten years indicates that values have not declined despite increased oil and gas development in the area. In fact, property values in Bazetta Township, where most existing oil and gas development is concentrated, have risen higher than Mecca or Greene Townships.

ROADS - Traffic associated with oil and gas operations may impact roads in the Mosquito Creek Lake planning area.

Additional passenger and commercial vehicles would utilize local roads as a result of either alternative. Under both alternatives traffic levels (as estimated at intersection of State Route 305 and Hoagland Blackstub Road) would increase less than one percent during the drilling and production phases. It is anticipated that this figure overestimates the actual increases in traffic, since it is likely that some vehicles would travel to existing private and newly permitted facilities on concurrent trips. Regulation of commercial vehicles is administered by the State and county.

1.5 Relationship to Other Plans, Programs and Policies

Existing Land Use Planning Decisions

There is no existing BLM plan that covers the Mosquito Creek Lake project area. Thus, any decision to lease Federal oil and gas resources in the region will be based upon the analysis found in this document.

The following documents represent existing COE planning direction for the project area:

> Mosquito Creek Lake Master Plan, Design Memorandum No. 1, U.S. Army Corps of Engineers, July 1993
>
> Forest, Fish & Wildlife Management Plan, Appendices B and D to the Master Plan, U.S. Army Corps of Engineers, Fahringer McCarty Grey Inc., September 1978
>
> Lakeshore Management Plan, Part II.7.A of the Operational Management Plan, U.S. Army Corps of Engineers, April 1987 (to be revised as Shoreline Management Plan, April, 1998)

Based on an examination of these plans, COE advised BLM that, in order to protect project purposes and the public interest and maintain consistency with these plans, it would not allow surface occupancy on the Federal lands (Massey, 1997).

Existing COE planning decisions will not be modified as a result of this PA/EA. Decisions reached through this analysis process will be made within the context of existing goals and objectives, management prescriptions, land use allocations, and land use or projected land use.

The LLSD tract (32.46 acres) is used in its entirety at some time throughout the year as an environmental land laboratory. The educational value of this land centers around its opportunity to provide learning in its current natural state. In addition, the LLSD, which is the surface owner, has advised BLM that the land may be used as a future site for construction of a school building and has requested that occupancy not be permitted for this tract. Disruption of the area for oil and gas activities, even for short periods of time, are in direct conflict with the existing and future primary land uses of the area. In light of the potential resource conflicts, it is reasonable to not allow surface occupancy of the tract.

Surface Owner Rights

Management of Federal oil and gas resources developed from wells located on private lands is somewhat different from management on lands where both surface and mineral ownership are Federal. The BLM does not have the legal authority to regulate how private surface is managed by the surface owner. However, for wells which produce Federal oil and gas through either a Federal drilling permit (Application for Permit to Drill, APD) or Federal agreement (Compensatory Royalty Agreement or Communitization Agreement), the BLM does have the authority to require measures to avoid or minimize adverse impacts that may result from federally authorized activities, i.e. approving the Federal drilling permit or agreement. These measures are intended to protect or preserve the privately owned surface resources and prevent adverse impacts to adjoining lands, not to dictate management by the surface owner. Use of these mitigating measures allows for the management of Federal oil and gas resources while protecting other resources and land uses. If the surface owner does not agree with the recommended mitigating measures, or impacts cannot be lessened or eliminated, the BLM can ultimately deny a drilling permit or deny approval of a Federal agreement.

FEDERAL/STATE POLICIES

BLM Minerals Policy

The *Mining and Minerals Policy Act of 1970* sets forth Federal policy for the development and management of mineral resources owned by the United States (30 U.S.C. 21a). This policy was reiterated by Congress in 1976 by Section 102(a)(12) of FLPMA (90 Stat. 2745). These laws stated that it is the Federal government's policy to develop an economically sound and stable domestic minerals industry through the orderly and economic development of its domestic mineral resources. The BLM was given the responsibility to implement these policies by making available mineral resources owned by the Federal government. BLM mineral resources policy states specifically that "except for Congressional withdrawals, public lands shall remain open and available for mineral exploration and development unless withdrawal or other administrative action is clearly justified in the national interest" (Policy Statement, BLM Director, December 1, 1982).

Department of the Army Oil and Gas Leasing Policy

Department of the Army oil and gas leasing policy states that "in accordance with Department of Defense policy to promote the optimal use of its lands under the multiple-use principle, it is the policy of the Department of the Army that all lands under its control will be made available for oil and gas leasing, except at installations or civil works projects specifically excluded from such leasing upon the recommendation of the Chief of Staff or Chief of Engineers, respectively, and approval by the Secretary of the Army." (Letter from Secretary of the Army to Secretary of the Interior, April 10, 1987)

Corps of Engineers' Goal Statement

The Corps of Engineers is the Federal steward of the lands and waters at Mosquito

Creek Lake. Its natural resources management mission is to manage and conserve those natural resources, consistent with ecosystem management principles, while providing quality public outdoor recreation experiences to serve the needs of present and future generations. In all aspects of natural and cultural resources management, the Corps of Engineers is responsible to promote an awareness of environmental values and ensure adherence to sound environmental stewardship, protection, compliance, and restoration practices. The Corps of Engineers manages for long-term public access to, and use of the natural resources at Mosquito Creek Lake in cooperation with other Federal, State, and local agencies as well as the private sector. Particularly, in cooperation with the State of Ohio, it integrates the management of diverse natural resource components such as fish, wildlife, forests, woodlands, soil, air, and water with the provision of public recreation opportunities that contribute to the quality of American life. (Goga, 1998)

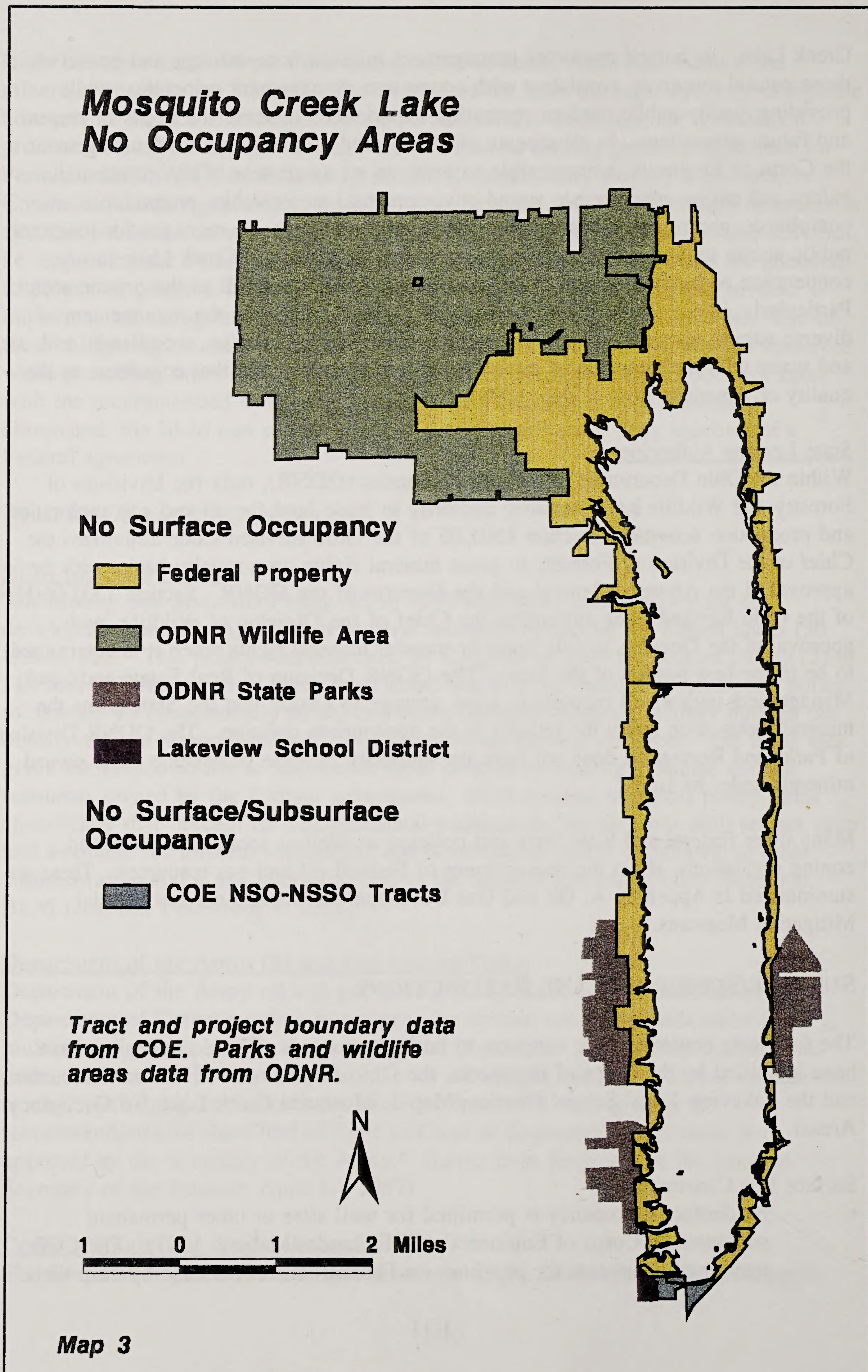
State Leasing Authorities
Within the Ohio Department of Natural Resources (ODNR), only the Divisions of Forestry and Wildlife have statutory authority to lease land for oil and gas exploration and production activities. Section 1501.05 of the Ohio Revised Code authorizes the Chief of the Division of Forestry to grant mineral rights on a royalty basis, with the approval of the Attorney General and the Director of the ODNR. Section 1531.06(H) of the Ohio Revised Code authorizes the Chief of the Division of Wildlife, with approval of the Director, to sell, lease or transfer mineral rights when it is determined to be in the best interest of the State. The ODNR Division of Real Estate and Land Management reviews all requests to lease acreage to ensure that the State owns the mineral rights, then refers the request to the appropriate division. The ODNR Division of Parks and Recreation does not have the authority to lease or develop State owned minerals under its lands.

Many other Federal and State laws and policies, as well as local ordinances and zoning regulations, affect the management of Federal oil and gas resources. These are summarized in Appendix A, Oil and Gas Development Constraints and Special Mitigation Measures.

Surface/Subsurface Use Restrictions

The following constraints are common to both alternatives. These constraints have been identified by the Corps of Engineers, the Ohio Department of Natural Resources, and the Lakeview Local School District (Map 3, Mosquito Creek Lake No Occupancy Areas).

Surface Use Constraints:
- No Surface Occupancy is permitted for well sites or other permanent structures on Corps of Engineers' (COE) lands (Massey, 1997). The COE may grant easements for pipelines on Federal lands on a case-by-case basis.


Mosquito Creek Lake
No Occupancy Areas
No Surface Occupancy
Federal Property
ODNR Wildlife Area
ODNR State Parks
Lakeview School District
No Surface/Subsurface Occupancy
COE NSO-NSSO Tracts
Tract and project boundary data from COE. Parks and wildlife areas data from ODNR.
N
1 0 1 2 Miles
Map 3

- Ohio Department of Natural Resources (ODNR) will not permit occupancy for well sites, other permanent structures, or pipelines in the State Park or Wildlife Area (West, 1997 and Grahl, 1997).
- No Surface Occupancy is permitted for well sites or other permanent structures on the Lakeview Local School District property (Raidel, 1996).

Subsurface Use Constraints:
- No Subsurface Occupancy is permitted on two COE tracts near the dam (A-146 and A-138 west of the intersection of Warren-Meadville Road and State Route 305) (Purdy, 1996).
- The ODNR Division of Parks and Recreation has no authority to develop State owned minerals. Therefore, the State spacing setback of 500 feet would apply and the bottomhole location of wells would be at least 500 feet away from the State property line (West, 1997).
- The ODNR Division of Parks and Recreation may grant easements for directional drilling through State owned minerals on a case-by-case basis (West, 1997).

1.6 RESOURCE OBJECTIVES

Resource objectives were developed to address specific issues or concerns as outlined on page 1-4. Management actions developed through this planning process strive to meet the outlined resource objectives. These specific objectives, as they relate to oil and gas leasing and development, are to:

- Maintain existing surface and groundwater quality in the Mosquito Creek Lake watersheds.
- Maintain or minimize the impacts to the aesthetic values present at the Mosquito Creek Lake area.
- Sustain and/or improve current safety levels for recreational users and residents.
- Maintain and/or enhance wetland values in the Mosquito Creek Lake watersheds.
- Maintain and/or enhance the historical, archaeological, and traditional cultural resource values.
- Maintain and/or enhance special status species populations and suitable habitat.
- Maintain current outdoor recreational opportunities and facilities and minimize impacts to future opportunities and facilities.

In some instances, BLM has not identified a specific objective to protect a particular resource value, but has instead relied on existing laws and regulations that serve the same purpose. These will be noted in the PA/EA where applicable.

- Ohio Department of Natural Resources (ODNR) will not permit occupancy for well sites, other permanent structures, or pipelines at the State Park or Wildlife Area (West, 1997 and [illegible], 1997).
- No Surface Occupancy is permitted for well sites or other permanent structures on the Lakeview Local School District property (Rankel, 1996).

Subsurface Use [illegible]
- No Subsurface [illegible] tracts near the dam (A-145, [illegible] Road and State Route [illegible]).
- The ODNR [illegible] authority to develop State owned [illegible] setback of 500 feet would apply and [illegible] be at least 500 feet away from the State property [illegible].
- The ODNR Division [illegible] Recreation may grant easements for directional drilling [illegible] State owned minerals on a case-by-case basis (West, 1997).

1.6 RESOURCE OBJECTIVES

Resource objectives were developed to address specific issues or concerns as outlined on page 1-4. Management actions developed through this planning process strive to meet the outlined resource objectives. These specific objectives, as they relate to oil and gas leasing and development, are to:

- Maintain existing surface and groundwater quality in the Mosquito Creek Lake watershed.
- Maintain or minimize the impacts to the aesthetic values [illegible] the Mosquito Creek Lake area.
- Sustain and/or improve current safety levels for recreational users and residents.
- Maintain and/or enhance wetland values in the Mosquito Creek Lake watershed.
- Maintain and/or enhance the historical, archaeological, and traditional cultural resource values.
- Maintain and/or enhance special status species and designated wildlife habitat.
- Maintain current outdoor recreational opportunities and facilities and minimize impacts to future opportunities and facilities.

In some instances, [illegible] has not identified a specific objective to protect a particular resource value, but has instead relied on existing laws and regulations that serve the same purpose. [illegible] will be noted in the PA/EA where applicable.

Chapter Two - Alternatives

The alternatives have been selected to provide a range of management options to resolve resource conflicts associated with the identified issues. The range of alternatives is limited, however, by the fact that COE has stipulated that wells cannot be located on its lands. This stipulation effectively means that any wells drilled will be located on adjacent private lands.

Two alternatives will be considered for analysis in this document. They are:

- Alternative A: No Action/No Lease
- Alternative B: Lease with No Surface Occupancy

This document identifies Alternative B as the preferred alternative. This alternative reflects the agency's proposed action, that of leasing the Federal oil and gas resources at Mosquito Creek Lake. Following public review and comment, it is possible that BLM may choose a hybrid of Alternative A and B to arrive at its preferred alternative at the conclusion of this planning process. That is, certain areas considered for leasing under Alternative B may be designated for no leasing in order to protect sensitive resource values.

2.1 Alternative A: No Action/No Lease

Under Alternative A, no Federal leases would be issued at the Mosquito Creek Lake project area, i.e. no Federal wells would be drilled to extract Federal oil and gas. However, under this alternative, some of the Federal oil and gas could be developed by "pooling" the unleased Federal minerals with private minerals through a Federal agreement called a Compensatory Royalty Agreement (CRA). Federal agreements allow a portion of the Federal oil and gas resources to be developed through private wells. The Federal government would collect revenues from the portion of Federal oil and gas being produced.

It is predicted that up to 14 private wells may be drilled from 14 well pads even if no Federal leasing occurs. Operators will continue to develop untapped oil and gas resources in the vicinity of Mosquito Creek Lake by drilling private wells adjacent to the Federal property.

Under State spacing regulations, an operator must maintain a bottomhole location which is 500 feet from a property owner who is not participating in the drilling unit. This means that if the Federal acreage is not included in a Federal agreement, the bottomhole location of any private wells drilled would be greater than 500 feet from the Federal property line. BLM would have no control over these private wells. If the operator would like to drill closer than 500 feet from the Federal property line and include unleased Federal oil and gas in a drilling unit, he/she must demonstrate to the State that he/she has a right to develop these minerals. This can be done through an approved Federal agreement from BLM. Without this agreement, the State will not grant a variance to the spacing setback and the wells must be drilled at a distance greater than 500 feet from the COE property.

When an application for a Federal agreement is received, BLM would request the operator to provide information relating to proposed surface disturbing activities and a site specific environmental analysis would be completed, if necessary, to identify potential measures to lessen or eliminate anticipated impacts resulting from well construction/production related activities (see Section 2.4 for details on processing agreements). Although BLM does not have permitting authority for private wells, BLM can attach protection measures to the Federal agreement. If the operator does not agree with these terms, BLM could deny the agreement and not participate in the drilling unit. This would mean that the well could not be drilled in the proposed location. The bottomhole location of the well would have to be greater than 500 feet from the Federal property line and BLM would have no control over the well.

2.2 ALTERNATIVE B: LEASE WITH "NO SURFACE OCCUPANCY" STIPULATION (PREFERRED ALTERNATIVE)

Under Alternative B, Federal leases would be issued with a No Surface Occupancy restriction, i.e. no well sites or other permanent facilities would be permitted on Federal lands. Leased Federal oil and gas resources would be developed through either: (1) directionally drilled Federal wells located on private lands adjacent to the State/COE property, or (2) pooling Federal minerals with private minerals through a Federal agreement called a "Communitization Agreement" (CA). It is anticipated that the 14 private wells projected under Alternative A would be included in Federal agreements. In addition, it is projected that 27 federally permitted wells would be directionally drilled from adjacent private land. These 41 wells would be developed from 24 well pads located on adjacent private land.

Wells that are proposed on adjacent private lands that bottomhole in Federal minerals would be approved and permitted through the BLM's Application for Permit to Drill (APD) process. Site specific environmental analysis would be done at the time a well is proposed and measures would be identified to lessen or eliminate impacts resulting from well construction/production related activities. Conditions of approval would be developed through this site specific analysis process and would be attached to the Federal drilling permit.

Leased Federal acreage may also be developed through the approval of Federal agreements. Federal acreage included in an approved agreement could be developed through either private or federally permitted wells. At the time an application for a Federal agreement is received, the operator would be asked to provide information relating to proposed surface disturbing activities and a site specific environmental analysis would be completed, if necessary, to identify potential measures to lessen or eliminate anticipated impacts. In the case of a private well, BLM does not have permitting authority. However, BLM would attach protection measures to the Federal agreement. For a federally permitted well, BLM would attach conditions of approval to the Federal drilling permit. If the operator does not agree with these conditions, BLM could deny the agreement or drilling permit.

2.3 Alternatives Considered But Eliminated From Detailed Analysis

In August of 1996, the BLM, COE, and ODNR met to develop a set of draft alternatives for analysis. These draft alternatives were identified as:

- Alternative 1: Lease with existing regulations and standard protection measures;
- Alternative 2: Lease with existing regulations, standard protection measures and special resource protection measures (to be developed through the PA/EA process);
- Alternative 3: Lease with some "no lease" areas (certain portions of the Mosquito Creek Lake project area would not be leased); and,
- Alternative 4: No Action (no leases would be issued).

In May of 1997, COE determined that, in order to protect project purposes and the public interest and maintain consistency with the approved project management plans, it would not allow surface occupancy for oil and gas operations on Federal lands. This decision eliminated Alternatives 1, 2 and 3 as described above from detailed analysis.

2.4 Compensatory Royalty Agreements/Communitization Agreements (Federal Agreements)

Throughout this document reference is made to BLM's review procedures under the National Environmental Policy Act (NEPA) with regard to approving Federal agreements. In general, these agreements are considered administrative actions that are normally excluded from the requirement for an environmental analysis. However, BLM must review a proposed agreement to determine if an environmental assessment (EA) is necessary. BLM's review would be limited to activities within the boundaries of the Federal agreement. In the review process, BLM would evaluate the proposed agreement against ten environmental criteria to determine if any criteria are met. These criteria are:

- significant adverse effects on public health and safety;
- adverse effects on unique geographic characteristics;

- highly controversial environmental effects;
- highly uncertain or potentially significant effects;
- establish a precedent for future actions;
- individually insignificant, but cumulatively significant;
- adverse effects on properties listed or eligible for the National Register of Historic Places;
- adverse effects on threatened or endangered species or critical habitat;
- require compliance with Executive Order (E.O.) 11988, Floodplain Management and E.O. 11990, Protection of Wetlands, or the Fish and Wildlife Coordination Act; or
- threaten to violate a Federal, State, local or tribal law or requirement.

If any of these criteria are met, an EA would be completed. BLM would coordinate the review and any resulting EA with the COE, the private surface owner, and other State and Federal agencies, as appropriate. This site specific assessment would address potential impacts from the drilling/production activities within the Federal agreement. Special mitigation measures identified through the analysis would be attached as terms of agreement.

2.5 Reasonably Foreseeable Development Scenario

The Reasonably Foreseeable Development Scenario (RFDS) is a projection of the probable oil and gas exploration, development, and related activities that would occur within the planning area for each alternative. The projections are based on credible geologic, reservoir engineering, and oil and gas production information. The projections take into account existing regulatory, technical, and geographic limitations applied to oil and gas exploration and development at Mosquito Creek Lake. The primary limitation is that no surface occupancy may occur on any of the lands proposed for leasing.

The RFDS must address oil and gas resource potential, but for the most part addresses the development potential within the planning area (a more detailed RFDS can be found in Appendix B). The projected development outlined in the RFDS establishes a baseline upon which to compare impacts of oil and gas related activity between the two alternatives.

The following table shows the total number of projected wells (private and federally permitted), well pads, and acres disturbed/reclaimed by each alternative.

Table 2-1. Summary of Potential Development under Alternatives A and B

Summary of Projected Number of Wells/Well Pads	Alternative A (No Leasing)	Alternative B (Lease with No Surface Occupancy)
Private Wells	14	14
Federally permitted Wells	0	27
Well Pads	14 (new pads)	24 (6 existing pads, 14 pads from Alt. A, 4 new pads)
Total Acres Disturbed/Reclaimed[1]	62/55	77/65

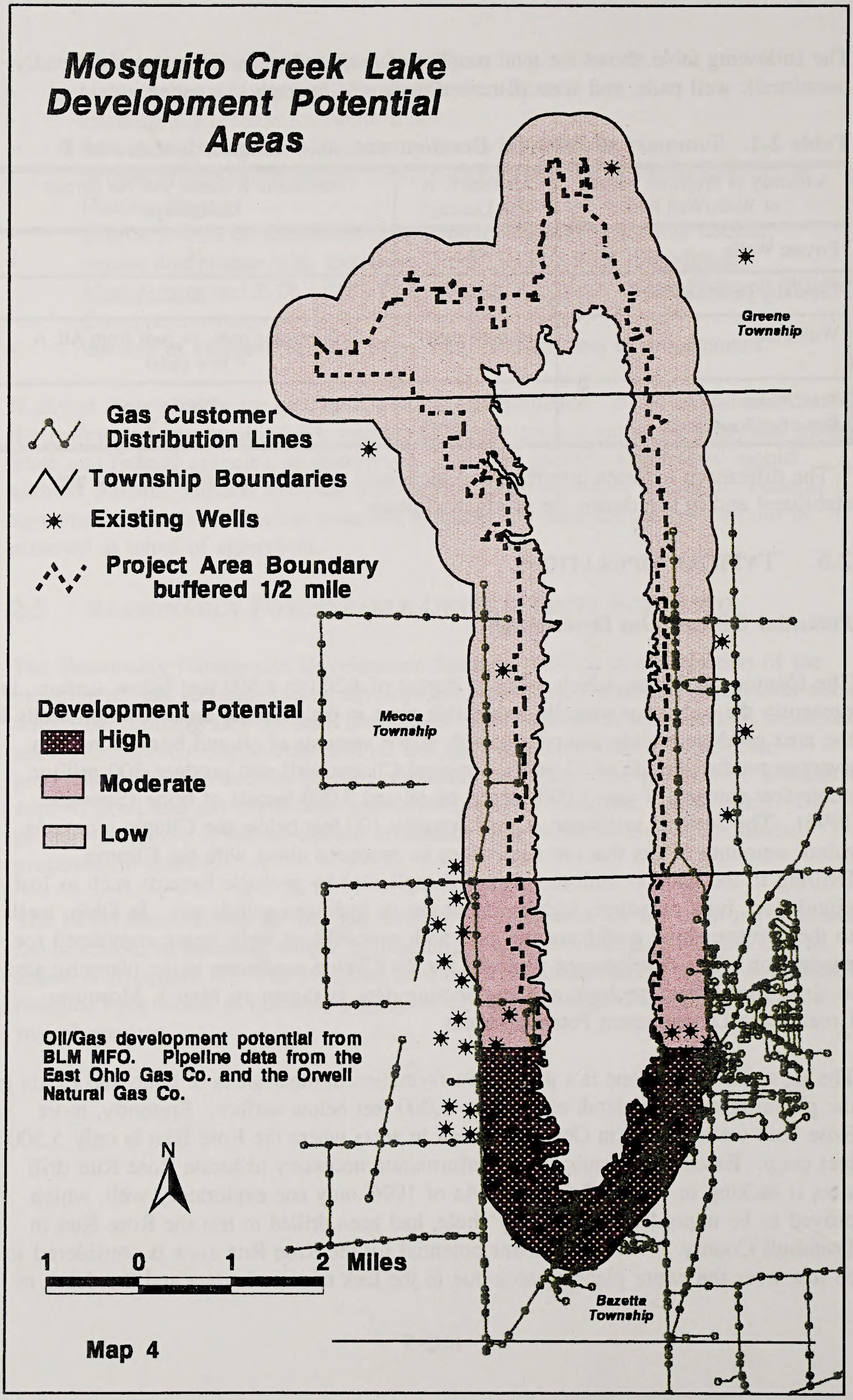
1/ The difference between disturbed and reclaimed acres represents acres that are stabilized and in use during the production phase.

2.6 Typical Operations

Potential Oil and Gas Development

The Clinton sandstone, which exists at depths of 4,200 to 4,500 feet below surface, is presently the only economically producible zone in the planning area. Clinton wells in the area produce mainly natural gas with minor amounts of oil and brine. Over an average productive life of 25 years, a typical Clinton well will produce 300 million cubic feet (mmcf) of gas, 1,000 barrels of oil and 3,000 barrels of brine (Stewart, 1996). The Medina sandstone, a zone roughly 100 feet below the Clinton, contains minor amounts of gas that can sometimes be produced along with the Clinton. Drilling to the Clinton sandstone is not complicated by geologic hazards such as lost circulation, high pressures, high temperatures or hydrogen sulfide gas. In Ohio, wells to the Clinton enjoy a high success rate with over 90% of wells being completed for production. The development potential for the Clinton sandstone in the planning area as determined from geologic and engineering data, is shown on Map 4, Mosquito Creek Lake Development Potential Areas.

The Rose Run sandstone is a productive formation in other areas of Ohio and exists in the planning area at a depth of 6,800 to 7,000 feet below surface. Presently, most Rose Run wells drilled in Ohio have been in areas where the Rose Run is only 5,500 feet deep. Extensive seismic survey information necessary to locate Rose Run drill sites is lacking in Trumbull County. As of 1996, only one exploratory well, which proved to be unproductive or a "dry" hole, had been drilled to test the Rose Run in Trumbull County. The development potential for the Rose Run zone is considered to be low over the entire planning area due to the lack of seismic data and the depth of


Mosquito Creek Lake
Development Potential
Areas
Gas Customer
Distribution Lines
Township Boundaries
Existing Wells
Project Area Boundary
buffered 1/2 mile
Development Potential
High
Moderate
Low
Greene
Township
Mecca
Township
Bazetta
Township
Oil/Gas development potential from BLM MFO. Pipeline data from the East Ohio Gas Co. and the Orwell Natural Gas Co.
N
1 0 1 2 Miles
Map 4

the formation. BLM expects that if the Rose Run were to be tested in the planning area, exploratory wells would be drilled on adjacent private minerals.

Typical Oil and Gas Operations Summary

While operations may vary depending on site conditions and other factors, development of Clinton wells follows a typical pattern. The following section describes the phases used to develop wells from initial construction through plugging and abandonment. A detailed explanation can be found in Appendix B.

Initially, heavy earth moving equipment is used to build the access road and well pad. Topsoil is stockpiled for use in reclaiming areas not needed during the production phase. For access roads, a 30 foot wide area is disturbed to prepare a final road width of 15 feet. For the well pad, an area 210 feet by 210 feet (one acre) is leveled for a single well. A Rose Run well pad or a well pad hosting multiple Clinton wells is about 260 feet by 260 feet (1.6 acres) in size.

A Clinton well requires two pits to be dug on the cleared pad, one 40 feet wide by 60 feet long by 6 feet deep and the other 15 feet wide by 60 feet long by 6 feet deep. Rose Run wells or pads with multiple wells would require about double the pit area. Material excavated from the pits during construction is stockpiled on-site to backfill the pits when drilling is finished.

The diesel powered rotary drilling rig, associated equipment, and supplies are brought to the well pad by large trucks. During drilling, the mast of the rig extends from 80 to 100 feet in height. Since drilling is a continuous operation until the total depth of the well is reached, the lights and engine noise from the rig are evident throughout the day and night.

Drilling operations require a fluid, e.g., freshwater, compressed air or drilling mud, to carry rock cuttings out of the wellbore to the surface pits. In the uppermost section of the wellbore, either freshwater or a mixture of bentonite clay and freshwater is used as the drilling fluid. For this purpose and other rig operations, from 2,000 to 10,000 gallons of water is trucked in and stored in tanks or in the pits. After drilling through all freshwater aquifers, the drilling fluid is switched to compressed air for the remainder of the drilling operation.

When the hole is drilled 50 feet to 100 feet below the bottom of the deepest freshwater aquifer, drilling temporarily stops and a thick walled steel pipe called casing is lowered into the well. Cement is pumped down through the wellbore and around to the outside of the casing to completely seal the space between the casing and the wellbore. Casing stabilizes the wellbore and protects groundwater from contamination. This first string of casing also provides an anchor for the blowout prevention equipment, which helps prevent the well from flowing out of control.

After the casing is set, drilling resumes and the hole is drilled to the producing zone. At various times throughout drilling, tests evaluate the productive potential of the well. Gas produced during testing is vented or flared into the surface pit. Brine produced during tests would be stored in tanks and properly disposed of. Any oil would be stored at the tank battery until there is a sufficient quantity to sell. If the tests confirm the well's productivity, another string of casing is set to extend from the producing zone to the surface.

If leasing occurs, wells drilled to develop Federal leases will be located entirely on adjacent private lands. These wells will include both private vertical wells and federally permitted directional wells. For directional wells, the location of the bottom of the wellbore would be horizontally off-set from its surface location. Special equipment gradually turns the wellbore to reach the drilling "target." Directional wells require ten days of continuous drilling to reach the target as opposed to five days for a vertical well.

The well completion phase follows drilling and prepares the well to produce. A smaller truck mounted rig and other specialized truck mounted equipment is used on the site at various times throughout the well completion phase. Small diameter pipe called tubing, through which the gas, oil and brine flow to the surface, is placed in the wellbore. Holes are made in the production casing with a specialized tool to access the producing zone. Pressurized fluids are pumped into the producing zone to create fractures in the rock to allow hydrocarbons to more easily flow into the well. Lastly, a wellhead, consisting of valves, fittings and gages, is installed to control the well at the surface. Producing wells will likely bring liquids to the surface by a system that has no visible moving parts at the surface.

Equipment called a tank battery, is necessary to separate, store, and measure produced fluids. A tank battery requires an area 2 feet by 50 feet for a single well or 50 feet by 100 feet for multiple wells. An earthen berm is constructed around the perimeter of the battery to contain possible leaks, spills or tank overflows. A typical tank battery for a single well contains a separator, a 100 barrel oil storage tank, a 50 barrel brine storage tank, and a gas meter. Tank batteries may be located either directly on the well pad or remotely located next to an all weather road.

Well fluids are transported from the wellhead to the tank battery by a buried pipeline. Another buried pipeline is constructed to carry natural gas from the tank battery to the closest distribution line to customers. Tanker truck trips would make regular trips to the tank battery to collect oil for sale and brine for disposal.

Production could eventually reduce pressure in the producing formation to the point that compressors would have to be installed to maximize recovery of natural gas. A typical compressor, positioned on a pad about 16 feet by 24 feet in size, is powered by an internal combustion engine using natural gas produced from the well. The compressor would run continuously. At this time, it is not possible to determine the exact number and locations of gas compressors. However, the likeliest locations would be where the gathering lines tie into the main gas distribution lines.

After the well is completed, surface areas not used for production are rehabilitated. Topsoil is graded, seeded, fertilized and mulched. Areas not reclaimed but stabilized would include the access road, a 16 feet square area around the wellhead and a turnaround area at the wellhead. Every three to five years during the life of the well, a truck mounted rig may be needed to perform routine well servicing operations in order to maintain or improve production. Servicing operations would not require any additional surface disturbance.

If a well is not productive, the wellbore would be plugged with cement and all disturbed surface areas would be revegetated. For a producing well that is depleted, in addition to plugging, flowlines and surface equipment would be removed prior to surface restoration.

compressor would run continuously, and this noise would be audible [illegible] of gas compressors. However, the [illegible] would [illegible]

After the [illegible], surface areas not needed for production [illegible] Topsoil is graded, seeded, [illegible] and [illegible]. Areas not reclaimed [illegible] would include the access road, a 10 feet square area around the wellhead [illegible] turnaround area at the wellhead. Every three to five years during the life of the well, a truck mounted rig [illegible] in order to [illegible] would [illegible] surface [illegible].

If a well is not productive, the wellbore would be plugged with cement and all disturbed surface areas would be reclaimed. [illegible] In addition to plugging, flowlines and surface equipment would be removed prior to surface restoration.

The well completion phase follows drilling and prepares the well to produce. A smaller truck mounted rig and other specialized work mounted equipment is used on the site at various times throughout the well completion phase. Small diameter pipe, called tubing, through which the gas, oil and water flow to the surface, is placed in the wellbore. Holes are made in the production casing with a specialized tool to access the producing zone. Pressurized fluids are pumped into the producing zone to create fractures in the rock to allow hydrocarbons to more easily flow into the well. Lastly, a wellhead, consisting of valves, fittings and gauges is attached to control the well at the surface. Producing wells will likely bring liquids to the surface by a system that has no visible moving parts at the surface.

Equipment called a tank battery, is necessary to [illegible] fields. A tank battery requires an area [illegible] feet by 50 feet for a single well or 50 feet by 100 feet for multiple wells. An earthen berm [illegible] constructed around the perimeter of the battery to contain possible leaks, spills or [illegible]. A typical tank battery for a single well contains a separator, a 300 barrel oil storage tank, a [illegible] barrel brine storage tank, and a gas meter. Tank batteries may be located either directly on the well pad or remotely located [illegible] all weather road.

Well fluids are transported from the wellhead to the tank battery by a buried pipeline. Another buried pipeline is constructed to carry natural gas from the tank battery to the closest distribution line or customers. Tanker truck [illegible] would make regular trips to the tank battery to collect oil for sale and brine for disposal.

Production could eventually reduce pressure in the producing formation to the point that compressors would have to be installed to maintain recovery of natural gas. A typical compressor, positioned on a pad about 16 feet by 24 feet in size, is powered by an internal combustion engine using natural gas produced from the wells. The

Chapter Three - Affected Environment

Introduction

This chapter provides a description of those portions of the environment that could be affected by the alternatives selected for analysis. It is not a comprehensive review of all environmental resources found in the region, but rather a discussion of only the relevant aspects of the natural and human environments which may be affected by implementing either of the alternatives.

3.1 Climate

The climate of Trumbull County is temperate and humid with fairly wide seasonal fluctuations in temperature. The area is subject to variable frontal activity with alternate polar and tropical air mass invasions. Prevailing winds are from the southwest. Normal monthly temperatures at the Youngstown Airport, which is about six miles southeast of Mosquito Creek Lake dam, range from 27.3° Fahrenheit (F) in January to 70.5° F in July with an average annual temperature of 48.8° F. The average frost-free period is about 150 days. The average annual precipitation at Mosquito Creek Lake is almost 36 inches, with maximum average monthly precipitation of 3.85 inches in June and minimum average of 1.81 inches in February. Summer precipitation is normally associated with thunderstorms, generally confined to small areas and of short duration. From November through April precipitation usually results from low pressure systems passing over the area. In general, the period of heaviest precipitation is May through August when most of the 40 or so yearly thunderstorms occur. Total yearly snowfall averages about 53 inches.

Climatic data for Northeast Ohio provide information on the frequency of certain rainfall events. The National Weather Service rates storm totals by their "return periods," or how often a particular storm might occur.

The following table describes the predicted return periods of various rainfall amounts for 6 hour, 12 hour and 24 hour storm events. However, these examples could occur with greater or lesser frequency.

Table 3-1. Return Periods for Certain Rainfall Events

	Return Periods		
Rainfall Amounts	*6 Hour Storm Totals*	*12 Hour Storm Totals*	*24 Hour Storm Totals*
1.6 inches	every year	every year	every year
2.2 inches			every year
2.7 inches	every 10 years	every 5 years	

	Return Periods		
Rainfall Amounts	*6 Hour Storm Totals*	*12 Hour Storm Totals*	*24 Hour Storm Totals*
3.1 inches	every 25 years	every 10 years	
3.2 inches			every 5 years

Source: National Weather Service.

3.2 Land Use

Introduction

This section describes land use on the Federal property, the Lakeview Local School District (LLSD) property, and adjacent lands. Refer to Map 1, Mosquito Creek Lake Land Management Entities for locations of areas discussed herein.

COE Project

The COE's administrative boundary contains 11,461.11 acres, including 11,180.62 acres held in fee title and 275.69 acres of perpetual flowage easements, which are non-federal property on which the owner granted the COE the right to flood. At the south end of the lake, the COE maintains 176 acres including an administration area, the dam structure and recreation areas. The remaining acreage involves 20 outgrants made by the COE. The largest outgrants are 5,635.5 acres leased to the ODNR, Division of Parks and Recreation for park management and 5,370 acres licensed to the ODNR, Division of Wildlife for fish and wildlife management. Smaller outgrants exist for various uses and facilities.

COE Land Use Planning and Management

The COE has developed several interrelated plans that address management of the multiple uses and resources on Federal lands. The COE Master Plan (1993) for Mosquito Creek Lake developed management units and established resource use objectives. The COE Forest, Fish and Wildlife Management Plan (1978) addressed policies and procedures for protecting and managing the biota and waters and designated land use compartments which are grouped into recreation lands (south of Mahan-Denman Road and administered by COE and ODNR, Division of Parks and Recreation and Division of Wildlife) and wildlife refuge lands (north of Mahan-Denman Road and administered primarily by ODNR, Division of Wildlife). The Shoreline Management Plan (1998), a revision of the Lakeshore Management Plan (1987), addressed the use of Federal property by adjacent private landowners.

Existing Federal Oil and Gas Lease and Agreements

One 12.72 acre Federal oil and gas lease exists near the south end of Mosquito Lake State Park. A producing private oil and gas well adjacent to this Federal lease allocates a proportionate share of royalties from the well to the Federal government under the terms of a communitization agreement (CA). The lease was issued in 1990 with a "no surface occupancy" restriction due to intensive recreation development. In 1993, the Federal government entered into a compensatory royalty agreement (CRA) for production from a private oil and gas well involving 15.9 acres of unleased Federal oil and gas rights on the east side of the lake.

Lakeview Local School District Property

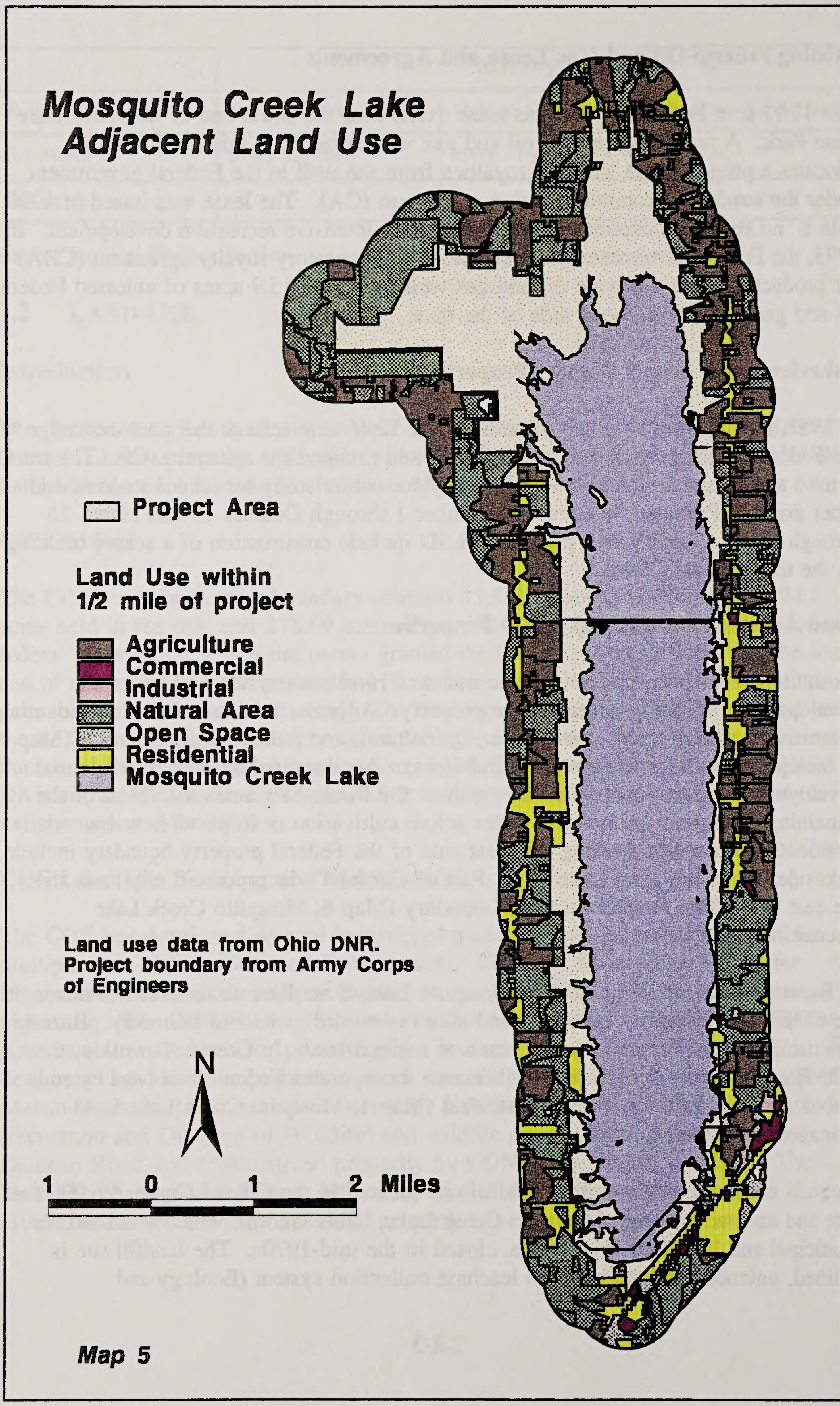
In 1981, the COE sold the surface estate of a 32.46 acre tract at the southwest edge of the Federal property boundary to the LLSD and retained the mineral estate. The tract is used as an environmental land laboratory for nature study by school students and other groups. Primary use occurs September 1 through October 15 and March 15 through June 1. Long-range plans by LLSD include construction of a school building on the tract (Raidel, 1996).

Land Adjacent to COE and LLSD Properties

Mosquito Creek Lake, which is in the midst of rural countryside and suburban development, primarily abuts private property. Adjacent land uses include residential, commercial, natural areas, open space, agricultural, and industrial development (Map 5, Mosquito Creek Lake Adjacent Land Uses). A substantial amount of residential development has occurred primarily south of the Route 88 Causeway. Most of the remaining contiguous property is under active cultivation or in pastures and woods. Residential allotments abutting the west side of the Federal property boundary include Lakeside, Jewel Bay, and Lakeview. Part of Cortland's incorporated city limit abuts the east side of the Federal property boundary (Map 6, Mosquito Creek Lake Recreation Areas).

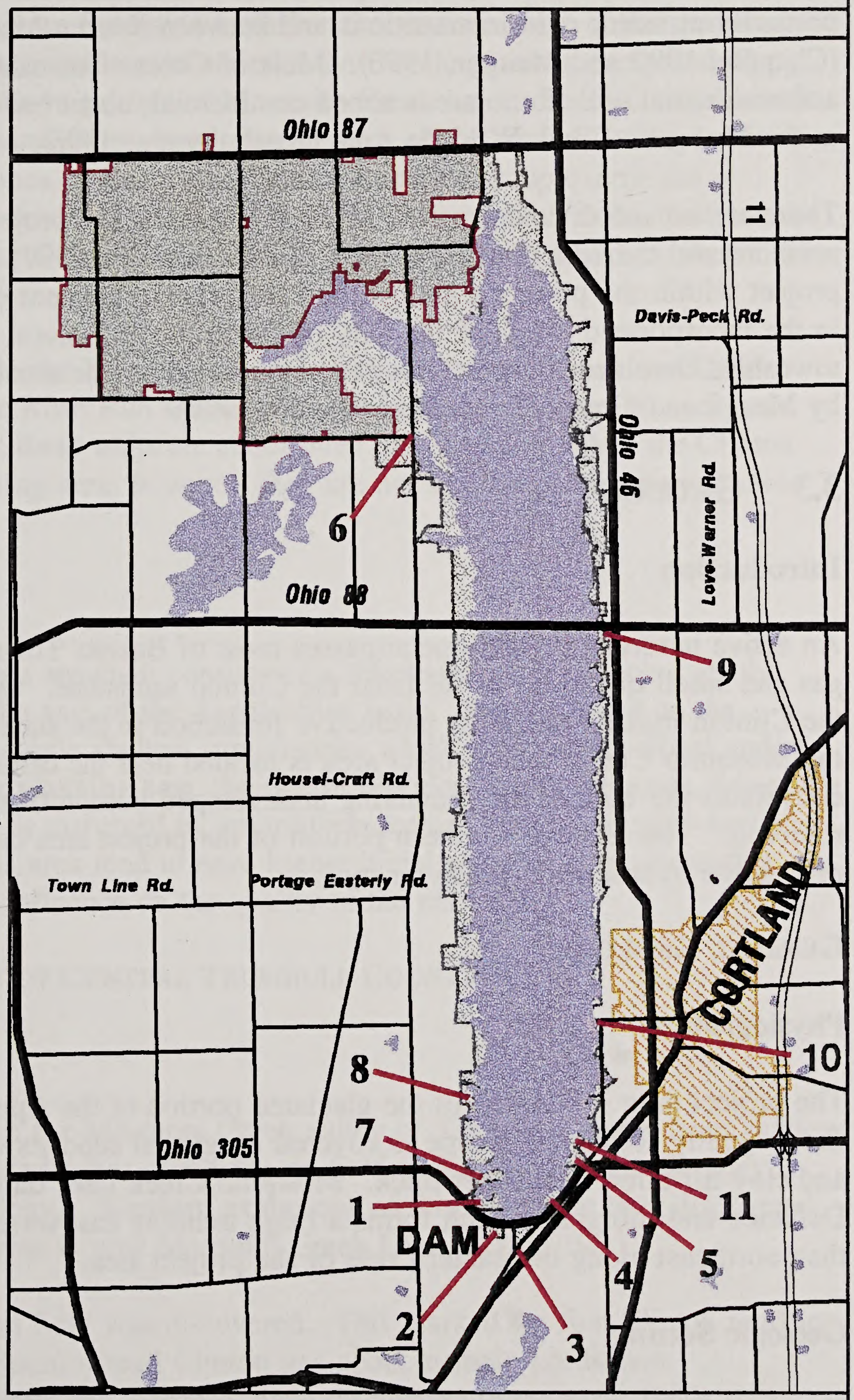
In Bazetta Township, the ODNR's Mosquito Lake State Park abuts over two-thirds of the COE's west property boundary and about one-third of its east boundary. Bazetta Township Park incorporates seven acres of Federal land. In Greene Township, the ODNR's Mosquito Creek Lake wildlife area incorporates Federal lands and extends onto State lands to the west and northwest (Map 1, Mosquito Creek Lake Land Management Entities).

There is one inactive Superfund landfill site located in the City of Cortland 6,000 feet east and up gradient from Mosquito Creek Lake. This landfill, which was used for municipal and light industrial waste, closed in the mid-1970s. The landfill site is unlined, unfenced and contains no leachate collection system (Ecology and


Mosquito Creek Lake
Adjacent Land Use
Project Area
Land Use within
1/2 mile of project
Agriculture
Commercial
Industrial
Natural Area
Open Space
Residential
Mosquito Creek Lake
Land use data from Ohio DNR.
Project boundary from Army Corps
of Engineers
N
1 0 1 2 Miles
Map 5

Mosquito Creek Lake Recreation Areas

1 Dam Site Picnic Area
2 Tailwater Access Area
3 Mosq. Ck. Picnic Area
4 Lakeview Picnic Area
5 Rt. 305 Boat Launch
6 Mahan-Denman Rd. Boat Launch
7 Mosq. Ck. State Park
8 Mosq. State Park Campground
9 Causeway Boat Launch
10 Main St. Boat Launch
11 Bazetta Twp. Park



N

1 0 1 2 Miles

ODNR State Wildlife Lands
Federal Property Bnd.

Map 6

Environment, Inc. 1989).

Trumbull County does not have a zoning plan (Nuskiewicz, 1997). Bazetta and Greene Townships have zoning ordinances but no zoning plans. Mecca Township has neither. Most of Bazetta Township is zoned residential with land zoned commercial primarily at major road intersections and between Warren-Meadville Road and Route 5 (Chapple, 1997 and Mauger, 1996). Most of Greene Township is zoned agricultural and residential with some areas zoned commercial; about one-third of the township is in the Mosquito Creek Wildlife Area (Bartholomew, 1996).

There are no sub-division or multi-building construction projects on unincorporated areas around the lake (Dubiaga, 1997 and Nuskiewicz, 1997). The largest construction project within the planning area is the Lake Vista retirement community, a 22 acre site in the incorporated limits of the City of Cortland (Dunsmoor, 1997). Of the three townships involved, Bazetta Township is undergoing the most development followed by Mecca and Greene Townships (Baudo, 1997).

3.3 Geology

Introduction

An active natural gas field encompasses most of Bazetta Township, producing natural gas and small quantities of oil from the Clinton sandstone. Oil and gas reservoirs in the Clinton make it the most productive formation in the state. The southern half of the Mosquito Creek Lake project area is located near the center of the field, and constitutes the bulk of the remaining undeveloped portion of the hydrocarbon reservoir. The extreme southern portion of the project area contains the most productive hydrocarbon reservoir rock.

General Geology

Physiography

The project area is situated in the glaciated portion of the Appalachian Plateau. The flat to gently rolling landscape is covered by glacial deposits that consist mainly of silt and clay till three to ten feet thick. Mosquito Creek Lake dam is situated on the Defiance end moraine, which forms a ridge trending east-west through the damsite, then northeast along the eastern side of the project area.

Geologic Setting

Trumbull County is located on the northwestern flank of the Appalachian basin. Thousands of feet of Paleozoic sediments overlie crystalline basement rocks formed 1.0-1.2 billion years ago. Rocks underlying the glacial deposits in the area consist of

Mississippian and Devonian sediments dipping at roughly 15-45 feet per mile (three-eight meters/kilometer) to the east-southeast, toward the axis of the basin.

Stratigraphy

The Mississippian Cuyahoga formation underlies the southern edge of the project area. The Berea and Cussewago sandstones underlie the Cuyahoga and are exposed along the periphery of the southern portion of Mosquito Creek Lake. Bedford shale, which normally separates the sandstones, is missing in parts of the area. South and east of the project area, sandstones of the Pennsylvanian Pottsville group overlie the Mississippian strata. A thick sequence of Devonian shales, known collectively as the Ohio Shale, underlies the Cussewago sandstone (refer to Figures 2 and 11, Appendix C, Hydrogeology).

Stratigraphic units within the Knox group, including the Beekmantown and Copper Ridge dolomites and the Rose Run sandstone, have become important oil and gas targets in parts of Ohio; these units are about three thousand feet below the Clinton sandstone. In the planning area, however, they are not known to contain producible hydrocarbons.

Structure

Northeastern Ohio's gross structure consists of a simple monocline dipping gently east-southeast, toward the axis of the Appalachian basin. Superimposed on the regional monocline are subtle shallow irregularities which reflect depositional and/or deeper structure. In the planning area, the rate of dip increases to the south, where the regular dip of the strata is disrupted by an antiform terrace trending roughly northeast-southwest. Wells in this area tend to have higher initial potential rates, indicating the possibility of structural influence on the quality of the reservoir.

PETROLEUM GEOLOGY OF CENTRAL TRUMBULL COUNTY

Exploration History

Oil was first produced in the Mosquito Creek valley of Trumbull County from shallow Berea and Cussewago sandstones of the Mecca field (refer to Petroleum Geology, Appendix C, Hydrogeology). Southern extensions of this field were later discovered, one just southwest of what is now Mosquito Creek Lake, around 1920.

In 1946, the East Canton field was discovered. This marked the first Clinton field in the eastern part of the State. Small Clinton gas pools, namely Lordstown, Leavittstown, Newton Falls and Hartford, were discovered in the early 1960s.

Since 1975, approximately 120 wells have been drilled in Bazetta Township within one mile of the project area. About 20 wells have been drilled in Mecca Township and five wells drilled in Greene Township. According to ODNR, Division of Oil and Gas, there were 178 producing oil and gas wells throughout the three townships in 1996. Completion reports indicate a completion rate of 97 percent and a median test rate of 550 Mcf/d (thousand cubic feet gas per day). Ultimate recoverable reserves for wells in Bazetta Township average at least 150 MMcf (million cubic feet) per well; cumulative oil production is less than 1,000 barrels per well over a typical 20 to 30 year well life.

The reservoir sands in the Clinton formation include the Stray Clinton, the Red and White Clinton, and the Medina sandstone. The Medina sandstone in this area rarely contributes significantly to overall reserves, and has been completed in only a few wells.

The Clinton reservoir here is a gas-expansion reservoir and where oil is present, it is produced by solution drive. Typical reservoir porosities are less than ten percent, although some reports indicate zones with porosities as great as 15 percent. Permeabilities of less than 0.5 md (millidarcies) are typical but higher permeabilities may be present locally. Because there appears to be little communication between wells, Clinton sands do not form a single contiguous reservoir.

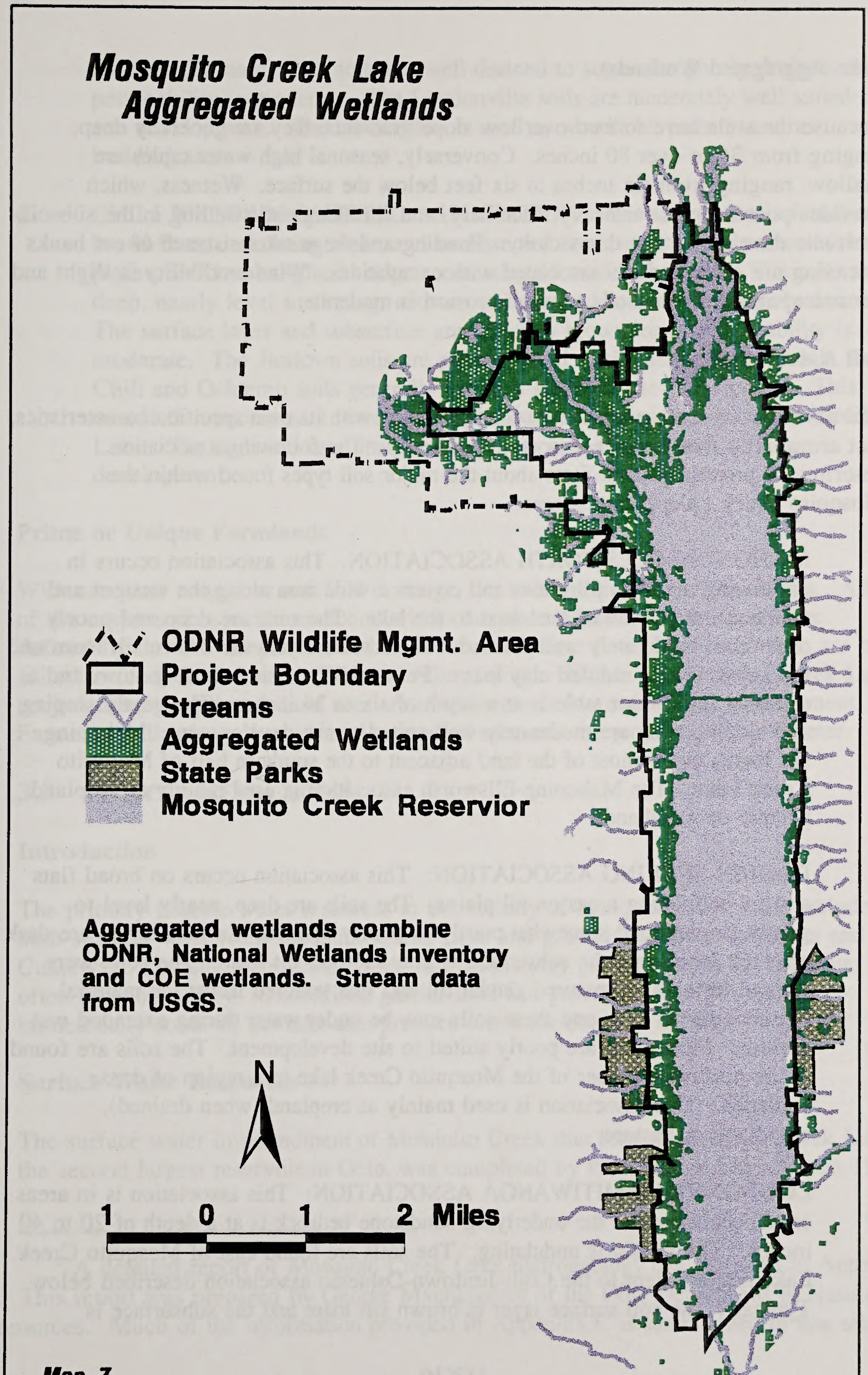
3.4 SOILS AND PRIME OR UNIQUE FARMLANDS[1]

Introduction

Soils within the planning area are broadly classified as either silt loams or alluvial soils. The proportion of fine textured clay particles in the uppermost 36 inches of these soils ranges from two to 45 percent. Fine textured clays are produced from the weathering of mineral compounds found in the glacial and alluvial deposits. As the clay proportion in soils increases, drainage is impeded and soils may remain wet for extended periods. Slopes generally range from zero to three percent in the planning area. This low relief also contributes to wetness during the spring and fall months and to ponding in depressions and in low areas surrounding Mosquito Creek Lake. Wetland ecosystems are associated with the slow permeability and flat topography, and they comprise approximately 18 percent of the planning area (Map 7, Mosquito Creek

---

[1] BLM is required to assess the impacts of its actions on prime or unique farmlands under the Surface Mining Control and Reclamation Act of 1977 (30 USC 1201, et seq.) Unless otherwise specified, all of the soil information cited in this section has been excerpted from the Soil Survey of Trumbull County, Ohio issued in March, 1992. The survey was prepared by the United States Department of Agriculture, Natural Resource Conservation Service (NRCS) in cooperation with the Ohio Department of Natural Resources, Division of Soil and Water Conservation, and the Ohio Agricultural Research and Development Center. The NRCS was formerly called the Soil Conservation Service. No site specific soil surveys were conducted by the BLM for the preparation of this section.


Mosquito Creek Lake
Aggregated Wetlands
ODNR Wildlife Mgmt. Area
Project Boundary
Streams
Aggregated Wetlands
State Parks
Mosquito Creek Reservior
Aggregated wetlands combine ODNR, National Wetlands Inventory and COE wetlands. Stream data from USGS.
N
1 0 1 2 Miles
Map 7

Lake Aggregated Wetlands).

Because the soils have formed over low slope gradients, they are generally deep, ranging from 36 to over 80 inches. Conversely, seasonal high water tables are shallow, ranging from six inches to six feet below the surface. Wetness, which provides poor support for heavy machinery, and shrinking and swelling in the subsoil, limit site development in this vicinity. Ponding and the weak resistance of cut banks to caving are other hazards associated with excavations. Wind erodibility is slight and the susceptibility of the soils to water erosion is moderate.

Soil Associations

Soil associations represent several soil types, each with its own specific characteristics, that are usually found together in close proximity. The following association descriptions provide general facts about the major soil types found within the Mosquito Creek Lake planning area:

1. MAHONING-ELLSWORTH ASSOCIATION: This association occurs in undulating areas on till plains and covers a wide area along the western and southeastern portion of land next to the lake. The soils are deep and poorly drained to moderately well drained. The surface layers are brown silt loam and the subsurface is mottled clay loam. Permeability is slow to very slow, and a seasonal high water table is at a depth of six to 36 inches. The gently sloping and sloping soils are moderately well suited to site development. Mahoning silt loams cover most of the land adjacent to the southern half of Mosquito Creek Lake. The Mahoning-Ellsworth association is used mainly as cropland, pasture or woodland.

2. DARIEN-SEBRING ASSOCIATION: This association occurs on broad flats and on undulating areas on till plains. The soils are deep, nearly level to gently sloping, and somewhat poorly to poorly drained. Surface layers are dark gray silt loams and the subsurface is gray mottled silt loam. The soils were formed in medium textured glacial till and fine textured lacustrine material. Permeability is slow and these soils may be under water during extended wet periods. Most areas are poorly suited to site development. The soils are found at the northwest corner of the Mosquito Creek lake in a region of dense wetlands. This association is used mainly as cropland (when drained), woodland or pasture.

3. LOUDONVILLE-MITIWANGA ASSOCIATION: This association is in areas on till plains where the underlying sandstone bedrock is at a depth of 20 to 40 inches. The terrain is undulating. The soils are found east of Mosquito Creek Lake and adjacent to the Chili-Jimtown-Oshtemo association described below. Typically, the soil surface layer is brown silt loam and the subsurface is

mottled silt loam. The soils are well drained to somewhat poorly drained, and permeability is moderate. The Loudonville soils are moderately well suited to site development. This association is used as woodland, pasture, and as building sites.

4. CHILI-JIMTOWN-OSHTEMO ASSOCIATION: This association is found on broad flats, undulating areas, and in dissected areas on stream terraces, outwash plains, and kames (glacial ridges consisting of sand and gravel). The soils are deep, nearly level to sloping, and are well drained to somewhat poorly drained. The surface layer and subsurface are typically brown loam. Permeability is moderate. The Jimtown soils are poorly suited to site development, while the Chili and Oshtemo soils generally are well suited to site development. This association occurs as a narrow band along the eastern side of Mosquito Creek Lake. The soils are used mainly for crops, pasture, woodland, or urban development.

Prime or Unique Farmlands

With adequate natural or artificial drainage, the soils are good agricultural soils. All of the major soil associations found within the planning area, when drained, are defined by the U.S. Department of Agriculture as prime farmland. These soils are best suited to food, feed, forage, fiber, and oilseed crops. Within the Mosquito Creek Lake project area, the primary land uses are outdoor recreation and wildlife management. Farms, woodlands, and residential properties surround the project area's perimeter.

3.5 Water Resources[2]

Introduction

The primary potable water resources in the vicinity of Mosquito Creek Lake include both surface water from Mosquito Creek Lake and groundwater from the Berea and Cussewago sandstone aquifers. Other formations may produce water, but the water is often of poor quality. Unconfined glacial sand and gravel valley-fill deposits immediately south of the lake also produce water for domestic supply.

Surface Water Resources

The surface water impoundment of Mosquito Creek that formed Mosquito Creek Lake, the second largest reservoir in Ohio, was completed by the Corps of Engineers in 1944

---

[2] A detailed report of Mosquito Creek Lake hydrogeology can be found in Appendix C. This report was prepared by George Mychkovsky of the Ohio Department of Natural Resources. Much of the information provided in Appendix C is summarized in this section.

to provide flood control, low flow augmentation, municipal water supply, and water quality control. The lake's surface acreage at summer pool elevation of 901.4 feet National Geodetic Vertical Datum (NGVD) is 12.3 square miles (7,850 acres), and it has an average discharge over the period from 1944 to 1996 of 103 cubic feet per second. Mosquito Creek, the lake's main water source, drains a 139.2 square mile basin (97.4 square miles lie above the dam) and is 33.7 miles long, 20 miles of which lie above the dam. Headwaters are northwest of Wayne Center, Ashtabula County.

Tables 3-2 and 3-3 depict water quality data collected from the waters of Mosquito Creek Lake. Table 3-2 lists common water constituents with measured concentrations from samples collected at the U.S. Geological Survey (USGS) gaging station below the Mosquito Creek Lake dam from 1965-77 and the Ohio Environmental Protection Agency (OEPA) aquatic life standard (ALS) and public water supply standard (PWSS), where applicable; measurements are in milligrams/liter (mg/l), micrograms/liter (μg/l), or microSiemans/centimeter (μs/cm).

Table 3-2. Water Quality Observations at Mosquito Creek Lake and OEPA Water Quality Standards

PARAMETER	MINIMUM[1]	MAXIMUM[1]	OEPA-ALS[2]	OEPA-PWSS[2]
pH	6.6	7.9	6.5 - 9.0	No standard
Specific Conductivity	202 μs/cm	382 μs/cm	2400 (30-day)	1200 - Max. 800 (30-day)
Total Dissolved Solids (TDS)	110 mg/l	234 mg/l	1500 (30-day)	750 - Max. 500 (30-day)
Total Alkalinity ($CaCO_3$)	41 mg/l	115 mg/l	No standard	No standard
Total Hardness ($CaCO_3$)	78 mg/l	160 mg/l	No standard	No standard
Sodium (Na)	12 mg/l	17 mg/l	No standard	No standard
Potassium (K)	2.6 mg/l	3.3 mg/l	No standard	No standard
Calcium (Ca)	16 mg/l	41 mg/l	No standard	No standard
Magnesium (Mg)	5.4 mg/l	7.2 mg/l	No standard	No standard
Iron (Fe)	<10 μg/l	100 μg/l	1000-total iron	300
Chloride (Cl)	13 mg/l	27 mg/l	No standard	250
Sulfate (SO_4)	33 mg/l	44 mg/l	No standard	250

Source: [1]ODNR, 1996, unpublished report, and [2]OEPA

Table 3-3 lists trace metals and volatile organic compounds (VOCs) with measured concentrations from samples taken at the Warren water plant intake; the most recent data are from 1995 (Peterson, et al., 1997). The existing level of manganese (90 μg/l) currently exceeds the OEPA PWSS (50 μg/l).

Table 3-3. Water Quality Observations and Standards for Certain Trace Metals and Volatile Organic Compounds

PARAMETER	CONCENTRATION (observed at Mosquito Creek Lake)	OEPA-PWSS
Trace Metals		
Arsenic (As)	<3 μg/l*	50 μg/l
Barium (Ba)	12 μg/l	2000 μg/l
Cadmium (Cd)	<0.5 μg/l*	5 μg/l
Chromium (Cr)	<5 μg/l*	100 μg/l
Lead (Pb)	< 2 μg/l*	50 μg/l
Nickel (Ni)	<20 μg/l	100 μg/l
Manganese (Mn)	90 μg/l	50 μg/l
Volatile Organic Compounds		
Benzene	<0.5 μg/l	No standard
Xylene	No Data	No standard
Toluene	No Data	No standard

* Values represent concentrations below detectable levels.
Source: Ohio Administrative Statutes Rule 3745-81-1 and Peterson, et al. 1997.

OEPA also evaluated reservoir water quality in 1989-90, and found the water quality to be acceptable. Low dissolved oxygen levels were present and organochlorine pesticide residue was present in bottom sediments, but pesticide concentrations in fish sampled were well below Food and Drug Administration action levels. Low oxygen levels resulted from a combination of high turbidity, high organic loading (eutrophication), and generally shallow lake depths; such conditions are commonly found in man-made impoundments in developed areas (DOI, 1995). The organic loading has been attributed mainly to plant materials.

In 1994, the OEPA reported that Mosquito Creek water quality suffered "extensive and severe impacts" from a variety of sources including wastewater effluent, sewer overflows, industrial and urban development and residual toxicity (mainly pesticides). Monitoring efforts between 1982 and 1994 indicated that minimal recovery had taken place (ODNR, 1996).

Groundwater Resources

The Cussewago sandstone aquifer is the principal aquifer in the county, supplying domestic, industrial and municipal wells from medium grained, poorly cemented sandstones 20 to 152 feet thick. The sandstone is primarily a confined aquifer, although in areas where it underlies alluvial or glacial sand and gravel it may be recharged directly from precipitation. There also appears to be a component of recharge from Mosquito Creek Lake where the elevations of the subcrop of the sandstone and the stage level of the lake coincide, although the recharge may be impeded by low-permeability lake-bed sediments (USGS, 1997). Groundwater flow within the aquifer appears to be east and southeast except for local reversal immediately east of Cortland due to cones of depression created by pumping from the municipal water well fields (ibid, p. 1).

Average transmissivity of the Cussewago in Trumbull County is about 13,000 gallons per day per foot (gpd/ft), with yields ranging from 20 to 50 gallons per minute (gpm). Overall water quality is acceptable, although total dissolved solids may exceed the USEPA "Secondary Maximum Contaminant Level" of 500 mg/l by 20 percent. In some areas, especially within the boundaries of the Mecca oil pool on the western side of the lake, oil and natural gas are commonly detected in the aquifer. Small shows of oil and natural gas, and more rarely brine and hydrogen sulfide, have been detected on both sides of the lake.

The Berea sandstone is also a source of groundwater, especially west of the project area, but does not match the Cussewago in terms of transmissivity (6,700 gpd/ft) or thickness (zero to 59 feet, but rarely exceeding 20 feet). Yields of 20-30 gpm are comparable locally, but south and east of the lake the Berea is shaly and yields are lower. The Berea was the main oil and gas reservoir in the Mecca pool, and shows of oil, gas, or other contaminants are far more common in the Berea than in the Cussewago. Contaminated zones in the Berea sandstone should be cased off when water wells are drilled, but well contamination may still occur during drought or while adjacent water wells are being drilled.

The Berea and the Cussewago aquifers are usually developed together and the water from the two commingled. Although the Berea is usually considered a confined aquifer, near the lake it may be recharged through the glacial overburden or through a "leaky" confining unit. This would seem to be true because oil production reportedly increased in the Mecca pool after heavy rain, indicating meteoritic influence over the aquifer's water levels. In some areas, the intervening Bedford shale unit may be absent and the Berea may overlie the Cussewago directly. The USGS (1997) indicated that communication between the two aquifers is likely, with the Berea sandstone providing vertical recharge to the Cussewago sandstone aquifer.

The only other aquifers of significance in the area around Mosquito Creek Lake are the channel-fill sand and gravel deposits lining the Mosquito Creek valley below the dam which are developed for private domestic use.

The BLM, ODNR, and USGS are sponsoring the sampling and analysis of hydrocarbons and brines from current and past producing formations in the Mosquito Creek Lake area in order to allow chemical differentiation of these oilfield substances. The "fingerprinting" may allow suspected contaminants found in water wells or other sources to be identified and the origins of the contamination to be traced. This research will be part of a larger hydrologic study funded by the City of Warren, and will provide valuable information that can be used during the investigation of present and/or future complaints of suspected water well contamination.

3.6 FLOODPLAINS

The Mosquito Creek floodplain is defined as that area below the 100 year flood elevation of 905.1 feet national geodetic vertical datum (NGVD). The floodplain lies along Mosquito Creek, the shoreline of Mosquito Creek Lake, and along the lake's perennial tributaries and intermittent drainages. In general, the Mosquito Creek floodplain is wholly within the COE property boundary (Maps 8N and 8S, Mosquito Creek Lake 100 Year Floodplain). Where the floodplain extends past that boundary, the COE has acquired flowage easements, within which the COE has authority to flood during high water events and restrict landowners from erecting permanent structures. Most of the flowage easements are on State Park land.

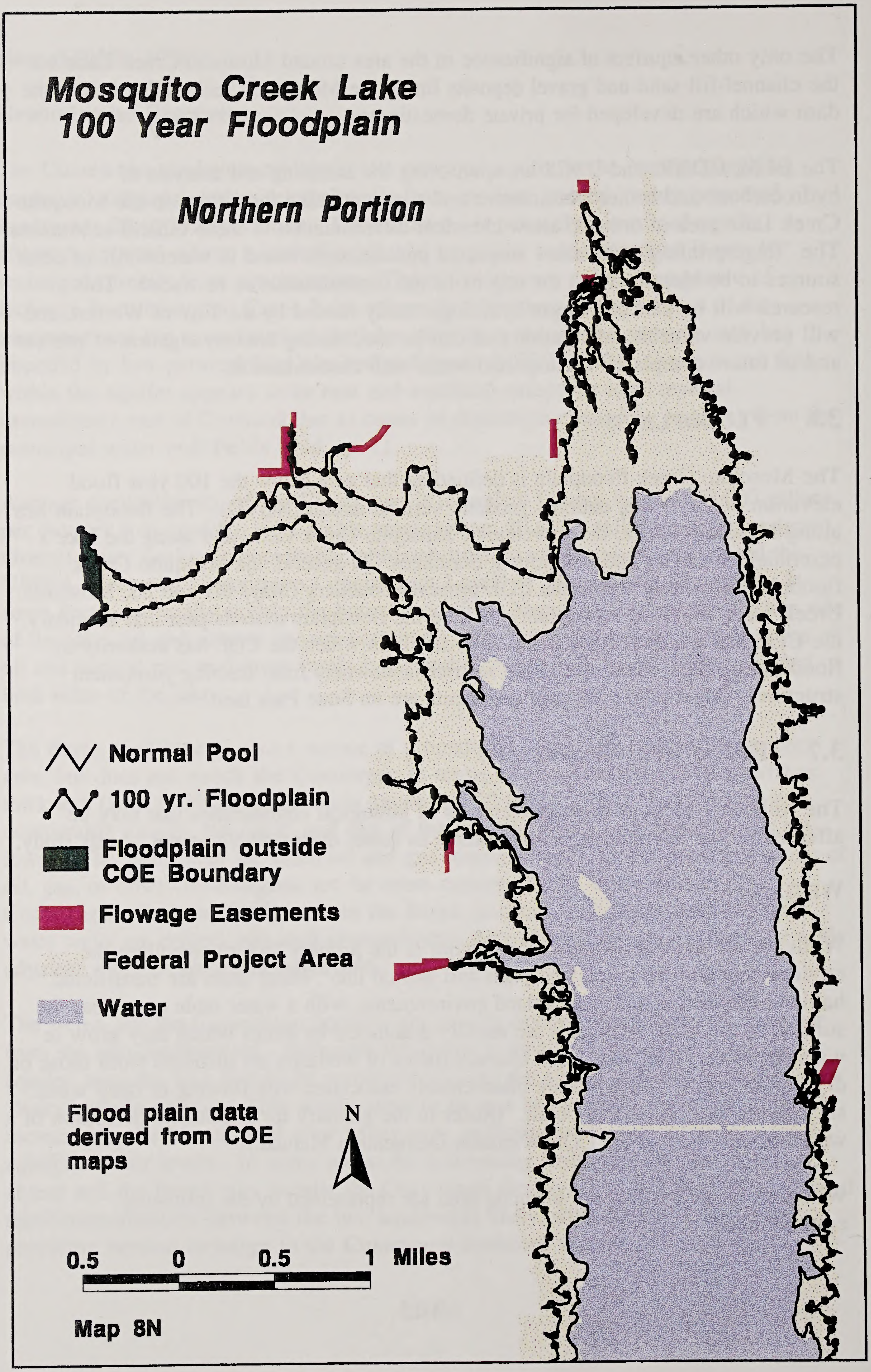
3.7 BIOLOGICAL RESOURCES

The following sections describe elements of biological communities that may be affected by the alternatives or were raised as issues during development of this study.

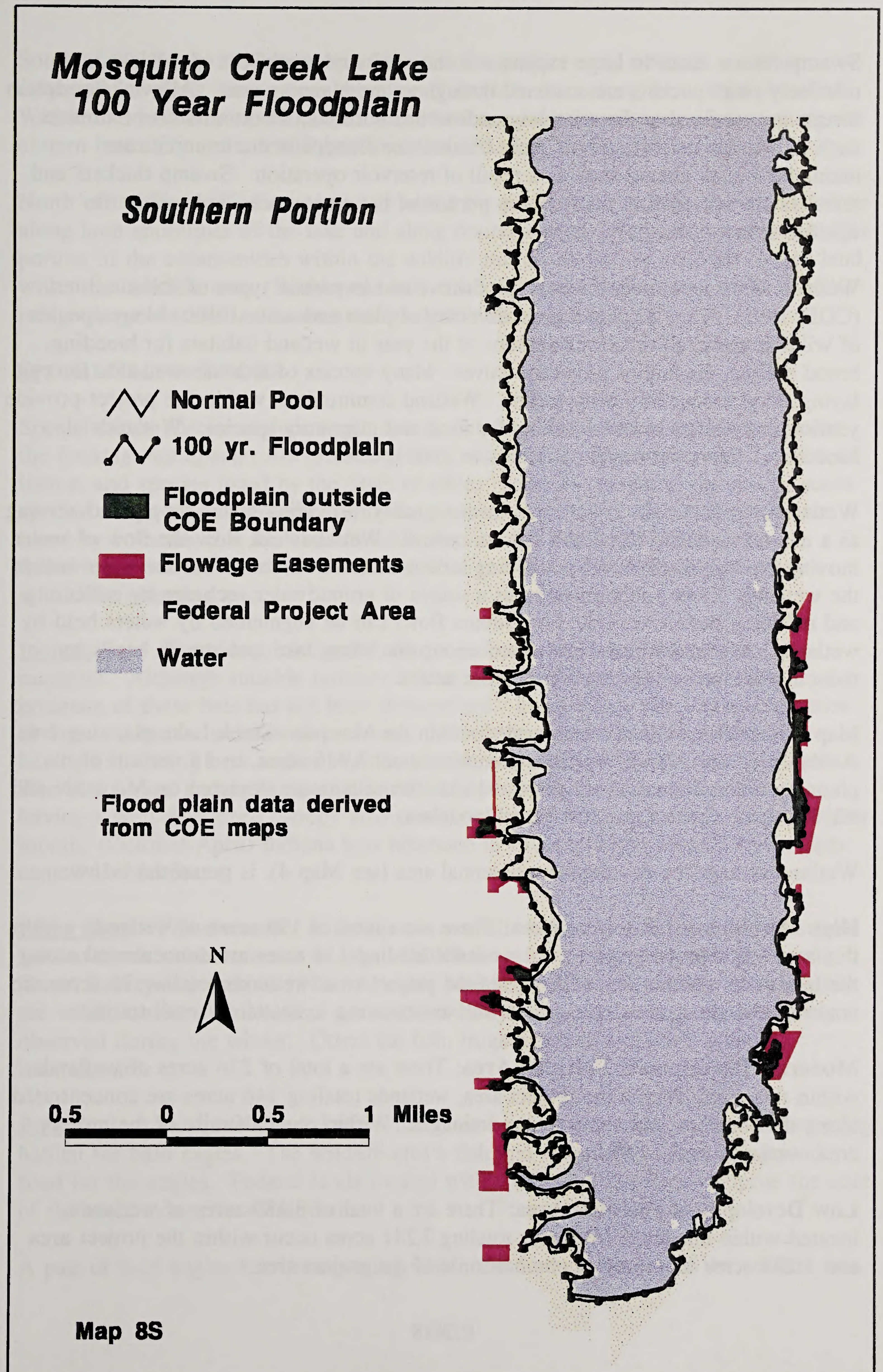
WETLANDS

Wetlands are defined as areas where water is the primary factor controlling the environment and the associated plant and animal life. These areas are transitional habitats between aquatic and upland environments, with a water table at or near the surface of the land. Wetlands are usually dominated by plants which may grow in water or in very wet soils. Soil characteristics of wetlands are different from those of dry, upland sites. Wetlands are often closely associated with flowing or deep water, such as streams, lakes and ponds. (Refer to the glossary for a technical definition of a wetland according to the COE Wetlands Delineation Manual.)

Wetlands located within the planning area are represented by the following communities:



Mosquito Creek Lake
100 Year Floodplain
Northern Portion
Normal Pool
100 yr. Floodplain
Floodplain outside COE Boundary
Flowage Easements
Federal Project Area
Water
Flood plain data derived from COE maps
N
0.5
0
0.5
1
Miles
Map 8N


Mosquito Creek Lake
100 Year Floodplain
Southern Portion
Normal Pool
100 yr. Floodplain
Floodplain outside COE Boundary
Flowage Easements
Federal Project Area
Water
Flood plain data derived from COE maps
N
0.5 0 0.5 1 Miles
Map 8S

Swamp forests occur in large expanses to the north and northwest of the lake, and relatively small pockets are scattered throughout the planning area. Alluvial floodplain forests are confined to the relatively undisturbed portions of bottomlands of streams such as Walnut and Mosquito Creeks. Lakeshore floodplain communities are maintained in an altered state as a result of reservoir operation. Swamp thickets and marshes are extensive in the northern portion of the project area and within the wildlife area.

Wetland areas are among the most productive and important types of communities (COE, 1993). They display a great diversity of plant and animal life. Many species of wildlife spend all or certain seasons of the year in wetland habitats for breeding, brood rearing, feeding or protective cover. Many species of fish use wetlands for egg laying, food production or protection. Wetland communities within the project provide yearlong as well as seasonal habitat for local and migratory species. Wetlands also function as important travel corridors for some species.

Wetlands are important in enhancing water quality, providing water supply and serving as a natural means of flood and erosion control. Wetlands can slow the flow of water moving through them, thereby allowing sediments to settle out before the water leaves the wetland. Some wetlands serve as a source of groundwater recharge by collecting and retaining surface waters. Low stream flows can be augmented by waters held by wetlands. Wetland vegetation can reduce erosion along lake and stream banks by reducing the forces associated with wave action.

Map 7 identifies wetland areas located within the Mosquito Creek Lake planning area. As delineated by Map 7, wetlands comprise about 3,946 acres, or 18 percent of the planning area. Streams, both perennial and intermittent, are depicted on Maps 8N and 8S, Mosquito Creek Lake 100 Year Floodplain.

Wetland acreage, by development potential area (see Map 4), is presented below:

High Development Potential Area: There are a total of 190 acres of wetlands within this area. Within the project area, wetlands totaling 114 acres are concentrated along the lakeshore. Within one-half mile of the project area, wetlands totaling 75 acres are concentrated along two drainages as well as occurring in scattered small tracts.

Moderate Development Potential Area: There are a total of 276 acres of wetlands within this area. Within the project area, wetlands totaling 146 acres are concentrated along the shoreline and along major drainages. Within one-half mile of the project area, wetlands total 129 acres.

Low Development Potential Area: There are a total of 3,480 acres of wetlands located within this area. Wetlands totaling 2,241 acres occur within the project area and 1,239 acres occur within one-half mile of the project area.

South of the Route 88 Causeway and within the project area, wetlands are more concentrated along the western shoreline of the lake than along the eastern shoreline. Within one-half mile of the project area, there are a few small tracts located along the eastern boundary and a few larger tracts located along the western boundary.

North of the Route 88 Causeway and within the project area, extensive wetlands occur along both shorelines of the lake and along drainageways. Wetlands comprise a major portion of the communities within the wildlife refuge, as well as the State owned land within the wildlife area. Within one-half mile of the eastern boundary of the wildlife refuge, large wetland areas are associated with drainageways.

SPECIAL STATUS SPECIES

Special status species include those species listed as threatened or endangered under the *Endangered Species Act of 1973* (ESA), as amended, species proposed for Federal listing, and species listed by the State of Ohio. Table 3-4 identifies the special status species which may be present within the planning area. Several animal species are listed by both the U.S. Fish and Wildlife Service (USFWS) and ODNR. The following are brief descriptions of the special status species which may be present within the planning area:

Indiana Bat - The Mosquito Creek Lake project area lies within the range of this mammal. Although suitable summer habitat exists within the project area, the presence of these bats has not been documented. Indiana bats form nursery colonies in forests adjacent to lakes and streams. Mature live trees, as well as dead trees, having exfoliating bark and/or cavities provide important maternity roosts for the bats. The bats forage under the riparian and floodplain trees. Adjacent upland forests having a well developed canopy also provide potential roosting habitat. During winter months (October-April) Indiana bats hibernate in caves located primarily in the east-central United States.

River Otter - The river otter is an aquatic animal, but it will travel several miles over land to reach another stream or lake. ODNR introduced river otters into the nearby Grand River watershed in 1988. A viable breeding population of river otters inhabits the wildlife area. While otters are not commonly seen, otter excrement is routinely observed during the winter. Otters eat fish, frogs, crayfish and other aquatic invertebrates.

Bald Eagle - Mosquito Creek Lake wildlife area provides feeding, nesting and roosting habitat for bald eagles. The wildlife area's fish and waterfowl populations provide food for the eagles. Federal lands located within the wildlife refuge comprise the core of the more extensive wildlife area.

A pair of bald eagles has been nesting within the northern portion of the wildlife area in past years (Grahl, 1996). A pair of eagles will often use a specific nest site year after year, however they may choose an alternate site, especially if the existing nest has been damaged. There is an established nesting territory located within the extreme western portion of the wildlife refuge, although bald eagles are not currently using the nest site (Grahl, 1997). The Northern States Bald Eagle Recovery Plan (USFWS, 1993) states that conserving and managing nesting habitat is more important than identifying and preserving individual nest sites. The north end of the refuge provides wintering habitat for bald eagles.

Bald eagle tolerance of human activities varies seasonally as well as among different individuals and pairs. Bald eagles are more sensitive to disturbances during the six month cycle beginning with courtship activities (February) and extending about six weeks after the young birds leave the nest (July).

Osprey - This bird inhabits river and lake areas, and has been observed within the wildlife area. Fish comprise most of its diet, although ospreys have been known to take rodents, birds and crustaceans.

Northern Harrier - This bird is known to inhabit the marshlands and fields of the wildlife area. Major prey species of the harrier include mice, rats, frogs, snakes, insects and birds.

King Rail - This secretive inhabitant of marshes may be present within the wildlife area. It feeds in shallow water and mud flats for crabs, crayfish, small fish, insects, and some plants.

Virginia Rail - This elusive inhabitant of marshes has been observed within the wildlife area. Breeding Virginia rails usually inhabit sites having cattails, reeds or dense grass. The rails feed by probing the mudflats with their bills in search of snails, worms and insects.

Eastern Massasauga - This rattlesnake species is of concern to the USFWS and may be federally listed in the near future. The massasauga is known to occur within the wildlife area. Grassy marshes and wet meadows are the preferred feeding and breeding habitats for the species, although massasauga will utilize dry woodland. Prey species include mice, voles, shrews, frogs and birds.

Eastern Sand Darter - Streams within the project area may provide suitable habitat for this small fish species.

Clubshell mussel - Mosquito Creek Lake waters could be providing habitat for this endangered mussel. Mussels filter water for food and oxygen, and are relatively immobile. They are, therefore, quite susceptible to changes in water quality or stream channel stability.

Gray Birch - This small tree species in not abundant in Ohio, but has been documented within the wildlife area. Gray birch is an invader of old fields, or other disturbed sites where it grows on wet or dry sandy and gravelly soils.

Oak-Maple Swamp - An example of this type of rare community has been documented within one and one-half miles west of the project area. It is possible that such a community could exist within the wetland forests found in the project area.

Table 3-4. Special Status Species Which May Be Present Within or Near the Mosquito Creek Lake Project Area

COMMON NAME (*Scientific name*)	STATUS	PRESENCE (Source)
Indiana bat (*Myotis sodalis*)	F-E; S-E	Possible (1)
River Otter (*Lutra canadensis*)	S-E	Verified (2)
Bald eagle (*Haliaeetus leucocephalus*)	F-T; S-E	Verified (1,2,3)
Osprey (*Pandion haliaetus*)	S-E	Verified (2)
Northern harrier (*Circus cyaneus*)	S-E	Verified (2)
King rail (*Rallus elegans*)	S-E	Possible (2)
Virginia rail (*Rallus limicola*)	spt	Verified (3)
Eastern massasauga (*Sistrurus catenatus catenatus*)	fsc; S-E	Verified (1,2,3)
Eastern sand darter (*Etheostoma pellucidum*)	fsc	Possible (1)
Clubshell mussel (*Pleurobema clava*)	F-E; S-E	Possible (1)
Gray birch (*Betula populifolia*)	sc	Possible (3)
Oak-maple swamp	snf	Possible (3)

F: Federal species listed by the USFWS under ESA
- E Endangered species
- T Threatened species
- fsc Species identified as a Federal species of concern

S: State species listed by the ODNR
- E Endangered species
- spt species could become State listed
- sc State species of concern
- snf significant natural feature

Presence Definitions:
Possible - Suitable habitat is present but the species has not been documented
Verified - Species has been verified within the Mosquito Creek Lake wildlife area

Sources: (1) USFWS, (2) ODNR, Mosquito Creek wildlife area records, (3) ODNR, Division of Natural Areas and Preserves, Natural Heritage Program

Wildlife

During the scoping process, the major concerns related to wildlife involved protection of waterfowl, fisheries, and special status species/habitat. The information below will provide general information on the major categories of wildlife, including waterfowl.

The 5,370 acres of the Federal land north of the Route 88 Causeway are managed by the ODNR, Division of Wildlife (Map 1, Mosquito Creek Lake Land Management Entities). Within this area, the 2,119 acres immediately north of the causeway are managed for wildlife values and dispersed recreation such as fishing, hunting, boating and hiking. The remaining 3,251 acres located north of the lake buoy line and Mahan-Denman Road are managed as a wildlife refuge in conjunction with State owned land. The refuge is managed as an integral part of the larger Mosquito Creek wildlife area which is comprised of Federal land and 6,011 acres of State land.

The 5,645 acres of Federal land south of the causeway are managed by ODNR, Division of Parks and Recreation (Map 1). While overall management emphasis is on recreation, management actions may involve wildlife.

In addition to wetland communities, the following communities provide feeding, resting and breeding habitat for wildlife within the planning area: upland forests, altered woodlands, thickets, meadows and cultivated fields. Upland forests, especially mature forests, are significant in that they provide important nesting and living sites for cavity dwelling birds and mammals, as well as nest sites for numerous other bird species.

<u>Waterfowl</u> - Management of waterfowl and associated wetlands species is granted a high priority pursuant to the cooperative agreement signed between the Department of Interior and Department of the Army in January of 1989. The agreement calls for the coordination and cooperation between USFWS and COE in implementing the North American Waterfowl Management Plan (USFWS, 1986).

During 1956, the ODNR, Division of Wildlife established a captive Canada goose flock of 12 breeding pairs in the project area. A resident flock of nearly 3,000 birds now use the area. The wildlife area is an important location for the migrating Southern James Bay population of Canada goose.

Waterfowl management within the refuge, as well as the larger wildlife area, benefits both resident and migrant birds. Management practices which provide or enhance feeding and nesting habitat include planting food crops, mowing meadows, creating ponds, and installing nesting boxes.

During the fall migration, small flocks of migrant snow geese often use the area. Tundra swans use the wildlife area and adjacent locations for about six weeks each spring and for shorter periods during the fall migration. Duck populations are high in the wildlife area. The more common species include mallards, black ducks, wood ducks, blue-winged teal and lesser scaup.

Small Game - The most common small game mammals throughout the project area include the eastern cottontail rabbit, eastern gray squirrel, eastern fox squirrel and woodchuck. The woodcock and ruffed grouse are small game birds of the woodland areas. Furbearers within the planning area include beaver, raccoon, mink, red fox, gray fox, coyote and muskrat.

Upland Game Birds - Mourning doves, ring-necked pheasants, and bobwhite quail inhabit grain fields in the wildlife area, as well as the adjacent habitat.

Big Game - White-tailed deer are abundant and populations are scattered throughout the project area. Wild turkeys were introduced into the wildlife refuge during 1989 and flocks have become established in the more wooded portions.

Nongame Species - This wildlife group is quite varied and includes birds, small mammals, reptiles, amphibians and invertebrates. A great variety of both nesting and migratory birds inhabit the wildlife area. Of particular significance is the spring migration of shorebirds and warblers, and fall migration of hawks. Also of significance is a great blue heron breeding colony located in the northwestern part of the wildlife refuge.

Fisheries and Aquatic Animals

The ODNR, Division of Wildlife's overall management objective for Mosquito Creek Lake is to maintain a quality warm water fishery. The lake supports healthy populations of game fish. Specific objectives are to maintain a self-sustaining largemouth bass fishery and a quality walleye fishery through the stocking of fry.

A ten year walleye stocking program was discontinued in 1961, but was resumed in 1963 after it was determined that natural spawning was not occurring. Later research studies showed that the aquatic environment of Mosquito Creek Lake is not conducive to natural spawning at a level which can sustain the demand for recreational fishing. More than seven million walleye fry are released into Mosquito Creek Lake each year. Consequently, the lake is generating large numbers of quality size walleye. ODNR utilizes the Mosquito Creek Lake population as a dependable source of eggs to support Ohio's walleye stocking program.

A stable, self-sustaining population of largemouth bass is being maintained in Mosquito Creek Lake. Other populations of game fish include white and black crappies, bluegills, northern pike, bullheads, white bass, channel and flathead catfish, and yellow perch. Forage fish populations of gizzard shad, carp, shiners, suckers and catfish are considered to be at adequate levels. The reservoir outlet area supports large numbers and variety of panfish, as well as good populations of game fish.

While inventories have not been conducted to document all aquatic vertebrate and invertebrate species in the lake, it is assumed that a variety of aquatic insects, crayfish and mollusks inhabit the lake and its tributaries. To document adult aquatic insects in the Mosquito Creek Lake project area, the COE has conducted light trap sampling at the reservoir outlet in 1987, the inflow area in 1992, the natural spillway area in 1994, and Mud Creek in 1997 (COE, 1998). Over 30 different kinds of aquatic insects, including 27 kinds of caddisflies, were found in these studies. Many of the invertebrate species, as well as small animals, provide important food sources for fish populations. Adding to fish diversity, the tailwaters support smallmouth bass, muskellunge and warmouth. Warmouth is a reliable indicator species of good water quality because of its sensitivity to environmental disturbances.

The lake and its tributaries also provide habitat for numerous species which are dependent upon the water for food, cover or breeding sites. The lake is the primary source of food for bald eagles in the Mosquito Creek Lake project area. Animals which frequent the lake waters include beaver, muskrat, river otter, mink, shorebirds, wading birds, marsh birds, waterfowl, snakes, turtles, toads, frogs and salamanders.

3.8 Air Quality and Noise

Air Quality

The Clean Air Act (CAA) authorized the U.S. Environmental Protection Agency (USEPA) to set air quality standards and regulate air emissions.[3] The CAA Amendment of 1970 established National Ambient Air Quality Standards (NAAQS) to safeguard public health and welfare. Ambient air is that which is accessible to the

---

[3]/ Descriptions of Federal and State air quality regulations are extracted from the Ohio Environmental Protection Agency's (OEPA) *1996 Ohio Air Quality Report*; communication with personnel in OEPA, Division of Air Pollution Control; *An Introduction to Federal Environmental Regulations for the Petroleum Industry* (Gregston, 1993); *Air Quality Analysis for Beaverhead National Forest Oil and Gas Leasing Final Environmental Impact Statement* (BLM/FS, 1995); and *Technical Appendix 4 - Air Quality, from the Programmatic Environmental Impact Statement for Oil and Gas Drilling and Production in Montana* (MBOGC, 1989). Air quality information for Ohio and Trumbull County was obtained from personal communication with personnel in the OEPA, Division of Air Pollution Control and the *1996 Ohio Air Quality Report*. Information about ozone was extracted from *Environmental Quality: The Twenty-fourth Annual Report of the Council on Environmental Quality* (1993) and *An Introduction to Federal Environmental Regulations for the Petroleum Industry* (Gregston, 1993).

general public. NAAQS address six criteria pollutants including sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), lead (Pb), and particulate matter equal to or less than 10 microns in size (PM_{10}). (See Table 3-5). Federal air quality regulations require States to carry out the requirements of the CAA by developing and implementing State Implementation Plans (SIP), which provide for attainment and maintenance of air quality standards. In Ohio, the Ohio Environmental Protection Agency (OEPA) carries out the requirements of the CAA and its amendments. Ohio Ambient Air Quality Standards (AAQS) are identical to NAAQS (OEPA, 1996a).

Trumbull County currently meets Ohio AAQS and is, therefore, an attainment area for all criteria pollutants. For a period of years, the county did not meet Ohio AAQS for ozone. However, in 1996 OEPA designated the county as an attainment area for ozone (OEPA, 1996a and 1996b). Nitrogen oxides (NO_x) and volatile organic compounds (VOCs) are precursor compounds for ozone. Primary sources of NO_x and VOCs are transportation and industrial emissions. OEPA has granted a NO_x waiver to the Youngstown area (Mahoning and Trumbull Counties) because OEPA determined that ozone standards can be maintained without special NO_x control measures at emission sources (Goulish, 1996b). The primary precursor compounds of concern in the county are VOCs (OEPA, 1996a). There are 12 major point sources of VOCs in the county. Point sources closest to the planning area are six manufacturing plants in Warren, Ohio which emitted levels of VOCs ranging from 14 tons per year (TPY) to 189 TPY in 1995/96 (OEPA, 1996c). The total VOCs from point, area, and mobile sources in the county averaged 51.872 tons per day in 1990, and OEPA projected levels of 44.072 tons per day for 1993/94 and 44.159 tons per day for 2006 (Judson, 1997 and OEPA, 1994).

In addition to measurable factors such as pollutants, another, more subjective aspect of air quality is odor. Existing sources of odors in the planning area could include, but are not limited to, transportation emissions; farm activities; burning of wood, coal, trash, debris, if permitted; sewage/septic systems; road asphalting; painting; and vapors from existing oil and gas tank batteries.

Table 3-5. National Ambient Air Quality Standards

			MAXIMUM ALLOWABLE CONCENTRATION	
POLLUTANT	DURATION	RESTRICTION	PRIMARY*	SECONDARY**
PM_{10}	Annual arithmetic mean	Not to be exceeded, average over three years	50 ug/m^3	50 ug/m^3
	24 hour concentration	Not to be exceeded more than once per year, average over three years	150 ug/m^3	150 ug/m^3
SO_2	Annual mean	Not to be exceeded	0.03 ppm (80 ug/m^3)	
	24 hour mean concentration	Not to be exceeded more than once per year	0.14 ppm (365 ug/m^3)	
	3 hour mean concentration	Not to be exceeded more than once per year		0.5 ppm (1300 ug/m^3)
CO	8 hour mean concentration	Not to be exceeded more than once per year	10 mg/m^3 (9.0 ppm)	
	1 hour concentration	Not to be exceeded more than once per year	40 mg/m^3 (35.0 ppm)	
O_3	1 hour concentration	Not to be exceeded on more than one day per year, average over three years	0.12 ppm (244 ug/m^3)	
NO_2	Annual mean	Not to be exceeded	0.053 ppm (100 ug/m^3)	
Pb	3 month mean concentration	Not to be exceeded	1.5 ug/m^3	

Notes: *protect human health, **protect property, livestock and vegetation
PM = particulate matter, ug/m^3 = micrograms per cubic meter,
ppm = parts per million, mg/m^3 = milligrams per cubic meter
Source: Ohio Air Quality Report, 1996, OEPA

NOISE

Sound is a vibration in the air that can be measured. Noise is sound that annoys a listener, interferes with the listener's activity, or is in some way unwanted (USDA, 1980). Sound is measured in decibels (dB), a unit that represents sound pressure levels. Background noise levels and common noise sources are usually measured in dB(A), the unit of measure using the A-weighted scale, which approximates what the human ear hears. Zero decibels is the threshold of audible sound for healthy human ears. Each increase of ten decibels is a ten-fold increase in loudness.

In general, sound levels are higher during the day than at night due to increased human activity. At recreation sites, sound levels would be highest during the summer recreation season with the influx of visitors and vehicles, especially on the Memorial Day, Independence Day and Labor Day week ends. BLM recorded sound levels at 16 sites around the project area in April and June of 1996. Sound levels ranged from lows of 36 dB(A) at the wildlife refuge and 37 dB(A) at the Mosquito Lake State Park campground to highs of 56 dB(A) at the COE office and visitor center and 64 dB(A) at the Lakeview Picnic area. Both high levels were with traffic on the adjacent road.

Table 3-6 illustrates yearly loudness day-night (L_{dn}) sound levels by different neighborhood types and population densities. The planning area ranges from "rural-undeveloped (35 dB(A))" in the wildlife refuge to "normal suburban/urban(50-55 dB(A))" at the City of Cortland. However, most of the project area probably falls into the "rural-partially developed (40 dB(A))" category. USEPA (1978) also determined average outdoor L_{dn} levels for various neighborhood types. Of these categories, the planning area includes "rural residential" (39 dB(A)), "agricultural cropland" (44 dB(A)), and "wooded residential" (51 dB(A)). Interior portions of the wildlife refuge may be similar to "wilderness ambient" (35 dB(A)). Traffic noise on local roads may vary from about 65 to 80 dB(A).

Table 3-7 compares different noise levels associated with oil and gas operations with more common noise sources.

Table 3-6. Yearly Day-Night Sound Levels for Various Residential Neighborhoods

DESCRIPTION	POPULATION DENSITY (people/square mile)	L_{dn}* dB(A)
Rural (undeveloped)	20	35
Rural (partially developed)	60	40
Quiet suburban	200	45
Normal suburban	600	50
Urban	2,000	55
Noisy urban	6,000	60
Very noisy urban	20,000	65

* L_{dn} = average day-night sound level
Source: USEPA, 1982

Table 3-7. Noise Level Comparison

dB(A)	How It Feels	Equivalent Sounds	How It Sounds (compared to 75 dB(A))	Sounds From Drilling Operation
140	Near permanent damage to ears		64 times as loud	
130		Jackhammer		
120	Pain to ears	Firecracker at 15 ft. Rock and roll band	32 times as loud	
110	Uncomfortably loud	Unmuffled motorbike at 2-3 ft.	16 times as loud	
100	Discomfort threshold Very loud	Car horn Unmuffled cycle at 25 ft.	8 times as loud	Typical pipeline compressor line at 50 ft.
90	Conversation stops	Garbage trucks and city buses Power lawnmower	4 times as loud	
80	Intolerable for phone use	Steady flow of freeway traffic Garbage disposal	2 times as loud **75 dB(A)**	Oilfield access road as trucks pass at 25 ft. Drilling rig at 200 ft. from drill hole
70	Extra-auditory physiological effects	Passenger car 65 mph at 25 ft. Busy downtown	1/2 as loud	
60			1/4 as loud	At pumpjack run by electric motor
50	Quiet	Normal conversation		Typical oil pump jack at 100 ft. (natural gas powered)
40	Sleep interference		1/8 as loud	
30			1/16 as loud	
20				Drill rig at 1/2 mile from drill hole
10				Ambient sound levels in the area of concern
0				

Source: Adapted from BLM, 1987

3.9 Recreation and Visual Resources

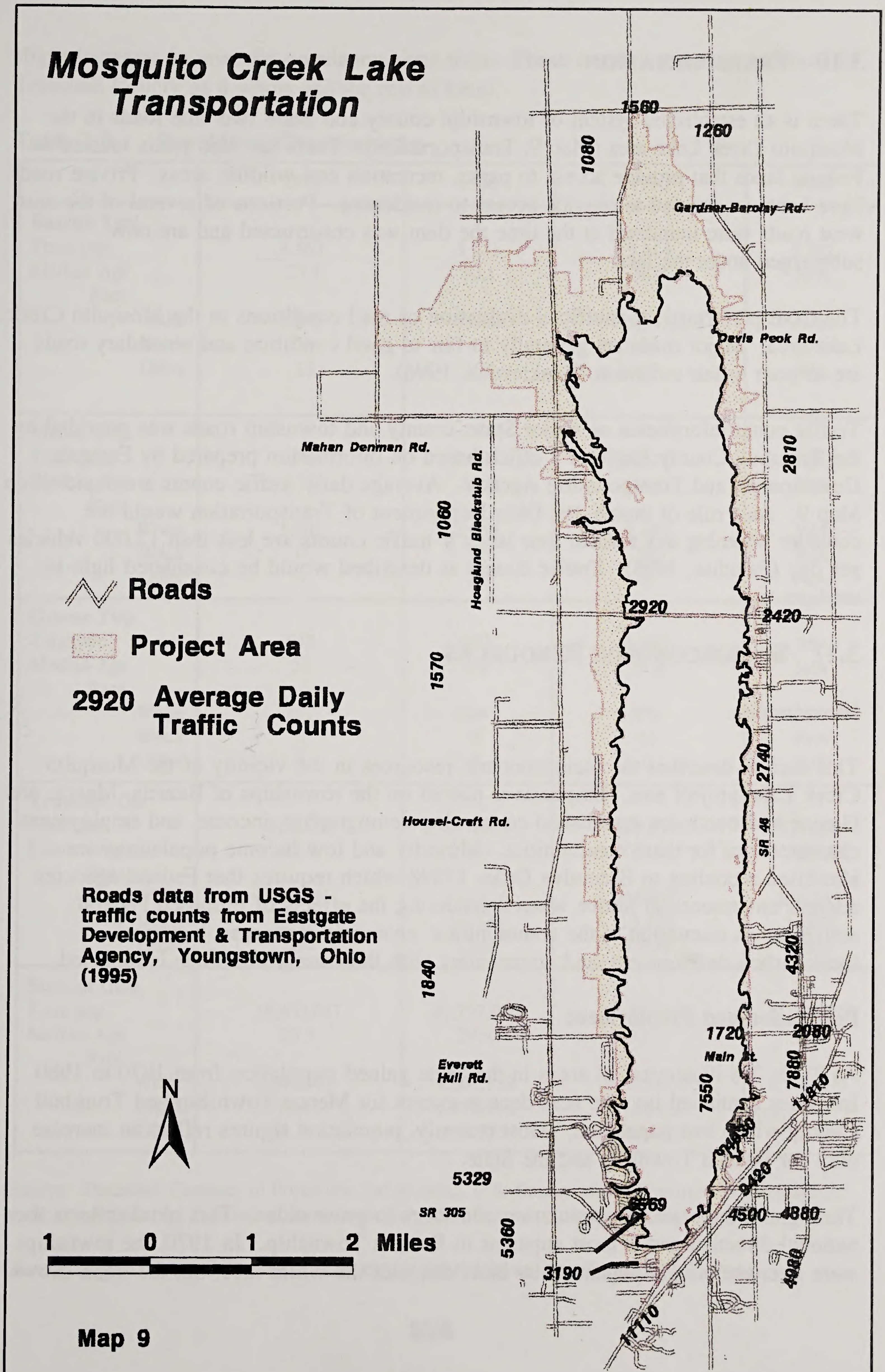
Introduction

The Mosquito Creek Lake project area is managed to provide multiple uses including flood control, municipal water supply, fish and wildlife management, and recreation. Land uses on private property adjacent to the project are mixed and include agriculture, residences, and limited commercial enterprises. Private property owners have been permitted by the COE to maintain mowed lawns and boat docks on project area lands that abut their properties and reach the lake shore. The aesthetic and visual perception of the landscape is one of suburban and rural countryside. The topography is relatively level and undeveloped natural areas are covered in grassland, marshlands, and woodland vegetation. The high quality of the scenic and recreational resources is important to those who visit or reside in the Mosquito Creek Lake area (Public Meeting, May 1996, Cortland, Ohio).

Location of Recreational Areas

Development has been most intense in the area south of the Route 88 Causeway. Here, the dam, project operations, the majority of recreational facilities, residences, and roads are located (Map 6, Mosquito Creek Lake Recreation Areas and Map 9, Mosquito Creek Lake Transportation). Recreational facilities available within the project area's southern boundary include year round campgrounds, swimming beach, picnic sites, and boat launches. Fishing opportunities, which are available all year, are considered excellent, particularly at the dam site, but hunting is not permitted between the dam and Everett-Hull Road. (Ruszkiewicz, 1997). Boat launches, fishing, and recreational trails occur on both sides of the lake. Both local and regional visitors are attracted to the area's excellent fishing and hunting opportunities. Visitation is estimated at approximately two million visitors per year (COE, 1993). The City of Cortland in Bazetta Township dominates the substantial residential development that has taken place in the area southeast of the lake.

The northern section of the lake, in contrast, is predominately waterfowl habitat and is surrounded by wetlands and woods. Hunting of migratory game, waterfowl, white-tail deer, and smaller game is allowed by permit between Mahan-Denman Road and the Route 88 Causeway. Hunting is also permitted in designated areas along both east and west shores, but is not allowed in the game refuge located north of Mahan-Denman Road. Private properties adjacent to the project area and surrounding the lake are also heavily hunted (Malloy, 1997). Hunting season for deer and smaller game spans the months of September through February (ODNR, 1997b). Wild turkeys are hunted during April and May. The season for duck and other waterfowl hunting is variable but generally opens in mid-October, concludes the end of November, and re-opens for two weeks in December.


Mosquito Creek Lake
Transportation
Roads
Project Area
2920 Average Daily
Traffic Counts
Roads data from USGS - traffic counts from Eastgate Development & Transportation Agency, Youngstown, Ohio (1995)
N
1 0 1 2 Miles
Map 9
1560
1260
1080
Gardner-Barclay Rd.
Davis Peck Rd.
Mahan Denman Rd.
Hoaglund Bleakstub Rd.
1060
2810
2920
2420
1570
2740
Housel-Craft Rd.
SR 46
4320
1840
1720
2080
Main St.
Everett
Hull Rd.
7550
7880
5329
SR 305
5360
3190
4500
4880
4980
11110

3.10 TRANSPORTATION

There is an established system of township, county and State two-lane roads in the Mosquito Creek Lake area (Map 9, Transportation). There are also roads located on Federal lands that provide access to parks, recreation and wildlife areas. Private roads have been constructed to provide access to residences. Portions of several of the east-west roads were inundated at the time the dam was constructed and are now submerged under the lake.

The COE performed an unofficial evaluation of road conditions in the Mosquito Creek Lake area. Major roads are generally in fair to good condition and secondary roads are in poor to fair condition (Ruskiewicz, 1996).

Traffic count information on major State, county and township roads was provided by the Trumbull County Engineer's office based on information prepared by Eastgate Development and Transportation Agency. Average daily traffic counts are depicted on Map 9. As a rule of thumb, the Ohio Department of Transportation would not consider widening any road to four lanes if traffic counts are less than 12,000 vehicles per day (Paradise, 1996). Traffic counts as described would be considered light-to-medium use.

3.11 SOCIOECONOMIC RESOURCES

Introduction

This section describes the socioeconomic resources in the vicinity of the Mosquito Creek Lake project area. Emphasis is placed on the townships of Bazetta, Mecca, and Greene and trends are established concerning demographic, income, and employment characteristics for these communities. Minority and low income populations are identified according to Executive Order 12898 which requires that Federal agencies address environmental justice when considering the effects of proposed Federal activities. A discussion of the communities' economic resources, historical hydrocarbon development, and connections with the county and State is included.

Population and Employment

As Table 3-8 illustrates, all areas in the State gained population from 1970 to 1980. Increases continued into the next decade except for Mecca Township and Trumbull County which lost population. Most recently, population figures reflect an increase only for Bazetta Township and the State.

Throughout the State, the population continues to grow older. This trend reflects the national direction and is most apparent in Bazetta Township. In 1970, the townships were overwhelmingly populated by individuals of the white race, but the trend shows slight increases in minority population since then. These trends are being mirrored in Trumbull County as a whole and the rest of Ohio.

Table 3-8. Population Characteristics

	1970	1980	1990	1996
Bazetta Twp.				
Total pop.	4,563	5,121	5,414	5,542
Median Age	27.1	30.1	36.8	N/A
Race				
White	4,545	5,060	5,347	N/A
Black	3	42	54	N/A
Other	15	19	13	N/A
Mecca Twp.				
Total pop.	1,704	2,695	2,525	N/A
Median Age	27.6	28.6	34.1	N/A
Race				
White	1,701	2,656	2,499	N/A
Black	0	12	20	N/A
Other	3	27	6	N/A
Greene Twp.				
Total pop.	877	903	1,017	959
Median Age	25	29	31.8	N/A
Race				
White	877	894	952	N/A
Black	0	9	65	N/A
Other	0	0	0	N/A
Trumbull Co.				
Total pop.	232,579	241,863	227,813	227,069
Median Age	27.7	30.8	35.6	N/A
Race				
White	218,881	225,816	210,830	208,837
Black	13,104	14,679	15,179	16,629
Other	594	1,368	1,804	1,603
State of Ohio				
Total pop.	10,652,017	10,797,630	10,847,115	11,172,782
Median Age	27.7	29.9	33.3	N/A
Race				
White	9,646,997	9,607,133	9,525,016	9,766,839
Black	970,477	1,076,742	1,152,230	1,264,493
Other	34,543	113,755	169,869	141,450

Source: Decennial Censuses of Population and Housing, U.S. Bureau of the Census; 1996 Population estimates prepared by Population Estimates Branch, U.S. Bureau of the Census.

According to Table 3-9, wealth and employment have improved in all areas.

However, poverty rates have declined only in Bazetta and Mecca Townships. All three townships currently have higher median income levels than the county and the State. Bazetta Township appears to be the most affluent with the highest income and lowest unemployment and poverty rates.

Table 3-9. Income and Poverty Rate

	1970	1980	1990	1996
Bazetta Twp.				
% unemployment		8.2	4.9	N/A
median family income		$25,946	$39,473	
% poverty rate		5.4	4.1	
Mecca Twp.				
% unemployment		12.7	4.4	N/A
median family income		$23,305	$38,182	
% poverty rate		7.0	5.6	
Greene Twp.				
% unemployment		7.5	4.5	N/A
median family income		$20,625	$35,000	
% poverty rate		11.7	15.3	
Trumbull Co.				
% unemployment	5.2	10.3	7.6	6.2
median family income	$10,778	$22,066	$33,313	N/A
% poverty rate	7.0	8.1	11.4	N/A
State of Ohio				
% unemployment	4.1	8.0	6.6	4.9
median family income	$10,313	$20,909	$34,351	N/A
% poverty rate	10.0	10.3	12.5	N/A

Source: Decennial Censuses of Population and Housing, U.S. Bureau of the Census; 1996 Unemployment rates prepared by Labor Market Information, Ohio Bureau of Employment Services.

Slight increases in jobs associated with the agriculture, forestry, and fishing industries were recorded for all areas except Greene Township during the 1980-1990 decade (Table 3-10). Retail trade declined in Bazetta and Greene Townships, but increased in Mecca Township, Trumbull County, and the State during the 1980s. The service sector showed the largest gains in employment while a corresponding decline in manufacturing was reflected throughout the State. This shift conforms to the national trend away from manufacturing toward services that was first observed around 1970 (Beauregard, 1989). Still, manufacturing remained the major employer in all three townships and the county in 1990. Bazetta Township is unique in that the number of employed persons declined by almost forty percent, perhaps reflecting an increase in the retired population in this community.

Table 3-10. Employment by Sector, Percentage of Persons

	1970	1980	1990	1995
Bazetta Twp., total employment		4,538	2,804	N/A
agriculture, forestry, fisheries		1.0	1.7	
manufacturing		42.1	35.3	
retail trade		17.9	4.3	
services		21.7	29.5	
Mecca Twp., total employment		1,093	1,181	N/A
agriculture, forestry, fisheries		2.9	3.6	
manufacturing		50.4	48.4	
retail trade		11.9	3.5	
services		17.8	17.5	
Greene Twp., total employment		344	515	N/A
agriculture, forestry, fisheries		8.7	8.7	
manufacturing		38.7	35.0	
retail trade		10.2	5.8	
services		9.2	28.0	
Trumbull Co., total employment	88,335	98,312	98,808	85,271
agriculture, forestry, fisheries	1.0	1.0	1.5	0.4
manufacturing	49.1	42.0	32.3	40.4
retail trade	15.0	16.4	18.6	22.1
services	18.2	22.3	27.9	23.6
State of Ohio, total employment	4,103,763	4,558,442	4,931,357	4,550,590
agriculture, forestry, fisheries	1.9	1.8	1.9	0.5
manufacturing	33.8	30.1	23.1	24.0
retail trade	16.1	16.3	17.6	21.7
services	21.8	26.8	31.4	31.6

Source: U.S. Bureau of the Census; 1995 Employment by Sector data from County Business Patterns, 1995.

Land Tenure and Use

Approximately one-third of each township is publicly owned and used for recreational purposes (Trumbull County Auditor's Office, Real Estate Division, 1997). Per capita recreational acres are almost one acre in Bazetta Township, two and one-half acres in Mecca, and nearly six acres in Greene Township. Recreational and residential land uses have been increasing in the townships since the mid-1970s (Mauger, 1997). Residential development has proceeded rapidly on former cropland, particularly in Bazetta Township. Visitors to the area are increasingly taking advantage of the recreational opportunities that are provided at the Mosquito Creek Lake project area (COE, 1993). The recreational facilities serve those coming from both within and outside of the county. The influx of recreationists utilizing facilities in Bazetta Township is increasing.

Property Values

Figure 3-1 (Assessed Property Valuation) illustrates property values for the three townships since 1987. Bazetta Township is again unique in demonstrating the greatest increase in property values during the last decade.

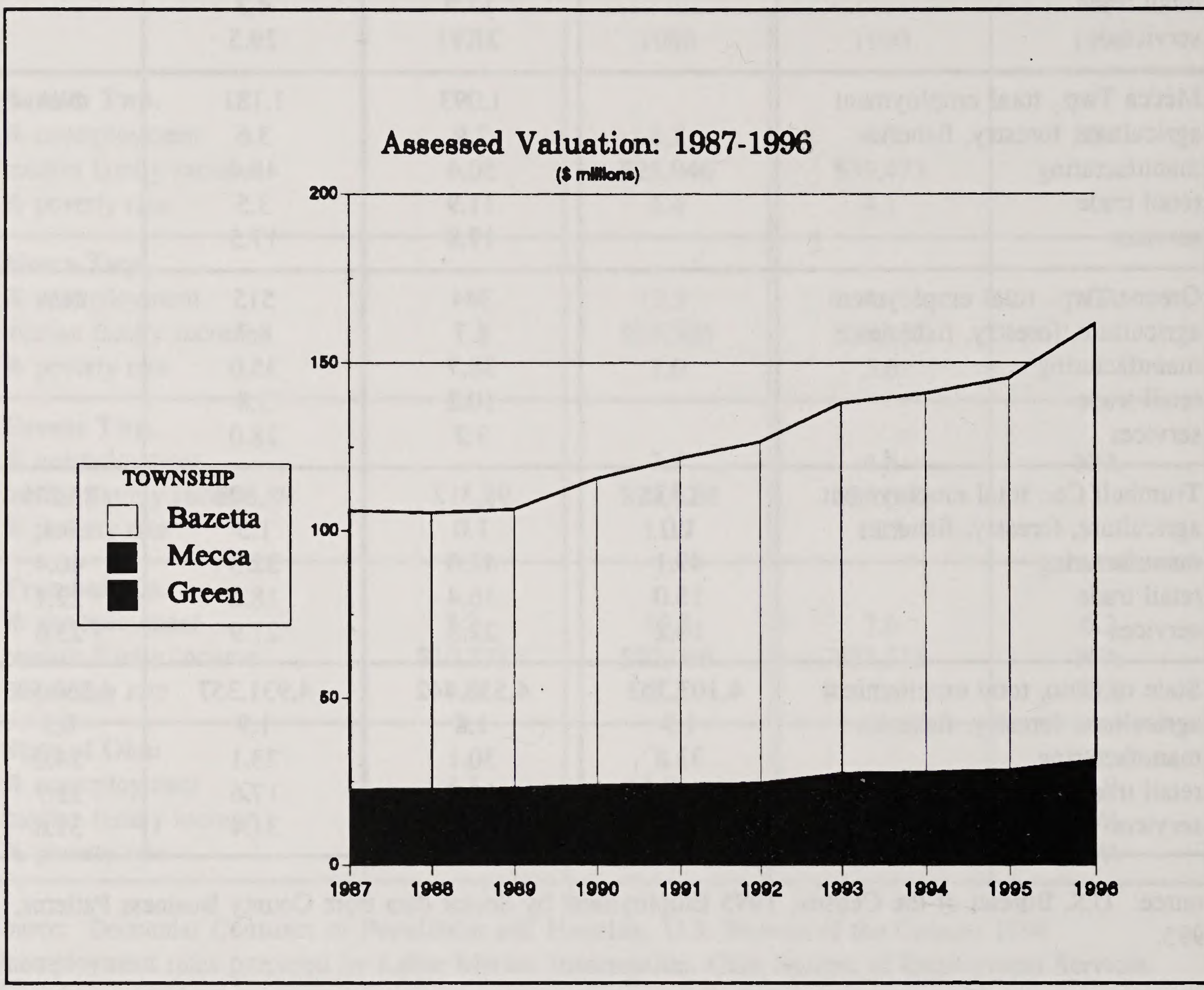


Figure 3-1. Assessed Property Valuation in Bazetta, Mecca and Greene Townships, 1987-1996.

Source: Trumbull County Auditor

Previous Hydrocarbon Development

Thousands of oil wells were drilled in this area during the second half of the 1800s (Simmers, 1997). The pace of development declined in the early 1900s, but drilling to multiple formations on a random basis continued to mid-century. In 1975, the first well to the Clinton formation was completed in Bazetta Township. Since then, development has been concentrated in Bazetta where approximately 120 gas wells have been drilled within one mile of Mosquito Creek Lake. About 20 wells have been drilled in Mecca Township, and most of these are located near the Bazetta/Mecca Township line. Five wells have been drilled in Greene Township since 1975. According to ODNR, Division of Oil and Gas, there were 178 producing oil and gas wells throughout the three townships in 1996. Most of the hydrocarbon resources are piped out of the local communities, although some of the natural gas is consumed locally during the winter months. All of the resources serve customers in the Ohio and Pennsylvania region.

3.12 PUBLIC HEALTH AND SAFETY

Appendix D summarizes public health and safety requirements. These include Federal, State, county and township public health and safety requirements, bonds and liability coverage, inspections, and emergency response.

3.13 CULTURAL RESOURCES

During early 1996, BLM and COE conducted a preliminary documentary search to identify known historic, prehistoric or traditional cultural properties within the Mosquito Creek Lake planning area and to assess the probability for locating yet-to-be identified properties. Additionally, in accordance with the implementing regulations for Section 106 of the National Historic Preservation Act (NHPA), BLM asked the State Historic Preservation Officer (SHPO) if any historic or prehistoric properties were known within the Mosquito Creek Lake planning area.

The full nature, extent and diversity of cultural resources in the planning area are unknown. While numerous archaeological and architectural surveys have been completed within Trumbull County, no comprehensive and scientifically controlled cultural resource studies of the Mosquito Creek Lake planning area have been conducted. Over the past 50 years, 37 prehistoric sites or "artifact find localities" have been reported by local avocational collectors within the Mosquito Creek Lake project area (Raymond, 1996). In 1996, the COE discovered an additional site immediately adjacent to the Mosquito Creek Lake project area (Payette, 1996).

Two broad-area archaeological surveys have been completed in the vicinity of the project area (White, 1971; Trumbull County Planning Commission and Cleveland Museum of Natural History, 1982). These surveys, plus studies that analyze museum and private collections from the general region, as well as interviews with collectors (Blank, 1970) and literature reviews (Sofsky, 1956), indicate that the 37 known sites do not represent the distribution or full range of cultural resources. The reported and collected artifacts, in all likelihood, represent only a portion of the full range of Indian artifacts that could be expected if systematic surveys were conducted in the Mosquito Creek Lake planning area.

No traditional tribal uses of the area were identified during the preliminary literature search. Further discussions with the SHPO confirmed that the Mosquito Creek Lake planning area is not within the historical range of any recognized Native American tribal groups (Tuckey, 1996).

3.14 Critical Elements Not Present or Affected

This proposal could potentially affect critical elements of the human environment as listed in BLM's National Environmental Policy Act Handbook H-1790-1 (BLM 1988). The following resource elements, while critical, are not present in the analysis area and, therefore, will not be addressed further: areas of critical environmental concern (ACEC), wild and scenic rivers, and wilderness areas. ACECs are authorized in Section 202(c)(3) of the Federal Land Policy and Management Act. An ACEC is a BLM designation for an area within the public lands where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards. Because BLM is not the Federal surface management agency at Mosquito Creek Lake, BLM has no authority to designate these lands as an ACEC.

CHAPTER FOUR - ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter describes the potential environmental consequences or impacts under either alternative. The analysis is based on the best available information and current scientific understanding of the impacts of hydrocarbon development. These analyses are based on assumptions from the reasonably foreseeable development scenario (RFDS) (Appendix B). The RFDS has identified high, moderate and low development potential areas Map 4, Mosquito Creek Lake Development Potential Areas, which reflect the likelihood of additional oil and gas development in the Mosquito Creek Lake planning area. Although impacts in the low development potential area are addressed, the analysis of impacts is focussed on the high and moderate development potential areas due to the increased likelihood of development.

The analysis of potential impacts is documented for two purposes. First, there is the statutory requirement for analysis of environmental impacts under the *National Environmental Policy Act of 1969*. Second, and more importantly, it documents the potential impacts so that resource specialists are able to develop appropriate mitigation measures to be considered to lessen or eliminate impacts resulting from oil and gas development.

Table 4-1 summarizes potential impacts and mitigation measures developed through this process. Section 4.2 contains a detailed description of potential impacts and identifies mitigation measures. Impacts are lessened to some extent by existing laws, regulations, or orders. However, in many cases, additional measures were identified to further lessen or eliminate specific impacts (Appendix A).

Following application of the special mitigation measures, some impact may still remain. This impact is called the residual impact. Residual impacts for each alternative by resource value are presented on Table 4-15. Mitigation measures and residual impacts are described by issue in Section 4.1.

Section 4.3 examines cumulative impacts under either alternative, section 4.4 summarizes anticipated impacts by resource value following mitigation, and section 4.5 outlines monitoring actions that would be implemented to ensure compliance with identified mitigation measures and achieve resource objectives.

4.1 SUMMARY OF POTENTIAL IMPACTS AND MITIGATION AND ANSWERS TO ISSUE QUESTIONS

The following information is presented as a summary of the detailed analysis found in Section 4.2. This section identifies potential impacts of leasing and subsequent development, addresses mitigation measures, and provides answers to the issue questions outlined in Chapter One (Section 1.4).

It should be mentioned that if development occurs, individual well site proposals will be reviewed and specific mitigation will be applied on a case-by-case basis prior to approval. Additional measures may be identified at that time.

ISSUE #1 - WATER QUALITY: Oil and gas leasing and subsequent operations may affect surface and groundwater quality in the watersheds of Mosquito Creek Lake. The resource issue questions are:

a. How will the quality of the municipal drinking water supplies be maintained?

Both the City of Warren and City of Cortland rely on Mosquito Creek Lake as a source of drinking water. This section deals directly with Mosquito Creek Lake as a primary drinking water supply to the City of Warren. Potential impacts and mitigation measures relate to the surface water. Potential impacts to the City of Cortland's water wells are addressed under Issue #1, question b.

Water quality of Mosquito Creek Lake would be protected in several ways. First, the location of any federally permitted wells would be some distance from the lake. In addition to the "no surface occupancy" restriction, the COE has identified a requirement restricting occupancy for well sites within 100 feet of intermittent and 200 feet of perennial streams located immediately adjacent to or crossing the COE property boundary. Second, oil and brine storage facilities would be surrounded by earthen berms which would contain potential leaks, spills and tank overflows. This mitigation measure would also prevent oil and brine from entering tributaries to the lake. BLM will also require mitigation measures to prevent well blowouts.

The transportation of produced oil and brine was raised as an issue by the public. The analysis found that under Alternative B and at full production, tanker trucks would service an additional 27 federally permitted wells and four tank batteries as compared to Alternative A, providing an additional 40 round trips per year. By comparison, tankers currently service tank batteries associated with 2,400 existing wells in Trumbull County. A statistical risk assessment of tanker truck accidents is not possible, since there have not been any documented accidents of this nature on Trumbull County roads. It can be assumed, however, that tankers servicing the four additional tank batteries would not pose a detectable increase in the probability of such accidents. It is likely that tankers visiting existing private wells would also service the tank batteries associated with the additional 27 federally permitted wells. Risk of tanker truck accidents diminishes further when considering only those accidents which might affect water quality of the lake.

Improper construction and stabilization of work sites and production facilities could also have an impact on water quality by adding sedimentation to nearby water bodies. Two analyses were conducted to assess whether and how much soil could be transported to the lake from areas being disturbed. The first study, conducted by Youngstown State University (YSU), found that leasing would add barely measurable levels of sediment to the lake and its tributaries. BLM applied YSU's methodology but included additional mitigation measures in its analysis to eliminate the potential for non-point source erosion.

b. How will existing groundwater quality and quantity be maintained?

This issue addresses both private and the City of Cortland's wells.

Groundwater quality would be protected by properly setting and cementing steel casing in the wellbore. Casing typically extends 50 feet to 100 feet below the bottom of the deepest freshwater aquifer. This practice protects aquifers by confining drilling and produced fluids, i.e. oil and brine, to the wellbore.

Casing and cementing of the wellbore reduces the risk of the drilled hole collapsing and prevents movement of fluids from one formation to another. Once casing is cemented in place, potential impacts to adjacent water wells, such as loss of pressure or increased turbidity, would be eliminated. Bazetta Township ordinances require operators to test not less than four water wells prior to drilling. BLM would extend a similar requirement to Mecca and Greene Townships.

c. How will quality outdoor recreational experiences be maintained?

This issue was raised when it was believed that Federal property would be used to locate wells and other facilities. Since then, the Corps of Engineers (COE) decided that no Federal surface land could be occupied ("no surface occupancy" restriction) for oil and gas drilling/production operations. It is possible, however, that some recreational experiences could be affected as a result of leasing, particularly from noise and visual impacts from operations on adjacent private land.

The COE has requested that no operation occur within 200 feet of developed recreational facilities. BLM would require operators to implement measures that would ensure noise levels during production do not exceed 45 decibels at recreational facilities and residences. These measures could include distance setbacks and/or technological/engineering features designed to lessen noise levels. In addition, BLM would restrict drilling during the primary recreation season (Memorial Day to Labor Day).

Operators would be required to use vegetative screens, or paint facilities to blend with the surrounding landscape. Recreational fishing would not be affected because Mosquito Creek Lake and its tributaries would not experience water quality degradation.

ISSUE #2 - AESTHETICS: Oil and gas leasing and subsequent operations could influence the aesthetic qualities of the Mosquito Creek Lake area for residents and users. Decisions will be made to address the following questions:

a. How will the scenic qualities of Mosquito Creek Lake be managed and maintained?

See Issue #1, question c.

b. How will noise levels be minimized?

See Issue #1, question c.

c. How will odors be minimized?

Some localized odors may be generated at tank batteries. BLM, in cooperation with State and local authorities and landowners, would document, investigate and resolve complaints regarding odors. In some instances, BLM would require charcoal filters on vent stacks.

ISSUE #3 - WETLANDS: Oil and gas leasing and subsequent operations may affect wetland and associated resources. Decisions will be made to address the following questions:

a. How will the wetland's hydrologic and biological functions be protected?

BLM would implement the provisions of Executive Order 11990, Protection of Wetlands, which require that Federal agencies avoid impacts to wetlands. BLM would work with operators to locate facilities in non-wetland areas, where possible. Indirect impacts to wetlands would be controlled by use of earthen berms around tank batteries and placement of erosion control measures around all disturbed areas. Operators would be required to obtain Section 404 permits from the COE to do any work in a wetland.

b. How will waterfowl habitat be protected?

Most waterfowl habitat is located in the low development potential area where there are extensive wetlands. See Issue #3, question a, above for a discussion of the residual impacts to wetlands. Some short-term disturbance to breeding and nesting waterfowl may occur due to noise. It is unknown how much noise will affect the nesting patterns of these birds. The greatest noise impacts will occur during drilling and would, therefore, be restricted to a two to three month drilling period.

ISSUE #4 - SPECIAL STATUS SPECIES: There are known Special Status Species in the Mosquito Creek Lake planning area. Decisions will be made to address the following question:

a. How will Special Status Species and their suitable habitat be protected?

Specific mitigation measures would be developed at the time individual wells are proposed. In general, however, special status species would be protected by avoidance of their habitats. Prior to any site disturbance, BLM would consult with the U.S. Fish and Wildlife Service regarding the effects of the proposed disturbance. BLM would not approve drilling permits or enter into Federal agreements if the well is within one-half mile of an active bald eagle nest or within one-half mile of an established nesting territory. Similarly, BLM would not agree to well locations which would negatively affect other species of concern such as the Indiana bat, massasauga rattlesnake, or gray birch.

ISSUE #5 - RECREATION: Oil and gas leasing and subsequent operations could have impacts on the outdoor recreation opportunities available at the Mosquito Creek Lake project area. Decisions will be made to address the following questions:

a. How can impacts to recreational users and facilities be minimized?

See Issue #1, question c.

b. How might duck hunting occur concurrently with oil and gas operations?

It is not anticipated that oil and gas development would affect hunting opportunities. The prime hunting areas are located at the northern end of Mosquito Creek Lake, which is an area of low development potential for oil and gas.

c. How will recreational fishing opportunities be maintained?

See Issue #1, question c.

ISSUE #6 - CULTURAL/HISTORIC, NATIVE AMERICAN RESOURCES: Oil and gas leasing and subsequent operations may affect historic, archaeological and traditional cultural properties. Decisions will be made to address the following questions:

a. How will National Register of Historic Places (NRHP) eligible resources be identified, evaluated and appropriately treated?

BLM would consult with the Ohio State Historic Preservation Officer prior to surface disturbance. Most areas would likely need on-the-ground cultural surveys prior to BLM approval of drilling permits or Federal agreements.

b. How will non-NRHP eligible resources be identified, evaluated and appropriately treated?

See Issue #6, question a.

ISSUE #7 - HEALTH AND SAFETY: Oil and gas leasing and subsequent operations could create health and safety concerns for recreational users and residents in the immediate Mosquito Creek Lake area. Decisions will be made to address the following question:

a. What actions can be taken to ensure safe operations?

Public health and safety may be affected by a loss of well control (blowouts), surface water or aquifer contamination, and injury during acts of vandalism or trespass. Although the analysis identified several potential impacts to public health and safety, the probability that any of them would occur is considered remote. To further reduce the possibility of public health and safety impacts, additional mitigation measures, beyond existing requirements, were identified to address concerns. Existing and additional measures include blowout prevention equipment, downhole cementing and casing program, safety setbacks, site security measures, site specific assessment at the time a well is proposed, marking of gas gathering lines, registration of underground utilities, and design features that lessen the chance of storage tank explosions/fires from lightening strikes (see Appendix A).

ISSUE #8 - LIABILITY: Oil and gas leasing and subsequent drilling, production and plugging operations could pose a liability problem if operators do not properly drill and maintain wells/facilities through a well's productive life or do not properly abandon wells/facilities at the time oil and gas resources are depleted. Decisions will be made to address the following question:

a. How will BLM ensure that wells and other facilities be operated in a manner that minimizes environmental and public health risks during the life of the wells and after they are depleted?

Existing economic (bonds) and regulatory (regulatory framework and progressive enforcement) controls and procedures exist that ensure wells/facilities are drilled and operated in a manner that does not pose an unnecessary risk to residents and visitors to the Mosquito Creek Lake area. These economic and regulatory controls would also ensure that wells and facilities are properly plugged and abandoned. In the event an operator does not properly plug and abandon a well, bonds can be used. If necessary, State orphan well funds could be used for plugging and abandonment.

Two issues were identified as being beyond the scope of the document. Although these issues are addressed in this document and potential impacts are described, there are no special mitigation measures developed specifically to address these issues. These two issues are:

ECONOMIC CONCERNS - Oil and gas leasing and subsequent operations may affect property values in the Mosquito Creek Lake planning area.

Analysis of property values during the past ten years indicates that values have not declined despite increased oil and gas development in the area. In fact, property values in Bazetta Township, where most existing oil and gas development is concentrated, have risen higher than in Mecca or Greene Townships.

ROADS - Traffic associated with oil and gas operations may impact road conditions in the Mosquito Creek Lake planning area.

Additional passenger and commercial vehicles would utilize local roads as a result of either alternative. Under both alternatives traffic levels (as estimated at intersection of State Route 305 and Hoagland Blackstub Road) would increase less than one percent during the drilling and production phases. It is anticipated that this figure overestimates the actual increases in traffic, since it is likely that some vehicles would travel to existing private and newly permitted facilities on concurrent trips. Regulation of commercial vehicles is administered by the State and county.

Table 4.1 summarizes potential impacts and mitigation measures by resource value. The resource values and associated resource objectives/evaluation criteria are identified in the first column. The second column outlines the potential impacts of leasing and subsequent oil and gas development. Impacts are those that have been identified prior to implementing any special mitigation measures. The third column identifies mitigation measures which would be used and/or considered if operations occur in the Mosquito Creek Lake planning area. These measures include both existing regulations, laws, orders, and ordinances as well as special mitigation measures identified as a result of the impact analysis process.

Table 4-1. Resource Values and Objectives, Potential Impacts and Mitigation Measures

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
LAND USE	Loss of use of portions of farmland, open space, natural areas, or residential property Introduction of an industrial setting or quality	Limit amount of disturbance to only area needed See potential mitigation under Noise and Recreation/Visual
GEOLOGY	Geologic hazards (blowouts) Irretrievable commitment of resources (Alt. B only)	BLM Onshore Order #2 Use of blowout prevention equipment Other special air drilling requirements

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
SOILS/PRIME FARMLAND Minimize soil erosion Minimize physical/chemical impacts Maintain existing surface and groundwater quality in the Mosquito Creek Lake watershed	Loss of soil Soil compaction Loss of productivity Modified soil structure Soil contamination Loss of agricultural land	Site specific assessment at time well is proposed Standard Army Mineral Lease Stipulation # 21 (100 foot and 200 foot setback from intermittent and perennial streams) Limit amount of disturbance to only area needed Clean Water Act Spill Prevention, Countermeasure and Control Plan requirements Federal Farmland Protection Policy Ohio Oil and Gas Regulations Storage and disposal of brine and other oilfield wastes Bazetta Township Gas and Oil Well Regulations Access road graded, vegetative buffer around tank battery Reserve pits would be lined with plastic Use of best management practices during construction activities Require re-grading, re-planting and mulching immediately after any construction is completed No earthen pits in areas of shallow high water tables Stockpiling topsoil, mulching exposed soil, use of sediment barriers, stabilizing road surfaces, seeding Cover/silt fence stockpiled soils to minimize soil loss Site specific - no construction within a defined distance of any drainageway or surface water

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
WATER RESOURCES Maintain existing surface and groundwater quality in the Mosquito Creek Lake watersheds.	Increase in suspended solids, sediment deposition, turbidity Surface/groundwater contamination Reserve pit fluids Drilling additives, fracturing fluids, saline formation fluids Oil/brine tanks, flowlines Brine disposal Turbidity in aquifers	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy of State lands Standard Army Mineral Lease Stipulation # 21 (100 foot and 200 foot setback from intermittent and perennial streams) Clean Water Act - Spill Prevention, Countermeasure and Control Plan (SPCC) requirements Safe Drinking Water Act - Underground Injection Control (UIC) program Federal Oil and Gas Requirements BLM Onshore Order #2 (casing and cementing program) BLM inspection program State Oil and Gas Requirements Regulates disposal of exploration and production wastes-Class II UIC wells State inspection program Copies of SPCC plans submitted to BLM and Mosquito Creek Lake Project Manager Special reserve pit liner/construction requirements Requirement for maintenance of 2 feet of freeboard in the reserve/working pits Requirement for pressure-vacuum thief hatch, vent-line valve, and plugs on all other vent ports on oil storage tanks Requirement for dike around tank battery Fluids used in fracturing will not be permitted in reserve pit Requirement for prompt removal of free liquids from reserve pit (see also Public Health and Safety) Water monitoring requirement Soil erosion control measures (see also Soils) Possible segregation of saline cuttings Possible solidification of pit contents prior to burial Site specific - No construction within a defined distance of any drainageway or surface water

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
FLOODPLAINS Avoid impacts associated with occupancy and modification of floodplains (Executive Order 11988)	See impacts to water resources, soils, wetlands, etc.	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy on State lands Avoidance of floodplains COE can prohibit private surface owner from installing a structure in an easement if structure is determined to be a detriment to Federal lands Site specific mitigation measures would be identified if location in floodplain could not be avoided
WETLANDS Maintain and/or enhance wetland values in the Mosquito Creek Lake watersheds. Avoid impacts to wetlands (Executive Order 11990)	Disruption of wetland species life cycles Loss of wetland vegetation, wildlife habitat Lessen ability to absorb and store floodwaters, recharge groundwater and filter pollutants	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy of State lands Avoidance of location in wetlands Site specific mitigation measures would be identified if wetlands could not be avoided Use of best management practices when crossing streams or wetlands Clean Water Act 404 permitting requirements See also Potential Mitigation under Water Resources, Soils

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
SPECIAL STATUS SPECIES Maintain and/or enhance special status species populations and suitable habitat. Endangered Species Act of 1973 Ohio Revised Code 1501:18-1-03, 1501:31-23-01, and 1531.25 (designation and protection of special status plants and animals)	Loss of feeding, resting, or nesting habitat Disturbance to bald eagle nesting cycles	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy of State lands No wells/facilities will be approved within one-half mile of active bald eagle nest No wells/facilities will be approved within one-half mile of an established bald eagle nesting territory Restrictions on locations where potential Indiana bat habitat is present Removal of gray birch will be avoided

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
WILDLIFE Minimize direct loss of wildlife Minimize loss of habitat	Habitat removal Loss of undeterminable number of reptiles, amphibians, small mammals, and invertebrate species Change in behavior patterns or abandon habitat due to noise	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy on State lands Limit amount of disturbance to only area needed Refer to Potential Mitigation under Noise
FISHERIES/AQUATICS Maintain current outdoor recreational opportunities and facilities and minimize impacts to future opportunities and facilities. Maintain existing surface and ground water quality in the Mosquito Creek Lake watersheds.	Disruption of life cycle of fish and other aquatic wildlife See also Impacts to Water Resources, Wetlands, Soils	Refer to Potential Mitigation under Water Resources, Soils and Wetlands

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
AIR QUALITY Maintain or minimize the impacts to the aesthetic values present at the Mosquito Creek Lake area. 40 CFR 51, "Subpart W-Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (ensure conformity with State Implementation Plan for maintaining and/or enhancing air quality)	Increase in particulates Increase in carbon monoxide, nitrogen oxide, total reduced sulfur compounds, volatile organic compounds Odors	COE NSO stipulation/No occupancy on State lands BLM Onshore Order #2 Dust control, automatic igniter BLM Onshore Order #4 Pressure-vacuum thief hatch and/or vent-line valve on oil tanks BLM Notice to Lessee 4A Prohibits venting or flaring of gas except during well testing or emergencies Existing State safety setbacks (see also Public Health and Safety) Bazetta Township ordinances Roads, odors, safety setbacks Cortland ordinances Roads, dust, noise, vibration, odor Requirement for pressure-vacuum thief hatch, vent-line valve, and plugs on all other vent ports of oil storage tanks No open burning of garbage or refuse Restriction on drilling operations between Memorial Day and Labor Day Consider activated charcoal filters on vent stacks Site specific dust suppression measures

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
NOISE Maintain or minimize the impacts to the aesthetic values present at the Mosquito Creek Lake area. Occupational Safety and Health Administration workplace noise exposure standards (29 CFR 1910.95) USEPA noise standards for construction equipment, medium and heavy weight vehicles (40 CFR 204 and 205) USEPA guidelines for noise levels below which there	Annoy recreational users Degrade recreation experience Impacts to residents Impacts to wildlife (bald eagle)	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy on State lands Standard Army Mineral Lease Stipulation # 14 (200 foot setback from developed recreation areas) State safety setbacks (see also Public Health and Safety) Bazetta Township ordinances Safety setbacks, dB(A) restrictions Cortland ordinances Restriction on drilling operations between Memorial Day and Labor Day BLM will not allow any producing well located adjacent to a COE or ODNR developed recreation area to emit noise that exceeds 45 dB(A) BLM will not allow well servicing or workover operations before sunrise or after 10:00 p.m. from Memorial Day to Labor Day Technological/engineering design features will be considered on a site specific basis to reduce noise impacts (see Appendix A for examples of design features) Refer also to mitigation measures under Special Status Species

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
RECREATION AND VISUAL Maintain current outdoor recreational opportunities and facilities and minimize impacts to future opportunities and facilities. Maintain or minimize the impacts to the aesthetic values present at the Mosquito Creek Lake area.	Annoy recreational users Degrade recreation experience Traffic, noise, dust, odors Modified landscape	Site specific assessment at time well is proposed COE NSO stipulation/No occupancy on State lands Standard Army Mineral Lease Stipulation # 14 (200 foot setback from developed recreation areas) Safety setbacks (refer to Public Health and Safety) Restriction on drilling operations between Memorial Day and Labor Day Site specific distance buffer from residences, recreational facilities, vegetative buffers, painting of facilities Refer also to mitigation measures under Air Quality and Noise
TRANSPORTATION	Road deterioration Increase in traffic Traffic accidents	Ohio Department of Transportation Special hauling permits County/Township Permitting, weight restrictions, frost laws, bonding Cortland Permits, bonds, liability Restriction on drilling operations between Memorial Day and Labor Day Royalty income targeted for use on roads and schools

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
CULTURAL RESOURCES Maintain and/or enhance the historical, archaeological, and traditional cultural resource values. National Historic Preservation Act, Section 106 American Indian Religious Freedom Act and the Native American Graves Protection and Repatriation Act	Loss of cultural sites	Site specific assessment at time well is proposed BLM must consult with State Historic Preservation Officer prior to surface disturbance BLM must consult with Native American tribal groups with interests in the planning area to identify issues or concerns Because very little is known, surveys will likely be required prior to any surface disturbance

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
PUBLIC HEALTH AND SAFETY Sustain and/or improve current safety levels for recreational users and residents. State/township safety setbacks Refer also to Water Resources and Noise Criteria	Loss of well control Emergency response capability Public safety Contamination of drinking water (see also Water Resources Impacts)	Site specific assessment at time well is proposed Underground utilities register with Ohio Utility Protection Service (OUPS) ODNR, Division of Oil and Gas requirement for marking of gas gathering lines Bazetta Township ordinances Setbacks, review of proposal, site security, maintenance of tank battery facilities, flame arresters, notification requirements Onshore Order #2 requirements Blowout prevention equipment, casing and cementing program, air drilling requirements BLM Onshore Order #4 Pressure-vacuum thief hatch and/or vent-line valve on oil tanks BLM/State inspection program The following measures apply for well sites near residential areas: Free liquids from drilling pits will be removed within seven days Unattended drilling pits for well sites will be fenced Drilling pits will be closed within 14 days after drilling Requirement for pressure-vacuum thief hatch, vent-line valve, and plugs on all other vent ports of oil storage tanks Requirement for pressure switch at wellhead Requirement for fencing and locked gate at wellhead, tank batteries, production equipment, and access road Requirement for tank battery to be placed on 5 inch bed of limestone and/or natural stone Tank battery site, fence and surface equipment shall be made of non-corrosive material or painted with weather proof paint Requirement for public notification Signage at wellhead and tank battery Refer also to Potential Mitigation Measures for Water Resources, Air Quality, Noise

Resource Value, Resource Objective/ Evaluation Criteria	Potential Impacts	Existing Constraints, Mitigation Measures
SOCIOECONOMICS	Change in property values Royalty income to county Multiplier effect	None

4.2 Analysis of Environmental Impacts

This section provides the analysis of environmental impacts under both management alternatives. As noted in several locations, "no action" and "no lease" does not mean that operators will not continue to develop and extract oil and gas resources in the area. Rather, it means that operators will not access Federal minerals through directional drilling. It is anticipated that companies will enter into surface use agreements and private leases on adjacent private lands regardless of any decisions stemming from this PA/EA. In some instances, operators may wish to include unleased Federal oil and gas resources in a drilling unit which is developed through a private well. BLM may enter into a type of Federal agreement called a Compensatory Royalty Agreement (CRA) with operators to recover the proportionate share of Federal royalties. If a Federal agreement is approved, the operator could request a variance to the State spacing setback of 500 feet. This would allow the operator to locate the bottomhole of a well closer than 500 feet from the Federal property line.

Under Alternative A ("No Action"), it is anticipated that 13 new well pads would be constructed for private wells drilled to develop the Clinton formation. It is possible that a single, more expensive well may be drilled into the deeper Rose Run formation. No wells would be drilled into the Federal mineral estate. If Alternative B (leasing under a "No Surface Occupancy" stipulation) is chosen, up to 27 additional federally permitted wells may be drilled. If leasing occurs, BLM may enter into a type of Federal agreement called a Communitization Agreement (CA) to include leased Federal oil and gas in a drilling unit with adjacent private minerals. This drilling unit may be developed through either a private well or federally permitted well. Please consult Chapter Two for a complete explanation of the alternatives and how the reasonably foreseeable development scenario was developed.

4.2.1 Land Use

Under either alternative, the primary impact to land use would be long-term loss of use of portions of farmland, open space, natural areas, or residential property. Under Alternative A and Alternative B, approximately seven acres and 12 acres respectively would be removed from current use during the production phase. These areas would be stabilized and used for access roads, wellhead and turnaround areas, and tank batteries. In some areas, burial of pipeline could preclude use of the land for construction projects during the production phase. A long-term aesthetic impact could result from introduction of an industrial setting or quality near a recreation area or in a natural or residential area. Impacts and mitigation measures related to this aesthetic impact are addressed in Sections 4.2.7, Air Quality/Noise and 4.2.8, Recreation and Visual Resources.

4.2.2 GEOLOGY

Introduction

This section analyzes the potential impacts associated with geological factors, such as blowout potential, ground subsidence caused by drilling, and movement along fault areas caused by drilling fluid disposal.

ANALYTICAL ASSUMPTIONS

Alternative A

Federal oil and gas resources in the project area would not be available for leasing. However, these resources could be developed through Federal agreements which combine private and Federal minerals in 40 acre drilling units. By entering into these agreements, operators would be able to drill closer to the Federal property than the State spacing setback of 500 feet. Assuming wells would be drilled approximately 200 feet from the Federal property boundary, Federal participation in the drilling unit is estimated to be approximately 33% (13.25 acres) for any given well. A Federal property boundary of 42,000 linear feet in the high/moderate development potential areas results in a maximum produced Federal area of 530 acres.

Alternative B

Federal oil and gas resources in the project area would be leased, but no drilling would be permitted on project area lands. Wells would be directionally drilled from adjacent private land to develop Federal oil and gas resources. Under current economics, BLM projects that directional wells would extend up to 2,300 feet from surface locations. This projection, coupled with an assumed productive area of 40 acres surrounding the bottom of each well, means that this alternative would effectively develop an area 3,050 feet wide around the perimeter of the high/moderate development potential areas. Under this alternative, operators would be more likely to use existing well pads at a distance of 500 feet from Federal property boundaries. If half of the wells are drilled in this manner, an average setback distance of 350 feet from the Federal property boundary would result. Using this model results in production from about 2,600 Federal acres, or about five times as much produced acreage as in Alternative A.

IMPACTS BY ALTERNATIVE

Potential impacts and hazards based on geological factors, and mitigation/preventive measures used to avoid them or counteract their effects, will not vary based on the alternative selected. Impacts from drainage of Federal and private acreage will vary by alternative. The following sections identify and analyze potential impacts and hazards based on geological factors. Other impacts may be found in specific resource sections throughout this chapter.

Drainage Potential

Drainage occurs when a well (i.e., an "offending well") produces oil and gas from beneath an adjacent property and the mineral owner of that property does not receive any revenue from the well. Drainage can occur even though a well is drilled in conformance with State spacing requirements as wells can recover oil and gas from beyond the boundaries of a 40-acre spacing unit. Most oil and gas leases, including Federal leases, contain a clause that requires a lessee to protect the lease from drainage. A lessee may protect a lease from drainage by either: 1) drilling a well to offset the effects of the offending well; 2) paying royalty (i.e., compensatory royalty) to the lessor on the amount of oil and gas being drained from the lessor's property; or 3) entering into an agreement with the offending well's owner to share costs and revenues from the offending well. If the land being drained is not leased, the mineral owner is typically left with little choice but to suffer the economic loss of their oil and gas to the offending well.

If Federal minerals in the Mosquito Creek Lake project area are not leased (Alternative A), drainage of the Federal lands is likely to occur as wells are drilled on adjacent private minerals. Revenue losses due to drainage would depend on the success of BLM to enter into Federal agreements with the operators of offending wells. Leasing the Federal minerals (Alternative B) would place the responsibility for drainage correction on the Federal lessee, making correction and prevention more likely. Concern has been expressed that Federal leasing would result in reduced production from existing private oil and gas wells near the Federal property. Indeed, wells drilled to develop Federal minerals may adversely affect production from adjacent private wells and may in fact drain undeveloped private minerals. This is a reality of oil and gas development that cannot be avoided if all mineral owners wish to timely and efficiently develop their properties. BLM will ensure that an equitable spacing of wells is adhered to in the drilling of any Federal wells at Mosquito Creek Lake to protect the rights of adjacent well owners. Also, to the extent possible, BLM will utilize Federal agreements with adjacent private mineral owners to avoid creating drainage of private oil and gas.

Blowout Potential

Blowouts are uncontrolled flows of formation fluids (brine, natural gas, and oil) from the wellbore which reach the surface. Blowouts can result in explosions and fires. "Kicks," or pressure spikes encountered during drilling are short-term increases in gas returns due to penetration of unexpected high-pressure, low-volume gas pockets. Kicks may signal an impending blowout in some producing areas, but in the Trumbull

County area there are no reservoirs known of sufficient volume or pressure to create a true blowout. Kicks are normally handled by choke/manifold systems and flaring of the encountered gas.

Ground Subsidence Potential

Concern has been expressed over the possibility of ground subsidence because of the withdrawal of reservoir fluids during production. Subsidence has been noted in several areas of long-term, high volume shallow oil production in the United States, such as parts of the Bradford oil field, Pennsylvania, the Louisiana gulf coast, and the Los Angeles basin oil fields.

For ground subsidence to occur, oil-saturated, usually semi-consolidated, thick sequences of stacked sandstone reservoirs must be close to the surface and must be produced for many decades. These factors are not present in Trumbull County.

Movement Along Fault Zones Caused by Disposal Wells

Fault movement due to deep-well disposal of liquid wastes in fault zones has been documented in Colorado and has been suspected elsewhere. Fault zones must be present and must confine the disposed fluids for movement to take place. Such fluidization of faults is thought to "lubricate" the zones, reducing friction along the adjacent walls and allowing movement to take place.

Concern has been expressed that disposal of fluid waste (drilling fluids, completion and workover fluids, brine) in disposal wells will cause movement along fault or fracture zones. This has been identified as a concern because small earth tremors felt in Ashtabula County, Ohio, have been attributed by some researchers to injection of liquid wastes from a power plant into potential fault zones in the deep Mt. Simon formation or the crystalline Precambrian basement (Ahmad, 1989). It is important to note that other researchers have disagreed with this conclusion (Roeloffs, 1989). The northeastern corner of the state, i.e., the Lake Erie shoreline of eastern Ashtabula County, is naturally seismically active. The wells cited are deep Class I hazardous waste disposal wells, not the shallower Class II wells used to dispose of drilling and production wastes.

Liquid wastes from oil and gas wells in Ohio are typically injected into the Newburg formation, or depleted zones of the Clinton sandstone, both well above any potential Precambrian fault or fracture zones. There is no evidence that subsurface disposal of oil and gas wastes into Class II disposal wells has caused any kind of earth movement in the State.

Irretrievable and Irreversible Commitment of Resource

Under Alternative B, approximately 10.25 billion cubic feet (BCF) of natural gas and 57,000 barrels of oil would be produced over the life of the project. If Alternative A is chosen, roughly 3.5 BCF and 20,000 barrels of oil would be produced. These projections were developed by MFO petroleum engineer, Tim Abing, using ARIES software.

4.2.3 SOILS AND PRIME FARMLANDS

This section describes the impacts to soils and prime farmlands. Impacts are related to soil erosion and sedimentation and contamination due to spills of oil and other chemicals.

SOILS

Introduction

Activities typically associated with oil and gas development involve access road construction, well site clearing and well pad construction, drilling and well completion, pipeline construction, service and maintenance during the life of a well, and abandonment and site restoration. Potential impacts to soils resulting from these activities include erosion, compaction, and chemical pollution. Runoff and surface water sedimentation are problems linked to erosion. The two major concerns related to oil and gas operations at Mosquito Creek Lake are erosion and the resultant sedimentation of the lake and streams. Protection of water quality is the overwhelming concern expressed by members of the Mosquito Creek Lake residential community (Tribune Chronicle, Warren, Ohio, May 21, 1996; and Peterson, et al. 1997).

Alternative A

Surface disturbance related to well construction includes removal of vegetation; stripping and stockpiling of topsoil; excavation and stockpiling of subsoils for purposes of reserve pits; soil compaction from heavy equipment traffic; and temporary removal and possible mixing of top and sub soil horizons during construction of pipeline corridors. Given Alternative A, total projected surface disturbance is approximately 62 acres. Construction and drilling at the individual well sites will be completed within two months. It is expected that approximately 55 acres of the total disturbed surface will be reclaimed. The difference between disturbed and reclaimed acres (seven acres) represents acreage that is stabilized but will continue to be used during the productive life of the well. Ohio Oil and Gas Law requires that within nine months after drilling begins, the disturbed area not required in production be graded and planted or seeded.

During the two month construction/drilling period and before reclamation takes hold, disturbed soils at the individual sites would be exposed and the potential for erosion would exist. Clearing vegetation from well sites and constructing access roads in any setting disturbs the soil and leads to accelerated erosion. The amount of soil erosion is conditional on many variables including soil type, topography, season, and water and wind velocity (Ward and Elliot, 1995). Rain erosion is dependent upon slope and infiltration capacity of the soil. Rainfall that exceeds the rate of downward movement of water into the soil could cause ponding and/or flooding. It the land is sloping, runoff could occur. During periods of heavy rainfall, sediment from exposed soils may increase the sediment load of streams that drain the land and empty directly into Mosquito Creek Lake. Sediments carried by runoff may also be deposited in the surrounding wetlands.

The silt loams typical of the soils adjacent to Mosquito Creek Lake are deep, poorly drained, clayey, and prone to wetness. For the Mahoning series, which is the predominant soil type covering the southern half of the land area adjacent to the lake, high water tables are commonly found only six inches below the surface. Excavation in this case would be impossible without incurring ponding.

Because permeability is slow in the fine textured silt loams, there exists the potential for runoff to occur. However, the slight land gradient inhibits water and sediment from travelling except during heavy rain storms. A review of the complaint log of oil and gas code violations maintained by ODNR, Division of Oil and Gas showed no record of complaints associated with erosion and sedimentation for Trumbull County during the period 1990-1995 (Kell, 1997). Observations by ODNR personnel also indicate that erosion and sedimentation are not recognized as problems resulting from existing oil and gas operations in Trumbull County. Moreover, since 1990, ODNR personnel have noted a reduction in the time taken by oil and gas operators to close reserve pits and reclaim well sites. These actions are now being accomplished in less time than the respective five and nine month intervals required by the ODNR (ibid). The preceding discussion provides evidence that soil erosion and sedimentation are not major impacts issuing from existing oil and gas activities in the Mosquito Creek Lake area.

A quantitative estimate of soil erosion from a proposed well construction project was obtained by applying the Revised Universal Soil Loss Equation (RUSLE) to typical conditions associated with Mahoning silt loam soils. The equation is:

$$A = R \times K \times LS \times C \times P$$

A = predicted average soil loss in tons/acre/year
R = rainfall factor
K = soil erodibility factor

LS = slope factor, based on both length and steepness of slope
C = cover management factor
P = management or conservation practices factor

For Trumbull county, R has a value of 105 (NRCS Field Office Technical Guide, State of Ohio, Section I, p. 1-15). For Mahoning silt loam, the adjusted value for K is 0.40 (p. 2-5). Average slope in the area is 2%, and typical slope length for construction sites is 300 feet. The LS value, representing a ratio of the length and slope variables, is 0.43 (p. 4-3). The P factor, 0.12, stands for the erosion management practice of installing silt fencing at the construction sites.

The first three factors in the equation are fixed by local conditions and together express a given set of rainfall, soil, and slope conditions typical for this area. The C factor, however, is variable and is based on several conditions specific to the time and duration of construction activity. The C factors particular to autumn, winter, and spring seasons were computed with the aid of RUSLE software and the assistance of Dr. George Foster, Agricultural Research Service, College Station, Texas. The predicted soil loss, or value for A, from a characteristic well site averaging 1.87 acres is 0.32 tons per year when construction is initiated during autumn. For construction that begins during the winter and spring seasons, the amount of soil loss is 0.17 tons and 0.49 tons respectively. These figures represent expected erosion from disturbance related to constructing a single well pad, new access road, tank battery, and flowline corridor. Estimates for acreage that might be disturbed during gathering line construction were not included because of the uncertainty about the amount of new construction that would be required for gathering lines. Predicted soil loss from acres disturbed in each of the development potential areas is shown in Table 4-2.

Table 4-2. Alternative A, Projected Tons of Soil Loss Per Year

Season	High Potential Area	Moderate Potential Area	Low Potential Area	Total
Autumn C Factor=0.08	3.14	1.98	5.42	10.54
Winter C Factor=0.04	1.66	1.05	2.87	5.58
Spring C Factor=0.12	4.80	3.02	8.29	16.11

An independent assessment of the environmental impacts related to leasing Federal mineral rights at Mosquito Creek Lake was conducted by a team of researchers from Youngstown State University (Peterson, et al., 1997). The team employed an earlier version of the Universal Soil Loss Equation to estimate the amount of erosion that might occur from a typical drilling site. The figure the team obtained, 2.52 tons per well site per year, is greater than the average figure calculated for the present assessment which is 0.32 tons per well site per year. Different values for the parameters of the equation and for the amount of disturbed acreage per well site account for the variation. Even though the soil erosion model developed by YSU did not include any erosion control measures, the conclusion was offered that, "soil erosion at well sites does not represent a serious threat to either the safety of Warren's drinking water supply or the storage capacity of Mosquito Creek reservoir" (ibid, p. 8).

Erosion of soil by wind is a problem primarily in dry regions. Silt loams and silty clay loams, which are the major soil types in the Mosquito Creek Lake region, are the least susceptible soil types to wind erosion (Hausenbuiller, 1980).

Soil compaction could occur from repeatedly running over the surface with heavy equipment during oil and gas operations. Both soil structure and soil productivity could be adversely affected (Brady, 1996). Deep ruts may develop in roadways particularly if operations take place during a wet season.

Soils may become contaminated if spills occur from tanks, equipment and/or flowlines (probability of spills is addressed in Section 4.2.12, Public Health and Safety). Leaks may also originate from reserve pits containing drilling fluids and cuttings. Primary constituents of the drilling fluids are expected to be salt water (brine) and biodegradable soap (See Chapter Two and Appendix B, Reasonably Foreseeable Development Scenario). Contamination from reserve pit brine leachate may have a deleterious effect on the chemical and physical properties of soils and in turn on vegetative growth. Brine contamination of soils may lead to soil sterilization. Brine spills may also originate from produced water stored in tanks at the well sites. Fracturing fluids, however, would not be stored on site but transported to and from the well sites via tanker trucks. Fracturing fluids will be disposed of at a State approved disposal facility.

Impacts to adjacent soils and surface waters may result if brine contaminated sediments are transported off site following rain storms. During drilling, operators would be required to have reserve/working pit fluids removed by a State approved hauler and disposed of in a State approved facility as needed to maintain at least a two-foot freeboard (i.e. the space between the top of the fluids and the top of the pit dike). If sediments are transported off site due to heavy rains, it is likely that contaminants would be so diluted they would be immeasurable. (A discussion of reported brine spills for Trumbull County is carried in Section 4.2.4, Water Resources).

Peterson, et al. (1997) analyzed the type and frequency of code violations related to oil and gas activities in Trumbull County. They concluded that oil spills were the most frequent violation, but that 97% of the spills involved less than 100 gallons (2.4

barrels) of oil. The average annual volume of oil spilled per well was determined to be less than one-half gallon. According to the researchers, these spills, "pose little environmental risk" (ibid, p.47). In any event, the silt loams, with a higher percentage of clay particles, would retard the percolation of chemical pollutants.

If runoff from the well construction sites were to be heavy, sedimentation of wetland ecosystems could occur with possible permanent change in portions of wetland habitat. Chemical contamination in wetland areas is also possible if soil sediments were polluted. However, the primary possible impact of oil and gas development on wetlands is the destruction and loss of the wetlands themselves rather than the impact expected from infilling and sedimentation resulting from soil erosion.

Finally, the loss of good agricultural land would result from developing oil and gas sites in the Mosquito Creek Lake planning area, except for urban areas, because most of the soils, when drained, are considered to be prime farmland.

Mitigation

Soil erosion, sediment control, management of oil and gas pollution, and the protection of wetlands/prime farmland are subject to the provisions of various Federal, State and local laws and regulations which include, but are not limited to:

Federal Clean Water Act
Federal Executive Order 11990, Protection of Wetlands
Federal Farmland Protection Policy
Ohio Water Pollution Control Act
Ohio Oil and Gas Law
Bazetta Township Gas and Oil Well Regulations

Minimizing soil erosion and sedimentation via the various regulations is addressed through Federal and State sediment control and reclamation plans, conditions attached to State and Federal permits, local standards, and best management practices which are policies promulgated by individual public agencies and private businesses. The latter include stockpiling topsoil, mulching exposed soil, lining the perimeter of exposed areas with sediment barriers such as hay bales and/or silt fabric fencing (which must be trenched in the ground to be effective), stabilizing road surfaces, and temporary and permanent seeding.

Individual well sites under five acres in size do not have to comply with the National Pollutant Discharge Elimination System (NPDES) permit requirements. The State of Ohio requires a surface restoration plan to be submitted with an application for a State drilling permit. Although a surface management plan is not required to accompany the State application, best management practices for construction are expected to be applied (Brown, 1997). Within nine months after commencing drilling, the State requires that the area not needed in production of the well be graded and seeded. Bazetta Township requires that all access roads be graded and surfaced with gravel.

If BLM enters into Federal agreements, the agency would include measures to increase erosion and sedimentation control at individual well sites even though the affected surface properties are privately owned. These terms would be subject to the approval of the surface land owners. The most effective protection against erosion is a dense cover of plants (Hausenbuiller, 1980). Maintaining as much vegetative cover as possible on the site would be the initial erosion control measure. Site specific measures would require the use of sediment barriers, mulch, and stockpile covers at construction sites; immediate revegetation or at the start of the next growing season; no earthen pits in soils exhibiting a high water table; and no construction within a defined distance of any drainageway or surface water in the proximity of the site. The COE has identified a requirement restricting occupancy for well sites within 100 feet of intermittent and 200 feet of perennial streams located immediately adjacent to or crossing the COE property boundary. All of these practices would increase sediment conservation and consequently reduce erosion below the levels predicted by the RUSLE model.

Crude oil spills associated with all wells are addressed by Federal Spill Prevention Control and Countermeasures (SPCC) planning requirements (See Section 4.2.12, Public Health and Safety). The storage and disposal of brine and other oilfield wastes are regulated by Ohio Oil and Gas Law. In order to additionally protect soil resources from spills, terms of the Federal agreement would specify that reserve pits be lined with synthetic liners.

Minimizing compaction is difficult in wet soils. However, soil compaction can be partially mitigated by tilling the soil prior to reseeding or replanting.

Before entering into Federal agreements, BLM would cooperate with the NRCS in determining the suitability of protecting a site as prime farmland. The Department of Agriculture is responsible for implementation of the Federal Farmland Protection Act. The act requires that the actions of Federal agencies do not cause the irreversible conversion of farmland to nonagricultural uses. Nevertheless, the act does not regulate the use of private or non-federal land.

Alternative B

Because all of the federally permitted wells projected for Alternative B would be directionally drilled, multi-well pads would be used and only four new multi-well pads would be developed in addition to the 14 single well pads forecast for Alternative A. Thus, 18 new well sites would be constructed for the entire planning area. Total estimated surface disturbance is 77 acres, or 15 acres more than that which is considered likely if Federal leasing does not occur. Construction and drilling at each multi-well pad site would be completed within two to three months. It is expected that 65 acres of the total disturbed surface would be reclaimed after well completion.

The potential impacts to soils identified under Alternative A would be the same under Alternative B, namely, erosion, compaction, and chemical contamination. Given the increase in disturbed acreage and the increase in length of time for development, the degree of each impact could be greater under Alternative B. Although 27 wells are projected to be developed under Alternative B, surface disturbance in the high potential area, which would be developed first, involves only 3.15 additional acres over what would occur if no Federal leases are issued (see Appendix B, RFDS Tables). For the moderate potential area an additional 10.63 acres would be disturbed to construct the four new multi-well pads expected under Alternative B. An additional 1.26 acres would be cleared in the low potential area during the conversion of two single well pads to multi-well pads in this region. But actual development in the low potential area is considered unlikely given either alternative.

Applying the Revised Soil Loss Equation to the acreage figures that are expected to be disturbed for Alternative B, the predicted erosion from a multi-well pad averaging 2.50 acres is 0.98 tons per year when construction is started during autumn. When construction begins in winter or spring, the values for predicted soil loss are 0.33 tons and 1.35 tons, respectively. Expected soil loss from acres disturbed in each of the development potential areas is shown in Table 4-3.

Table 4-3. Alternative B, Projected Tons of Soil Loss Per Year

Season	High Potential Area	Moderate Potential Area	Low Potential Area	Total
Autumn, C Factor = 0.18	4.37	5.39	5.91	15.67
Winter C Factor = 0.06	2.07	2.30	3.03	7.40
Spring C Factor = 0.25	6.48	7.83	8.97	23.28

Figures for Alternative B were computed by combining the tons of soil loss for Alternative A and the tons of soil loss resulting from the additional acreage required to construct multi-well pads under Alternative B. For the moderate development potential area, the C factor and resultant A value for the multi-well scenario were only applied to acreage disturbed for well pad and tank battery construction. Figures for soil loss occurring during new road and flowline construction were obtained by using the same values for C and A as were used for these parameters in Alternative A.

Erosion is least when construction is started during autumn and winter months and is the greatest when initiated during the spring. An additional 5.13 tons of soil loss is predicted for Alternative B over Alternative A for the autumn construction scenario, and an additional 1.82 tons is predicted if construction takes place during winter, and 7.17 additional tons of soil loss is expected given the spring construction scenario.

Mitigation

In addition to the requirements associated with Federal, State, and local regulations cited under Alternative A, leasing of Federal minerals at the Mosquito Creek Lake project area would involve the development of lease notices attached to the Federal leases that would address the implementation of best management practices, the prohibition of earthen pits in areas of shallow high water tables, and implementation of Executive Order 11990, Protection of Wetlands. These special conditions would intensify erosion and sedimentation control and the control of chemical pollution beyond the limitations that already exist via law and regulation. A summary of possible mitigation is found in Table 4-1 and Appendix A.

PRIME OR UNIQUE FARMLANDS

The Trumbull County Soil survey prepared by the NRCS has classified approximately 10,290 acres of land within the planning area as prime farmland. In general terms the NRCS considers prime farmland to be "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oil seed crops and is available for these uses." The Farmland Protection Act (Title 7 Code of Federal Regulations (CFR) Part 658.2c) states:

> The term Federal program does not include Federal permitting, licensing, or rate approval programs for activities on private non-federal lands. Further, Part 658.3c of the Farmland Protection Policy act states "The act and these regulations do not authorize the Federal Government in any way to regulate the use of private or non-federal land, or in any way affect the property rights of owners of such land".

4.2.4 WATER RESOURCES

Introduction

This section analyzes impacts to the water quality of Mosquito Creek Lake surface waters, i.e., rivers, streams and the lake, and groundwater aquifers. Impacts to water quality could be caused by sedimentation and/or chemical/brine spills and leaks, which could make water unavailable to humans or wildlife for short periods of time on a local basis. Primary water quality issues raised by the public during development of the PA/EA were related to municipal and domestic water supplies, aesthetics, and fisheries. For purposes of determining sedimentation impacts to surface water quality, we have applied the soil erosion calculations from Section 4.2.3, Soils, to the model used by the Youngstown State University (Peterson, et al. 1997) team.

Potential Impacts Under Both Alternatives

Potential sources of pollution during construction and drilling operations are:

1) Soil erosion caused by runoff from the access road, well pad, and pipeline corridors during and after construction;

2) Drilling fluids from a leaking or breached reserve pit.

Potential sources of pollution during production operations are:

1) Leakage of oil and/or brine from a corroded or broken flowline (the line running from the wellhead to the tank battery);

2) Leakage or overflow of oil and/or brine from storage tanks at the tank battery;

3) Spills during transportation of oil, drilling fluids or brine.

During and after construction at sites where mitigation measures are not present, sediment laden runoff could enter local water bodies prior to stabilization and revegetation, increasing turbidity and possibly affecting aquatic life. Soil loss from a characteristic well site incorporating the use of silt fencing is estimated to be a maximum of 0.49 tons per year for Alternative A and 1.35 tons per year for Alternative B (see Section 4.2.3, Soils). Peterson (1997) analyzed the impacts of increased sedimentation on surface water by identifying:

1) Projected increase in suspended solids concentration; and

2) Additional sediment deposition as a percentage increase in the current estimated annual sediment accumulation rate in Mosquito Creek Lake.

Using the same scenario and assumptions as used by Peterson, et al. (pp. 8-9), it has been calculated that there would be a projected increase in suspended solids concentration of 0.058 mg/l and 0.160 mg/l for Alternatives A and B, respectively, which results in additional sediment deposition of 0.0034 acre-feet per year and 0.00870 acre-feet per year. These sedimentation rates represent an increase of 0.0009% and 0.0024% over the current estimated annual sediment accumulation rate of

367 acre-feet per year, supporting the conclusion that "soil erosion at well sites does not represent a serious threat to either the safety of Warren's drinking water supply or the storage capacity of Mosquito Creek Reservoir" (ibid.).

Soil erosion may be minimized by using vegetative and structural erosion control measures as described in Section 4.2.3, Soils. Prior to any surface disturbance, each proposed well site would be evaluated by BLM, private surface owner, adjacent surface management entity and other State/Federal agencies, as appropriate. Specific erosion control measures would be identified on a case-by-case basis.

Drilling pits would be used to contain brine, cuttings (including halite, or "rock salt"), and drilling fluids. Fracturing fluids are not permitted to be stored of in the drilling pits; these materials would be brought on site by tanker trucks and pumped downhole from tanker trucks or steel tanks. Any backflow to the surface would be directed into an empty tank for storage until disposal at a State approved facility.

If drilling pit fluids escape and flow over ground into a water body, the fluids could increase the salinity or turbidity of surface waters which could, in turn, affect aquatic life. Escaped pit fluids could also percolate through the soil into shallow aquifers and degrade groundwater, potentially affecting local water wells in unconfined aquifers. Groundwater impacts would be significantly reduced for ions (especially sodium) and trace metals due to adsorption and ion exchange properties of clays in the soil (ODNR, 1989). Most private and public water supply wells in the vicinity of Mosquito Creek Lake are developed in confined aquifers and are less susceptible to contamination from surface sources. The degree of impact would depend on the volume of pit fluids released, the salinity of the fluids and site specific geologic conditions that influence pollution potential.

In order to mitigate potential impacts of pit fluids, BLM would require conditions or terms of approval on drilling permits or Federal agreements outlining site specific reserve pit preparation, construction, liner and operational practices. (see Table 4-1 and Appendix A.) In addition, BLM could require segregation of all saline cuttings, if warranted. During drilling, reserve/working pit fluids must be removed by a State approved hauler and disposed of in a State approved facility as needed to maintain at least a two foot freeboard (i.e., the space between the top of the fluids and the top of the pit dike).

The fate of the pit cuttings and liner would remain a negotiable item to be addressed at the time specific proposals are received so that factors such as soil type, drainage patterns, distance to water wells, depth of water table, and alternate methods of pit closure and reclamation may be evaluated. Typical operations include encapsulation of the drill cuttings in the pit liner. Pit solidification would be considered on a case-by-case basis.

Overland flow of oil and/or brine from corroded or damaged flowlines or storage tanks may impact surface waters. In order to determine the relative impact to municipal drinking water supply, the loss of an entire truckload (80 barrels; 3,360 gal.) of Clinton formation brine water into Mosquito Creek Lake was assumed via a spill directly into Walnut Creek near the City of Cortland. As a reference, the capacity of a typical brine storage tank in the project area is 100 barrels. The probability of spills occurring is extremely low as analyzed in Section 4.2.12, Public Health and Safety.

Mean concentrations of total dissolved solids (TDS), trace metals and volatile organic compounds (VOCs) characteristic of Clinton formation brines in northeastern Ohio were used, as was a volumetric analysis which considered only that portion of Mosquito Creek Lake's volume (10.6%) that lies south of the inlet from Walnut Creek. No adjustments were made for the removal of various constituents of the brine from the water column by turbulent mixing, meteorological, biochemical, or bottom-sediment processes. Instead, the analysis assumes that all brine constituents remain in the water until natural flow removes them from the lake. The conclusions of this analysis are shown on Table 4-4.

Table 4-4. Water Quality Impacts to Mosquito Creek Lake from Hypothetical Brine Spill

Parameter	Existing Condition	Increase over Background	% Change
Salts[1]			
Chloride (Cl)	28 mg/l	0.157 mg/l	+ 0.56
Sulfate (SO_4)	27 mg/l	0.002 mg/l	+ 0.01
Calcium (Ca)	22.3 mg/l	0.033 mg/l	+ 0.15
Sodium (Na)	17.3 mg/l	0.052 mg/l	+ 0.30
Magnesium (Mg)	5.4 mg/l	0.048 mg/l	+ 0.89
Potassium (K)	3.1 mg/l	0.002 mg/l	+ 0.06
Trace Metals[2]			
Arsenic (As)	<3.0 μg/l*	<0.001 μg/l	N/A
Barium (Ba)	12 μg/l	0.002 μg/l	+ 0.02
Cadmium (Cd)	<0.5 μg/l*	0.019 μg/l	N/A
Chromium (Cr)	<5.0 μg/l*	0.002 μg/l	N/A
Lead (Pb)	<2.0 μg/l*	0.056 μg/l	N/A
Manganese (Mn)	90 μg/l	0.003 μg/l	+ 0.003

Parameter	Existing Condition	Increase over Background	% Change
Nickel (Ni)	<20 μg/l*	0.002 μg/l	+0.003
Volatile Organic Compounds[2]			
Benzene	<0.5 μg/l	0.107 μg/l	N/A.
Xylene	No data	0.011 μg/l	N/A.
Toluene	No data	0.009 μg/l	N/A.

* Values represent concentrations below detectable levels.
Sources: ODNR, 1996 and Peterson, et al., 1997

The increase in common ions associated with the salts is not significant with the highest increases being 0.56% for chlorides from 28 to 28.157 mg/l which is still well within the public water supply standard (PWSS) (250 mg/l) and 0.89% for magnesium from 5.4 to 5.448 mg/l (no PWSS). None of the public water supply standards would be exceeded for these common ions (salts) as a result of the analyzed spill scenario. For comparison purposes, a typical truckload of brine water contains approximately 8,495 lbs. of total salt while a typical salt truck used for de-icing purposes by Bazetta township contains approximately 8,400 lbs. of total salt and the township typically applies approximately 600,000 lbs./year (300 tons) to local roads (Bazetta Township Road Department, 1997).

Levels for trace metals would be neither altered substantially (maximum increase 3.8% for cadmium) nor approach the PWSS allowables. The addition of VOCs to the public water supply would be considered harmful. These chemicals are carcinogenic and are considered potentially damaging to public health. Benzene, and to lesser degrees, xylene and toluene are subject to volatization, photochemical and microbial action which would mitigate their levels (ODNR, 1989). Because they are less dense than water, they would remain on the surface and evaporate before reaching the municipal water intakes at the dam.

The flushing rate of Mosquito Creek Lake is roughly one lake volume per year. Based on the calculations provided by the U.S. Geological Survey (USGS, 1997) and the assumption of a spill located in the lower ten percent of the lake, the majority of impacts of such a spill would be undetectable within 36 days after the spill occurred.

The impacts of brine spilled directly into the lake or one of its tributaries would result in a localized area of salt inundation with temporary impacts to that portion of the tributary or a small plume area into the lake. After entering the lake, the lower density organics would remain on the surface and result in shoreline soil and/or lake sediment contamination (COE, 1998). The higher density brine would flow to the bottom or deepest portion of the lake. The dilution of brine will be minimal due to the lack of mixing by wind or wave action. While the presence of the water borne contaminants would be limited to 36 days, the indirect impacts caused by the contaminants could affect aquatic life for a longer period of time through sediment contamination, loss of mature harvest size fish, disruption of life cycles, and the reduction of reproductive rates of some species. The intake tower of the Mosquito Creek Lake outlet has a capability of multi-level withdrawal and proper coordination with the COE could achieve dilution and expulsion from the lake. However, this expulsion may be at the expense of fish and aquatic life in the downstream river system. Any combination of other factors (i.e. less volume, spill on land, rainfall, vegetation, etc.) could substantially reduce these impacts.

Oil or brine could also percolate through the soil into shallow aquifers in the glacial drift and degrade groundwater, ultimately affecting local water wells developed in unconfined aquifers. The physical and chemical soil characteristics, most notably clay content and type, would mitigate impacts resulting from oil and/or brine spills. The silt loams in this area, with a higher percentage of clay particles, would retard the percolation of chemical pollutants (see Section 4.2.3, Soils).

Section 4.2.12, Public Health and Safety, addresses flowline and pipeline failures. A mitigation measure requiring the use of pressure switches would be considered. Pressure switches would limit the amount of oil/brine released in the event of the flowline failure. An earthen dike around the tank battery would act as a containment barrier for an overflow event, until the operator can vacuum out the spilled liquid. BLM would require that each tank battery be constructed so that it is surrounded by a berm capable of containing 200% of the capacity of the battery's tanks. For example, a battery consisting of a 100 barrel oil tank and a 50 barrel brine tank would require a berm capable of holding 300 barrels. Designing for 200% capacity will contain the entire contents of all tanks in the battery; two consecutive 4 inch, 24 hour rainfall events; and two days of production from a well. The principle assumption in this design is that any releases from tanks would not go undiscovered for more than 48 hours. Tank batteries would be secured by fencing and locks to minimize the potential impacts due to spills caused by vandalism (see Section 4.2.12, Public Health and Safety).

Operators would be required to provide copies of a Spill Prevention, Control and Countermeasures (SPCC) Plan to BLM and the COE Mosquito Creek Lake Project Manager. The Ohio Environmental Protection Agency (OEPA) is responsible for administering the SPCC program. SPCC plans address prevention, containment, training and notification procedures to be followed in the event of a spill (see Section 4.2.12, Public Health and Safety.

Avoidance and minimization of impacts of oil or brine leaks or overflows depends primarily on the operator's diligence in regularly inspecting and maintaining production equipment and reacting quickly in containing, cleaning up, and reporting a release. Inspections of these facilities by Federal and State oil and gas inspectors serve to point out lapses in diligence; they do not supplant the operators' responsibilities. Spill response provisions are discussed in Section 4.2.12, Public Health and Safety.

The disposal of exploration and production waste is regulated by ODNR, Division of Oil and Gas. Waste includes drilling fluids, completion and workover fluids, brine, and cuttings. Concerns have been expressed with regard to impacts associated with illegal brine disposal. During the period from 1990-96, there was one verified brine dumping incident in Trumbull County (Kell, 1997). The incident involved a registered hauler transporting brine to storage tanks at an abandoned industrial site in Warren. Several other reported incidents of brine dumping, when investigated, were found to be trucks withdrawing fresh water from local creeks or streams for use in drilling operations.

The COE has identified a requirement restricting occupancy for well sites within 100 feet of intermittent and 200 feet of perennial streams located immediately adjacent to or crossing the COE property boundary. The need for additional distance setbacks between oil and gas facilities and water bodies would be determined on a case-by-case basis as proposed well sites are evaluated. This buffer zone would provide a filter strip to slow and absorb any residual runoff resulting after application of erosion control measures discussed above, and would slow and absorb oil or brine releases. Collectively, these measures, adapted on a site specific basis, adequately mitigate the potential impacts to surface water.

From 1985-95, the ODNR, Division of Oil and Gas, Groundwater Protection Section has investigated 45 complaints regarding contamination of private groundwater supplies in Trumbull County (Kell, 1996). The highest number of citizen complaints came from residents of Bazetta (7), Champion (5), and Fowler (5) Townships. The Division determined that five private water supplies were impacted by oil field activities. Four complaints, three in Howland and one in Warren Township, involved temporary increases in turbidity resulting from surface hole drilling operations. The Division determined that a chloride contamination problem in Champion Township was caused by improper storage and/or disposal of brine. However, the contamination event occurred prior to 1985 during a period when Ohio oil and gas law allowed "storage" of brine in unlined earthen pits. Earthen pits were banned for storage of production brines by passage of Amended Substitute House Bill 501 in 1985. The Division determined that the majority of complaints (35) involved private water supplies with naturally occurring contaminants. Most of these water wells were developed in the Berea Sandstone aquifer which naturally yields oil and/or gas in the vicinity of Bazetta, Champion, Howland, and Mecca Townships.

Some potential exists for downhole pollution of aquifers during drilling and production. This potential is mitigated by employing existing operating regulations and conditions or terms of approval on Federal drilling permits or agreements that require all shows of fresh and potable water to be protected. Protection involves setting and cementing casing through all potable aquifers encountered during drilling. In general, casing would be set approximately 300 feet deep. This would prevent drilling fluids, as well as formation fluids encountered below the bottom of the surface casing, from contaminating aquifers. BLM and ODNR, Division of Oil and Gas evaluate each drilling proposal as to the adequacy of casing and cementing. Casing and cementing requirements are standard features of every permit to drill issued by ODNR, Division of Oil and Gas. Localized turbidity in subsurface aquifers may occur while drilling through the surface section of the hole prior to setting the surface casing. This turbidity is localized and temporary and results from changes in pressure and water flow. When properly installed, surface casing adequately mitigates potential impacts to groundwater.

Bazetta Township presently requires that not less than four fresh water wells, public or private, be tested prior to drilling. This requirement would be extended to Mecca and Greene townships. The U.S. Geological Survey is presently conducting studies in the Mosquito Creek Lake area which may result in a "fingerprint" of all potential contaminant sources (see Section 3.5, Water Resources). If successful, the source of contaminants would be identified more easily if complaints are made.

4.2.5 Floodplains

Introduction

This section analyzes impacts to the 100 year floodplain as defined by Executive Order (E.O.) 11988, Floodplain Management. Impacts that may affect resources in the floodplain, such as soils, wetlands, water, or wildlife, are addressed in separate sections of this chapter. Potential mitigation measures, which were listed in Table 4.1 and Appendix A, include technological/engineering design features, restricted practices, and time of use restrictions.

The resource objective is to avoid any occupancy in floodplains. Should occupancy be considered, the provisions of E.O. 11988 would be applied. The E.O. directs Federal agencies to avoid, to the extent possible, floodplain development and impacts associated with occupancy and modification of floodplains. Each Federal agency must evaluate potential effects of any actions it may take in a floodplain. If an agency decides to allow an action in a floodplain, the agency must consider alternative sites, alternative actions, or denial of the proposed action in order to avoid adverse effects and incompatible development. If the floodplain cannot be avoided, the agency must adjust the proposed action to minimize hazard and risk of flood loss, as well as impacts on human safety, health, and welfare, and to restore and preserve natural and beneficial floodplain values.

Impacts Common to Both Alternatives

Most of the floodplain and most flowage easements would be under the no surface occupancy restriction that applies to the COE and State Park properties (Map 3, Mosquito Creek Lake No Occupancy Areas). The few acres of floodplain outside of these properties are at the north end of the project area in the low development potential area where potential for impacts is low. Provisions of E.O. 11988 and COE's authority to restrict structures in a flowage easement would apply to these remaining acres. Allowable uses within the floodplain may include, but not be limited to, temporary above ground structures, roads, and buried pipelines. At the time a drilling permit or Federal agreement is applied for, BLM would evaluate the proposed well site on a site specific basis at the time an application for a drilling permit or Federal agreement is received. The COE would have to review and approve structures or activities on COE easement lands prior to initiation.

4.2.6 Biological Resources

Introduction

This section will describe impacts to the following biological resources: wetlands, special status species, wildlife, and fisheries/aquatic animals. Impacts to these resources can be directly tied to the following environmental factors: (1) sedimentation/siltation; (2) chemical/toxic contamination; (3) loss of productivity/habitat. As noted previously, mineral development under either alternative has the potential to cause soil erosion, siltation, chemical pollution, and the modification or destruction of areas inhabited by certain plant, animal and fish species. In this section, we utilize the impact assessments from physical elements (e.g., Sections 4.2.3, Soils, and 4.2.4, Water Resources) of the environment to project impacts on the various biological components.

Wetlands

The analysis in Section 4.2.3, Soils, concluded that the primary possible impact of oil and gas development on wetlands would be from the direct loss of wetlands themselves rather than from impacts related to sedimentation and contamination. The following analysis addresses this potential impact.

The actual well site and facility locations are not known, and therefore, it is necessary to make assumptions concerning the likelihood of placing well sites and facilities in wetland areas and of constructing roads and pipelines across streams. The locations and distribution of wetlands and streams (Map 7) were analyzed in relation to the number and potential location of well sites and facilities as outlined in Appendix B.

The Regulatory Branch of the COE would be contacted for wetland delineation early in the process of evaluating a proposed well site. Wetland boundaries would be identified through field inspection by agency personnel. Working in, and in some cases, adjacent to wetlands requires review and the issuance of permits, as specified in the Clean Water Act (CWA) and associated State regulations. Development activities which would result in discharges affecting up to three acres of headwater streams or isolated water and associated wetlands, would require an appropriate permit under Section 404 of the CWA. Mitigation would be required to offset any adverse effects to the aquatic environment. A Nationwide permit would be required for minor road crossings. This permit is limited to disturbances of no more than one-third acre and less than 200 linear feet of fill material. Any activities that affect wetlands must be reviewed and permitted by the COE regardless of whether impacts are on private or Federal lands.

Any construction likely to affect wetlands will be subject to provisions of Executive Order (E.O.) 11990, Protection of Wetlands to the extent it can be applied to private land. The E.O. provides for the analysis of impacts of the proposed action on wetlands; identification of alternative sites which are located outside of wetlands; public notice/comment period; and justification for the siting in wetlands, if that is the decision.

Alternative A

The location and distribution of wetlands outside of the Mosquito Creek Lake project area should allow new well pads projected in the high and moderate development potential areas to be located outside of wetland areas. Based on the small size and scattered distribution of wetlands in the one-half mile buffer around the project area, tank batteries, roads and flowlines are not expected to be developed within wetlands, nor are roads or flowlines expected to cross wetlands. With an estimated length of three miles, it is likely that the gathering line corridors in the high and moderate potential areas would cross streams and possibly one or more small, isolated wetland tract(s).

Wetlands are extensive within the low development potential area, and it could be difficult to avoid placing some portion of the well pads or access roads within a wetland at the northernmost portion of the area. It is expected that all tank batteries could be located outside of wetlands. It has been assumed that a gathering line corridor would not be located north of the Route 88 Causeway, since wells drilled in this area are expected to be sub or non-economic. South of the causeway, the gathering line corridor would likely cross small streams and possibly small wetland areas.

In accordance with E.O. 11990, BLM will encourage operators to avoid development in wetlands and look for alternative sites. Prior to entering into Federal agreements, site specific analysis would determine if there will be any impacts to wetlands or streams, and if so, identify mitigation measures. The degree of direct and indirect impacts associated with loss of wetland areas, whether on private land or the project area, would be dependent upon the size of area disturbed and the type of wetland involved. When stream or wetland crossings cannot be avoided, BLM would require the use of best management practices associated with construction activities in streams and wetlands to minimize the direct loss of wetland area, maintain sediments on-site, and maintain water flow through the system. Federal agreements would not be approved unless wetland values can be maintained.

The COE may grant easements for pipelines on Federal property on a case-by-case basis. These pipelines would likely cross the Federal property boundary where it is necessary to access private land.

Indirect impacts to wetlands as a result of sedimentation or contamination may be prevented, or greatly reduced, through site location and application of site specific mitigation measures (see Section 4.2.3, Soils). Table 4.1 and Appendix A identify specific mitigation measures that may be placed on Federal agreements.

Alternative B

Potential impacts to wetlands would be similar to those identified under Alternative A. The NSO stipulation would prevent any direct surface disturbance to wetland communities in the Mosquito Creek Lake project area as a result of the construction of well pads, roads, and tank batteries. The COE may grant easements for pipelines on Federal property on a case-by-case basis. Potential impacts to wetlands from the construction of pipelines would be the same as identified under Alternative A. Mitigation measures identified under Alternative A would be attached to Federal drilling permits or agreements approved under Alternative B.

Special Status Species

This section describes potential impacts to plant and animal species protected under the Endangered Species Act (ESA) of 1973, as amended, and species listed by the State of Ohio. All activities which require Federal approval are subject to the provisions of ESA. It is BLM policy to coordinate with State agencies and recognize State laws with regard to special status species. Therefore, BLM would consider the impact to State listed species in its decisions relating to potential leasing and subsequent development of the Federal oil and gas resources.

Alternative A

In order to comply with the provisions of the ESA, a determination will be made as to the presence of special status species on or adjacent to the lands involved in Federal agreements at the time a well is proposed. If present, a determination will also be made as to the affect of the proposed development on the species.

Under this alternative, except for possible pipeline crossings, there would be no direct impacts to special status species inhabiting the Mosquito Creek Lake project area. There would be no loss of special status animals, loss of feeding, resting or nesting habitat, and no loss of special status plants or communities. All of the special status species identified in Chapter Three, Table 3-1 occur or may occur within the wildlife refuge, of larger wildlife area. Well sites would not be permitted on State owned lands in the wildlife area adjacent to the COE property boundary (Grahl, 1996). Potential well sites may be located adjacent to the eastern boundary or extreme northern tip of the wildlife refuge, areas identified as low potential for oil and gas development (See Map 4, Mosquito Creek Lake Development Potential Areas).

Analyses in Sections 4.2.3, Soils, and 4.2.6, Wetlands, indicate that well development will not indirectly impact the wetlands, and thus will not impact wetland habitat that is important to numerous special status species within the refuge. Compliance with ESA, State laws regarding protection of special status species, and mitigation measures identified in Sections 4.2.3, Soils, 4.2.4, Water Resources, and 4.2.6, Wetlands, adequately protect most of the special status species. Several species require additional protection measures beyond what has already been addressed. These species are discussed below.

Development and construction activities could impact breeding bald eagles if a well site is located within one-half mile of the active nest site located in the wildlife refuge near the north end of the lake. Human activity and noise from drilling may cause the nesting pair of eagles to abandon the nest site. Drilling and development within one-half mile of an established bald eagle nesting territory, even though the nest site is not active, could prevent future use of the nest site by bald eagles. Activities required to maintain the drill site or facility could prevent a breeding pair from relocating in the nesting territory in the future. Therefore, to prevent impacts to nesting bald eagles, and protect the value of established bald eagle nesting territories, proposed well sites and associated facilities would not be approved if located within one-half mile of an active bald eagle nest or within one-half mile of an established nesting territory.

Indiana bats could be impacted on private land if large tress with cavities and/or exfoliating bark are cut down in forest communities during construction of well sites and facilities. Removal of such trees would decrease the number of suitable sites available to breeding females, which roost in colonies. Habitat would be protected with a mitigation measure directed at protecting roost trees.

Gray birch populations would be impacted if well site development in old fields or other disturbed sites, results in the destruction of gray birch trees. If gray birch trees are present in an area of proposed disturbance, impacts would be prevented by requiring the operator to avoid removal of the trees or consider an alternate site.

Alternative B

The COE "no surface occupancy" stipulation would prevent loss of special status species habitat in the Mosquito Creek Lake project area. Mitigation measures identified under Alternative A would be applied to activities authorized by Federal drilling permits or Federal agreements. The project development under Alternative B is not expected to adversely impact special status species or their habitat.

WILDLIFE

Introduction

The following impact analysis will focus on impacts to wildlife in general, including small game, big game, upland game birds, non-game and waterfowl. Additional analyses can be found under the special status species, fisheries/aquatic animals, and wetlands sections in this chapter.

Alternative A

The drilling and development of 14 wells would result in direct impacts to wildlife through initial habitat removal on a total of 62 acres. Drilling and development activities would cause birds and larger, more mobile species to move into adjacent areas where they would compete with resident species for available food, cover, resting and nesting habitat. Surface disturbances would result in the loss of reptiles, amphibians, small mammals and invertebrate species which are unable to move out of the areas of disturbance.

Reclamation and revegetation is expected to occur on 55 acres of disturbed habitat. The remaining seven acres represents that area stabilized and in use during the production phase. The plant communities established and the subsequent use by wildlife would be dependent upon the types of plants seeded or planted on the sites. Animals from adjacent areas would eventually repopulate the reclaimed habitat.

Impacts to wildlife would be greatest if drilling and development occur in wetland and aquatic communities. Potential wetland impacts have been analyzed in Sections 4.2.6, Wetlands and Fisheries/Aquatic Animals. Clearing areas of forest for well pads and facilities could eliminate large trees which provide habitat for cavity dwelling and nesting mammals and birds. Creating openings in forest communities may make the habitat less suitable for some migratory bird species which prefer to nest in large blocks of forest habitat. Within the planning area, the most extensive blocks of forest habitat occur within the Mosquito Creek Lake project area and therefore, would not be impacted by drilling and development. The presence of other plant communities would allow for the placement of well pads and facilities in non-forested areas (ODNR, 1977).

Noise disturbances could cause some animals to change behavior patterns or to abandon habitat at drill sites (see Section 4.2.7, Noise). The degree of impact to any one species would vary depending upon the susceptibility of the particular species to noise disturbances, the season (e.g., breeding vs. non-breeding), the ability of the species to avoid the disturbance, and quality of habitat involved. Wildlife habitats considered to be most sensitive to noise disturbances, especially for breeding birds, are the extensive wetland and mature forest communities of the wildlife refuge. The wildlife refuge will not be available for development and hence, there would be minimal impacts to wildlife from noise.

Impacts to wildlife, in general, would be short-term and site specific. Fifty-five acres of habitat would be revegetated and seven acres would be stabilized and used for roads and production equipment.

Alternative B

In comparison to Alternative A, there would be 77 acres (additional 15 acres) of initial disturbance with 12 acres (additional five acres) of habitat lost which would be used for roads and production equipment. Impacts to wildlife in general would be short-term and site specific except for 12 acres of habitat lost for the productive life of the wells.

Fisheries/Aquatic Animals

Introduction

The following section describes impacts to fisheries and other aquatic animals. Most, if not all, of the impacts related to these resources were previously covered in Sections 4.2.6, Wetlands, and 4.2.4, Water Resources; mitigation measures may be found in Table 4.1 and Appendix A. Implementation of special mitigation measures identified in these sections will retain sediments and contaminants on-site. Therefore, impacts to fisheries and aquatic wildlife are not expected as a result of on-site development. Refer to the analyses in Sections 4.2.3, Soils, 4.2.4, Water Resources, and 4.2.6, Wetlands.

Impacts to fisheries and aquatic wildlife could occur if a large amount of brine were to be released directly into a tributary of Mosquito Creek Lake, or the lake itself. The likelihood of a tanker truck accident is extremely low (see Section 4.2.12, Public Health and Safety). Also, according to the Trumbull County Local Emergency Planning Committee (LEPC) there have been no reported tanker truck accidents or spills in the county since the LEPC began keeping detailed records in 1988 (see Section 4.2.12, Public Health and Safety). However, for the purpose of this analysis, it will be assumed that an accident will result in the release of a tanker load (80 barrels) of Clinton brine directly into Walnut Creek. As stated in Section 4.2.4, Water Resources, the brine spill would affect the water quality of the lake from the mouth of Walnut Creek and southward. The spill would result in the direct loss of invertebrate and vertebrate aquatic life in Walnut Creek, in the lake from the mouth of Walnut Creek southward to the dam, and Mosquito Creek downstream from the dam. The impacts would be greatest in Walnut Creek and at the mouth of the creek. After entering the lake, the lower density organics would remain on the surface and result in shoreline soil and/or lake sediment contamination (COE, 1998). The higher density brine would flow to the bottom or deepest portion of the lake. The dilution of brine will be minimal due to the lack of mixing by wind or wave action. The intake tower of the Mosquito Creek Lake outlet has a capability of multi-level withdrawal and proper coordination with the COE could achieve dilution and expulsion from the lake. However, this expulsion may be at the expense of fish and aquatic life in the downstream river system.

While the presence of the water borne contaminants would be limited to 36 days, the indirect impacts caused by the contaminants could affect aquatic life for a longer period of time through sediment contamination, loss of mature harvest size fish, disruption of life cycles, and the reduction of reproductive rates of some species (COE, 1998).

4.2.7 Air Quality/Noise

Air Quality

Introduction

The public's primary concern in regard to air quality is odors. OEPA's primary concern is volatile organic compounds (VOCs) which are the primary precursor compounds of concern for ozone in Trumbull County. BLM must evaluate potential VOC emissions in regard to the requirements of the Federal regulations at 40 CFR 51, "Subpart W-Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (OEPA 1996b). The purpose of a conformity determination is to assure that Federally licensed, permitted, approved or financially assisted actions conform to the State Implementation Plan (SIP) for maintaining and/or enhancing air quality.

This section will analyze both short and long-term impacts of anticipated air pollutants. Potential mitigation measures, which are discussed in this section, are also addressed in Table 4.1 and Appendix A. The measures include technological/engineering design features, restricted practices, time of year restrictions, and distance setbacks.

IMPACTS COMMON TO BOTH ALTERNATIVES

Air Pollutants Generated by Oil and Gas Operations

Oil and gas operations generate gaseous compounds and particulate matter. The gaseous compounds include sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), and VOCs, which with NO_x, may chemically react in the atmosphere to form ground level ozone. Particulate matter includes total suspended particulates (TSP) (particles less than 30 microns in size) and PM_{10} (particles less than 10 microns in size). For the purposes of impact analysis, oil and gas operations can be divided into the drilling phase (includes construction, drilling, well stimulation and completion activities) and the production phase. Table 4-5 summarizes air pollutants and sources generated during these phases.

Table 4-5. Summary of Air Pollutants and Sources from Oil and Gas Activity

Pollutant	Drilling Sources	Production Sources
Particulates (TSP/PM-10)	Site construction activities Diesel engine exhaust Fugitive dust from dirt access road, traffic on road	Fugitive dust from dirt access road, traffic on road Diesel engine exhaust from trucks and well servicing/workover rig engines
Carbon Monoxide (CO)	Diesel engine exhaust Light-duty vehicle exhaust Potential flaring of gas	Light-duty vehicle exhaust Potential for exhaust from natural gas run pumpjack* Potential for exhaust from gas compressor engine*
Nitrogen Oxide (NO_x)	Drilling rig diesel engine exhaust Vehicular engine exhaust	Diesel engine exhaust from trucks and well servicing/workover rig engines Vehicular engine exhaust Potential for exhaust from natural gas run pumpjack* Potential for exhaust from gas compressor engine*

Pollutant	Drilling Sources	Production Sources
Total reduced sulfur compounds (e.g., SO_2)	N/A	Storage tank working** and breathing*** loss
Volatile Organic Compounds (VOCs)	Drilling rig diesel engine exhaust Light-duty vehicle exhaust Potential flaring of gas	Light-duty vehicle exhaust Diesel engine exhaust from trucks and well servicing/workover rig engines Storage tank vaporization of crude oil condensates, distillates, etc. Storage tank working **and breathing*** loss

* This equipment may be necessary later in the life of the gas field.
** Vapors released during filling and emptying of storage tanks.
*** Vapors released during expansion/contraction of oil and because of changes in temperature and barometric pressure.

Source: Adapted from Table 14, MTBOGC (1989)

Malodorous/Noxious Gases

During the drilling phase, engine exhaust from construction equipment, vehicles, the drilling rig and associated equipment would cause odors. During the production phase, hydrocarbon vapors emitted from oil storage tanks would cause odors. Natural gas and associated oil from the Clinton and Rose Run formations does not contain hydrogen sulfide gas or other odorous sulfur compounds which have a "rotten egg" odor.

AIR QUALITY IMPACTS

Odors

The YSU (Peterson, et al., 1997) review of the ODNR, Division of Oil and Gas, "Violation/Complaint Log" for Trumbull County indicates that from 1990 to June 1996, the agency received 29 complaints categorized as "gas leak or odor reported." An average of 4.5 complaints per year during a period that averaged 2,400 producing wells per year in the county indicates that the likelihood of odor problems is very low.

During the drilling phase, odors would be localized, highly variable, and temporary (up to 85 days at a multi-well pad). During production, odors associated with a plunger lift system or a pumpjack run by an electric motor would be minimal to non-existent. A natural gas run engine on a pumpjack would intermittently produce exhaust fumes. The odor of hydrocarbon vapors from oil storage tanks would be a long-term impact.

Effects on residents or recreation areas would depend on distance from the odor source, wind speed and direction, temperature, humidity, overall weather conditions, surrounding terrain, and intervening vegetation. Additional factors for oil storage would be rate of production, as well as gravity of the oil and percent of dissolved gas in the oil (Simmers, 1998). Odors from oil tanks are most noticeable in calm weather in the late evening to early morning hours, with low wind speeds, and downwind from tanks (MTBOGC, 1989). ODNR and Bazetta Township safety setbacks between oil tanks and residences would provide some relief from odors.

Air Pollutants

During the drilling phase, air quality impacts would be short-term and localized. Primary contaminants would be exhaust emissions of NO_x, SO_2 and VOCs from vehicles and equipment and dust from construction activity and unpaved roads. The amount of dust would vary by soil type, condition, and seasonal/weather conditions. Most soils in the area are not susceptible to wind erosion (see Section 4.2.3, Soils).

For the production phase, potential dust sources would be eliminated as disturbed areas are reclaimed, access roads are surfaced, and areas devoted to production equipment are stabilized. Bazetta Township requires that the well/tank battery access road be surfaced so as to prevent mud from getting on roads and to minimize dust. NO_x, SO_2, and CO emissions from gas wells would be negligible. Exhaust emissions of NO_x, SO_2 and VOCs would be minimal because traffic would be limited to daily visits by the well pumper and infrequent visits by tanker trucks for pick-up of oil and brine. A natural gas run engine on a pumpjack would intermittently produce exhaust fumes. The primary long-term impact would be VOC emissions from bulk storage and transportation of oil.

If net emissions of VOCs from the leasing alternatives equal or exceed the *de minimis* level[1] of 100 tons per year of VOCs, BLM must conduct a conformity determination. If net emissions do not equal or exceed the *de minimis* level, BLM must determine whether the alternatives are a "regionally significant action" which is defined as a Federal action for which the direct and indirect emissions of the pollutant represents ten percent or more of a non-attainment or maintenance area's emissions inventory for that pollutant (40 CFR 51.852). If the activity is not regionally significant, then no further steps are required.

Table 4-6 displays VOC emissions based on Alternative B and reflects the maximum

---

[1]In regard to criteria air pollutants, the level of pollutant below which the U.S. Environmental Protection Agency has determined that there would be no significant detriment to the environment.

drilling phase and production phase activity in any one year. This overestimates the VOC emissions because it assumes that the most intense activity of the drilling phase overlaps with the most intense activity of the long-term production phase. The maximum yearly VOC emissions of approximately 12 tons would not exceed the *de minimis* level. OEPA's projected VOC emissions from point, area, and mobile sources in Trumbull County for 1993/94 and 2006 represent annual emissions of 16,086.28 tons per year and 16,118.035 tons per year, respectively. Ten percent of these annual emissions are 1,608.6 tons and 1,611.8 tons, respectively. Because the total VOC emissions would not exceed ten percent of the emission inventory, the VOC emissions would not be regionally significant. Alternative A would result in fewer wells which would result in even lower VOC emissions and would therefore not be regionally significant.

Table 4-6. Volatile Organic Compounds (VOCs) Emitted During a Single Year with Maximum Oil and Gas Activity

Source*	VOCs (pounds per year)
Construction equipment (dozer, grader, backhoe)**	26.35
Light-duty gasoline vehicles**	1,146.88
Heavy-duty diesel vehicles**	253.06
Drilling rig engines**	4,230.00
Oil storage tanks(without vapor control device***)	18,339.30
TOTAL VOCs (pounds per year)	23,995.59

* Numbers/types from Appendix B and Transportation sections; assumed 15 miles per one-way trip.
** Emission factors from USEPA (1995c) and USEPA (1991).
***Based on BLM, T. Abing (1994).

Mitigation

Existing BLM, State, and township regulations provide some mitigation of air quality impacts through safety setbacks, required technological/design features on drilling and production equipment, required construction practices, and prohibition of certain practices. BLM may require dust suppression measures for construction and drilling operations as determined by site specific analysis. Activated charcoal filters may be required on oil storage tank vent stacks if site specific analysis indicates odors could cause long-term impacts to adjacent residences or recreation areas. Measures that would apply to all sites include a prohibition against open burning of garbage and refuse at oil and gas sites and the requirement that thief hatch covers on oil storage tanks be kept locked down. The public health and safety requirement for installation of pressure-vacuum thief hatches, vent-line valves, and plugs on all vent ports on oil tanks would eliminate continuous emissions of hydrocarbon vapors. The time of year restriction developed to reduce noise impacts of drilling operations on developed recreation areas would also reduce odor impacts on those areas.

NOISE

Introduction

The public's primary concern in regard to noise is its impact on the overall quality of recreation experiences at the Mosquito Creek Lake project area. Perception of sound is determined by the listener's distance from the sound source, intensity and pitch of the sound, air temperature and density, humidity, air turbulence, wind direction, screening or focusing effects of topography and vegetation, and individual variability as to acceptable types and levels of sound (MTBOGC, 1989; BLM, 1997). In general, sound levels decrease by a factor of six dB(A) for each doubling of distance from the source as the sound spreads out (USDA, 1980; MTBOGC, 1989). Evenings with still, humid air provide near optimal conditions for sound to carry, while turbulent, dry-air conditions dampen sound transmittance (MTBOGC, 1989). Tall grass and shrubs reduce noise levels three to four dB(A) per 100 feet, while hills and trees reduce noise by 5 to 20 dB(A) (NY State, 1992).

Noise sensitive areas in the planning area include:

Mosquito Lake State Park (State lands and COE lease/license areas);
Mosquito Creek Wildlife Area (State lands and COE lease/license);
COE developed recreation areas;
COE operations area;
Hiking trails outside of developed recreation areas;
Bazetta Township Park;
Lakeview Local School District property; and
Residences/residential allotments.

In the high and moderate development potential areas, most reasonably foreseeable well pads may be adjacent to COE and State park lands, including developed recreation areas, undeveloped State Park lands, and residences. There is some potential for well sites near Bazetta Township Park, the LLSD property, the COE operations area south of Route 305, and hiking trails on COE or Park lands outside of developed recreation areas. In the low potential area, most of the reasonably foreseeable wells may be located adjacent to undeveloped lands in the ODNR, Divisions of Parks and Recreation and Wildlife license/lease areas, as well as residences.

This section will analyze both short and long-term impacts of anticipated noise. The exact level, duration and type of noise impact on a specific noise sensitive area can not be determined until the time of a site specific proposal. Potential mitigation measures, which are discussed in this section, are also addressed in Table 4.1 and Appendix A. The measures include technological/engineering design features, time of year restrictions, maximum allowable noise levels, and distance setbacks from sensitive noise recipients or areas.

IMPACTS COMMON TO BOTH ALTERNATIVES

Noise Generated by Oil and Gas Operations

As a general rule, the short-term drilling phase would be the loudest, while the long-term production phase would be the most quiet. Table 4-7 compiles sound levels, durations and time of day of activities during the short-term drilling phase. Table 4-8 compiles sound levels emitted by equipment in the long-term production phase. Figures 4-1 through 4-4 display average envelopes of noise around drilling rigs, oil field access roads, as well as natural gas-driven pumpjacks and pipeline gas compressor units, both of which may be required later in the life of the gas field. (See Chapter Three, Figure 3-5 for a comparison of noise levels between oil and gas operations and more typical everyday sounds.)

Table 4-7. Sound Levels, Duration and Time of Day Noise Impacts During Drilling Phase

Activity	Sound Level at Source (dB(A))	Duration	Time of Day	Data Source for Sound Levels
Construction of road/pad	84 to 115	3-4 days	daytime	1, 2
Well drilling	up to 115	5 days (vertical) 10 days (directional)	daytime and night	3
Casing installation	up to 105	1-2 days	daytime	2
Production testing/ flaring	70 to 105	variable	daytime	2, 3, 4
Well stimulation (hydrofracturing)	up to 105	1-2 days	daytime	2
Pipeline installation	84 to 115	variable (one mile/week)	daytime	1, 2

Activity	Sound Level at Source (dB(A))	Duration	Time of Day	Data Source for Sound Levels
Traffic	trucks-up to 95 crew vehicles-53 to 70	throughout drilling phase	daytime and night	1, 3, 5, 6

Sources: 1) Jones, H. W., 1979
2) MTBOGC, 1989, Appendix 7
3) MTBOGC, 1989, Table 24.
4) BLM, 1987.
5) NY State, 1992
6) BLM, 1996b

Table 4-8. Sound Levels From Production Operations

Operations Equipment	Sound Level at Source or As Indicated (dB(A))	Data Source for Sound Levels
Plunger (rabbit) lift system	almost silent - clinking noises of plunger in wellbore; sound of oil flowing into storage tank	BLM field observation
Pump jack, natural gas run*	61 at 100 feet 95-100 (measured at unmuffled exhaust)	1, 2, 3
Pump jack, electric*	65	2, 3
Gas compressor*	87 to 105	1, 2, 3
Well servicing rig	up to 90	2
Well workover rig	up to 90	2

*might be required in later stages of gas field
Sources: 1) BLM, 1992, 2) MTBOGC, 1989, Appendix 7, and 3) MTBOGC, 1989, Table 24

Drilling Phase Impacts

In general, the increased level, duration, and type of noise created by the short-term drilling phase would negatively affect humans in noise sensitive areas to varying degrees, depending on how close operations are to noise recipients and the effect of other noise-influencing factors previously discussed. During the drilling phase, noise would be created by road and pad construction, well drilling, casing installation, well fracturing, production testing and flaring, and pipeline construction. Well drilling and related traffic would occur 24 hours a day. The remaining activities would normally be restricted to daylight hours. As Table 4-7 and Figures 4-1 and 4-2 indicate, noise levels generated at and around each drilling operation and the related access road would be higher than existing background levels in noise sensitive areas.

Effects of the increased level, duration, and type of noise on recreational users would vary. Noise may affect people using jet skis or motorboats on the lake very little, whereas noise could cause a loss of sleep for campers (see Figure 3-5 - sleep interference begins at about 47 dB(A)). People utilizing the recreation areas for picnicking or swimming for the day could experience irritating noise the entire day. Trail hikers could experience transitory unwanted noise as they pass a nearby drilling site. Noise impacts would occur to the greatest number of recreational users if drilling operations were located adjacent to developed recreation areas during the primary three month recreation season (Memorial Day through the Labor Day). Although short-term in nature, the two to three month drilling phase at any one multi-well pad could coincide the recreation season.

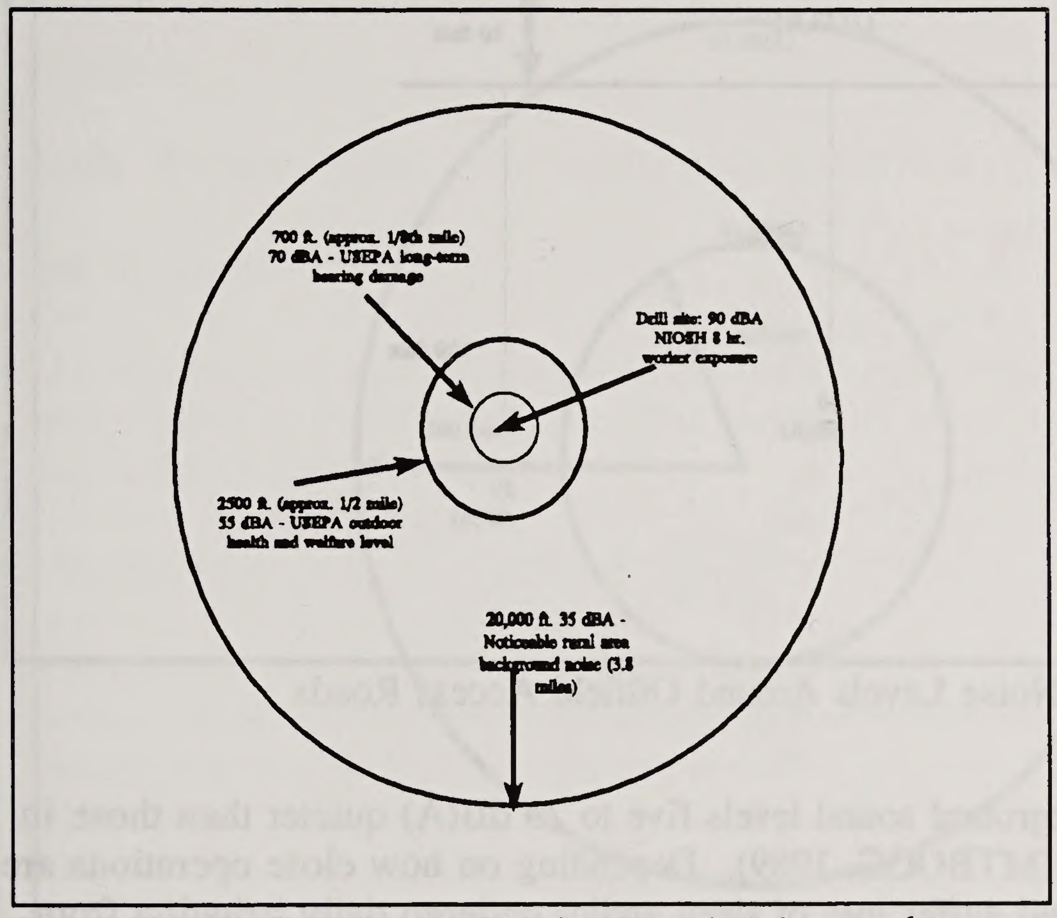


Figure 4-1. Envelope of Noise Levels Measured Around a Drilling Rig
Source: MTBOGC, 1989.

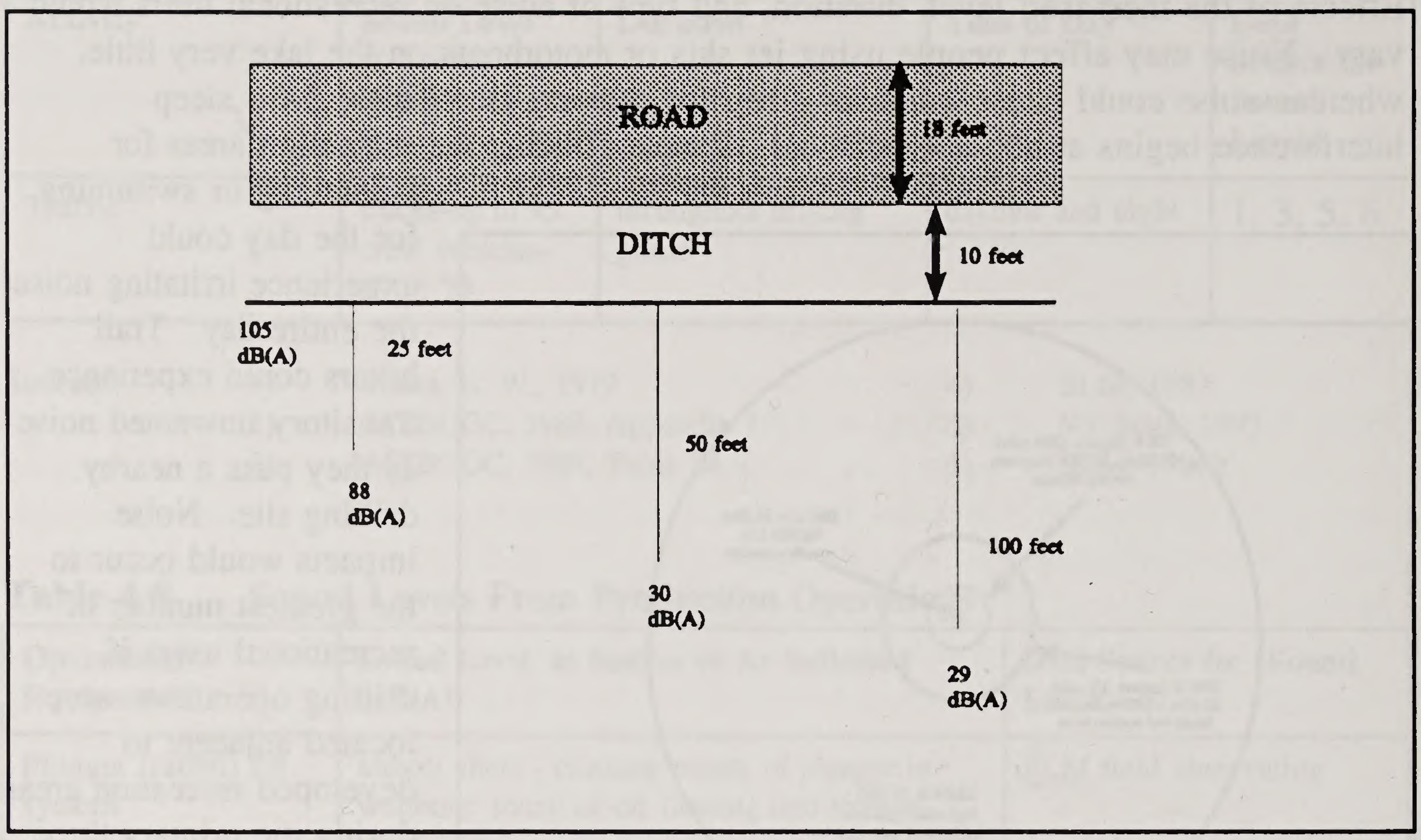


Figure 4-2. Envelope of Noise Levels Around Oilfield Access Roads

Rural residents expect background sound levels five to 20 dB(A) quieter than those in urban and developed areas (MTBOGC, 1989). Depending on how close operations are to a dwelling, residents could suffer loss of sleep and/or undergo daily irritation from noise for two to three months for a multi-well pad. Factors which could influence impacts to residents are whether the residents are at work during the day or night, indoor levels of noise, and the sound level reduction of buildings. The national average sound reduction provided by buildings is 15 dB(A) with windows open and 25 dB(A) with windows closed (USEPA, 1978).

Well sites would likely be developed either sequentially or with overlapping activity among several sites. Therefore, the drilling phase would create temporary pockets of increased noise levels at different locations over a period of time. A longer term increase in traffic noise could occur along a road serving as the main transportation corridor to several well sites being sequentially drilled or have overlapping activity.

Production Phase Impacts

In general, the production phase would have little to no effect on noise sensitive areas. The tank battery and a plunger lift system at the well would generate minimal noise. Daily visits by the well pumper and infrequent tanker truck pick-ups of brine and oil would cause periodic minor increased traffic noise along local roads. However, as Table 4-8 and Figures 4-3 and 4-4 indicate, noise levels generated by well servicing or workover operations, a well converted to a natural gas run pumpjack, or a gas compressor would be higher than existing background levels in noise sensitive areas.

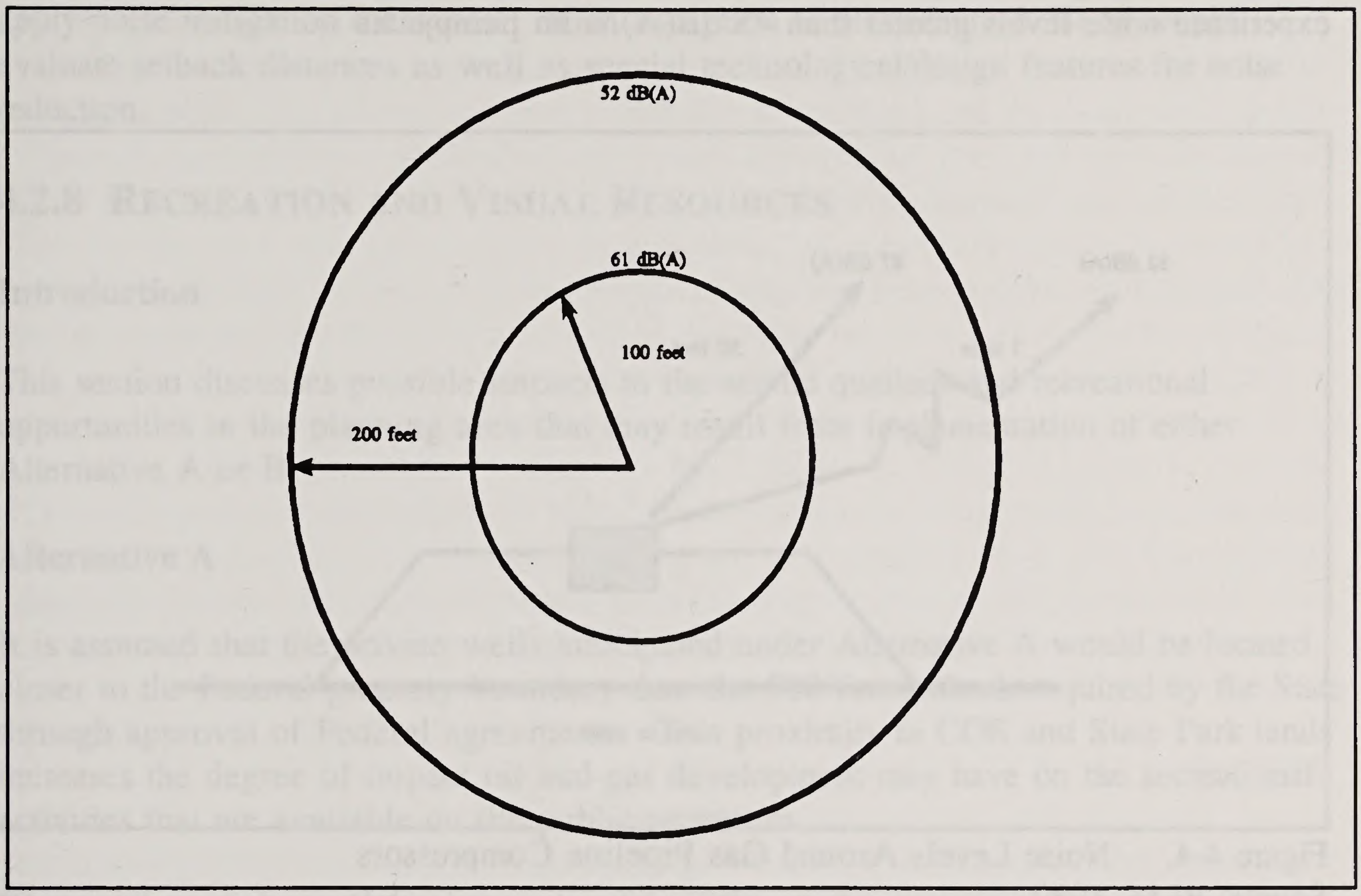


Figure 4-3. Noise Levels Around Natural Gas-Driven Pumpjack
Source: BLM, 1987

Well servicing operations would increase daytime noise levels for one week or less. Smaller rigs used for these operations would be quieter than a standard rotary drilling rig. Well workovers would be similar to well servicing operations but would occur less frequently. Well servicing or workover noise could affect recreational users and residents in ways similar to the drilling phase, but the duration of the noise would be for one week, or less, versus two to three months.

If used later in the life of the field, pumpjacks would create intermittent noise. Natural gas-run pumpjacks would be louder than pumpjacks run on electric motors. Most of the projected wells would be drilled in Bazetta Township which requires that a producing well cannot emit noise which, when measured at the nearest residence not in the drilling unit, exceeds 45 dB(A). This restriction means that the long-term noise levels at the nearest residence outside the drilling unit would be quieter than the level that interferes with sleep and would match the USEPA recommended night-time level.

This would reduce impacts to both recreational users and residents outside the drilling unit. However, residences and recreation areas inside the drilling unit may experience noise levels greater than 45 dB(A). Residences and recreational users in Mecca and Greene Townships, where there are no noise ordinances for producing wells, could experience noise levels greater than 45 dB(A) from pumpjacks

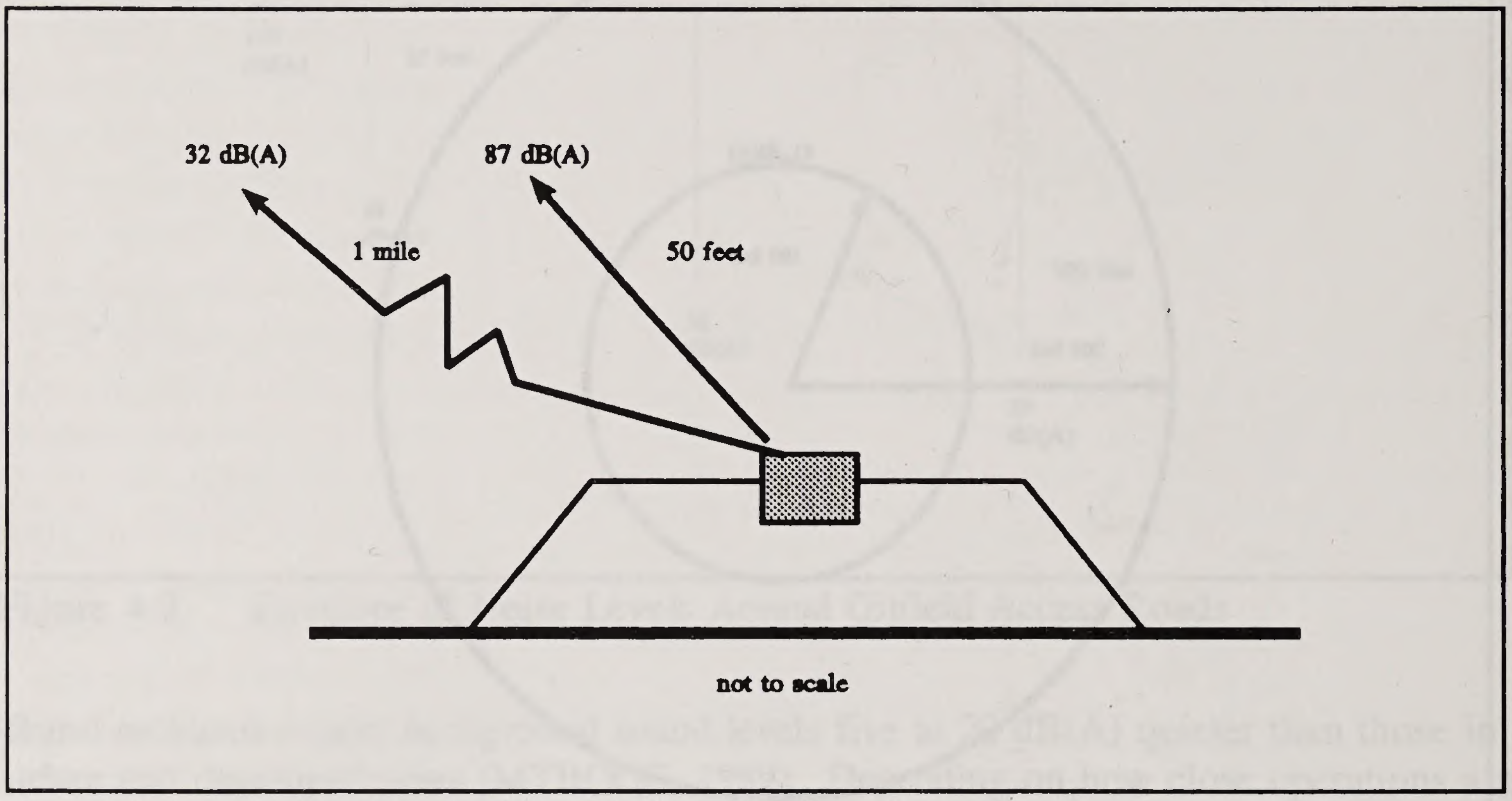


Figure 4-4. Noise Levels Around Gas Pipeline Compressors
Source: BLM, 1987

Gas compressors would run 24 hours a day and may operate for years. Impacts to nearby recreational users and residents could include long-term loss of sleep and/or daily irritation from noise.

Mitigation

BLM, State, and township regulations provide some mitigation of noise impacts through safety setbacks and noise level restrictions for producing wells in regard to residences outside the drilling unit. For each well, BLM would evaluate on a case-by-case basis additional setback distances as well as special technological/ design features for noise reduction and would require these measures as needed. BLM would apply three measures to all sites adjacent to COE and ODNR developed recreation areas: (1) a prohibition on well drilling, plugging back, and deepening operations from Memorial Day to Labor Day, (2) a noise level restriction for producing wells of no greater than 45 dB(A) measured at the recreation area, and (3) from Memorial Day to Labor Day, well servicing or workover operations, would not be allowed before sunrise or after 10 p.m. At all other producing well sites, BLM would apply the 45 dB(A) noise level restriction in regard to residences outside the drilling unit. Gas compressors are usually located where gathering lines tie into gas sales/distribution lines. Because of this, gas compressors in the planning area are expected to be located where BLM does not have jurisdiction and, therefore, cannot apply noise mitigation measures. If an exception to this occurred, BLM would evaluate setback distances as well as special technological/design features for noise reduction.

4.2.8 Recreation and Visual Resources

Introduction

This section discusses possible impacts to the scenic qualities and recreational opportunities in the planning area that may result from implementation of either Alternative A or B.

Alternative A

It is assumed that the private wells anticipated under Alternative A would be located closer to the Federal property boundary than the 500 foot setback required by the State through approval of Federal agreements. This proximity to COE and State Park lands increases the degree of impact oil and gas development may have on the recreational activities that are available on the public properties.

Construction of the wells and associated facilities, and subsequent production operations may affect the quality of visual and recreational resources by increasing traffic, producing noise, dust, and odors, and by adding drilling and production equipment to the landscape. Increased vehicular traffic that would result from additional oil and gas development is examined in Section 4.2.9, Transportation. During construction, the increased traffic on local roads may affect access to recreational areas. Also, residents and recreational users may experience the dust, noise, and odors that accompany construction activities (see Sections 4.2.7, Air Quality/Noise).

Because the terrain is relatively level, construction equipment would be visible from surrounding residences and local roads. Drilling of the wellbore would occur around the clock and the well pads would be illuminated at night. These impacts would be confined to the construction and drilling phases and last approximately two months. The timing of construction would influence the degree of impact to the various recreational opportunities available in the project area during any one season.

Hunting activities would occur concurrently with oil and gas operations. It is possible that some hunting locations on private lands would be lost when converted to well sites. Safety concerns for both hunters and oil and gas personnel are small as is the likelihood of a notable reduction in the availability of game.

As previously noted in Section 4.2.3, Soils and 4.2.4, Water Resources, impacts to water quality in the lake are unlikely under this alternative because erosion and construction runoff would be controlled. It is expected that the six new well pads forecast for the high and moderate development potential areas under Alternative A would not alter the water quality and, hence, the availability of recreational fishing opportunities at Mosquito Creek Lake.

During the long-term, the six well pads projected to be located in the high and moderate development potential areas would present a permanent visual impact to the residents and recreational users in the southern portion of Mosquito Creek Lake. Since 1975, approximately 120 oil and gas wells have been drilled within one mile of the Federal property boundary in the high and moderate development potential areas. Thirty-four of these wells are within one-half mile of the Federal property. This is the area most likely to be affected as it is improbable that the eight wells forecast for the low development potential area would ever be developed. The total recreational area that is available in the vicinity of Mosquito Creek Lake is large relative to the recreational area that may be affected.

Mitigation

State and local standards and regulations that specifically protect recreational and visual resources have not been developed. An existing COE surface use constraint requires a 200 foot setback from developed recreation areas on Federal lands.

Given the likelihood of Federal agreements, it is assumed that BLM would develop specific terms with the owners of the private wells. The agreements would include measures to reduce the impacts to recreational and visual resources. Potential protective measures include requiring distance buffers between residences and private or public recreational facilities; no well drilling, plugging back, or deepening operations during the summer when recreational use is greatest; limitations on time of well servicing/workover operations during the summer; screening wellhead and production facilities with vegetative buffers; painting all production facilities to harmonize with natural surroundings; and appropriate noise and odor abatement (see Table 4-1 and Appendix A).

Alternative B

The number of vehicular trips during the production phase would increase the amount of traffic above the level expected under Alternative A (See Section 4.2.9, Transportation). Otherwise, the short-term and permanent impacts would be the same as those discussed above for Alternative A. Additional construction would occur given the four new multi-well sites forecast for the moderate development potential area, and construction and drilling time would increase from two to three months. Visual impacts associated with the additional construction would be minor given what is expected to occur under Alternative A.

Mitigation

Well site locations may be restricted by the presence of recreational areas. Recreational and visual protective measures identified under Alternative A would be attached to Federal drilling permits or Federal agreements as conditions of approval or terms of the agreement.

4.2.9 TRANSPORTATION

This section will discuss potential impacts to transportation and roads within Trumbull County. Because impacts would be similar, this assessment will provide one analysis for both alternatives. Impacts include potential road damage, localized traffic congestion, noise, and safety concerns, i.e., accident frequency.

Existing Restrictions/Controls

Oil and gas operators would be subject to existing State, county and township regulations pertaining to permitting, bonding, or site specific inspection of proposed roadways prior to any permitting or use. This includes State/county permitting for oversize/overweight vehicles, county/township weight restrictions on local roads, bonding, and road inspections, where required. An explanation of these existing restrictions/constraints are found in Table 4-1, Appendix A, and Table D-2, Required Permits, Bonds, and Liability Coverage (Appendix D).

Impacts Common to Both Alternatives

Site construction, well drilling, well completion and production phases would involve hauling heavy equipment over local roads. The weight of the construction/production equipment, frequency of travel, and the nature and construction of the roadbed would determine the level of impacts to the roads. Potential impacts to roads by heavy vehicles would be greatest during the drilling phase. The drilling rig requires a special overweight hauling permit for transport. Existing controls imposed at the State, county and township level are designed to minimize potential damage to local roads.

In the event road deterioration does occur, it could be difficult to establish liability if oil and gas related vehicles are of similar weight or if they use primarily the same roads as existing truck traffic. Road inspections, as required under Bazetta Township ordinances, would be the best indicator of road deterioration as a result of oil and gas operations. In addition to State/local bonding requirements, Trumbull County's share of the royalty income resulting from the production of Federal minerals is designated to be used for roads and schools. If road damage does occur, this money would be available to local authorities for road repairs.

Impacts to traffic patterns on roads would vary depending on the proposed well location. A measure identified through the analysis of noise and recreation impacts was a restriction that would prohibit drilling, plugging back or deepening of wells during the primary recreation season. This measure would lessen transportation related impacts to recreationists.

Oil and gas drilling/production and plugging/abandonment operations would increase traffic on local roads. Since most operations would occur in Bazetta Township, the intersection of State Route 305 and Hoaglund Blackstub Road is used in calculating the percentage increase in traffic over existing levels. (Specific traffic increases cannot be known until proposed well sites are identified. Projected vehicular activity, as shown in Appendix B, Table B-1, was used in calculating the projected percentage increase in traffic. Projected traffic increases are exaggerated due to the fact that a certain level of traffic associated with well site/facility maintenance and oil/brine hauling currently exists for private well sites/facilities, primarily in Bazetta Township.)

Traffic count information is depicted on Map 9, Mosquito Creek Lake Transportation. On State Highways, average daily traffic (ADT) information is available by vehicle class. Vehicle classes are defined as: (Ohio Department of Transportation, 1997)

- Passenger/Class A vehicles - passenger cars, panel vans, pick-up trucks, motorized recreational vehicles, school buses;
- Class B/C vehicles - commercial tractor-trailers, trucks with semi-trailer, trucks with trailer.

ADT information for State Route 305 east and west of Hoaglund Blackstub was averaged to depict a "mean" ADT on State Route 305 at this intersection. Annual vehicular activity by class was outlined in Table B-1 in Appendix B. Existing and projected ADT information by class is presented on Table 4-9.

Table 4-9. Existing/Projected Average Daily Traffic Count at Intersection of State Route 305 and Hoaglund Blackstub Road

Average Daily Traffic (ADT)[1]	Passenger/Class A	Class B/C	Total
Mean ADT State Route 305	5742	207	5949
Drilling/Production (maximum activity that could occur in one year)[2]			
Add'l. ADT "No Lease"	36	9	45
% Increase "No Lease"	0.63	4.3	0.76
Add'l. ADT "Lease with NSO"	50	9.4	59.4
% Increase "Lease with NSO"	0.87	4.6	1.0
Plugging/Abandonment (maximum vehicular traffic in one year would be the same under either alternative)[2]			
Add'l. ADT	1.1	0.60	1.7
% Increase	0.02	0.3	.03

Source: [1] Eastgate Development and Transportation Agency, 1995; [2] Appendix B, Table B-1, Annual Vehicular Activity by Vehicle Class.

Given the small traffic increases associated with the projected development and the excess capacity of the highways providing access to the area, decreases in level of service are not anticipated.

For the period 1994-95, there were a total of 104 accidents involving cars/pick-ups and six accidents involving large trucks recorded in Bazetta Township on State Route 305 (Bowens, 1996). Using the information from the table above, ADT for cars and large trucks on this same highway is 5,742 and 207, respectively. This equates to approximately 4,000,000 cars and 150,000 large trucks travelling on the highway over a two-year period. Based on these figures, the accident frequency is approximately 0.002% for cars and approximately 0.004% for large trucks. It is not expected that the accident rate would increase measurably as a result of oil and gas activity associated with development of the Federal minerals.

4.2.10 SOCIOECONOMICS

Introduction

This section examines possible socioeconomic impacts under both alternatives. Under Alternative A, no Federal leases would be issued and all 14 new wells would be drilled on private properties around the Federal project area. This development follows the continued expansion of the Clinton formation by industry since 1975. Twenty-seven additional wells are forecast to be developed on private surface for a total of 41 wells under Alternative B. All of the 27 additional wells would be directionally drilled into the Federal acreage leased at the Mosquito Creek Lake project area.

Economic Impacts

Mineral owners who enter lease agreements typically receive a leasing bonus, a yearly rental, and royalty payments from the company holding the lease. Leasing bonuses are one time payments made by leasing companies to mineral owners to persuade them to lease their properties. Leasing bonuses in Ohio commonly range between $10 and $15 per acre. Annual rentals are generally between $1 and $5 per acre, and lease terms are usually for one to five years (Stewart, 1997).

Royalties are paid on a quarterly basis after production is established. Federal leases as well as most private leases in Ohio are subject to 12.5% of the net value of the produced hydrocarbons. Federal lessees pay bonuses, rentals, and royalties to the Minerals Management Service (MMS). For Corps of Engineers' lands the MMS distributes the revenues according to U.S. Code Title 33, Navigation-Navigable Waters, Paragraph 701c-3, which requires that 75 % of these receipts be given to the State, ". . . to be expended as the State Legislature may prescribe for the benefit of public schools and public roads of the county or counties in which the property is situated." In this manner, 75% of the revenues paid by lessees of Federal lands is returned to the local economy.

A percentage of the value of oil and gas production is paid to the state via a severance tax. Ad valorem or property taxes on oil and gas production are also assessed by county governments and the receipts distributed to multiple local political subdivisions. In 1995, royalty payments for hydrocarbon resources in the state of Ohio were estimated to be 59.5 million dollars, based on a total market value of $476,340,199 for produced oil and gas (McCormac, 1997). Almost all of this royalty revenue was returned to private mineral owners as less than two percent of the produced hydrocarbons was publicly-owned. Severance taxes paid to the State on oil and gas production amounted to $3,841,632 in 1995. Ad valorem taxes on production were also paid to Trumbull County, but the amount of these taxes is unknown. Additionally, in 1995 the MMS reported that the Federal government shared $242,862.06 with the State of Ohio for receipts from Federal leases and hydrocarbon production, and Trumbull County received $1,080.61 of this share.

In summary, the beneficiaries of oil and gas leasing and production include: the State of Ohio through severance taxes on all produced hydrocarbons; local governments through ad valorem taxes and through 75% of bonus, rental and royalty revenues from

Federal leases; the Federal government through 25% of bonus, rental, and royalty revenues; private owners of mineral estates; lessees (private industry) of leased properties; and private firms and individuals who provide goods and services to the oil and gas industry.

Federal royalty payments associated with Alternative A and Alternative B are estimated to be $541,000 and $2.629 million respectively (Abing, 1997). The overall economic impact of additional industry activity to the State can be estimated by using the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Department of Commerce's Bureau of Economic Analysis (BEA). RIMS II multipliers show the interdependence of economic activity throughout a given area. Multipliers are provided for output, earnings, and employment. Using these multipliers and the assumption of the introduction of a project into a region, the increase in the output value, such as gross receipts or sales; earnings income such as wages, salaries, or proprietor's income; and employment levels for all other industries in the State can be calculated.

The RIMS II Final Demand Multipliers provided by the BEA for the Crude Petroleum and Natural Gas Industry are shown in Tables 4-10 and 4-11, and represent the total economic impact to a state relative to a change in demand of the output, which in this case is expressed as the value of hydrocarbon production in the State of Ohio given Alternative A or B. The multipliers include not only output, earnings, and employment in the crude petroleum and natural gas industry, but all secondary industries, goods, and services that are impacted in the State. The investment by the industry in oil and gas activity and the revenue generated by sale of the hydrocarbon resources would have a ripple effect throughout the State's economy.

Private wells would generate more than $13 million in gross receipts, nearly $2 million in salaries/income, and 75 new jobs statewide (Table 4-12). Estimates of the economic impacts resulting from Alternative B are nearly $39 million in Output, more than $5 million in Earnings, and an increase of 220 new jobs (Table 4-13).

Table 4-10. Alternative A, Economic Impacts

Revenue Hydrocarbon Sales Million $	Output Multiplier	Earnings Multiplier	Employment Multiplier	Output Million $	Earnings Million $	Employment Persons #
8.661	1.5289	0.2030	8.7	13.242	1.758	75.35

Source: Bureau of Economic Analysis, RIMS II Division and BLM, MFO

Table 4-11. Alternative B, Economic Impacts

Revenue Hydrocarbon Sales Million $	Output Multiplier	Earnings Multiplier	Employment Multiplier	Output Million $	Earnings Million $	Employment Persons #
25.364	1.5289	0.2030	8.7	38.779	5.149	220.67

Source: Bureau of Economic Analysis, RIMS II Division and BLM, MFO

The additional oil and gas activity forecast by either Alternative A or B will have a positive effect on the State, County and townships' economies. The magnitude of positive effect depends on the level of projected development, thus Alternative B would stimulate the economies more than Alternative A. All of the beneficiaries identified earlier would receive some economic gain, but the economies of the local communities in the vicinity of Mosquito Creek Lake would be the least impacted. Minor increases in economic activities would be expected, however, mostly through local expenditures by the oil and gas industry for goods and services.

Environmental Justice

Executive Order 12898 entitled, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations", requires each Federal agency to identify and address disproportionally high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations. Table 3-2 in Chapter Three indicates that both minority and low-income populations represent only a small percentage of the people living in the area surrounding the lake. Any development that may result from the proposed leasing of the Federal oil and gas minerals would be scattered throughout the planning area. Well sites would be located on private lands adjacent to the State/Federal property boundary. Wells would not be concentrated in any one area causing a disproportionate impact to any specific group or entity. Given the dispersed nature of the well sites and the limited concentration of either minority or low-income populations, it is not anticipated that there will be a disproportionally high and adverse human health or environmental impact on minority and low-income populations in this area.

Impacts to Property Values

Property values for Bazetta, Mecca, and Greene Townships have not declined during the last decade (See Chapter Three, Figure 3-2). In fact, the most increase in valuation has been in Bazetta Township where the existing oil and gas development is concentrated. Given the low level of activity forecast for either Alternative A or B, it is not expected that property values would be negatively affected.

Other Impacts

Changes in township and county populations are expected to be minor given Alternative A or B because the level of projected oil and gas activity is low. The median age and race of the communities will not be affected by either alternative. Lastly, the need to develop a local emergency response plan is analyzed in Section 4.2.12, Public Health and Safety.

4.2.11 CULTURAL RESOURCES

As noted in Chapter Three, the nature, extent and diversity of cultural resources within the planning area are presently unknown. It was also noted there are currently no listed National Register of Historic Places (NRHP) sites located in the Mosquito Creek Lake project area. This is not to say that no sites may be present, but rather, none have yet been documented.

BLM is responsible for evaluating the effects of any of its actions and authorizations on cultural resources (historic, archaeological, architectural, historic, or traditional cultural properties) listed in or eligible for listing in the National Register of Historic Places. This evaluation would be done at the time a well site is proposed. BLM would consult with the State Historic Preservation Officer (SHPO) on the need for a site specific cultural survey for the areas proposed for surface disturbing activities. Because very little is known about the cultural resources in the area, cultural resource surveys will likely be required prior to any surface disturbing activities. If historic properties are found, conditions or terms will be placed on the drilling permit or agreement that would either require that the operator: (1) avoid the resources, if warranted; or (2) prepare a plan for recovery of the information related to the site. In addition, a standard Federal lease term requires that if, during the conduct of surface disturbing activities, objects of historic or scientific interest are found, the operator would immediately cease any operations that would result in the destruction of such objects.

No impacts to traditional cultural properties are expected since this area is not within the historical range of any recognized Native American tribal groups.

Existing laws, regulations, and operating constraints, including requirements for consultation with SHPO, are adequate to mitigate impacts to cultural resources (see Table 4-1 and Appendix A).

4.2.12 PUBLIC HEALTH AND SAFETY

Introduction

The public expressed concern about a considerable number of public health and safety issues. Table 4-12 illustrates potential health and safety concerns and potential causes and impacts. Where the concerns, potential causes and impacts are primarily addressed in another resource section, it is so noted on the table.

The following section addresses potential impacts to public health and safety by concern and potential causes of each concern. Potential mitigation measures, which are discussed in this section, are also addressed in Table 4.1 and Appendix A. The measures include technological/engineering design features, restricted practices, notification/signage, and distance setbacks.

Bazetta Township requirements described in the following narrative would apply to six of the 14 wells under Alternative A, and 31 of the 41 wells under Alternative B. The remaining wells would be located in either Mecca or Greene Townships, neither of which has similar requirements for oil and gas operations. Unless indicated otherwise, the Trumbull County Local Emergency Planning Committee (LEPC) records referred to in the following narrative are the detailed records the LEPC has been keeping since 1988.

Oil/Brine Spills and Fires/Explosions

Most crude oil spills occur at oil storage tanks, flowlines, or wellheads. Reported causes of most oil spills are vandalism, lightning strikes or equipment malfunctions. The largest volume spills normally occur at tank batteries. According to the Trumbull County LEPC, vandalism is the primary cause of oil spills at tank batteries in the county (Bartlomain, 1997).

A review of OEPA, LEPC and ODNR records from 1990 through 1996 showed that the number of crude oil spills that required reporting to OEPA or LEPC ranged from an annual high of seven in 1990 to zero in 1993 and averaged two per year. Spill volumes ranged from 250 (six barrels (bbls)) to 6,000 gallons (143 bbls) (Kell, 1997). Neither OEPA nor LEPC had record of any crude oil spill from existing oil and gas operations entering Mosquito Creek Lake (ibid.) Non-reportable spills were those that were either contained within tank battery berms or were of small volume and did not enter waterways or wetlands. During this same period, the LEPC reports that 435 chemical spills were reported by industry or businesses not related to oil and gas activities, an average of 67 spills per year (Bartlomain, 1997). Two reportable crude oil spills per year represents an annual probability for a reportable spill of 0.08% per well, assuming an average 2,400 producing wells per year in the county.

Table 4-12. Primary Public Health/Safety Concerns

	POTENTIAL CAUSE OF CONCERN BY OIL AND GAS ACTIVITY							
Concern	Construction	Drilling	Completion Phase	Oil/Brine Hauling	Well, Pad	Tank Battery	Flow/gathering lines/compressor	Plugging/ Abandonment
Oil/brine spills and fire/ explosion	Excavation around buried utility	Loss of well control (geology) Leachate from pits (water quality)	Loss of well control (geology) Leachate from pits (water quality)	Tanker truck accident (transportation) Illegal dumping of brine (water quality)	Plunger lift-damage by machinery Pumpjack-vandalism Equipment failure	Vandalism Lightening strike Equipment failure Corrosion	Corrosion Damage by excavating equipment Equipment failure	
Contam-ination of drinking water (surface and aquifer)	Erosion/ sedimentation (soils)	Leachate from pits (water quality) Chemical spill (water quality) Oil/brine spill (water quality) Surface casing set improperly (water quality)	Leachate from pits (water quality) Chemical spill (water quality) Oil/brine spill (water quality)	Tanker truck accident (transportation) Illegal dumping of brine (water quality)	Leachate from closed pits (water quality) Oil/brine spill (water quality)	Oil/brine spill (water quality)	Oil/brine spill (water quality)	Abandoned unplugged wells (water quality) Improper plugging of well (water quality)
Endan-germent to life/ limb of public at operation s site	Operation of heavy equipment Increased traffic (transp.)	Operation of heavy equipment Open pits Increased traffic (transportation)	Operation of heavy equipment Open pits Increased traffic (transportation)	Tanker truck traffic (transportation)	Pumpjack - moving parts	Ignitable vapors and liquids in oil tank Tanker truck traffic (transportation)	Excavation into pipeline Pipeline failure, explosion	Operation of heavy equipment Increased traffic (transp.)

Fires and explosions may result from ignition of hydrocarbon vapors and oil in storage tanks, ignition of natural gas from pipeline leaks or ruptures, or ignition of an uncontrolled flow of gas or oil from a wellbore (blowout). According to the LEPC there have been minor fires at tank batteries in the county, most likely due to lightning strikes. None of the fires endangered the public and there is no record of explosions related to oil and gas drilling and production (Bartlomain, 1997). Statewide, ODNR is aware of at least six oil and gas operations related explosions resulting in fatalities to the public. These deaths included four teenagers at tank batteries, a man who ran his tractor into a visible idle well, and a man in a house explosion caused by his removal of pressure-regulating safety equipment from his "free gas" hook-up (Kell, 1997).

Excavation Around Buried Utilities or Pipelines

The likelihood of fire or explosion caused by excavation into a buried utility or gas pipeline during construction would be low because of State notification and flagging requirements.

Loss of Well Control

The likelihood of a well blowout or well fire during drilling of Clinton wells in the Mosquito Creek Lake area is considered to be low because of local operators' extensive knowledge of downhole conditions, the nature of downhole conditions in the area, and requirements for use of blowout prevention (BOP) systems. Well blowouts are uncommon events. ODNR is not aware of any blowouts or well fires that have occurred in Trumbull County while drilling into the Clinton sandstone. The LEPC has no record of well blowouts or fires related to Clinton well drilling (Bartlomain, 1997). Similarly, at the COE Berlin Lake Project in Mahoning, Portage and Stark Counties, Ohio, no blowouts or well fires occurred during drilling of the 53 wells associated with development of Federal oil and gas.

Minor amounts of gas encountered while drilling to the Clinton sandstone would be circulated out in the drilling medium and diverted with cuttings out the discharge line to the reserve pit. BLM requires that all air drilling operations have an automatic igniter or pilot light on the discharge line so that any ignitible concentration of gas would burn off at the end of the discharge line, a process called flaring, referred to locally to as a "controlled burn." Flaring can be a spectacular sight, but does not present a threat to public health and safety when properly managed by experienced drilling contractors (Kell, 1997). Flaring is anticipated on any wells drilled into the Rose Run formation. ODNR implemented special permit conditions in 1989 for wells drilled through the Rose Run Sandstone with air rotary tools because it is expected that flaring would occur. ODNR evaluates each Rose Run drill site as to the suitability of air rotary drilling versus mud drilling and to assure sufficient distance between discharge lines and surrounding vegetation and houses. Since 1989, over 1,500 wells have been safely drilled to the Rose Run Sandstone in accordance with these conditions (ibid.)

Tanker Truck Accidents

The LEPC has no record of tanker truck accidents or spills in the county (Bartlomain, 1997). The likelihood of a tanker truck accident is low due to the minimal increase in traffic that would be caused by oil and gas operations and no overall anticipated increase in traffic accidents (see Section 4.2.9, Transportation). If an oil tanker truck ignited or exploded, emergency response by the local fire department, the LEPC, one of the HazMat teams in the county, and OEPA would be the same as currently exists for such accidents in Trumbull County. See also the Impact to Local Emergency Response Capability in this chapter.

Vandalism

The LEPC reports that vandalism is the primary cause of oil spills at tank batteries in Trumbull County. The likelihood of vandalism would be reduced by Bazetta Township requirements for fencing of the wellhead and tank battery and closure of the access road with a locked gate or cable. The ODNR may require valves on storage facilities be secured by locks, bull plugs, or similar devices so as to discourage vandalism. If a vandal by-passed a fence and turned a tank valve, the berm around the tank battery would normally contain the spilled oil. Analysis in Section 4.2.4, Water Resources, identified a mitigation measure requiring that tank battery facilities be surrounded by a berm that is capable of holding two times (200%) the total volume of the tanks in the battery. This measure was developed with consideration for storage capacity, rainfall events, and length of time between a spill and its discovery. OEPA Spill Prevention, Control and Countermeasure (SPCC) plans require that a tank battery berm contain 110% of the volume of the largest tank or the volume of all tanks if the tanks are in parallel without one-way check valves (Simmers, 1998). SPCC requirements apply to those tanks that have potential to discharge crude oil to navigable water.

Lightning Strikes

Lightning can cause oil tanks to ignite and explode resulting in release of oil. The LEPC reports that some minor fires have occurred at tank batteries in the county, most likely due to lightning strikes; however, the LEPC has no record of a tank explosion (Bartlomain, 1997). Bazetta Township requires flame arresters on oil tanks. A flame arrester is a safety device installed on the vent line of an oil tank that, in the event of ignition of the venting vapor, would prevent the flame from flashing to the vapors inside the tank. BLM requires use of a pressure-vacuum thief hatch and a vent-line valve. If an oil tank ignites or explodes, emergency response by ODNR, local fire department, the LEPC, one of the HazMat teams located in the county, and OEPA would be the same as currently exists for such accidents in Trumbull County. See also Impact to Local Emergency Response Capability in this chapter.

Flowline and Production Equipment Failure

A flowline carries produced fluids from a wellhead to a separator at the tank battery for separation of liquids into storage tanks and gas into the gathering line system. Over time, steel flowlines could corrode and leak; polyvinyl chloride (PVC) lines could develop a bubble at a weak point in the line and fail. A slow leak, which would be the most difficult to detect, would eventually be evidenced by oil and brine, or possibly gas bubbling, at the ground surface. A flowline rupture would cause a sudden pressure drop in the system and a drop in production. The well pumper in the course of a routine production inspection would usually detect a pipeline rupture due to the drop in production rates. Some operators choose to outfit wellheads with a pressure switch which would detect a pressure drop from a rupture and shut-in the well automatically thus stopping the gas/oil/brine flow. In this situation, oil and brine released from a flowline rupture would be limited to no more than what is contained in the flowline at the time of rupture. However, wells are not currently required to be fitted with pressure switches.

Rupture of a flowline between the wellhead and the separator would result in release of liquid already in the flowline plus liquid produced from the well until the well pumper discovers the rupture and shuts in the well. Rupture of a two inch diameter flowline with an average length of 660 feet would result in loss of about 102 gallons of liquid over a 24 hour period, including 84 gallons from the line and 18 gallons of produced fluid. Rupture of flowlines from the separator and the oil and brine tanks would not cause backflow from the tanks because the lines enter the tanks at or near the top of the tanks above the fill line. Rupture of these lines would mean loss of less than one-half barrel (21 gallons) of liquid from the line.

Separators are designed to withstand the maximum pressure the system could experience. A typical maximum design pressure for separators in the project area would be about 500 pounds per square inch (psi). If this pressure were exceeded, gas would be released through a pressure relief valve until normal operating pressures were regained.

Corrosion of oil storage tanks can cause oil leakage. However, corrosion is a gradual process and would normally be detected by the well pumper during maintenance checks of production equipment. BLM requires all storage tanks be painted and kept in good working condition. Bazetta Township specifies all tank battery sites, fence and surface equipment be either made of non-corrosive material or painted with a weather proof paint and that these components be maintained throughout the life of the well. In addition, Bazetta Township requires tanks be set on a five inch bed of limestone and/or natural stone. In normal rainfall events, this would keep the tanks above standing water and lessen the likelihood of corrosion. Because of these combined requirements, corrosion would be expected to play a minimal role in oil tank leakage.

The potential for leakage of a wellhead in a plunger lift system is minimal because it is a closed, self-contained system. The wellhead would have to suffer major physical damage in order to release the gas/oil/brine mixture. There is more potential for a leak of low volume from a pumpjack type system caused by equipment failure. Such equipment failures would usually be found by the well pumper in the course of regular maintenance checks.

Gas Pipeline Failure

If a gas pipeline were to fail, natural gas would be released. Some oil and brine may be released with the gas because a separator does not remove all oil and brine from the gas stream by a separator. The greatest hazard from a major gas pipeline rupture would be a fire or explosion. The primary cause of gas pipeline failure is outside forces such as damage by bulldozers and backhoes, earth movement due to washouts or land slides, willful damage and human error. Less frequent causes include corrosion, material defect, and construction defect. Pipeline failures tend to be higher on older and on smaller diameter lines. Many older pipelines lack the more durable coatings and cathodic protection systems common on new pipeline systems. Large diameter transmission lines tend to have lower failure rates than small gathering lines.

The State requires operators of underground utilities to register with the Ohio Utility Protection Service (OUPS). Excavators are required to give OUPS 48 hours notice prior to commencing operations. The operator of the buried utilities must flag the lines prior to commencing excavation. These procedures greatly reduce the likelihood of damage to pipelines from excavation.

The LEPC has no record of pipeline ruptures in the county (Bartlomain, 1997). Most reported nationwide rates for sweet gas pipeline failures range from one to two failures per thousand miles per year (BLM, 1997; BLM, 1996a; and FERC, 1997). An average of 1.5 failures per 1,000 miles per year represents 0.0015 failures per mile per year, an annual probability of 0.15% of a failure occurring on any one mile in any given year, and a potential of one rupture for 18 additional miles of gathering over the maximum life of the field.

For the period from 1970 through 1993, the average fatality rate among the public from failure of natural gas gathering and transmission lines was 2.6 per year during a time when about 300,000 miles of pipeline was in service in any one year (FERC, 1997). The fatality rate for that mileage of pipeline represents about 0.008 fatalities per 1,000 miles per year. For 18 additional miles of gathering line, the probability of a fatality among the public due to pipeline failure would be 0.52% for the entire maximum life of the field.

If a pipeline failure were to occur, the operator of the line would report to the appropriate regulatory and emergency management agencies and take appropriate measures to correct the problem. See also Impact to Local Emergency Response Capability in this chapter.

Reporting Requirements

Appendix D, Public Health and Safety, describes reporting requirements for spills and accidents. BLM will notify the COE Mosquito Creek Lake Project Manager of all incidents reported to the BLM per the requirements of Notice to Lessees and Operators 3A (NTL-3A), Reporting of Undesirable Events.

Contamination of Drinking Water (Surface and Aquifer)

Impacts to drinking water are addressed in Section 4.2.4, Water Resources.

Endangerment to Life and Limb of Public At Oil and Gas Sites

The likelihood of oil and gas operations in the planning area causing physical harm to members of the public is minimal. As indicated in the above analysis, there would be a negligible increase in the likelihood of well blowouts and fires, tank explosions, pipeline ruptures, oil spills, and traffic accidents as the result of drilling of 14 to 41 additional wells.

There are no exact statistics available regarding deaths among members of the public related to oil and gas drilling and production operations in Ohio. According to the LEPC there has been one fatality to a member of the public in Trumbull County (Bartlomain, 1997). This involved a young man who was asphyxiated when he was deliberately breathing hydrocarbon vapors at the thief hatch on top of an oil tank.

Distance setbacks established by ODNR and Bazetta Township (see Appendix D, Public Health and Safety) are designed to isolate the public from harm should something go wrong at an oil and gas site. As with any industrial site, a member of the public who chooses to enter an oil and gas site could pose a safety risk to himself and to the operations or operations personnel. The most intense period of activity for heavy equipment operation, trucks and other vehicle traffic would be during the construction, drilling and well completion phase, which could last up to 85 days for a multi-well pad. The site would have open working and reserve pits. ODNR requires all pits be closed within 5 months after the drilling of the well commences. ODNR is authorized to shorten the pit closure time frame. It is standard industry practice in Ohio to close pits shortly after drilling operations are completed. A landowner may specify closure of the pits at an earlier date. Unattended open pits could pose an inviting nuisance to children from nearby residences.

BLM may require special measures to secure sites from entry, on a case-by-case basis. These measures would be attached as conditions of approval to a Federal drilling permit or as terms of a Federal agreement. During the production phase, ODNR requires that "pits, pumps, and flares must be safely fenced if within one-hundred and fifty (150) feet of an existing inhabited structure and if in the opinion of the [c]hief (Division of Oil and Gas), such fence is necessary to protect life and limb." No flares or permanent pits would be associated with the production phase in the planning area.

Most residents in the immediate vicinity of a proposed oil and gas site would be aware of the operations. In Bazetta Township, residents in the immediate area of impending drilling operations would know the approximate start-up date and duration of activity because of township requirements. For new access roads, Bazetta Township requires the operator to notify all occupants within 200 feet of the well site access road that drilling activity would be commencing and provide an approximate time table for it. For an existing road, the operator must notify occupants inside the "Restricted Road Area" (i.e. the drilling unit). Additionally, notice of pending well sites is available to the public through an ODNR County Engineer's Report, which is mailed to the county engineer on a weekly basis.

Impact To Local Emergency Response Capability

Because Trumbull County has had an average of 2,400 producing wells per year between 1990 and 1996, it is not anticipated that the proposed additional wells would require increases in local emergency response capability. Local emergency response capability includes local fire departments, the County HazMat team, and HazMat teams from the City of Warren, Mineral Ridge Township, and the City and Township of Hubbard. According to the LEPC, these teams are fully trained and have the necessary supplies and equipment available for emergency response (Bartlomain, 1998).

Liability and Bonds

BLM, ODNR, Ohio Department of Transportation, Trumbull County and Bazetta Township have various requirements for bonds and insurance coverage for liability and property damage. These requirements are summarized on Table D-2 in Appendix

D, Public Health and Safety. As noted on that table, for federally permitted wells BLM may require an increase in the bond amount if the BLM determines that the operator poses a risk for reasons including, but not limited to, a history of violations, uncollected royalties due, or if the total cost of plugging existing wells and reclaiming lands exceeds the present bond amount.

In the unlikely event that a well operator refuses to properly plug and abandon a well, BLM would initiate enforcement actions including monetary penalties and claiming the Federal bond. If additional funds are needed, BLM would pursue collection of the funds through civil court proceedings. In the event that a well operator is insolvent, no longer exists, or cannot be located, BLM would claim the Federal bond and in coordination with the ODNR, Division of Oil and Gas, utilize the State of Ohio's idle and orphan well fund for any funds needed in addition to the bond.

Mitigation

The existing BLM, State and township regulatory requirements for the most part provide for adequate protection of public health and safety through safety setbacks, required technological/design features on drilling and production equipment, required construction practices, and prohibition of certain practices. The mitigation measures discussed below have been identified to further strengthen protection of public health and safety and extend protection to Mecca and Greene Townships.

BLM would apply to all well sites the requirements developed by Bazetta Township for safety setbacks, public notification, fencing of wellhead, tank battery and related production equipment, fence with locked gates/cables at access roads, placing tanks on limestone and/or natural stone, and having tanks, fencing, and other surface equipment of non-corrosive material or painted weather-proof paint.

Measures that BLM would apply to all sites include installation of pressure switches on wells, and installation of pressure-vacuum thief hatches, vent-line valves, and plugs on all vent ports on oil tanks; the requirement for tank battery berms capable of holding at least twice (200%) the total volume of the storage tanks in the battery (see Section 4.2.4, Water Resources); and the requirement for a sign displaying the operator's name, well name, State permit number and 24 hour emergency number at both the wellhead and tank battery. For well sites near residential areas during drilling and well completion or later well workover operations, BLM would require free liquids be removed from pits within seven days after the completion of drilling or well workover operations and maintained liquid free until pit closure; all unattended drilling pits for well sites be fenced; and pits be closed within 14 days after drilling or subsequent well workover operations cease.

BLM would evaluate the need for warning signs near the access road entry during construction or drilling operations on a case-by-case basis.

4.3 CUMULATIVE IMPACTS

Federal regulations define cumulative impacts (40 CFR 1508.7) as:

> "...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time".

In assessing cumulative impacts, BLM must look at past, present, and foreseeable future actions of other oil and gas operations in addition to actions that could cause similar impacts. This means that, in addition to impacts associated with oil and gas sites, BLM must consider impacts of activities such as construction projects, recreation, and others to determine whether these collective actions would create a significant environmental impact.

Potential impacts associated with oil and gas operations may be grouped into three general categories. These are: 1) change in the existing character of the land or land use classification, 2) sedimentation, and 3) chemical contamination. Impacts tend to be either short or long-term in nature. In general, the cumulative impacts discussion will not consider short-term, localized impacts. However, these would be considered if they lead to long-term, more widespread impacts.

Existing Character of the Land

Map 5 identifies land use categories for lands adjacent and within one-half mile of the Mosquito Creek Lake project area. The total acreage of each category of land use and overall percentage of the total acreage represented is depicted below:

Table 4-13. Land Use Classification for Adjacent Private Lands

Land Use Classification	Acreage	% of Total
Agricultural	4,239.7	21.2
Commercial	122.2	.6
Industrial	86.1	.4
Natural Area (includes Lakeview Local School District property)	8,438.6	42.2

Land Use Classification	Acreage	% of Total
Open Space	231.7	1.2
Residential	6,878.7	34.4
TOTAL	19,997.0	100.0

Source: MFO Geographic Information System (GIS) based on Ohio DNR, Map 5

Federal property is delineated into land use categories in the Mosquito Creek Lake Master Plan (this does not include water acreage). The following represents acreage by classification for the Federal property:

Table 4-14. Land Use Classification - Federal Lands

Land Use Category	Acreage	% of Total
Limited Development Area	101.7	2.5
Protected Lakeshore Area	3,381.7	83.8
Existing Recreation Area	360.7	8.9
Future Recreation Area	193.1	4.8
TOTAL	4,037.2	100.0

Source: MFO GIS based on COE Lakeshore Management Plan,
Mosquito Creek Lake Master Plan

Although land use on Federal and adjacent lands includes residential, industrial and commercial areas, there is still a large acreage that can be considered undeveloped.

Existing/Future Oil and Gas Activities

Since 1975, approximately 120 oil and gas wells have been drilled in Bazetta Township within one mile of Mosquito Creek Lake. About 20 wells have been drilled in Mecca Township and five wells drilled in Greene Township. According to ODNR, Division of Oil and Gas, there were 178 producing oil and gas wells throughout the three townships in 1996. As is emphasized throughout this assessment, it is unlikely that oil and gas development will ever occur in the northern two thirds of the project area or low potential development area (Mecca and Greene Townships). However, for analysis purposes, this document does project exploratory drilling in the low development potential area.

If the BLM decides not to lease under Alternative A, it is predicted that 14 private wells would be drilled anyway. Each of these wells would require construction of a new well pad and associated facilities. The total acreage disturbed and reclaimed as a result of developing these wells is approximately 62 acres and 55 acres, respectively (includes roads, well pad, tank batteries, flowlines, gathering lines). The remaining 7 acres would be stabilized and used for access roads, wellhead/turnaround areas, and tank batteries.

If BLM decides to lease under Alternative B, it is predicted that a total of 41 wells could be drilled. This includes the 14 wells drilled under Alternative A and an additional 27 Federal wells. There would be a total of 24 well pads. Six existing well pads and 18 new well pads would be required (includes the 14 well pads identified under Alternative A). The total acreage disturbed and reclaimed as a result of developing these wells is approximately 77 acres and 65 acres, respectively. The remaining 12 acres would be stabilized and used for access roads, wellhead/turnaround areas, and tank batteries.

The development of additional well sites at Mosquito Creek Lake could convert present land use to an "industrial" setting. An additional 7-12 acres of land could be converted to the "industrial" classification under the two alternatives. This represents an increase of 8-14% over what is presently classified as "industrial", but would be less than one percent of the total area within one-half mile of the Federal property.

Other Activities Affecting Existing Character of the Land

The Trumbull County Planning Commission states that there are no sub-divisions or multi-building projects being constructed on unincorporated areas around the lake. The largest construction project underway within one-half mile of the lake is the Lake Vista retirement community, a 22-acre site on the east side of the lake in the incorporated limits of the City of Cortland. According to the Bazetta Zoning Commissioner, there is a boat storage facility being constructed near the intersection of State Route 305 and McCleary-Jacoby Road.

Building permit information provided by the Trumbull County Building Department shows that there were 84, 23, and 3 building permits issued for Bazetta, Mecca, and Greene Townships, respectively, in 1996. Slightly less than half of the permits in Bazetta and Mecca townships were for residences (single family homes, duplexes, quadriplexes, modular units) and two of the permits in Greene township were for residences (single family home and temporary residence). Estimates of total acreage involved in these permits were not available. Acreage disturbed would depend upon the type of building permit issued.

Sedimentation

Sedimentation can result from any action which results in surface disturbance. It has been stated in Chapter Four that construction activities related to oil and gas development have the potential to result in sedimentation problems if not properly mitigated. Chapter Four outlines measures that would be implemented under either Alternative A or B for control of sedimentation and erosion. With proper use of sediment control barriers and other measures, sedimentation from disturbed sites would be minimized.

Sedimentation can also result from farmland surrounding Mosquito Creek Lake. According to the Ohio Nonpoint Source Management Program, agriculture produces the largest share of sediment and is the major source of nonpoint source pollution impacting water quality in Ohio (ODNR, 1989). As indicated in Table 4-13, there are over 4,000 acres of land classified as agricultural land within one-half mile of Mosquito Creek Lake. It is not known what percentage of this acreage is considered to be active farmland as compared to idle farmland. Localized construction activity, as identified above, while not producing the greatest amount of total sediment, may exceed agriculture in the amount of sediment produced per acre. The estimated annual sediment accumulation rate at Mosquito Creek Lake reflects a high rate of sedimentation (COE, 1993). Peterson, et al., 1997, concluded that oil and gas drilling is a minor source contributing to the sedimentation of Mosquito Creek Lake.

Chemical Contamination

Chemical contamination can result from release of drilling or production fluids. It is not anticipated that there will be a catastrophic oil or brine spill if oil and gas development takes place. The potential for oil or brine spills and associated impacts are addressed in Chapter Four. Drilling and production activities have the potential to result in chemical contamination of soils and water resources if not properly mitigated. Chapter Four outlines measures that would be implemented for control of drilling and production fluids. With effective implementation of mitigation measures, chemical contamination from drill sites or production facilities would be minimized.

Chemical contamination of Mosquito Creek Lake is presently occurring from other non-oil and gas related activities. Recreational activities, including boating and jet-skiing, result in the release of refined oils and gasoline into the Lake. Non-point sources of contamination are also present in the area. Potential for increased salinity of the Lake as a result of oil and gas operations has been identified as a concern. Bazetta Township presently uses approximately 300 tons of road salt per year for road de-icing purposes (see Section 4.2.4, Water Resources). Salting of roads in the immediate vicinity of the lake would result in increased salinity of adjacent waters if run-off occurs. Other non-point sources of contamination include run-off from industrial activity, service stations, driveways, or roads. Run-off from agricultural or cropland could result in chemical contamination of the waters of Mosquito Creek Lake from fertilizers, pesticides, or herbicides. As stated in Section 3.5, Water Resources, the OEPA reported that Mosquito Creek water quality suffered "extensive and severe impacts" from a variety of sources including wastewater effluent, sewer overflows, industrial and urban development and residual toxicity (mainly pesticides).

Cumulative Impact Summary

Oil and gas development presently exists in the vicinity of Mosquito Creek Lake. Even if a decision is made to not lease, it is expected that an additional 14 wells could be drilled. Additional wells projected under Alternatives A or B could result in changes in present land use. However, the total acreage of initial disturbance under either alternative is very small in comparison to the total acreage in the analysis area. Mitigation measures have been identified under Alternatives A and B to lessen or eliminate the impacts associated with sedimentation or chemical contamination as a result of oil and gas development. Present sources of sedimentation and chemical contamination in the Mosquito Creek Lake area far exceed what may be expected as a result of oil and gas development under either Alternative A or B.

4.4 SUMMARY OF ANTICIPATED IMPACTS

Following application of the identified mitigation measures, some impacts to resource values may remain. These impacts are termed residual impacts. The following table summarizes the remaining impacts associated with Alternatives A and B.

Table 4-15. Summary of Residual Impacts by Alternative

Resource Value	Alternative A	Alternative B
LAND USE	Sixty-two acres of land initially disturbed. Fifty-five acres revegetated and seven acres stabilized but unreclaimed. Land would be dedicated to oil and gas production facilities for the productive life of the wells.	Seventy-seven acres of land initially disturbed. Sixty-five acres revegetated and 12 acres stabilized but unreclaimed. Land would be dedicated to oil and gas production facilities for the productive life of the wells.
GEOLOGY	Development of 530 acres of Federal oil and gas. Production of 1.2 billion cubic feet of Federal gas; 6,400 barrels of Federal oil.	Development of 2,600 acres of Federal oil and gas. Production of 7.8 billion cubic feet of Federal gas; 44,000 barrels of Federal oil.

Resource Value	Alternative A	Alternative B
Soils/Prime Farmland	Soil loss would be controlled through existing mitigation and best management practices. Additional measures may be identified on a site specific basis.	Same as Alternative A.
Water Resources	No measurable increase in total suspended solids, turbidity, or chemical contamination of surface water is expected. Short-term impacts on adjacent water wells such as localized turbidity, drop in water levels, or introduction of contaminants from other zones could occur during drilling.	Same as Alternative A.
Floodplains	No specific impacts are anticipated. Floodplains would be avoided. If avoidance is not possible, specific mitigation would be developed on a case-by-case basis.	Same as Alternative A.
Wetlands	No direct impacts from well site construction is anticipated. Wetlands will be avoided. The COE may grant easements for pipelines on a case-by-case basis. Indirect impacts to wetlands are not anticipated due to mitigation measures identified in Sections 4.2.3, Soils, and 4.2.4, Water Resources.	Same as Alternative A.
Special Status Species	No impacts are anticipated. Coordination with U.S. Fish and Wildlife/ODNR and site specific analysis would mitigate impacts.	Same as Alternative A.
Wildlife	Approximately 7 acres of wildlife habitat lost. for the productive life of the wells.	Approximately 12 acres of wildlife habitat lost for the productive life of the wells.
Fisheries/Aquatics	No impacts are anticipated. Mitigation measures for "soils" and "water resources" would mitigate indirect impacts to fisheries/aquatics.	Same as Alternative A.

Resource Value	Alternative A	Alternative B
AIR QUALITY	During drilling phase, short-term emissions of nitrogen oxides, sulfur dioxide, and volatile organic compounds (VOCs). During production, VOCs would be emitted by oil storage tanks. Long-term odors of hydrocarbon vapors from oil storage tanks. Maximum yearly VOC emissions would be 12 tons per year.	Same as Alternative A.
NOISE	Short-term noise impacts during drilling phase. Impacts could last up to two months per well site. Seasonal drilling restriction would lessen potential impacts to recreationists during summer months. Long-term noise levels for production facilities would be maintained at < 45 dB(A) outside the drilling unit. Long-term specific impacts from potential gas compressors are unknown.	Same as Alternative A except that impacts could last two to three months.
RECREATION AND VISUAL	Short-term annoyance to recreationists resulting from noise, dust, traffic, odors, and changed landscape. Seasonal drilling restriction would lessen potential impacts to recreationists during summer months. Long-term impacts relating to changed land use, odors, and noise (see Land Use, Air Quality and Noise).	Same as Alternative A.
TRANSPORTATION	Maximum increase in traffic counts per year of < 1%. Potential road deterioration if existing controls relating to overweight/oversize vehicles are not implemented.	Maximum increase in traffic counts per year of 1%. Potential road deterioration if existing controls relating to overweight/oversize vehicles are not implemented.

Resource Value	Alternative A	Alternative B
SocioEconomics	Generate more than $13 million in gross receipts, $2 million in salaries/income, and 75 new jobs statewide over the producing life of the wells. Total Federal royalties are expected to be $541,000 Negative impacts to property values are not anticipated.	Generate nearly $39 million in gross receipts, more than $5 in salaries/income, and 220 new jobs statewide over the producing life of the wells. Total Federal royalties are expected to be $2.629 million. Negative impacts to property values are not anticipated.
Cultural Resources	No impacts are anticipated.	No impacts are anticipated.
Public Health and Safety	Risk of accidents is considered negligible.	Risk of accidents is considered negligible.

4.5 Monitoring

The purpose of a monitoring program is to ensure that the long-term objectives or criteria as identified in Table 4-1 are met. Because it is expected that development would occur under either alternative and BLM would potentially be involved in some type of decision relating to the development of Federal minerals (whether through a Federal drilling permit or agreement), a monitoring program is necessary for either alternative. The following narrative describes actions that would be taken during monitoring. Although actions have been identified as if a decision has been made to lease, this is done only for purposes of developing the plan. No decisions have been made on leasing of the Federal mineral interest.

The primary focus of the monitoring program will be to ensure compliance with existing rules, regulations, and any special mitigation measures developed through the environmental analysis process. Mitigation measures may be imposed in different ways depending upon the type of document authorizing the activity. Measures would be attached to an approved drilling permit as conditions of approval (for federally permitted wells) or they would be attached to Federal agreements as terms of the agreement. Measures may also be attached at the State level through the State drilling permit or through licenses which would allow directional drilling through State owned minerals, if applicable.

Monitoring will also provide information on the effectiveness of the prescribed measures by assessing how resource objectives are being met, both in the short-term and long-term. These determinations will be made through site inspections, general observation, quantitative measurements where possible, contact with landowner and adjacent surface management entities, and assessment by potentially affected parties.

Short-Term Monitoring Actions

BLM's inspection program includes environmental, drilling, production and abandonment/reclamation related inspections. Inspections are prioritized based on a number of criteria. The presence of important or sensitive resource values is one factor that is considered. Due to the location of potential well sites relative to wetland areas, streams, and drainageways located near Mosquito Creek Lake, and the fact that the reservoir serves as the drinking water source for the City of Warren and surrounding communities, BLM will rank both environmental and drilling inspections as a high priority should wells be drilled in this area. BLM would be notified of the start of site construction activities and well drilling. At the time BLM is notified of the start of activities, an assessment would be made regarding the sensitivity of the proposed area for disturbance and appropriate inspections would be planned. Adjacent surface management agencies, surface owners, other State or Federal agencies, as appropriate, would also be notified of inspections that may be scheduled. Inspections conducted by the Ohio Department of Natural Resources (ODNR), Division of Oil and Gas would also provide opportunity to ensure compliance with conditions or terms of appropriate permits and agreements.

For federally permitted wells or private wells participating in a Federal agreement, pre-drilling inspections will take place prior to any surface disturbing activities. During this inspection, the operator's proposed drilling and surface use plans would be discussed. These inspections would be conducted during the processing of the Federal drilling permit or agreement. These site inspections are typically attended by a BLM representative, other Federal/State entities as appropriate, the oil and gas operator, dirt contractor, drilling contractor, and the landowner. During this inspection, each proposed and/or staked well site, tank battery, access road, and pipeline location will be analyzed so that site specific recommendations and mitigation measures may be developed.

Drilling inspections will ensure compliance with the conditions or terms of the approved drilling permit(s)/agreements, as applicable. Typical requirements relate to site construction, blowout prevention equipment, mud program, and casing and cementing program.

Once the drilling is completed, the well would either be put into production if productive, or plugged and abandoned. Site restoration and reclamation would be done on those areas no longer needed for oil and gas related activities (for non-productive wells, the entire well site would be reclaimed as quickly as possible). Once productive wells have been depleted, production equipment would be removed and the wells would be plugged and abandoned. Those areas used for production facilities would also be reclaimed. Prior to release of the Federal bond (for federally permitted wells), BLM would ensure that appropriate reclamation has taken place. This would either be done through a site inspection or consultation with the surface owner and adjacent surface management agencies, as appropriate. State bonds are also required. Bonds are detailed in Appendix D, Table D-2, Required Permits, Bonds and Liability Coverage.

Long-Term Monitoring Actions

Monitoring actions extend beyond the site construction and drilling phase. Long-term resource objectives and management prescriptions outlined in plans of adjacent land management agencies, in addition to objectives and criteria identified in Table 4-1, are to be maintained through the life of the producing wells. Proper maintenance of producing wells and associated facilities in compliance with terms of the associated permits or agreements would be necessary to ensure that these objectives or prescriptions are met.

BLM and State inspectors conduct on-site inspections during the producing phase of a well. BLM production inspections, conducted by a Petroleum Engineering Technician, are conducted once per year. If conditions or terms of the permits/agreements require additional expertise from other staff within BLM or entities with specialized knowledge, appropriate personnel would be involved. This could include resource protection specialists, such as wildlife biologists, environmental scientists, or others. Consultation with outside subject matter experts would be requested, as necessary. Inspections include an assessment of compliance with the conditions/terms and special mitigation measures, whether production is being properly measured and reported for royalty purposes, whether public health and safety is protected, whether site security is adequate, and whether the environment is being protected. BLM would coordinate monitoring efforts with the adjacent surface management agencies, where appropriate. Should the COE or ODNR observe problems or receive complaints specific to well sites or production facilities, BLM would be contacted and appropriate action would be taken to correct the situation.

During the production phase, regular inspection and preventive maintenance visits to the well and tank battery would be made by the operator's well tender/pumper. These are opportunities for the operator to identify and quickly remedy problems that may occur.

Monitoring actions are focused on ensuring the effective implementation of the prescribed mitigation measures which, in turn, will result in maintaining resource objectives and meeting evaluation criteria. If resource objectives are not maintained or evaluation criteria are not met, corrective action would be required. Specific actions would differ depending upon the identified problem.

Appendix D, Table D-3, Inspections, outlines inspections performed by the various regulatory agencies during all phases of oil and gas operations. The agencies may make additional inspections on an as-needed basis at any time. BLM inspects federally permitted wells to assure that the wells are in compliance with all the requirements of BLM lease terms, regulations, Orders, Notices to Lessees and conditions of the drilling permit. In cases of non-compliance, BLM takes measures that become progressively more severe if an operator continues in non-compliance. In order from least to most severe, these measures include Notice of Incidents of Non-Compliance (INC), which requires correction within a specified time frame; monetary assessments; shutting down operations; civil penalties; claiming the Federal bond; and finally lease cancellation. In cases of non-compliance that threaten severe environmental damage or loss of life, BLM can enforce immediate shut down of operations. The ODNR has a similar program of progressively severe enforcement measures if an operator continues in non-compliance.

actions would differ depending upon the identified problem.

Appendix D, Table D-3, Inspections, outlines inspections performed by the various regulatory agencies during all phases of oil and gas operations. The agencies may make additional inspections on an as-needed basis at any time. BLM inspects federally permitted wells to assure that the well is in compliance with all the requirements of BLM lease terms, regulations, Orders, Notices to Lessees and conditions of the drilling permit. In cases of non-compliance, BLM takes measures that become progressively more severe if an operator continues in non-compliance. In order from least to most severe, these measures include Notice of Incidents of Non-Compliance (INC), which requires correction within a specified time frame; monetary assessments; shutting down operations; civil penalties; claiming the Federal bond; and finally lease cancellation. In cases of non-compliance that threaten severe environmental damage or loss of life, BLM can enforce immediate shut down of operations. The OGCB has a similar program of progressively severe enforcement measures if an operator continues in non-compliance.

Chapter Five - Consultation and Coordination

Public Participation

The BLM and COE have sought public input throughout the development of this document. Public participation began with the publication of legal notices on April 18, 1996 in the Warren Tribune Chronicle and the Youngstown Vindicator providing information on the leasing proposal and scheduled public meetings. A notice was also published in the Federal Register on April 23, 1996. Two scoping meetings were held in Cortland on May 8, 1996. On June 18-19, 1996, the Trumbull County Council of Governments sponsored two public forums on the leasing proposal in the Warren City Council Chambers. From information gathered at these meetings, BLM and the COE were able to develop and prioritize issues to be considered in the Mosquito Creek Lake Planning Analysis/Environmental Assessment (PA/EA).

An interagency working meeting was held in Niles, Ohio, on February 12, 1997 to discuss the preliminary analysis of the draft leasing alternatives for the PA/EA. The meeting was conducted by the BLM, COE, and the Ohio Department of Natural Resources (ODNR). Melissa Long from the City of Cortland, Terry Lipstreu from Warren Water Treatment Plant, Bill Glancy from Bazetta Township, and George Bucella from Congressman Traficant's office attended the meeting as public observers.

State Senator Anthony Latell requested that an independent study of the leasing proposal be conducted by Youngstown State University. The results of this study were presented at a public meeting sponsored by Senator Latell on April 11, 1997 in Warren. On May 12, 1997, State Representative Michael Verich sponsored a public meeting to present BLM and COE with petitions signed by approximately 6,000 residents expressing their concern over the proposed leasing. Agency representatives from BLM, COE and ODNR attended these meetings.

On September 18, 1997, the BLM and COE hosted a visit to the COE Berlin Lake project area to give concerned citizens an opportunity to view existing Federal oil and gas wells and associated production facilities. On September 19, 1997, BLM made a presentation to the membership of the Mahoning River Consortium. The purpose of this meeting was to help the Consortium arrive at a position on the leasing proposal, which it did later in the fall.

At critical points in the planning process, project newsletters were mailed to over 200 people listed on the project mailing list. These newsletters kept interested parties apprised of the status of the document. In addition, a project homepage was established on the internet in the Fall of 1997.

Coordination with Other Federal, State and Local Government Entities

BLM contacted various Federal, State and local government entities during the development of this document. In addition to the public meetings mentioned above, other meetings were held at various points in the process. On July 22, 1997, the BLM, COE, and ODNR attended a meeting of local governmental officials at the Warren City Council Chambers to discuss the COE's decision to prohibit surface occupancy on Federal land for well sites. On July 23, 1997, the BLM and COE attended a meeting with the Trumbull County Planning Commission for the same purpose.

Contacts were also made with various Federal, State and local entities during the analysis process to gather information, seek assistance, and ensure compliance with existing laws, regulations, or land management objectives (see list below). Congressional entities were also briefed periodically.

Entities Consulted

The following agencies, individuals and groups were consulted during the preparation of the PA/EA:

Federal Agencies
Department of the Interior
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

Department of Agriculture
- Natural Resources Conservation Service

Department of Commerce
- National Weather Service

Department of Defense
- U.S. Army Corps of Engineers

State Agencies
Ohio Environmental Protection Agency
Ohio Department of Natural Resources
- Division of Geological Survey
- Division of Oil and Gas
- Division of Parks and Recreation
- Division of Water
- Division of Wildlife

Ohio Department of Transportation
State Historic Preservation Office

Trumbull County Agencies
Trumbull County Council of Governments
Trumbull County Engineer's Office
Trumbull County Local Emergency Planning Committee (LEPC)
Trumbull County Planning Commission

Bazetta Township

Greene Township

Mecca Township

City of Cortland

City of Warren

Groups Contacted
Coalition Opposing the Drilling of Gas at Mosquito Lake
Mahoning River Consortium

Congressional Entities
State Senator Anthony Latell
State Representative Michael Verich

Senator Michael DeWine
Senator John Glenn
Representative Sherrod Brown
Representative James Traficant

TEAM MEMBERS AND RESPONSIBILITIES

The following individuals contributed written sections of the PA/EA:

BLM, Milwaukee Field Office
Tim Abing, Petroleum Engineer
Responsibilities: Royalty projections
H. Singh Ahuja, Physical Scientist
Responsibilities: Hazardous Materials
LaRoye Chisley, Cartographic Technician
Responsibilities: Cartographic support
James Engstrom, GIS Specialist
Responsibilities: Geographic Information Systems, Mapping products
Chris Hanson, Assistant Field Manager
Responsibilities: Technical and Management Review

Sylvia Jordan, Natural Resource Specialist

Responsibilities: Wildlife, Wetlands, Special Status Species, Fisheries/Aquatics

Howard Levine, Planning and Environmental Coordinator

Responsibilities: Planning/NEPA Policy, Editorial

Becky Metz, Environmental Scientist

Responsibilities: Reasonably Foreseeable Development Scenario, Noise Impacts, Air Quality, Public Health and Safety, Floodplains

Jeff Nolder, Geologist

Responsibilities: Geology, Socioeconomics

Cinde Ponder, GIS Technician

Responsibilities: Geographic Information Systems

Richard Ruth, GIS Intern

Responsibilities: Geographic Information Systems

Terry Saarela, Team Leader, Environmental Scientist

Responsibilities: Transportation Networks, Project Leadership, Editorial

Miriam Simonds, Environmental Scientist

Responsibilities: Soils, Recreation and Visual Resources, Socioeconomics, Editorial

Carol Van Ryzin, Fluid Minerals Assistant

Responsibilities: Team Facilitator, Editorial

Dalia Varanka, Physical Science Technician

Responsibilities: Geographic Information Systems

<u>BLM, Eastern States Office</u>

Sarah Bridges, Cultural Resource Program Lead

Responsibilities: Cultural and Paleontological Resources

Ken Fitzpatrick, Economist

Responsibilities: Economics

Jan Townsend, Cultural Resource Program Lead (peer review)

Responsibilities: Cultural and Paleontological Resources

Geoff Walsh, Natural Resource Specialist

Responsibilities: Wildlife (peer review)

<u>BLM, Jackson Field Office</u>

Clay Moore, Natural Resource Specialist

Responsibilities: Soils, Recreation and Visual Resources

<u>Ohio Department of Natural Resources</u>

Scott Kell, Assistant Chief, Division of Oil and Gas, Columbus, Ohio

Responsibilities: Water Resources

George Mychkovsky, Hydrologist, Division of Oil and Gas

Responsibilities: Water Resources (Hydrogeology Appendix)

Rick Simmers, Regional Supervisor, Division of Oil and Gas, Uniontown, Ohio

Responsibilities: Water Resources

Appendix A - Oil and Gas Development Constraints and Special Mitigation Measures

APPENDIX A - OIL AND GAS DEVELOPMENT CONSTRAINTS AND SPECIAL MITIGATION MEASURES

Introduction

This appendix is divided into three sections. The first section provides information relating to existing surface and subsurface constraints. These constraints were identified early in the planning process by surface management entities in the Mosquito Creek Lake project area. The second section provides information relating to existing laws, regulations, orders, and ordinances at the Federal, State and local level that would be imposed on oil and gas operations occurring under either alternative. The third section details special mitigation measures developed through the impact analysis process. These measures would apply to oil and gas operations which produce Federal mineral resources and are authorized through Federal drilling permits or agreements. Certain measures would be applied to all operations and others would be considered on a case-by-case basis following site specific analysis.

Existing Surface and Subsurface Constraints

The following constraints are common to both alternatives. These constraints have been identified by the Corps of Engineers, the Ohio Department of Natural Resources, and the Lakeview Local School District.

Surface Use Constraints:

- No surface occupancy is permitted for well sites or other permanent structures on Corps of Engineers' (COE) lands. The COE may grant easements for pipelines on Federal lands on a case-by-case basis.
- Ohio Department of Natural Resources (ODNR) will not permit occupancy for well sites, other permanent structures, or pipelines in the State park or wildlife area lands.
- No surface occupancy is permitted for well sites or other permanent structures on the Lakeview Local School District property.

Subsurface Use Constraints:

- No subsurface occupancy is permitted on two COE tracts near the dam (A-146 and A-138 west of the intersection of Warren-Meadville Road and State Route 305).
- The ODNR Division of Parks and Recreation has no authority to develop State owned minerals. Therefore, the State spacing setback of 500 feet would apply and the bottomhole location of wells would be at least 500 feet away from the State property line.
- The ODNR Division of Parks and Recreation may grant easements for

directional drilling through State owned minerals on a case-by-case basis.

For operations on private land, surface use agreements would be developed between the oil and gas operator and the private landowner. Terms of these agreements would be determined by the operator and landowner on a case-by-case basis.

Existing Laws, Regulations, Orders, Ordinances

The following table outlines the existing laws, regulations, orders, and other controls that would regulate or control any operations that may be proposed.

Table A-1. Existing Laws, Regulations, Orders, and Other Controls Placed on Oil and Gas Operations

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	**General Requirements**
FEDERAL CONTROLS	
BLM OIL AND GAS OPERATING REQUIREMENTS FOR FEDERAL WELLS (those marked with ** would also apply to private wells included in Federal agreement)	
43 CFR Part 3160 Regulations - Onshore Oil and Gas Operations BLM	Provides general information relating to responsibilities and requirements of lessees and operators, incidents of noncompliance, assessments and penalties **Requires that operators conduct operations in a manner which protects the mineral resources, other natural resources, and environmental quality **Requires that operators perform operations and maintain equipment in a safe and workmanlike manner Authorizes BLM inspection program (**production only)
Onshore Order #1 - Approval of Operations on Onshore Federal and Indian Oil and Gas Leases BLM	**Requires site specific surface use plan and drilling program Addresses subsequent operations, well abandonment, and reports and activities after well completion
Onshore Order #2 - Drilling Operations on Federal and Indian Oil and Gas Leases BLM	Addresses well control requirements, casing and cementing requirements, mud program requirements, drill stem testing requirements, special drilling operations (including air drilling), surface use, and drilling abandonment **Blowout preventer (BOP) requirements **Cementing and casing program **Air drilling requirements

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	**General Requirements**
Onshore Order #3 - Site Security BLM	**Establishes minimum standards for site security by providing a system for production accountability
Onshore Order #4 - Measurement of Oil BLM	**Establishes requirements and minimum standards for measurement of oil Requires each sales tank to be equipped with a pressure-vacuum thief hatch and/or vent-line valve
Onshore Order #5 - Measurement of Gas BLM	**Establishes the requirements and minimum standards for the measurement of gas and establishes abatement periods for corrective action when noncompliance with minimum standards is detected.
Onshore Order #7 - Disposal of Produced Water BLM	**Specifies requirements for disposal of produced water Operators must apply to BLM for approval of the disposal of produced water.
Notice to Lessee 3A - Reporting of Undesirable Events BLM	**Specifies requirements for reporting of spills, discharges, or other undesirable events
Notice to Lessee 4A - Royalty or Compensation for Oil and Gas Lost BLM	**Specifies circumstances under which oil and gas production is/is not subject to royalty **Prohibits venting or flaring of gas from a gas well except during well testing or emergencies
BLM Washington Office Instruction Memorandum No. WO-95-93 BLM	BLM would require that operators construct exhaust stacks so as to prevent entry by birds and bats; and to the extent possible, operators discourage the perching of birds
BLM Washington Office Instruction Memorandum No. WO-93-344 BLM	Requires all National Environmental Policy Act documents list and describe any hazardous and/or extremely hazardous substances that would be produced, used, stored, transported, or disposed of as a result of a proposed project

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	General Requirements
BLM Milwaukee Field Office Standard Requirement for Hazardous Materials BLM	Standard condition of approval requires operators to furnish an inventory of all drilling, completion, testing, and workover additives used during well operations within 30 days after the end of the drilling phase
BLM Standard Oil and Gas Lease Stipulation # 6 BLM	**Standard lease term requires operators to conduct operations in a manner that minimizes adverse impacts to land, air, water, cultural, biological, visual and other resources, and to other land uses or users. Areas to be disturbed may require inventories or special studies to determine the extent of impacts to resources. If, in the conduct of operations, threatened or endangered species, objects of historic or scientific interest, or substantial unanticipated environmental effects are observed, operator shall immediately cease operations and immediately contact BLM.
STANDARD ARMY MINERAL LEASE STIPULATIONS FOR LANDS UNDER JURISDICTION OF COE (to be applied to operations on adjacent private lands)	
Stipulation #14 BLM/COE	No drilling or other surface disturbance will be permitted within 200 feet of a COE developed recreation area unless otherwise approved by the BLM in consultation with the COE.
Stipulation # 21 BLM/COE	No surface occupancy is permitted within 200 feet of the meander line of a perennial stream in a zone extending out 200 feet on the surface from the Federal property boundary unless otherwise approved by the authorized officer of the BLM in consultation with the Army Corps of Engineers. No surface occupancy is permitted within 100 feet of the meander line of an intermittent stream in a zone extending out 100 feet on the surface from the Federal property boundary unless otherwise approved by the authorized officer of the BLM in consultation with the Army Corps of Engineers.
Stipulation #24 BLM/COE	The oil and gas lessee will be liable for pollution or other damages, as a result of their operations, to Government owned lands and property and to the property of the Government's authorized surface user.

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	General Requirements
Other Laws/Executive Orders/Requirements (apply to Federal and private wells)	
American Indian Religious Freedom Act and Native American Graves Protection and Repatriation Act BLM	Requires consultation with Native American tribal groups with interests in the planning area to identify issues or concerns, particularly related to traditional or sacred use of the area
Clean Air Act 40 CFR Parts 50-99 USEPA/State	Establishes air quality standards and provides regulation of air emissions Ensures conformity with State Implementation Plan for maintaining and/or enhancing air quality
Clean Water Act 40 CFR Parts 110-113 (Oil pollution/spills) 40 CFR Part 122 (NPDES) 33 CFR Parts 320-330 (Discharge of dredged or fill material/wetlands) 40 CFR Section 112.3 (SPCC) USEPA/COE/State	Regulates the discharge of toxic and nontoxic pollutants into the surface waters of the United States National Pollutant Discharge Elimination System (NPDES) program Regulates the discharge of dredged or fill materials into navigable waters Section 404 permitting Spill Prevention, Control, and Countermeasure (SPCC) plan requirements
Comprehensive Environmental Response, Compensation and Liability Act 40 CFR Parts 300-372 USEPA/ODNR	Establishes reporting and cleanup requirements for release of hazardous substances
Endangered Species Act 16 USC 1531 BLM	Requires agencies to protect threatened and endangered species and the ecosystems on which those species depend Provides Federal designation of species and prohibits the taking of an endangered or threatened species of fish, wildlife, or vegetation
Executive Order 11988 - Floodplain Management BLM	Directs Federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	General Requirements
Executive Order 11990 - Protection of Wetlands BLM	Directs Federal agencies to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative
Federal Farmland Protection Act Dept. of Agriculture, Natural Resources Conservation Service	Requires that the actions of Federal agencies do not cause the irreversible conversion of farmland to nonagricultural uses. The Natural Resources Conservation Service (formerly Soil Conservation Service) would determine the suitability of protecting a site as prime farmland. The policy does not regulate the use of private or non-Federal land
National Historic Preservation Act 36 CFR Part 800 BLM	BLM must consult with the Ohio State Historic Preservation (SHPO) Officer in the identification and evaluation of historic properties in the area of the undertaking
Natural Gas Pipeline Safety Act 49 CFR Part 192 Public Utility Commission of Ohio	Identifies minimum Federal standards for transportation of natural gas and other gas by pipeline selection, design, protection from corrosion, safety requirements for populated areas
Noise Control Act 40 CFR 204 and 205 USEPA	Noise standards for construction equipment, medium and heavy weight vehicles Guidelines for noise levels below which there are no documented adverse effects to human health or welfare (USEPA, 1974). The guidelines are Loudness-Day-Night (L_{dn}) outdoor sound levels of 55 dB(A) (daytime) and 45 dB(A) (nighttime). These levels apply to long-term continuous noise exposure.
Occupational Safety and Health Act 29 CFR Part 1910 Occupational Safety and Health Administration	Worker safety Workplace noise exposure standards
Oil Pollution Act 58 Federal Register 8824-8879 (OPA proposed rules, 2/17/93) USEPA/Coast Guard	Requires response plans above and beyond SPCC plan regulations Requires operators to maintain response plans

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	**General Requirements**
Resource Conservation and Recovery Act 40 CFR Part 148 (Hazardous waste injection restrictions) 40 CFR 260-272 (Hazardous waste mgmt. system) 58 Federal Register 15284 (3/93) (Clarification of regulatory determination for exploration/ production waste) USEPA/State	Regulates management of solid and hazardous wastes, including oil and gas exploration and production exempt and non-exempt wastes Provides tracking hazardous waste from point of generation to ultimate disposal
Safe Drinking Water Act 40 CFR Parts 144-146 USEPA/ODNR	Provides for the protection of underground sources of drinking water by regulating drinking water systems and injection wells Resulted in development of Underground Injection Control (UIC) program Class II UIC wells - commonly used for disposal of drilling/production liquid wastes
Superfund Amendments and Reauthorization Act 40 CFR Part 355 40 CFR Part 370 USEPA/State	Emergency Planning and Community Right to Know Act Requires community notification of presence of hazardous materials on site Establishes State Emergency Response Commission, Local Emergency Planning Committees
Title 33 United States Code, Navigation - Navigable Waters, Paragraph 701c-3	Identifies distribution of lease receipts - 75% of all (royalty) moneys are distributed to the State, to be disbursed to the County level for use in roads and schools
STATE REGULATORY CONTROLS	
Chapter 1501 of Ohio Administrative Code - Oil and Gas Rules ODNR, Division of Oil and Gas	Provides rules relating to well drilling and operations permits (1501:9-1-01 through 07), injection and control of produced waters (1501:9-3-01 through 13), enhanced recovery operations (1501:9-5-01 through 11), safety practices for drilling and producing oil and gas wells (1501:9-9-01 through 07), pipelines (1501:9-10-01 through 06), and plugging of wells (1501:9-11-01 through 12)
Ohio Revised Code, Sections 1509.05 to 1509.072 ODNR, Division of Oil and Gas	Provides requirements relating to applications for permit to drill, bonding procedures, and surface restoration.

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	General Requirements
Ohio Revised Code, Sections 5577.01 to 5577.09 Ohio Department of Transportation	Establishes limitations on length, height, width and weight for vehicles travelling on public highways, streets, bridges, or culverts - authorizes board of county commissioners to classify county and township roads and bridges with reference to maximum weights and speeds permitted on such roads and bridges
State regulations implementing Natural Gas Pipeline Safety Act Public Utility Commission of Ohio	U.S. Dept. of Transportation regulations at 49 CFR 192 adopted and amended by State - establishes minimum safety standards for transportation of natural gas and other gas by pipeline
Ohio Revised Code, Sections 1501:18-1-03, 1501:31-23-01, and 1531.25 ODNR	Requirements relating to designation and protection of State sensitive plant and animal species
40 CFR 51, Subpart W- Determining Conformity of General Federal Actions to State or Federal Implementation Plans (Clean Air Act and OEPA, Letter, 1996). OEPA	Requires conformity determination to assure that Federally licensed, permitted, approved or financially assisted actions conform to the State Implementation Plan (SIP) for maintaining and/or enhancing air quality
Trumbull County	
Ohio Revised Code Section 5577.08, Road Permits/Bonds	Journalized weight restrictions on roads/bridges Road Bond requirements - $100,000
County frost laws	Restrictions on use of roads by heavy vehicles when the roads would be most readily damaged (road use by overweight vehicles is typically restricted during the period February 15-April 15.)

Existing Laws, Regulations, Orders, Ordinances/ Responsible Entity	General Requirements
Bazetta Township	
Section 28: Gas and Oil Well Regulations	Public Health and Safety-related regulations Requires Certificate of Compliance Establishes safety setbacks* Bonding requirements Resident notification requirements* Inspections Identifies road specifications Addresses odors, dust, noise and vibrations* Identifies requirements for wellhead and tank battery sites (fencing, gates, painting or non-corrosive materials)* Locked gate or cable on access road* Requires adjacent water well monitoring by operator* Requires use of flame arresters on tank vents * These measures also will be extended to Mecca/Greene Township through Special Mitigation Measures Identified Through Analysis
Mecca/Greene Township	
No ordinances specific to oil and gas, however, BLM will extend certain Bazetta Twp. requirements to Mecca/Greene Twps.	See Bazetta Township
City of Cortland	
City ordinances at Chapter 761: Oil and Gas Wells	Include provisions for issuance of City drilling permits, bonds and liability insurance, site plans, site inspections, restoration plans, site maintenance Addresses odor, dust, noise, vibration Identifies safety setbacks

Special Mitigation Measures Identified Through Analysis

The following section outlines special mitigation measures developed through the analysis process to prevent or minimize impacts to resources and maintain resource objectives (resource objectives/potential impacts/mitigation are outlined in Chapter Four, Table 4-1 and potential impacts are detailed in Section 4.2). Mitigation measures have been separated into those that would apply to all operations and those that would be applied on a case-by-case basis. They have also been "grouped" by primary issue. However, the issues identified in Section 1.4 may have overlapping resources of concern. For example, the quality of recreation opportunities in the Mosquito Creek Lake area depends upon water quality and aesthetics; the quality of wetland values affects water quality; and some health and safety concerns are linked to water quality issues. The link between issues must be considered in evaluating the overall affect of the measure.

MEASURES THAT ADDRESS ALL ISSUES:

- The operator must notify BLM at least 3 days before beginning approved operations under a permit. This includes surface disturbance on private surface that is associated with approved Federal drilling permits and/or agreements.

- The operator must notify BLM at least 24 hours before spudding a well to allow BLM the opportunity to witness critical well operations.

MEASURES THAT ADDRESS PRIMARILY WATER QUALITY AND PUBLIC HEALTH/SAFETY ISSUES:

- Operators must use best management practices during construction activities. This would require the use of sediment barriers, mulch and stockpile covers at construction sites; grading, planting and mulching immediately after any construction is completed.

- Operators must file copy of Spill Prevention, Control and Countermeasure (SPCC) plans with BLM and COE Mosquito Creek Lake Project Manager.

- Only drilling muds, drilling additives, drilling fluids, cuttings, cementing materials, native soils, and/or approved pit solidifying materials would be permitted to be placed in the reserve pit.

- Reserve/working pit fluids must be removed by a State approved hauler and disposed of in a State approved facility as needed to maintain at least a two foot freeboard (i.e. the space between the top of the fluids and the top of the pit dike).

- Muds and cuttings must be encapsulated above the annual high water table level, or disposed by another method approved by the BLM, ODNR, and/or private surface owner.

- The rat and/or mouse hole must be liquid-tight and constructed of steel pipe with a welded basal plate or bull plug. The annulus should be sealed with bentonite to prevent backside loss of brine or drilling fluids.

- The cellar shall be lined in a manner that collects and channels all fluids that accumulate beneath the rig substructure to the reserve pit.

- A continuous spill prevention apron should extend from the cellar, beneath the discharge line, to the reserve pit. The lined trough should have sufficient slope to enable all overflow from the cellar to drain into the reserve pit.

- Reserve pits should be excavated in native ground. If this is not possible, at least 50% of the reserve pit should be constructed below original ground level to prevent failure of the pit dike.

- The bottom and sides of all pits shall be graded and free of objects which could perforate the liner. If it is impractical to remove all objects which could puncture a liner, the base of the pit should be padded with straw, sand, clay, geotextile fabric, or other material capable of preventing damage to the liner. Side walls should be covered with a cellotex, or other similar material, to preserve liner integrity.

- If the location has sufficient size, pit side slopes should be at least twenty degrees out of vertical to prevent slumping of side walls.

- All reserve/working pits should be lined with a single piece liner that meets or exceeds the following standards:

	Tensile Strength/Elongation	
Non-reinforced Liners	ASTM D 882-83	1550 PSI, 300%
Reinforced Liners	ASTM D 882-83	1500 PSI, 10%
Puncture Resistance	ASTM 2582-67	40 lbs. force
Hydrostatic Resistance	ASTM D 751-A-31 or FTMS 191-5512	50 lbs.
Seam Strength	Meet or exceed parent material properties for factory seams and 80% for field seams for the aforementioned standards.	

- If permeable sand and/or gravel deposits or fractured bedrock is encountered during excavation of the drilling pit, the owner shall spray apply a bentonite slurry to the pit base and sidewalls prior to emplacing the synthetic liner.

- The liner apron shall be secured around the berm in a manner which would prevent slumping of the liner below fluid level prior to pit closure.

- The liner shall be installed with sufficient slack to prevent tearing of the liner when the pit is filled with cuttings and fluid.

- All discharge into the pit from drilling and completion operations must be performed in a manner that would prevent damage to the pit liner.
- If the liner is damaged, at no time should fluid be allowed to rise above a tear which would allow the escape of brine or oilfield waste.
- No hazardous substances as defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) shall be used in the circulating medium when drilling through uncased zones containing potable water.
- Surface casing must be set at least 50 feet below the base of the underground source of drinking water and cemented back to surface either during the primary cement job or during remedial cementing.
- Tank batteries would be secured by fencing and locks to minimize the impact related to oil spills caused by vandalism.
- BLM would require the installation of pressure switches on all wells.
- Crude oil storage tanks shall be equipped with a pressure-vacuum thief hatch, vent-line valve, and plugs on other vent ports of the tank.
- Tank batteries be surrounded by an impervious dike capable of containing 200% of the total volume of the storage tanks in the battery.
- Only cuttings, drilling fluids, native soils, cementing materials and/or approved pit solidification materials may be placed in reserve pit(s). Non exempt, exploration and completion wastes, as defined by USEPA's regulatory determination (53 FR 25453-25454) should be segregated from exempt wastes. All non-exempt wastes shall be disposed in accordance with OEPA regulations and guidelines.
- No annular waste disposal is allowed.
- The operator will contain all fracturing fluids in steel tanks and haul them to an approved disposal site.
- Based on COE policy, BLM would not approve operations that involve installation of permanent above ground structures at or below the full-pool elevation of 904.0 feet. These structures include, but are not necessarily limited to, wellhead and associated artificial lift equipment, tank batteries (oil and brine storage tanks, separators, meters) and gas compressors.

Site specific requirements relating to the following measures would be developed on a case-by-case basis:

- Specific water well monitoring requirements would be developed at the time a well site is proposed. BLM would evaluate site specific information relative to fresh water aquifers in the area of a proposed oil and gas well, considering the relative depth of the aquifer, well construction specifications of adjacent water wells, and topography as it relates to the proposed site. Based on these criteria, BLM would select four wells to be sampled and tested. Samples shall be collected in approved containers and tested in laboratories using OEPA test methods, including appropriate quality assurance/quality control, and parameters would have errors not to exceed percentages defined by method and concentration. The tests would include, but not be limited to, testing for the presence of: carbonates and bicarbonates (mg/l); filtered sample for water soluble barium (filtered unpreserved sample) (µg/l); calcium (mg/l); chloride (mg/l); magnesium (mg/l); potassium (mg/l); sodium (mg/l); sulfate (mg/l); and residue as total filterable residue (mg/l). Test results shall be filed with the BLM and ODNR, Groundwater Protection Section, and the township Zoning Inspector, if applicable.

- Reserve/working pits shall not be excavated into the water table. Steel tanks must be used in lieu of pits if high water table renders construction of adequate size drilling pits impractical. If steel tanks are used, they must be underlain by a plastic apron to capture any fluids that are not contained by the tank.

- If well pads and access roads are proposed to be partially located in floodplains and no alternative sites are available, the following would be considered:
  - a. put the well pad on a level area to avoid the use of fill;
  - b. grade the well pad to direct surface runoff and accidental spills away from the floodplain area;
  - c. shut-in the well during flooding of the well pad or access road; and/or
  - d. install remote shut-off devices for the well.

- Examples of sediment barriers that may be employed to control soil erosion and sedimentation at a particular well site include: the construction of an earthen berm (using the subsoil from the reserve pit excavation) around the perimeter of the well pad; or the construction of a shallow ditch around the well pad to collect runoff; or trapping sediment by placing filter fencing and/or hay bales around the well pad. One other site specific protective measure would include identification of the appropriate amount of vegetation to be removed from the site.

- Standard Army Mineral Lease Stipulation # 21 requires a 100 foot setback from intermittent streams and a 200 foot setback from perennial streams. This stipulation would apply to those streams that cross or are adjacent to Federal property. The need for additional setbacks between surface disturbance, oil and gas facilities and water bodies would be determined on a case-by-case.

- BLM could require segregation of all saline cuttings from reserve pits if warranted by site conditions.

- The fate of the pit cuttings and liner would remain a negotiable item to be addressed at the time specific proposals are received so that factors such as soil type, drainage patterns, distance to water wells, depth of water table, and alternate methods of pit closure and rehabilitation may be evaluated. Typical operations include encapsulation of the drill cuttings in the pit liner. Pit solidification would be considered on a case-by-case basis.

MEASURES THAT ADDRESS SPECIAL STATUS SPECIES:

Site specific requirements relating to the following measures would be developed on a case-by-case basis:

- Proposed well location and associated facilities would not be approved if within one-half mile of an active bald eagle nest.

- No surface occupancy would be permitted on or within one-half mile of an established bald eagle nesting territory.

- Within potential Indiana bat habitat, suitable maternity roost trees (cavities and/or exfoliating bark) would not be cut down if it is possible to avoid doing so. If such trees must be removed, they cannot be cut down between the period of April 15 through September 15. If potential roost trees are present and the time restriction is unacceptable, mist net surveys, or other surveys, should be conducted to determine if bats are present. If the survey determines that Indiana bats do not inhabit the area, the identified trees may be cut down during any time of year.

- If Gray birch is found on proposed development sites the lessee/operator would be required to avoid removal of the trees.

MEASURES THAT ADDRESS AESTHETICS, INCLUDING AIR QUALITY, AND NOISE. INDIRECTLY, THEY WOULD ALSO ADDRESS CONCERNS RELATING TO TRAFFIC/SAFETY CONCERNS:

- BLM would not allow any well located adjacent to COE or ODNR developed recreation areas to be drilled, plugged back, or deepened during the time period beginning on Friday of the Memorial Day holiday week end through Monday of the Labor Day holiday weekend.

- BLM would not allow well servicing operations or workover procedures to be conducted on any producing well between 10 p.m. and sunrise from Memorial Day to Labor Day.

- BLM would not allow any producing well located adjacent to COE or ODNR developed recreation areas to emit noise which, when measured at the nearest developed recreation area, exceeds 45 dB(A).

- Thief hatch covers on oil storage tanks would be kept in a locked down, latched position.

- No open burning of garbage or refuse is permitted at drill sites or other oil and gas facilities.

- With surface owner consent, all access roads must be properly graded and surfaced with gravel or paving material to prevent mud from getting to State, county, and township roads and to minimize dust from forming during the use of the access road.

Site specific requirements relating to the following measures would be developed on a case-by-case basis:

- Tank battery facilities would be evaluated on a case-by-case basis. If necessary, vent stacks on oil storage tanks would be fitted with activated charcoal filters. Such filters shall be cleaned or replaced as needed to adequately suppress odor.

- Proposed operations would be evaluated on a site specific basis to determine if dust suppression measures are necessary during construction to reduce or eliminate the impacts of fugitive dust on air quality. Dust suppression measures would be determined on a case-by-case basis (examples of measures - application of water, dust-suppressing chemicals, graveling of soils susceptible to wind erosion, etc.).

- Noise impacts may be reduced by one or more of the following technological/ engineering design features:

  Require mufflers on engines on the drill rig (hospital or residential grade), natural gas run pump jack, and gas compressor;

  Require orientation of exhaust pipes for engines on drill rig, pump jack, gas compressor away from noise recipients;

Require blooie line discharge pointed away from noise recipient;
Require electric motor vs. natural gas run engine on pump jack;
Require natural or artificial noise barriers during drilling, well testing, fracturing, and/or production (e.g. hang tarps between noise generator and noise recipient during drilling, bank up earth removed from reserve/working pits between noise generator and recipient);
Require use of vegetative screens to muffle sound between noise generator and recipient;
Require sound minimizing housing around gas compressors; and
Require compressor housing doors to be oriented away from noise recipient.

- The COE Standard Army Mineral Lease Stipulation # 14 requires a 200 foot setback from developed recreation areas. Additional distance setbacks between oil and gas operations and noise sensitive areas could be developed in site specific analyses.

- BLM may require special noise reduction measures for well drilling, completion and production operations proposed adjacent to noise sensitive areas including, but not limited to, residences or residential allotments, the Bazetta Township Park, the Lakeview Local School District property, the COE operations area or hiking trails on COE or State lands. BLM would conduct a site specific analysis to determine what noise reduction measures may be required.

- Measures would be identified to reduce impacts to recreational and visual resources and include: requiring a distance buffer from residences and private or public recreational facilities; using vegetative buffers to screen the wellhead and production facilities; painting all production facilities to harmonize with natural surroundings; and appropriate noise and odor abatement. Well site locations may be restricted by the presence of recreational areas.

MEASURES THAT ADDRESS PUBLIC HEALTH AND SAFETY:

- A sign displaying the operator's name, well name, State permit number and 24 hour emergency number would be placed at both the wellhead and tank battery.

- The tank battery shall be placed on a minimum 5 inch bed of limestone and/or natural stone.

- The tank battery site, fence and surface equipment shall be made of non-corrosive material or painted with weather proof paint. These components shall be maintained throughout the life of the well.

- All wellhead, tank batteries and related production equipment shall be enclosed with a six foot high chain link fence with a locked gate, three strands of barbed wire at the top with a clearance of 4 feet from the limits of the equipment.

- Access roads shall be of sufficient width with turnarounds to allow ingress and egress for safety equipment.

- All access roads to the drill site or tank battery shall have a fence with a locked gate or cable that limits passage to operator's personnel, the land owner, the township Zoning Inspector, if applicable, and fire department. The gate and cable shall be locked and one key given to BLM, the township Zoning Inspector, if applicable, and the fire department.

- For new access roads, operators must notify all occupants within 200 feet of the well site access road that drilling activity would be commencing and provide an approximate time table for it. For an existing road, the operator must notify occupants inside the drilling unit.

- Access road shall be a minimum of 100 feet from the nearest residence building outside the drilling unit and a minimum of 50 feet from the nearest residence building within the drilling unit unless prior written consent of all property owners within the drilling unit has been obtained and submitted to BLM and the township Zoning Inspector, if applicable.

- The tank battery and related production equipment shall be located not less than 130 feet from any residence building outside the drilling unit, and not less than 100 feet from any residence building inside the drilling unit unless prior written consent of all residence building occupants within the drilling unit is obtained and submitted to BLM and the township Zoning Inspector, if applicable.

- Vibrations which are perceptible without the aid of an instrument shall not be permitted beyond the drilling unit.

- For well sites near residential areas during drilling and well completion phase or later well workover operations:

  Free liquids would be removed from pits within 7 days after the completion of drilling or well workover operations.

  All unattended drilling pits for well sites located near residential areas would be fenced.

  All pits would be closed within 14 days after drilling or subsequent well workover operations cease.

Site specific requirements relating to the following measure would be developed on a case-by-case basis:

- BLM would evaluate the need for warning signs near access road entry during construction and drilling operations.

MEASURES THAT ADDRESS CULTURAL RESOURCES:

Site specific requirements relating to the following measure would be developed on a case-by-case basis:

- The need for cultural resources surveys would be determined on a site specific basis. Existing information indicates that surveys would likely be required prior to any surface disturbing activities.

Appendix B - Reasonably Foreseeable Development Scenario

APPENDIX B - REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

Introduction

The Reasonably Foreseeable Development Scenario (RFDS) is a projection of the oil and gas exploration, development, and related activities that would occur within the analysis area under each alternative. The RFDS addresses the most likely drilling target(s), the oil and gas development potential, the anticipated typical oil and gas operations, estimates of the number of access roads, wells, well pads, pipeline corridors, and tank batteries, estimates of the acres of surface disturbance, and the rate of development. The projection is based on credible geologic, reservoir engineering, and oil and gas production information. The projection takes into account existing regulatory, technical, and geographic limitations applied to oil and gas exploration and development in the planning area. The projected number of wells to be drilled in the RFDS establishes a baseline upon which to compare impacts of oil and gas related activity between the proposed alternatives.

Most Likely Drilling Targets and Oil and Gas Development Potential Areas

The Clinton sandstone, which exists at depths of 4,200 to 4,500 feet, is presently the only economically producible zone in the planning area. Clinton wells in the area produce principally natural gas with minor amounts of oil and brine. Over an average productive life of 25 years, a typical Clinton well will produce 300 million cubic feet (mmcf) of gas, 1,000 barrels of oil and 3,000 barrels of brine (OOGA 1996). The Medina sandstone, a zone roughly 100 feet below the Clinton, contains minor amounts of gas that can sometimes be produced along with the Clinton. Drilling to the Clinton sandstone is not complicated by geologic hazards such as lost circulation, high pressures, high temperatures or hydrogen sulfide gas. In Ohio, wells to the Clinton enjoy a high success rate with well over 90% of wells drilled being completed for production. The development potential for the Clinton sandstone in the planning area as determined from geologic and engineering data, is shown on Map 4.

The Rose Run sandstone is a productive formation in other areas of Ohio and exists in the planning area at a depth of 6,800 to 7,000 feet. Presently, most Rose Run wells drilled in Ohio have been in areas where the Rose Run is only 5,500 feet deep. Extensive seismic survey information necessary to locate Rose Run drill sites is lacking in Trumbull County. As of 1996, only one exploratory well, which proved to be unproductive or a "dry" hole, had been drilled to test the Rose Run in Trumbull County. The development potential for the Rose Run zone is considered to be low over the entire planning area due to the lack of seismic data and the depth of the formation. BLM expects that if the Rose Run were to be tested in the planning area, exploratory wells would be drilled on adjacent private minerals.

Typical Oil and Gas Operations

The following narrative describes each phase in detail. The descriptions apply to drilling to Clinton targets; any difference between Clinton and Rose Run drilling operations are specified.

Site Selection

The following factors are considered in choosing sites for oil and gas wells and access roads:

(1) State spacing regulations
State well spacing dictates the minimum acreage allocated to a well to efficiently and economically drain a given hydrocarbon reservoir. In Ohio, wells drilled to a depth of 4,000 feet or more must have a drilling unit of at least 40 acres. In addition, the bottom of the well must not be any closer than 1,000 feet to a well drilled to the same formation and must be at least 500 feet from the boundary of the drilling unit.

(2) Regulatory setbacks for public safety, health and welfare
The Ohio Administrative Code (Oil and Gas Rules, Chapter 1501) establishes minimum distances at which well drilling operations and production equipment must be from inhabited houses, public buildings, the travelled part of roads, railroad tracks, and other wells (see Appendix D, Public Health and Safety). Also, Bazetta Township ordinances (Section 28: Gas and Oil Well Regulations) establish distance restrictions between residence buildings and new access roads, as well as tank batteries and related equipment. Mecca and Greene Townships do not have similar ordinances specific to oil and gas operations.

(3) Existing access routes and well pads
To minimize the construction costs, oil and gas operators use existing roads to access new well sites and existing producing well sites to locate new wells.

(4) Surface resource features
Topography, vegetative cover, soil type, and proximity to environmentally sensitive areas often influence site selection. Construction costs would be least for areas that are level, lightly vegetated, and have stable soil and subsoils. Sensitive areas such as known cultural sites, threatened and endangered species sites or habitat, or hazardous material sites would have to be avoided or have adverse impacts mitigated.

(5) Permitting and surface use agreements
Operators must obtain surface use agreements, easements, and/or rights-of-way from private property owners for location of access roads, well sites, tank batteries, and pipeline corridors.

(6) Economics of vertical wells versus directional wells
Because directional wells are more expensive to drill than a vertical well, operators try to minimize the horizontal distance between a well's surface and bottom hole locations.

(7) Other factors that influence drilling decisions
Corporate budget priorities, availability of rigs and crews, the market price for oil or gas, additional geologic and engineering information, and availability of investment capital can all have a bearing on the timing and location of drilling.

Construction

A bulldozer, backhoe and grader would be used to construct the access road and well pad. Construction could require up to four days and would occur during daylight hours. Construction begins by clearing and disposing of vegetation. Topsoil is then stripped and stockpiled to be used in reclaiming areas not needed in the production phase of the well. The access road may either be constructed with an all-weather base of gravel or crushed stone or consist of native materials until the well is completed and then converted to an all-weather base. The road would be crowned and ditched. Drainage conditions may require water bars, culverts, or other runoff control devices to be installed. The average width of area disturbed for access road construction would be 30 feet with a final running surface about 15 feet wide. The well pad is leveled but is not graveled. Well pad dimensions for a single well pad would average 210 feet by 210 feet (1.0 acre). A Rose Run well and a well pad hosting multiple Clinton wells would average about 260 feet by 260 feet (1.6 acres).

A Clinton well requires two excavated pits, one 40 feet wide by 60 feet long by 6 feet deep and the other 15 feet wide by 60 feet long by 6 feet deep. Rose Run wells or pads with multiple wells would require about double the pit area. Material excavated from the pits during their construction is stockpiled on-site to backfill the pits when drilling is finished. In some instances, metal tanks might be used in place of the smaller excavated pits. Pits are lined with a thick plastic sheeting to prevent fluid from seeping into the soil. Pits are necessary to contain the drilling mud or fresh water used during drilling. Pits also contain rock cuttings, water, excess cement, and any hydrocarbons generated during well drilling.

A small truck-mounted rig may be brought in to begin ("spud in") the main hole by drilling a 12-inch diameter "conductor hole" which would be up to 120 feet deep. The conductor hole would be lined with steel pipe to prevent surface cave-ins or washouts during the drilling of the surface section of the wellbore. At some locations, the conductor pipe can be pile-driven into the ground.

Rigging Up

"Rigging up" refers to setting up the drilling rig, associated equipment, and supplies on the well pad. This work, which takes one to two days, normally occurs during daylight hours. Equipment and supplies are brought to the site by large trucks. A diesel-powered rotary drilling would be used for drilling the well (Figure 1). The drilling mast would range from 80 to 100 feet in height. From 2,000 to 10,000 gallons of water to be used for drilling would be trucked in and stored in tanks or the pits. The most likely water source would be Mosquito Creek Lake, but water might also be transported from other sources. The well site layout would be similar to that shown on Figure 2.

Drilling Operations

After rigging up, drilling of the well begins. As drilling progresses, rock cuttings from the well are carried out of the wellbore to the surface pits by the drilling fluid which will be either fresh water, compressed air or drilling mud. Through the uppermost section of the well, the drilling fluid will usually be either fresh water or a mixture of bentonite clay and fresh water (drilling mud). After drilling reaches a point just below the lowest fresh water aquifer, compressed air will be the drilling fluid of choice for the remainder of the hole.

When compressed air is the drilling fluid, the air and rock cuttings are discharged to the reserve pit through a discharge pipe. This discharge creates dust which is normally controlled by application of water mist. A water mist and foaming additive such as a biodegradable soap may be added to the air stream to increase the efficiency of removing rock cuttings and to handle any formation water encountered. The total amount of foam additive used could average 150 gallons per well. If a lot of formation water is encountered during drilling, the drilling medium may be switched from air to freshwater or a freshwater bentonite clay mix in order to keep good control over the well. A water-based drilling medium could require from 2,000 to 10,000 gallons of water. In a water-based system, rock cuttings are separated from the drilling fluid, discharged into the reserve pit, and the drilling fluid is recirculated through the hole. Various chemical additives might be used in the drilling mud to control such things as pH, viscosity, mud density, water loss,.and calcium contamination.

Drilling progresses until the hole is drilled 50 feet to 100 feet below the bottom of the deepest fresh water aquifer. Drilling stops and a thick walled steel pipe, called casing, is lowered into the well. Cement is then pumped down through the bottom of the casing to completely seal the space between the casing and the wellbore from bottom to surface (Figure 3). Casing stabilizes the wellbore and protects fresh water aquifers from contamination. This first string of casing also provides an anchor for the blowout prevention equipment (BOP) which is installed and tested prior to drilling deeper. The BOP controls the well in the unlikely event of a blowout.

After the casing is set, drilling resumes and the hole is drilled to the producing zone. Drilling again ceases and various tests are performed to evaluate the productive potential of the well. Some testing procedures involve oil and gas being briefly brought to the surface. Gas produced during testing would be vented or flared into the reserve pit. Oil and brine produced during tests would be stored in tanks and properly disposed of. If the tests confirm the well's productivity, smaller diameter casing is set to extend from the surface to total depth of the well with the bottom of the casing cemented in the hole. The cemented production casing completely isolates the producing zone from the rest of the wellbore.

Because of surface restrictions, Federally permitted wells at the project area would have to be drilled entirely by directional methods. In a vertically drilled well, the location of the bottom of the wellbore is directly below its surface location. In a directional hole, the location of the bottom of the wellbore is off-set from its surface location. In directional drilling, a hole is initially drilled vertically to the kick-off point. Special equipment is then attached to the drill string to gradually turn the wellbore to an ever increasing angle to reach the drilling target (Figure 4). Measuring devices on the drill string give continuous information on the direction and angle of the wellbore. A variation of directional drilling that may be used at the project area is horizontal drilling, although the economics are presently not favorable for its use. In horizontal drilling, after a directional wellbore reaches the drilling target, drilling continues horizontally to expose more of the wellbore to the productive zone. Horizontal completions usually increase the rate at which oil and/or gas is produced and shorten the producing life of a well. Casing is set and cemented in directional wells just as it is in vertical wells. However, any horizontally drilled sections are normally left uncased.

Drilling operations would proceed continuously for five days (vertical wells) to ten days (directional wells). Rig crews would be changed every eight hours. Traffic during drilling would include crew vehicles, water and supply trucks, and vehicles of companies contracted to perform well tests and logging. The well pad area would be illuminated at night.

Rigging Down

"Rigging down" refers to disassembling and removing the drilling rig and associated equipment. This activity takes one to two days and is conducted during daytime.

Well Completion

This phase includes equipping the well to produce, perforating the production casing, stimulating the producing formation, possible production testing, and constructing a tank battery and pipelines. The well completion phase takes four to six weeks.

Well Stimulation

After removal of the drilling rig, a truck-mounted workover rig is moved onto the site. Production tubing, through which the gas, oil and brine flow to the surface, is placed in the wellbore. Holes are made in the production casing with a specialized tool to access the producing zone. The producing zone is then fractured (a process called hydrofracing in the industry). In hydrofracing, pressurized fluids are pumped into the producing zone to create fractures to increase the well's rate of production. The hydrofracing fluid consists of water, sand (proppants), and small amounts of chemicals to adjust properties of the fluid. Constituents of these chemicals, specifically ethylene glycol and methyl alcohol, are hazardous substances. Hydrofrac fluids and proppants are delivered to the site in tanker trucks. Other truck-mounted equipment include pumping units, and blending units. Through steel connecting lines, this equipment injects the hydrofrac fluids into the well. Some of the hydrofrac fluids are returned to the surface and directed into a tank for disposal at a State approved facility. The hydrofracing process takes one day.

After hydrofracing, the wellhead, which is an assembly of valves, fittings and gages that provide control of the well at the surface, is installed. Producing wells would likely use a plunger lift system to lift liquids from the producing zone to the surface (Figure 5). Excessive accumulation of liquids in the well would restrict gas production. With a plunger lift system there would be no visible moving parts at the surface. As the oil and gas reservoir pressure decreases over time, wells may be converted to a pumpjack to lift liquids to the surface. Pumpjacks have visible moving parts and are powered by either a small internal combustion engine or an electric motor (Figure 6).

Construction of Production Facilities

With the exception of State spacing regulations, the same considerations for locating access roads and well pads are also used for locating the tank battery and pipeline corridors. A tank battery with dimensions of 25 feet by 50 feet for a single well or 50 feet by 100 feet for multiple wells is constructed to process production from a well. An earthen berm is constructed around the perimeter of the battery to contain any possible leaks, spills or tank overflows. Construction would occur during daylight hours. The battery is usually placed along the well's access road close to a State or county road for easy access by oil and brine tanker trucks. A typical tank battery for a single well contains a separator, a 100 barrel oil storage tank, a 50 barrel brine storage tank, and a gas meter (Figure 7). In a multi-well situation, each well may have its own equipment for royalty accounting purposes. Otherwise, equipment would be sized to handle the additional production of multiple wells.

A pipeline is constructed to carry well fluids from the wellhead to the tank battery. The line is buried at least 24" deep in the area disturbed for the well pad and the access road. A pipeline is also constructed to carry natural gas from the tank battery to the closest distribution line to end users. The line is also buried and is located in the most direct route possible taking advantage of existing roads and rights-of-way. Pipelines are of coated steel or polyvinyl chloride (PVC) composition and 2 inches to 4 inches in diameter. All pipeline construction would occur during daylight hours.

An area about 25 feet wide would be disturbed for pipeline trenching operations. Figure 8 displays a cross-section view of a typical 4 inch gathering line installation. On the pipeline corridor the topsoil would be stripped for later re-spreading. A trencher excavates a trench about two feet wide into which the pipeline is laid. Pipelines are installed at the rate of about one mile per week. Figure 9 displays a typical pipeline laying operation. Topsoil would be re-spread and the corridor would be revegetated according to the requirements of the surface owner. About ten feet of the pipeline corridor is kept mowed and open for access during the life of the pipeline. Newly constructed pipeline is leak-tested with any rupture or leaks located and repaired.

Production

During the production phase, produced well fluids are separated into oil, gas and brine at the tank battery. The gas would be transported by pipeline to a customer distribution line. Oil and brine would be temporarily stored in tanks at the tank battery. Regular tanker truck trips would be made to and from the tank battery to collect oil for sale and brine for disposal. The frequency of tanker truck trips depends on the volume of oil and brine produced and the size of storage tanks. A well tender/pumper makes regular maintenance visits, sometimes on a daily basis, to the well and tank battery. Brine is most commonly disposed of by injection in a State permitted Class II disposal well.

During the life of the well, a truck-mounted rig is sometimes needed to perform routine well servicing operations to maintain or improve production. Well servicing operations are typically performed on an average well once every three to five years. More complex production problems require procedures called workovers. Though rare for Clinton wells, workovers involve pulling the tubing. The casing at the bottom of the well is then pumped or washed free of sand that may have accumulated (Langenkamp 1985). Workovers require a heavier duty rig than well servicing.

Production of the gas reservoir at the project area will eventually reduce gas pressure to the point that compressors may have to be installed on gathering pipelines. It is not possible to predict the exact number and locations of gas compressors. However, likely locations are where the gathering lines tie into the main gas distribution lines, such as the East Ohio Gas Company line that runs along State Route 5. A typical compressor is powered by an internal combustion engine and positioned on a skid pad about 16 feet by 24 feet in size. A gas compressor would run continuously.

Plugging and Site Restoration

For productive wells, all disturbed areas not necessary to production are graded, topsoil is spread, and seed, fertilizer, and mulch are applied. Reclamation work takes about two days. Areas that would be stabilized and in use during the production phase include the access road, an approximate 16 foot square around the wellhead and a turn around area at wellhead, and the tank battery.

Pits are typically rehabilitated by removing its free liquids, lapping of the liner aprons over the pit contents, backfilling with stockpiled sub-soil, spreading of topsoil, and seeding, fertilizing and mulching.

If a well is not productive, the wellbore would be plugged and all disturbed surface areas would be completely revegetated. For a producing well that is depleted, in addition to plugging, flowlines and surface equipment would be removed prior to surface restoration.

Variances

BLM may grant variances from certain Federal requirements if an operator proposes another approach that will meet the objective of the requirement. For example, on many Clinton wells in Ohio, BLM has granted variances to Federal air drilling requirements on the length of the discharge line and location of the air compressors. In these cases, BLM determined that a shorter discharge line and an alternate location for the air compressors did not create additional impacts to public health and safety or the environment. In fact, approving the variance resulted in less surface disturbance as the size of well pads could be reduced. Variances may also be granted for proposed operations at the project area if BLM determines that the proposal would meet or exceed the goals of BLM's regulations and sound resource management.

Estimation of Level of Activity and Resulting Surface Disturbance

No Surface Occupancy (NSO) Areas

The NSO area includes the entire 11,181 acre COE Mosquito Creek Lake Project and the 32.46 acre Lakeview Local School District property (collectively referred to as the project area). In addition, no subsurface occupancy may occur in COE Tracts A-146 and A-138 in order to protect the structural integrity of the dam. The only land potentially available for surface occupancy is private land *adjacent* to the project area (including private land within the administrative boundary of Cortland).

Assumptions

Table B-1 summarizes the vehicular activity, by alternative and vehicle class, that could occur in a single year. The summary includes number of vehicle trips and time frames.

Table B-2 displays the estimated acres disturbed for each construction activity and reclaimed after well completion under both alternatives. For Alternative A, Summary 1 describes the numbers of wells and level of activity if BLM does not lease Federal minerals. Summary 2 describes these factors under Alternative B (leasing with no surface occupancy). Tables within each of summary outline the anticipated numbers of wells and pads, surface disturbance, rate of development and duration of activity. These tables also describe activity by development potential area.

Table B-1. Annual Vehicular Activity by Vehicle Class

Type of Activity	One-Way Trips per Pad or Facility	Total One-Way Trips Alternative A	Total One-Way Trips Alternative B
Pre-Drilling and Permitting Phase			
Passenger/Class A	14	70	70
Class B/C	0	0	0
Total One-Way Trips	14	70	70
Construction Phase			
Access Road/Well Pad Construction (4 days/well) (1/8 mi. rd./well):			
Class A	8	40	40
Class B/C	36	180	180
Total One-Way Trips	44	220	220
Rigging Up/Down (1 day rigging up, 1 day rigging down):			
Class A	10	50	50
Class B/C	22	110	110
Total One-Way Trips	32	160	160
Drilling Activities (multi-well pad - one vertical well@5 days/well, 2 directional wells@10 days/well = 3 wells@25 drilling days (3.5 weeks))			
Class A	689	3445	3445
Class B/C	237	1185	1185
Total One-Way Trips	926	4,630	4,630

Type of Activity	One-Way Trips per Pad or Facility	Total One-Way Trips Alternative A	Total One-Way Trips Alternative B
Completion Phase			
Well Perforation/Stimulation/Completion (5 days/well@3 wells/pad, 5 well pads/year)			
Class A	162	810	810
Class B/C	272	1,360	1,360
Total One-Way Trips	434	2,170	2,170
Reclamation (max. 2 days/ well pad, 5 well pads/year)			
Class A	8	40	40
Class B/C	6	30	30
Total One-Way Trips	14	70	70
Tank Battery Installation (3 days, 1 facility/multi-well pad, 5 pads/year)			
Class A	12	60	60
Class B/C	20	100	100
Total One-Way Trips	32	160	160
Pipeline Construction (4 days, 1 pipeline per well pad/tank battery, 5 pads per year)			
Class A	24	120	120
Class B/C	16	80	80
Total One-Way Trips	40	200	200
Production Phase			
Production Operations and Maintenance (average well life - 25 years) **Well servicing or workover operation (5 days/well; conducted 6 times/well over 25 year life)**			
Class A		81	225
Class B/C		10	30
Total One-way Trips		91	255
Operations (average well life-25 years)			
Class A		8,310	13,381
Class B/C		226	364
Total One-Way Trips		8,536	13,745

Type of Activity	One-Way Trips per Pad or Facility	Total One-Way Trips Alternative A	Total One-Way Trips Alternative B
Well Plugging and Abandonment			
Plugging and Abandonment (3 days/well@3 wells/pad@5 pads max. reclaimed in one year)			
Class A	54	270	270
Class B/C	24	120	120
Total One-Way Trips	78	390	390
Tank Battery Dismantling and Reclamation (3 days/facility@5 max. dismantled in one year)			
Class A	12	60	60
Class B/C	14	70	70
Total One-Way Trips	26	130	130
Final Site Reclamation (3 days/well pad@5 pads max. reclaimed in one year)			
Class A	12	60	60
Class B/C	4	20	20
Total One-Way Trips	16	80	80

ASSUMPTIONS:

Maximum of 5 multi-well pads active in one year
Average multi-well pad has one vertical and two directional wells
High, moderate and low development potential areas would not be drilled concurrently

Table B-2. Estimated Acres Disturbed and Reclaimed after Well Completion - Impacts Common to Both Alternatives*

Construction Activity	Dimensions (feet)		Acres Disturbed/ **Acres Reclaimed**	Assumptions % Reclaimed/% In Use/Stabilized
	Length	Width		
New Access Road	660	30	0.45/**0.23**	50% reclaimed/ 50% stabilized running surface
Single Well Pad	210	210	1.01/**0.76**	75% reclaimed/ 25% stabilized wellhead/turnaround area
Multi-Well Pad	260	260	1.55/**1.16**	75% reclaimed/ 25% stabilized wellhead/ turnaround area
Single-Well Tank Battery	50	25	0.03/**0.00**	100% stabilized tank battery area

Construction Activity	Dimensions (feet)		Acres Disturbed/ **Acres Reclaimed**	Assumptions % Reclaimed/% In Use/Stabilized
	Length	Width		
Multi-Well Tank Battery	100	50	0.12/**0.00**	100% stabilized tank battery area
Flowline Corridor	660	25	0.38/**0.38**	100% reclaimed
Gathering Line Corridor	Variable	25	Variable	100% reclaimed

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Summary 1 - RFDS under Alternative A

A no lease decision means that Federal leases would not be offered or issued. Oil and gas companies could not drill into the Federal oil and gas estate at the project area. The no lease decision would not prohibit additional oil and gas development on private mineral leases around the project area. After making a no lease decision, BLM could notify oil and gas operators that BLM is willing to enter into a type of Federal agreement called a Compensatory Royalty Agreement (CRA) on a case-by-case basis and notify the ODNR that BLM will be committing unleased acreage to drilling units.

Federal agreements would allow:

> Oil and gas companies to form drilling units that include both private mineral lease acreage and unleased Federal acreage for the drilling of private wells; and
>
> The well bottom locations to be closer to the Federal property than the State spacing setback of 500 feet (in vertical wells this would mean that the surface location would be within 500 feet of the Federal property; in directional wells the surface location would most likely be greater than 500 feet from the Federal property).

Those oil and gas operators who hold private mineral leases adjacent to the project area and have not already committed lease acreage to a drilling unit would most likely enter into Federal agreements. These private wells would produce both private and Federal oil and gas, and the United States would be compensated for the share of Federal oil and gas produced. BLM would not be involved in permitting of any of these wells, because they would be drilled into private mineral leases.

ALTERNATIVE A ASSUMPTIONS

Wells could be drilled with bottom locations closer than 500 feet from the project area under the terms of a Federal agreement.

Oil and Gas Development Potential Areas

1. Areas of high, moderate, and low oil and gas development potential exist in the project area as shown on Map 4. These delineations are based on geologic and engineering data from wells drilled adjacent to the project area.

2. The results of previous drilling for oil and gas on private lands in the low potential area indicate that the likelihood of additional drilling in the area is minimal. However, for analysis purposes, it has been assumed that one exploratory well would be drilled about every two miles to evaluate the area.

Surface Locations

1. No surface occupancy will occur on any lands in the project area (possible case-by-case exceptions for buried pipeline rights-of-ways; for analysis purposes it will be assumed that 1/4 mile of pipeline could be buried on the project area).

2. State spacing orders for wells 4,000 feet or deeper (these apply to well bottom locations, but they directly affect the surface location of vertical wells):
   no less than 1,000 feet between wells;
   no less than 500 feet from boundary of subject tract or drilling unit (State can grant variance if adjacent mineral owners agree to variance).

3. No surface occupancy will occur on any adjacent State Park lands.

4. The only potentially available land for surface occupancy is private land adjacent to the project area (including private land within the administrative boundary of Cortland).

5. Possible occupancy sites on private land include existing producing well sites and areas classified by the ODNR as "agricultural", "open space", "natural area", and "residential" land use. Actual availability depends on whether oil and gas companies obtain surface owner permission. Each development potential area was evaluated for potential surface locations for oil and gas operations by taking into account existing land use patterns, location of existing oil and gas wells, and State spacing requirements.

6. Operators will obtain surface owner permission to locate oil and gas operations on private property.

7. Operators will obtain City of Cortland permits for occupancy on private land within the Cortland administrative boundaries.

Subsurface Limitations

1. No subsurface occupancy will occur in the project area.

2. State spacing orders for wells 4,000 feet or deeper (applies to bottom locations, but for vertical wells will also directly affect surface location):
   no less than 1,000 feet between wells;
   no less than 500 feet from boundary of subject tract or drilling unit (State can grant variance if adjacent mineral owners agrees).

3. The distance between bottom hole locations would average 1,250 feet.

How Federal Oil and Gas Would be Extracted

1. BLM will agree to enter into Federal agreements with lessee/operators who have private mineral leases adjacent to the project area, on a case-by-case basis.

2. Operators will form drilling units that include both private mineral lease acreage and unleased Federal acreage and drill private wells with well bottom locations closer to the Federal property than the State spacing setback of 500 feet.

3. The wells will produce predominantly private oil and gas.

4. Although there is potential for some of these wells to be directionally drilled from existing or new well pads, it will be assumed that all wells would be drilled vertically on new single-well pads.

Surface Disturbance for Infrastructure

1. Except for gathering lines in the high and moderate development potential areas, all construction will be new. Because the exact locations of future oil and gas operations are unknown at this time, it is unknown what opportunities exist to utilize existing roads, tank batteries, and pipeline corridors. Any co-location of new oil and gas facilities with existing facilities would reduce the amount of area affected.

2. Gathering lines:
   a. Because of the extent of existing pipeline corridors in the high and moderate development potential areas, it has been assumed that 50 percent of new gathering lines would be installed in new corridors and 50 percent would be installed in existing corridors (already disturbed areas).
   b. It is assumed that no gathering lines would be constructed north of the Route 88 Causeway because wells drilled north of the causeway would be uneconomic.

Number of Wells, Surface Disturbance/Development, Rate of Development and Duration of Activity[1]

Total Number of Wells and Projected Surface Disturbance

14 wells on 14 new well pads:

13 new well pads with 13 wells for exploration and development of the Clinton zone; and 1 new well pad with 1 well for exploration of the Rose Run (in low development potential area)

Total projected surface disturbance: 61.96 acres
Total projected surface reclaimed after well completion: 54.87 acres

Table B-3. Acres of Surface Disturbance and Reclamation Under Alternative A*

Activity	High Potential Area-Acres	Moderate Potential Area-Acres	Low Potential Area-Acres	Total Acres Disturbed/ **Reclaimed after Well Completion**
New Roads	2.25/**1.13**	0.45/**0.23**	3.60/**1.80**	6.30/**3.16**
Well Pads	5.05/**3.79**	1.01/**0.76**	8.08/**6.06**	14.14/**10.61**
Tank Batteries (all single well)	0.15/**0.00**	0.03/**0.00**	0.24/**0.00**	0.42/**0.00**
Flowlines	1.90/**1.90**	0.38/**0.38**	3.04/**3.04**	5.32/**5.32**
Gathering Lines	9.10/**9.10**	9.75/**9.75**	16.93/**16.93**	35.78/**35.78**
Total Acres Disturbed/ **Reclaimed After Well Completion**	18.45/**15.92**	11.62/**11.12**	31.89/**27.83**	61.96/**54.87**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

---

[1] Includes only private wells

Number of Pads/Wells by Oil and Gas Development Potential Area

High Development Potential Area

5 single well pads with 5 development Clinton wells

Moderate Development Potential Area

1 single-well pad with 1 exploratory/development Clinton well

Low Development Potential Area

7 single-well pads with 7 exploratory Clinton wells

1 single-well pad with 1 exploratory Rose Run well

Rate Of Development

High Development Potential Area

Would most likely be developed before drilling in the moderate area;
3 to 5 wells drilled per year;
Developed in a 1 to 2 year period.

Moderate Development Potential Area

Drilled after the high potential area is developed;
One well drilled in 1 year
Developed in 1 year.

Low Development Potential Area

Explored after development of the high potential area and exploration and development of the moderate potential area;
Exploratory wells - 1 to 2 per year;
Developed in a 4 to 8 year period.

Total Development Time for All Areas

6 to 11 years

Maximum Time for Activity at A Drilling Site (from initial construction to first production)

One Vertical Well	41 to 55 days

The maximum number of well sites expected to be actively drilling concurrently would be 2.

Table B-4. High Development Potential Area - Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative A*

Activity	Number	Area (Acres)	Total (Acres Disturbed/**Reclaimed**)
New access road	5	0.45	2.25/**1.13**
Single-well Pad	5	1.01	5.05/**3.79**
Multi-well Pad	0	1.55	0.00/**0.00**
Single-well Tank Battery	5	0.03	0.15/**0.00**
Multi-well Tank Battery	0	0.12	0.00/**0.00**
Flowline Corridor	5	0.38	1.90/**1.90**
Gathering Line Corridors	N/A	Measured length of 15,876 feet by 25 feet	9.10/**9.10**
TOTAL ACRES/**Acres Reclaimed**			18.45/**15.92**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Table B-5. Moderate Development Potential Area - Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative A*

Activity	Number	Area (Acres)	Total (Acres Disturbed/**Reclaimed**)
New Access Road	1	0.45	0.45/**0.23**
Single-well Pad	1	1.01	1.01/**0.76**
Multi-well Pad	0	1.55	0.00/**0.00**
Single-well Tank Battery	1	0.03	0.03/**0.00**
Multi-well Tank Battery	0	0.12	0.00/**0.00**
Flowline Corridor	1	0.38	0.38/**0.38**
Gathering Line Corridors	N/A	Measured length of 17,000 feet by 25 feet	9.75/**9.75**
TOTAL ACRES/**Acres Reclaimed**			11.62/**11.12**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Table B-6. Low Development Potential Area - Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative A*

Activity	Number	Area per Activity (Acres)	Total per Activity (Acres Disturbed/ **Reclaimed**)
New Access Road'	8	0.45	3.60/**1.80**
Single-well Pad	8	1.01	8.08/**6.06**
Multi-well Pad	0	1.55	0.00/**0.00**
Single-well Tank Battery	8	0.03	0.24/**0.00**
Multi-well Tank Battery	0	0.12	0.00/**0.00**
Flowline Corridor	8	0.38	3.04/**3.04**
Gathering Line Corridors	N/A	Measured length of 29,500 feet by 25 feet	16.93/**16.93**
TOTAL ACRES/**Acres Reclaimed**			31.89/**27.83**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

SUMMARY 2 - RFDS UNDER ALTERNATIVE B

The terms of the Federal oil and gas lease grant the company the right to explore and develop the oil and gas resources in the lease, as restricted by lease stipulations for protection of resources on the lease. Lease stipulations for protection of resources apply only to operations on the surface of the Federal lease. They do not apply to operations conducted off the Federal lease for the purpose of drilling into the lease. The No Surface Occupancy stipulation prohibits occupancy on the lease surface but would not prohibit exploration and development of the Federal leases. The no surface occupancy stipulation would displace surface activities onto adjacent property.

The Federal oil and gas could be extracted either by:

Directional wells drilled into the Federal lease from a surface location off the lease; and/or

Adjacent private wells which drain both private and Federal oil and gas under the terms of a Federal agreement with the BLM called a Communitization Agreement.

Federal agreements would allow:

Oil and gas companies to form drilling units that include both private mineral lease acreage and leased Federal acreage for the drilling of private wells; and

The well bottom locations to be closer to the Federal property than the State spacing setback of 500 feet (in vertical wells this would mean that the surface location would be within 500 feet of the Federal property; in directional wells the surface location would most likely be greater than 500 feet from the Federal property).

To drill Federally permitted wells from private surface the lessee/operator must obtain permission from:

The private surface owner (surface use agreement, right-of-way, easement, etc.)

The private mineral owner in order to drill through their minerals to access leases (lease, license, contract, etc.);

The BLM (application for permit to drill, APD);

ODNR, Oil and Gas Division (State drilling permit).

APDs are subject to BLM approval or disapproval regardless of the well's surface location.

On private surface, BLM:

Inspects the areas proposed for operations with the surface owner and drilling company (and other agencies, as appropriate);

Can require surveys as needed to comply with the non-discretionary Endangered Species Act and National Historic Preservation Act

Analyzes site specific environmental impacts of the proposal;

Develops mitigation measures, in consultation with the surface owner;

Confirms that the company has appropriate agreements for use of private surface, as well as the subsurface in situations where the operator must drill through private minerals to reach Federal oil and gas;

Applies mitigation measures as Conditions of Approval to APD (measures may not conflict with private surface owner's use of the surface/property rights).

ALTERNATIVE B ASSUMPTIONS

The RFDS for this alternative includes both Federally permitted wells and the private wells that would be drilled even if Federal leases were never issued. All Federally permitted wells would be directionally drilled into the leases. The 14 wells from Alternative A would be drilled closer than 500 feet from the project area under the terms of the Federal agreement.

Oil and Gas Development Potential Areas

1. Areas of high, moderate, and low oil and gas development potential exist in the project area as shown on Map 4.

2. The results of previous drilling for oil and gas on private lands in the low potential area indicate that the likelihood of additional drilling in the area is minimal. However, for analysis purposes, it has been assumed that one exploratory well would be drilled about every two miles to evaluate the area.

Surface Locations of Federally Permitted Wells

1. No surface occupancy will be permitted on any of the lands proposed for leasing in the project area (possible case-by-case exceptions for buried pipeline rights-of-ways; for analysis purposes it will be assumed that 1/4 mile of pipeline could be buried on the project area).

2. State spacing orders for wells 4,000 feet or deeper (these apply to well bottom locations, but for vertical wells also directly affect the surface location):
   no less than 1,000 feet between wells;
   no less than 500 feet from boundary of subject tract or drilling unit (State can grant variance if adjacent mineral owners agrees).

3. No surface occupancy will be permitted on any adjacent State Park lands.

4. The only land potentially available for surface occupancy is private land adjacent to the project area (including private land within the administrative boundary of Cortland).

5. Possible occupancy sites on private land include existing producing well sites and areas classified by the ODNR as "agricultural", "open space", "natural area", and "residential" land use. Actual availability depends on whether oil and gas companies could obtain surface owner permission. Each oil and gas development potential area was evaluated for potential surface locations for oil and gas operations taking into account existing land use patterns, location of

existing oil and gas wells, State spacing requirements, location of "no subsurface occupancy" tracts, and limitations on horizontal drilling offsets.

6. Operators will obtain private surface owner permission to locate oil and gas operations on private property.

7. The lessees/operators will obtain City of Cortland permits for occupancy on private land within the Cortland administrative boundaries.

Subsurface Limitations

1. No subsurface occupancy will be permitted in COE Tracts A-146 and A-138 in order to protect the structural integrity of the dam.

2. State spacing orders for wells 4,000 feet or deeper (applies to bottom locations, but for vertical wells will also directly affect surface location):
   no less than 1,000 feet between wells:
   no less than 500 feet from boundary of subject tract or drilling unit (State can grant variance if adjacent mineral owners agrees to variance)

3. The distance between bottom hole locations would average 1,250 feet. This average is based on a range from 1,000 feet, per State spacing orders, to 1,500 feet, the distance which was maintained in between Clinton wells at the Berlin Lake Project and verbal communication with the oil and gas industry.

4. In directional wells, the horizontal offset between the surface location and the bottom hole location would average 2,300 feet. This distance is based on the maximum horizontal offset utilized in wells drilled at the COE's Berlin Lake Project in Portage, Mahoning and Stark Counties, Ohio and verbal communication with the oil and gas industry.

5. Operators will obtain agreements from private mineral owners to drill through their minerals to access the Federal oil and gas leases.

How Federal Oil and Gas Would be Extracted

1. The Federal oil and gas resource will be at least partially extracted by a combination of the following:

   a.) directional wells drilled into the Federal leases; such wells may produce Federal oil and gas only or a combination of Federal and private oil and gas where well operators have developed leases/agreements with private mineral owners that allow operators to drill less than 500 feet from the private mineral boundary and assure compensation to the private mineral owner for drained oil and gas; and/or

b.) vertical wells drilled less than 500 feet from the project area boundaries that drain private, along with Federal, oil and gas; BLM would develop Federal agreements with the well operator to compensate the U.S. for drained Federal oil and gas.

2. High and Moderate Development Potential Areas

Most Federally permitted wells would be drilled from multi-well drilling pads hosting one to three directional wells and one vertical private well, which may be either one of the currently producing wells near the project area or a new well to be drilled as part of a Federal agreement. In the moderate development potential area a number of well pads may host only Federally permitted directional wells and no private vertical wells because private wells could not be pooled with oil and gas under adjacent ODNR Park lands.

3. Low Development Potential Area

The likelihood of directional drilling in this area is low because there would likely be insufficient economic return to justify directional drilling; however, some exploratory drilling would occur.

Surface Disturbance for Infrastructure

1. Because exact locations of future oil and gas operations are unknown at this time, it is unknown what opportunities exist to utilize existing roads, well sites, tank batteries, and pipeline corridors. Any co-location of new oil and gas facilities with existing facilities would reduce the amount of area affected. The following assumptions are made in regard to each area:

   HIGH DEVELOPMENT POTENTIAL AREA: Many producing oil and gas well sites exist around the periphery of the project area in this area. It is assumed that the private vertical wells will be drilled on new well pads and that about one-third of the Federally permitted wells would be drilled from these new pads and the remaining two-thirds will be drilled from existing producing well sites.

   MODERATE DEVELOPMENT POTENTIAL AREA: There are very few existing producing well sites close to the project area boundary in this area due to the presence of Park lands and residential allotments. It is assumed for the west side that about two-thirds of the Federally permitted wells would be drilled from new well pads and one third from an existing well site. It is assumed for the east side that two thirds of the Federally permitted wells would be drilled from new well pads and one third from either an existing producing well site or from a new well pad created for drilling of a vertical well.

LOW DEVELOPMENT POTENTIAL AREA: There are no existing producing well sites close to the project area boundary in this area. It is assumed that all well pads for vertical wells would be new and that the Federally permitted directional wells would be drilled from two of these pads.

2. Gathering Lines

a.) Because of the extent of existing pipeline corridors in the high and moderate potential areas, it will be assumed that 50% of new gathering lines will be installed in new corridors and 50% will be installed in existing corridors (already disturbed areas).

b.) No gathering lines will be constructed north of the Route 88 Causeway because wells drilled north of the causeway will be sub-or non-economic.

Number of Wells, Surface Disturbance/Development, Rate of Development and Duration of Activity[2]

Total Number of Wells and Projected Surface Disturbance

<u>41 wells</u> (27 Federally permitted wells plus 14 private wells from Alternative A)

Six currently producing well sites used for drilling of 11 Federally permitted directional wells;

Eighteen new well pads (the 14 pads from Alternative A plus 4 new pads from this alternative):

Ten pads with 6 private wells and 14 Federally permitted directional wells;

Eight pads with 8 private wells and 2 Federally permitted directional wells

<u>Total projected surface disturbance</u> - <u>77.00 acres</u>

<u>Total projected surface reclaimed (for production phase)</u> - <u>65.18 acres</u>

---

[2] Includes private wells from Alternative A and Federally permitted wells from Alternative B

Table B-7. Acres of Surface Disturbance and Reclamation Under Alternative B*

Activity	High Potential Area (Acres/**Acres Reclaimed**)	Moderate Potential Area (Acres/**Acres Reclaimed**)	Low Potential Area (Acres/**Acres Reclaimed**)	Total Acres Disturbed/ **Reclaimed After Well Completion**
New Roads	2.25/**1.13**	2.25/**1.13**	3.60/**1.80**	8.10/**4.06**
Single-well pads	0.00/**0.00**	0.00/**0.00**	6.06/**4.55**	6.06/**4.55**
Multi-well pads	7.75/**5.81**	7.75/**5.81**	3.10/**2.33**	18.60/**13.95**
Single-well tank battery	0.00/**0.00**	0.00/**0.00**	0.18/**0.00**	0.18/**0.00**
Multi-well tank battery	0.60/**0.00**	0.60/**0.00**	0.24/**0.00**	1.44/**0.00**
Flowlines	1.90/**1.90**	1.90/**1.90**	3.04/**3.04**	6.84/**6.84**
Gathering lines	9.10/**9.10**	9.75/**9.75**	16.93/**16.93**	35.78/**35.78**
Total Acres Disturbed/ **Acres Reclaimed after Well Completion**	21.60/**17.94**	22.25/**18.59**	33.15/**28.65**	77.00/**65.18**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Number of Wells by Development Potential Area

High Development Potential Area

<u>18 wells</u>

Five private wells (from Alternative A);

Thirteen Federally permitted directional wells (from Alternative B).

<u>Surface use</u>

Five new pads from Alternative A would host 5 private wells and 4 Federally permitted directional wells from Alternative B;

Five currently producing well sites would host 9 Federally permitted directional wells.

Moderate Development Potential Area

<u>13 wells</u>

One private well (from Alternative A);

Twelve Federally permitted directional wells

<u>Surface use</u>

Five new pads (1 new pad from Alternative A plus 4 new well pads under Alternative B would host 1 private well and 10 Federally permitted directional wells);

One currently producing well site would host 2 Federally permitted directional wells.

LOW DEVELOPMENT POTENTIAL AREA

10 wells

Eight private wells (from Alternative A);

Two Federally permitted directional wells

Surface Use

Eight new pads (from Alternative A);

Two of the new pads would host 1 Federally permitted directional well each;

One of the new pads would include a test well for the Rose Run.

Rate Of Development

HIGH DEVELOPMENT POTENTIAL AREA

Would most likely be developed before drilling in the moderate area;

Six to 9 wells drilled per year;

Developed in a 2 to 3 year period.

MODERATE DEVELOPMENT POTENTIAL AREA

Drilled after high development potential area is developed;

Exploratory wells - 3 to 6 drilled per year;

Development wells - 3 to 5 drilled per year;

Developed in a 2 to 4 year period.

LOW DEVELOPMENT POTENTIAL AREA

Explored after development of the high potential area and exploration and development of the moderate potential area;

Exploratory wells - 1 to 2 per year;

Developed in a 4 to 8 year period.

Total Development Time for All Areas

8 to 15 years

Maximum Time for Activity at a Drilling Site

One Vertical Well	41 to 55 days
One Directional Well	46 to 60 days
Multi-well Site (one vertical, 2-3 directional wells)	71 to 85 days

The maximum number of well pads expected to be actively drilling concurrently would be 3.

Table B-8. High Development Potential Area: Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative B*

Activity	Number	Area (Acres)	Total (Acres Disturbed/**Reclaimed**)
New Access Road	5	0.45	2.25/**1.13**
Single-well Pad	0	1.01	0.00/**0.00**
Multi-well Pad	5	1.55	7.75/**5.81**
Single-well Tank Battery	0	0.03	0.00/**0.00**
Multi-well Tank Battery	5	0.12	0.60/**0.00**
Flowline Corridor	5	0.38	1.90/**1.90**
Gathering Line Corridors	N/A	Measured length of 15,876 feet by 25 feet	9.10/**9.10**
TOTAL ACRES/**Acres Reclaimed**			21.60/**17.94**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Table B-9. Moderate Development Potential Area: Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative B*

Activity	Number	Area (Acres)	Total (Acres Disturbed/**Reclaimed**)
New Access Road	5	0.45	2.25/**1.13**
Single-well Pad	0	1.01	0.00/**0.00**
Multi-well Pad	5	1.55	7.75/**5.81**
Single-well Tank Battery	0	0.03	0.00/**0.00**
Multi-well Tank Battery	5	0.12	0.60/**0.00**
Flowline Corridor	5	0.38	1.90/**1.90**
Gathering Line Corridors	N/A	Measured length of 17,000 feet by 25 feet	9.75/**9.75**
TOTAL ACRES/**Acres Reclaimed**			22.25/**18.59**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

Table B-10. Low Development Potential Area: Surface Disturbance and Area Reclaimed after Well Completion by Activity - Alternative B*

Activity	Number	Area (Acres)	Total (Acres Disturbed/**Reclaimed**)
New Access Road	8	0.45	3.60/**1.80**
Single-well Pad	6	1.01	6.06/**4.54**
Multi-well Pad	2	1.55	3.10/**2.33**
Single-well Tank Battery	6	0.03	0.18/**0.00**
Multi-well Tank Battery	2	0.12	0.24/**0.00**
Flowline Corridor	8	0.38	3.04/**3.04**
Gathering Line Corridors	N/A	Measured length of 29,500 feet by 25 feet	16.93/**16.93**
TOTAL ACRES/**Acres Reclaimed**			33.15/**28.64**

*The difference between acres disturbed and acres reclaimed represents acres stabilized and in use during the production phase (access road, wellhead, wellhead turn-around area, and tank battery).

APPENDIX C - MOSQUITO CREEK RESERVOIR HYDROGEOLOGY

APPENDIX C - MOSQUITO CREEK RESERVOIR HYDROGEOLOGY

Editor's note: The following is a report prepared by George Mychkovsky, Ohio Department of Natural Resources, Division of Oil and Gas. Some figures have been omitted because they could not be cleanly reproduced. Other figures (Nos. 7-10) have been replicated by BLM for this PA/EA.

Regional Geology

Physiographic Setting

Trumbull County is located in the Grand River Upland Plateau region of the Glaciated Plateau province of Ohio (Ref: #2O). The region is characterized by rolling topography which is higher than the Lake Plain region to the north. The Grand River Upland Plateau is characterized by lowland and upland wetlands, clayey soils, very little outwash, and basins of former "finger lakes."

Structure

Trumbull County is located on the western flank of the Appalachian Basin. Strata in the area strike to the northeast, and dip gently to the southeast from 15 to 35 feet per mile. The top of the Onondaga Limestone (drillers "Big Lime") and the top of Berea Sandstone display homoclinal structure. The top of Cussewago Sandstone is depressed to the southwest of the reservoir with over 30 feet of closure. In addition, there is a minor arch on top of the Cussewago Sandstone in the south portion of the City of Cortland (Figure 9).

Surficial Deposits

ALLUVIUM

Valley fill sand and gravel deposits overlie glacial outwash, and have a combined thickness ranging from 65 feet to 140 feet. These unconsolidated deposits are a source of water along the floodplain of Mosquito Creek below the dam. In this area, erosion has removed bedrock units down to the Cleveland member of the Ohio Shale. On the basis of water well logs, alluvium along Mosquito Creek upstream of the reservoir is not a significant source of water (Figure 7) (Ref: #3 , #6, #9, and #12).

GLACIAL DRIFT

Wisconsinan stage Hiram Till is the dominant deposit in the general area. Pebbles and coarser size erratics are rarely encountered. The Hiram Till is clay-rich generally less than 10 feet thick, and is absent in places. The Defiance Moraine is the most prominent end moraine in the area. The moraine forms a ridge from one to three miles wide that rises 40 to 80 feet above the ground moraine to the south and east of the shoreline of the reservoir (Ref: #9).

Bedrock

In the immediate vicinity of Mosquito Creek Reservoir, bedrock ranges from the upper Devonian Cleveland Member of the Ohio Shale to the Sharpsville Sandstone of the Mississippian Cuyahoga Formation (Figures 1 and 2). The oldest bedrock unit in the area is the Cleveland member of the upper Devonian Ohio Shale (Figures 1 and 2) (Ref: #1). The outcrop of the overlying Cussewago Sandstone crosses the reservoir near the Bazetta Township/Mecca Township boundary. The Berea Sandstone crops out just south of the reservoir and runs parallel to the eastern and western shoreline of Mosquito Creek Reservoir. These two sandstones are separated by the Bedford Shale (Ref: #1). The Sunbury Shale underlies the higher elevations immediately to the south, east and west of the reservoir. Progressively younger strata are encountered at higher elevations to the east, culminating in the lower Pennsylvanian Sharon Sandstone, which outcrops approximately 2 1/2 miles east of Cortland (Ref: #7, Sheet 1 of 2).

Petroleum Geology

The first oil wells in the area were drilled in the Mecca Pool around 1860 (Ref: #4 and 5). This pool extended from central Mecca Township to the northern edge of Bazetta Township. The outline of the Mecca Pool, which produced oil from the Berea and Cussewago Sandstones, is shown on Figure 5 (Ref: #2, Plate 1). The first reported oil production from the Berea occurred in the spring of 1860, from a well drilled to a depth of 60 feet, with the oil reported at 45 feet (Ref: #5, pg. 300). Some of the early references to oil in the Berea may have been mistaken, since the Cussewago was commonly misidentified as the Berea, and is so to this day. In the 1920's, eight wells were drilled into the Cussewago Sandstone in the South Mecca Pool in northwest Bazetta Township (Ref: #23); however, none produced commercially. In 1965, the Kashmir Oil Company drilled a number of core holes into the upper section of the Cussewago Sandstone to assess the potential for enhanced oil recovery.

It is estimated that more than two thousand wells have been drilled in Mecca Township in search of oil in the Berea and Cussewago Sandstones, with the most prolific production located in the Cowles and Kingsbury tracts in the south-central portion of Mecca Township. The oil boom town of Oil Diggings was established in southern Mecca Township, only to become a ghost town during the Civil War (Ref: #25). There is virtually no production or reservoir data from these reservoirs, but it was reported that oil flow from wells in the Cowles and Kingsbury tracts was so profuse that tanks could not be constructed fast enough and hastily dug open pits were used for temporary storage (Ref: #25). Reservoir drive was probably water, as it was reported that following heavy rain, many oil wells produced extra oil.

Since the mid 1970's, the lower Silurian Clinton and Whirlpool (also referred to as the Medina) sandstones have been the exploration and development targets. These sandstones, which produce mainly gas, are approximately 4600 feet deep (Ref: #23). Figure 12 presents a cross-sectional view of a Clinton/Whirlpool well, with the enlargement of the near-surface portion of the well depicting protection of freshwater aquifers behind casing and a column of cement which has circulated from the surface casing seat to surface. To date no wells have been drilled to test deeper units below the Knox unconformity. Future deep exploration is a possibility because erosional remnants of the Beekmantown Dolomite, a deep target in other areas, is believed to underlie Greene Township and the northwest corner of Mecca Township (Ref: #24).

HYDROGEOLOGY

Cleveland Member of the Ohio Shale

The Cleveland member of the Ohio Shale is rarely developed for domestic groundwater supplies (Ref: #6). This unit is a black, organic-rich shale with interbedded siltstone (Ref: #22). Private water supplies can be developed where natural fracturing enhances permeability. Natural gas is known to occur in water wells developed in this shale in Ashtabula County, which lies immediately to the north of Trumbull County (Ref: #6). This shale may be the source of the hydrocarbons found in the Berea and Cussewago Sandstones (Ref: #27), thus it is not unexpected that gas would occur naturally in shale water wells in the Mosquito Creek area.

Cussewago Sandstone

The Cussewago Sandstone is the principal aquifer in the area, supplying domestic wells, municipal wells for the City of Cortland, and industrial wells (Ref: #6). The Cussewago is commonly referred to by drillers as the "white sand" (Ref: #6). It is a medium-grained, greenish-brown, poorly cemented quartz sandstone, with occasional conglomerate lenses. Iron oxide and clay are the primary bonding agents. (Ref: #1, Sheet 1 of 2). The gamma ray signature on electric logs of the Cussewago shows this unit to be relatively clean, with approximately 20% shale Figure 3 (Ref: #11). The Cussewago varies in thickness from 40 feet, to the southwest of the reservoir, to over 150 feet east of the reservoir at the south end of the City of Cortland. The Cussewago is also greater than 120 feet thick in parts of Mecca Township (Figure 10) (Ref: 6 and 11). These thick sandstone deposits represent reworked deltaic sediments in an offshore bar environment (Ref: #2). The maximum depth to the base of the Cussewago Sandstone is about 330 feet southeast of the reservoir (Ref: #6).

The Cussewago is occasionally misidentified as the Berea on water well logs, since drillers assume that the Berea is the first sandstone encountered. Typically, a shale break ranging from five to 20 feet separates the base of the Berea from the top of the Cussewago. The intervening Bedford Shale reaches a maximum thickness of 48 feet at the south end of the reservoir. Locally the Bedford shale is missing and the Berea sandstone immediately overlies the Cussewago (Ref: #6 and #11).

Wells drilled to the Cussewago Sandstone may obtain water exclusively from this aquifer, or water from this aquifer may be commingled with that of the shallower Berea Sandstone. In areas where contaminants from the Berea are not a problem, only about 25 feet of casing is run in the wells. In areas where the Berea Sandstone contains oil, gas, brine, and/or sulfur, this unit is cased off.

The Cussewago is primarily a confined aquifer. Near the outcrop where the unit is immediately overlain by glacial and/or alluvial sand and gravel, the Cussewago is unconfined (Figure 4) (Ref: #6). Groundwater flow is generally eastward, except within the cone of depression of Cortland's municipal water wells, and at the upstream end of the reservoir in Greene Township where groundwater flow in the area east of the reservoir is westward towards the reservoir. Only at the upstream end of Mosquito Creek Lake is the aquifer gaining groundwater from the east.

There is strong evidence of interconnection between Mosquito Creek Lake and the Cussewago Sandstone along the shoreline. The potentiometric surface of the Cussewago Sandstone is at roughly 900 feet, while the mean stage level elevation of the reservoir is 901 feet above mean sea level (a.m.s.l.). Therefore, the Cussewago subcrop, which parallels the shoreline of the reservoir, provides an avenue of communication with the reservoir.

There is a vertical hydraulic gradient between the Berea Sandstone and underlying Cussewago Sandstone such that the potentiometric surface of the Cussewago is lower than that of the Berea, so that contaminants in the Cussewago would not enter the Berea. To the east of the Village of Mecca, the Berea potentiometric surface is over 50 feet higher than that of the Cussewago. The average transmissivity of the Cussewago Sandstone for Trumbull County is 13,000 gpd/ft (Ref: #1, Sheet 2 of 2), while the yield ranges from 20 to 50 gpm (Ref: #6).

Locally the Cussewago aquifer yields natural gas, crude oil, and less commonly brine and/or hydrogen sulfide (Ref: #6). Crude oil in the Cussewago was concentrated in the area of the Mecca Pool. Beyond the Mecca Pool crude oil shows are isolated to small areas on both the west and east side of the reservoir. Water well logs show that crude oil has been cased off in one of two ways. Either the 6 inch casing was run through the oil-bearing zone, or the 6 inch casing was set at a shallow depth of about 25 feet and 4 inch casing was run through the oil-bearing zone (Ref: #6).

Table 1 includes water quality analyses from samples collected from five wells developed in the Cussewago Sandstone (Ref: #13, #14, and 28). The total dissolved solids concentrations are generally 20% above the USEPA Secondary Maximum Contaminant Level standard (SMCL) for public water supplies of 500 milligrams per liter (mg/I). The measured concentrations of iron, manganese, zinc, chloride, and sulfates, and the pH range met the SMCL standards. SMCL standards were established by the USEPA on the basis of aesthetic considerations such as taste, odor, and color (Ref: #21). Table II summarizes the various hydrogeologic parameters of the aquifers discussed in this report.

Berea Sandstone

Few water wells are developed exclusively in the Berea Sandstone, although many wells derive commingled waters from the Berea and Cussewago Sandstones. The Berea Sandstone is a source of groundwater for domestic water wells at the higher elevations in the vicinity of Mecca. To the south and east of the reservoir in Bazetta Township, the Berea is very shaly and is rarely identified as a separate unit from the surrounding shales (Ref: #6). The Berea is a fine-grained, massive to medium-bedded, quartz sandstone (Ref: #2, Pg. 73) with siltstone at the top (Ref: #10). The gamma ray signature of the Berea shows that the formation is argillaceous, with approximately 65% sand and 35% shale (Figure 3) (Ref: #11). The Berea varies in thickness from 3 to 59 feet, with thicknesses over 40 feet uncommon. The maximum measured depth to the base of this sandstone is 165 feet southeast of the reservoir and in the vicinity of the City of Cortland (Ref: #6 and 11).

The Berea Sandstone was deposited in a fluvial-deltaic system, and was reworked in a shallow sea (Ref: #2, Pg. 73). Water well logs show that the Berea is often replaced by shale, indicating facies changes over short distances. The first water encountered in many wells is in the Cussewago, even though the Berea Sandstone zone was penetrated, suggesting that the Berea is often shaly with poor aquifer properties.

Both the Berea and Cussewago Sandstones have been scoured out along the floodplain of Mosquito Creek below the reservoir and replaced by glacial and alluvial deposits. These deposits are dominated by clays and fine silts, according to data obtained by the USGS from corehole logs provided by the U.S. Army Corps of Engineers. Although localized interbedded sand and gravel deposits within the till serve as excellent aquifers, the alluvial/glacial deposits below the dam appear to isolate the Berea and Cussewago aquifers on the west side of the creek from those on the east (Figure 7).

Generally the Berea aquifer is confined. A notable exception is near the outcrop along the lake shoreline, where the Berea is immediately overlain by glacial and/or alluvial sand and gravel deposits. In these areas the Berea is unconfined and is directly recharged by percolation of surface runoff from precipitation. Ran, 1969, identifies an area of exceptional Berea recharge along the valley of Mosquito Creek just below the dam (Figure 4) (Ref: #1, Sheet 2 of 2).

South of the reservoir and beyond the floodplain of Mosquito Creek, the Berea aquifer is confined by a thick and impervious cover of glacial till and the Orangeville/Sunbury

Shale (Ref: #6). Because oil production was reported to increase in the old Mecca Pool following heavy rain (Ref: #25), the confining unit is believed to be leaky.

On the east side of Mosquito Creek Reservoir, groundwater flow in the Berea is westward toward the reservoir. There is virtually no data to the west of the reservoir, however it is probable that groundwater flow in that area is also toward the reservoir, i.e. to the east. There were no field measurements or site verification of the water level data, which was recorded over a period of time from the mid-1960's to the early-1990's. The lack of synchronous water level data is a factor that should be considered when interpreting potentiometric surfaces. The average transmissivity for the Berea Sandstone aquifer in Trumbull County is 6700 gpd/ft, and yield ranges from 20 gpm to 30 gpm, rarely reaching 60 gpm (Ref: #6).

Indians and early settlers in the area had been aware of oil occurrences near Mecca for many years prior to the first commercial production in 1860. One local entrepreneur sold small quantities of Mecca oil as a lubricant for machinery as early as the 1830's (Ref: #25). Early geologic literature states that "Early settlers were obliged to sink their wells into this sandstone, and the water obtained often carried globules of dark colored petroleum that would form a film over the surface" (Ref: #4, pg. 328). On rare occasions the logs of water wells developed in the Berea report shows of natural gas, brine, and/or hydrogen sulfide odor in addition to crude oil (Ref: #6). Limited water quality data from the Berea Sandstone is presented in Table 1 for well #504 (Ref: #13).

Sunbury Shale

The Sunbury Shale in the vicinity of Mosquito Creek consists of black bituminous shale and gray silt with a maximum thickness of 45 feet. Drillers have referred to this shale as the "coffee shale". The Sunbury Shale is not easily differentiated from the overlying Orangeville Shale due to the lithologic similarity of the two units. The Sunbury Shale was deposited in a shallow stagnant sea; the sandy character in the basal few inches of the unit resulted from reworking of the underlying Berea sands (Ref: #2, pgs. 41,42 and 91). A few wells are developed in this aquifer at higher elevations. One area of concentrated Sunbury Shale development is in Lot 42 of west-central Bazetta Township. Another is in the far southeast corner of Mecca Township. The Sunbury Shale yields from 15 to 34 gallons per minute under confined conditions from zones of enhanced permeability. No oil, gas, or brine contaminants were reported on the logs of water wells developed in this aquifer (Ref: #6).

Sharon Sandstone

Water wells are developed in the Sharon Sandstone aquifer in Fowler Township to the east of Bazetta Township (Ref: #6). This sandstone aquifer, which contains some conglomerate. was deposited in a fluvial-deltaic environment (Ref: #7, Sheet 1 of 2;

#8, pgs. 11 and 12). Formation thickness is variable, ranging from zero feet to 200 feet. Thicker sections are associated with channel deposits, based on a Portage County study. (Ref: #8, pgs. 11 and 12).

The aquifer is unconfined along its outcrop. The average transmissivity value for the Sharon Sandstone aquifer in Trumbull County is 2600 gallons per day per foot (gpd/ft). The average water well yields approximately 25 gpm. Greater yields are obtained in areas of thick channel deposits. A single water quality analysis for a well 4 1/2 miles southeast of the reservoir shows that the concentration of total dissolved solids is 356 mg/l (Ref: 47, Sheet 2 of 2).

Alluvial/Glacial Aquifer

While the entire county has been glaciated, only isolated areas immediately south of Mosquito Creek Reservoir derive water from those portions of the unconsolidated valley fill that contain thick sand and gravel deposits (Ref: #3, #6, and #9). The sand and gravel deposits are interbedded with the clay-rich till described previously. Despite its limited areal extent, this aquifer is important at the south end of the Mosquito Creek Reservoir, where maximum yields of 100 gallons per minute are obtainable. (Ref: #6). Groundwater from this aquifer is used for domestic water supply. Direct recharge by precipitation is limited to the outcrop area. Flow direction in this unconfined aquifer is generally towards Mosquito Creek.

A water quality analysis is presented in Table 1 from well E developed in a sand and gravel aquifer along the southwest shore of the reservoir (Ref: #3). The analysis shows that the concentration of total dissolved solids (TDS) is 554 milligrams per liter (mg/l) and total iron (Fe) is 4.2 mg/l. The TDS concentration exceeds the Secondary Maximum Contaminant Level (SMCL) standard of 500 mg/l, while the SMCL standard for iron is 0.3 mg/l.

Surface Water

Surface Water Hydrology

Mosquito Creek, 33.7 miles long, drains 139.2 square miles (Figure 5) (Ref: #15). Its headwaters are located in Lot 2, Wayne Township, Ashtabula County, northwest of Wayne Center, at an elevation of 1105 feet AMSL (Ref: #16). Mosquito Creek discharges into the Mahoning River at Niles, in Weathersfield Township, Trumbull County at an elevation of 846 ft. a.m.s.l. (Ref: #15). The average annual precipitation at Mosquito Creek Lake is 35.77 inches. February has the lowest precipitation average of 1.81 inches; the highest average, in June, is 3.85 inches (Ref: #17).

Development/Usage

Mosquito Creek Lake Reservoir, located in Greene, Mecca, and Bazetta Townships, was created in the 1940's when the U.S. Army Corps of Engineers dammed Mosquito Creek (Figure 5) (Ref: #25). Mosquito Creek Lake has an area of 13.44 square miles (8600 acres) (Ref: #19), and the stage elevation is 901 ft. a.m.s.l. (Ref: #18). The lake is a multiple use dammed impoundment providing flood control, recreation (boating, swimming and fishing) and water supply (City of Warren).

Flow History of Mosquito Creek

Gage station 03095500 was established on Mosquito Creek by the United States Geological Survey (USGS) in 1927 at an elevation of 873.98 feet a.m.s.l. (Figure 5). Between 1930 and 1943 no measurements were taken at this site. Measurements recommenced in 1944 following completion of the dam that impounded the reservoir. Flow at this gage station is regulated as the station is located below the dam. Measurements were made through 1991 when the station was removed from the USGS network. The streamflow daily values from 1944 to 1991 are plotted on the hydrograph provided by the USGS (Figure 6) (Ref: #26). The peak flow measured prior to dam construction was 1890 cubic feet per second (cfs) in 1929; peak discharge after dam construction during the monitoring period was 1280 cfs, recorded on June 5, 1947. The recorded maximum height above the gage elevation datum prior to dam construction was 11.5 feet, while the maximum following dam construction was 9.66 feet, recorded on June 5, 1947.

Water Quality

MOSQUITO CREEK

The 1994 Ohio EPA Water Resource Inventory (Ref: #29) concludes that Mosquito Creek water quality is poor "due to extensive and severe impacts from waste water treatment plants, industrial sources, combined sewer overflows, urban development, residual toxicity, low dissolved oxygen and riparian and instream habitat degradation." Based upon monitoring efforts between 1982 and 1994, Ohio EPA concludes that "recovery from these impacts has been minimal [and] some problems have worsened."

MOSQUITO CREEK RESERVOIR

Water quality data was collected at USGS gage station 03095500 from 1965 to 1977. Table III summarizes the range of values for parameters that might be impacted by oilfield operations (Ref: #26). The analyses indicate that all the values of the measured parameters of the water of Mosquito Creek lie within the acceptable OEPA surface water quality standards.

Ohio EPA, in accordance with Section 315 of the 1987 Water Quality Act Amendments, completed a water quality assessment for all significant publicly owned lakes (Ref: #29). Ohio EPA collected resource information by collecting and analyzing water column samples, sediment grab samples, and fish tissue samples during two spring/late-summer sampling cycles in 1989 and 1990. Mosquito Creek Reservoir was one of nine lakes (out of 52 lakes tested) with dissolved oxygen levels less than the 6.0 mg/l water quality standard for protection of exceptional warm water habitat life. Priority pollutant organochlorine pesticides were detected in lower water column, fish and bottom sediment samples. However, pesticide concentrations in fish samples were well below FDA Action Levels. Carlson's Trophic State Index (TSI) values were calculated for all lake sampling locations. Based upon chlorophyll-a and phosphorous concentrations of the spring sample and Secchi depth measurements of the summer sample, it was determined that Mosquito Creek Reservoir conditions ranged from eutrophic to mesotrophic.

References

1. "Hydrogeology of the Berea and Cussewago Sandstones in Northeastern Ohio," Jon L. Rau, 1969, USGS Hydrologic Investigations Atlas HA-341.

2. "Geology of the Bedford Shale and Berea Sandstone in the Appalachian Basin," Pepper, deWitt, Jr., and Demarest, 1954, USGS Professional Paper 259.

3. "Groundwater Resources of Trumbull County," William C. Haiker (after Crowell, 1979), revised 1996, Ohio Department of Natural Resources, Division of Water, Water Resources Section.

4. "Report of the Geological Survey of Ohio, Volume VI., Economic Geology", Edward Orton, 1888, Chapter IV., "Berea Grit as a Source of Oil and Gas in Ohio."

5. "The Occurrence and Exploitation of Petroleum and Natural Gas in Ohio," John Adams Bownocker, 1903, in Geological Survey of Ohio Fourth Series, Bulletin No. 1.

6. Water well logs on file with ODNR's Division of Water.

7. "Hydrogeology of the Pottsville Formation in Northeastern Ohio," Alan C. Sedam, 1973, USGS Hydrologic Investigations Atlas HA-494.

S. "Geology and Ground-Water Resources of Portage County, Ohio," Winslow and White, 1966, USGS Professional Paper 511.

9. "Glacial Geology of Trumbull County, Ohio," George W. White, 1971, Ohio Division of Geological Survey Report of Investigation No. 80.

10. Stratigraphic Sections 11402 through 11405, Eugene Szmuc, 1952, ODNR, Division of Geological Survey.

11. Electric logs on file with the Ohio Division of Geological Survey Subsurface Section.

12. "Sand and Gravel Resources of Trumbull County, Ohio," Dennis Hull, 1984, Report of Investigations No. 125, Ohio Division of Geological Survey.

13. "Nature of Saline Contaminants in Groundwater of Major Aquifers in Ohio," Don Clabaugh, consulting hydrogeologist CPU 7887, 1991, for the Division of Oil and Gas, Ohio Department of Natural Resources.

14. Ohio EPA. Division of Environmental Services, Analytical Laboratory Report for Kraft-Seal Test Well 49 sampled May 18, 1995, Lab 462534.

15. "Gazetteer of Ohio Streams," pg. 32, J. C. Kralczyk, 1954, ODNR, Division of Water.

16. Cherry Valley 7.5 Minute Series Topographic Quadrangle, USGS.

17. "Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1961-1990, Ohio," Climatography of the United States No. 81, National Climatic Data Center, Ashville, N.C. National Oceanic and Atmospheric Administration, US Department of Commerce.

18. Bristolville, Champion, Cortland, and Gustavus 7.5 Minute Series Topographic Quadrangles, USGS.

19. Personal communication with Mark Ogden, Program Manager, Dam Permits, Inspection & Water Engineering Assistance, Division of Water, ODNR.

20. Personal communication with Scott Brockman, ODNR, Division of Geological Survey.

21. "Field Investigation Manual for Soil, Surface Water and Groundwater Protection," ODNR, Division of Oil and Gas, 1993.

22. "An Integrated Study of the Devonian-Age Black Shales in Eastern Ohio," Gray and others, 1982, Ohio Division of Geological Survey, Final Report for USDOE, Eastern Gas Shales Project: USDOE Report #DOE/ET/12131/1399.

23. Oil and gas well cards on file with the Ohio Geological Survey Subsurface Section.

24. Personal communication with Ron Riley, geologist, Ohio Geological Survey Subsurface Section.

25. "Mecca-Ohio's First Oil Field," Andy Maslowski, 1988, Timeline, pp. 14-20.

26. United States Geological Survey, Water Resources Division, Ohio District, Columbus, Ohio. WATSTORE database.

27. Personal communication with Mark Baranoski, geologist, Ohio Geological Survey Subsurface Section.

28. Ohio Department of Health, Water Quality Data, provided by Northeast District Office of Ohio EPA for Cortland water supply wells.

29. 1994 Ohio EPA Water Resource Inventory.

FIGURES

1. "Top of Big Lime structure contour map of the Mosquito Creek area", George Mychkovsky, Geologist. Ground-Water Protection Section, ODNR, Division of Oil and Gas, 1996.

2. "Top of Cussewago structure contour map of the Mosquito Creek area", George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas, 1996.

3. "Top of Berea structure contour map of the Mosquito Creek area", George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas, 1996.

4. Generalized geologic section between eastern Lake County and Southwestern Mahoning County, from "Hydrogeology of the Berea and Cussewago Sandstones in Northeastern Ohio," Jon L. Rau, 1969, USGS Hydrologic Investigations Atlas HA-341.

5. Stratigraphic relations and general lithologic character of sections measured at Stebbins Gulch, Geauga County, and at Wick in Ashtabula County, from "Hydrogeology of the Berea and Cussewago Sandstones in Northeastern Ohio," Jon L. Rau, 1969. USGS Hydrologic Investigations Atlas HA-341.

6. Mosquito Creek area, from "Glacial Geology of Trumbull County, Ohio," George W. White, 1971, Ohio Division of Geological Survey Report of Investigation No. 80.

7. Mosquito Creek area, from "Sand and Gravel Resources of Trumbull County, Ohio," Dennis Hull, 1984, Report of Investigations No. 125, Ohio Division of Geological Survey.

8. Stratigraphic column of glacial deposits, "Glacial Geology of Trumbull County,

Ohio," George W. White, 1971, Ohio Division of Geological Survey Report of Investigation No. 80.

9. Type gamma ray/neutron log from Trumbull Co. P# 3388, the Parrott Energy Co. #2 Lakeview Board of Education, in Lot 31, Bazetta Township.

10. "Berea isopach map of the Mosquito Creek area", George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

11. Map showing locations of sites favorable for recharge to the Berea and Cussewago Sandstones, from "Hydrogeology of the Berea and Cussewago Sandstones in Northeastern Ohio." Jon L. Rau, 1969, USGS Hydrologic Investigations Atlas HA-341

12. "Berea potentiometric map of the Mosquito Creek area", George Mychkovsky Geologist, Ground-Water Protection Section, ODNR. Division of Oil and Gas.

13. Cussewago isopach map of the Mosquito Creek area, George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

14. "Cussewago potentiometric map of the Mosquito Creek area," George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

15. "Mosquito Creek drainage basin in Trumbull County," George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

16. "Bedrock geology of the Mosquito Creek Reservoir area, as determined by analysis of water well logs," George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

17. Schematic showing the relative scale of oil and gas wells and typical geology encountered during drilling in the Mosquito Creek area of Trumbull County, ODNR, Division of Oil and Gas.

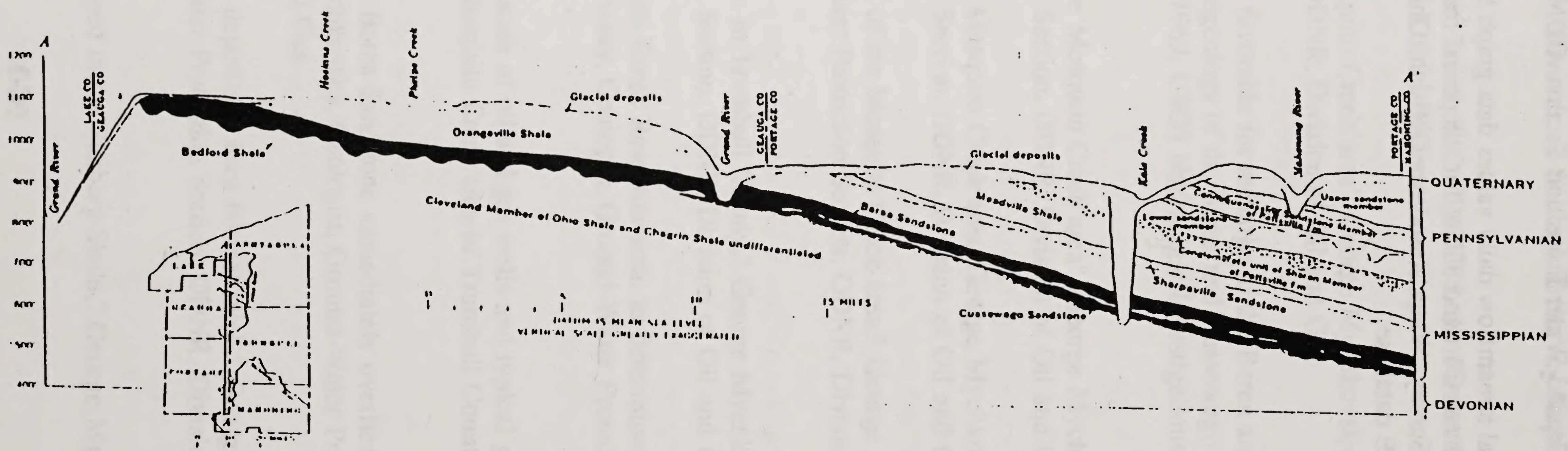
18. "Water well locations where the Berea Sandstone immediately overlies the Cussewago Sandstone," George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR. Division of Oil and Gas.

19. "Isopach map of unconsolidated deposits at least 60 feet thick," George Mychkovsky, Geologist, Ground-Water Protection Section, ODNR, Division of Oil and Gas.

20. "Location of water wells developed in the Sunbury Shale," George Mychkovsky,

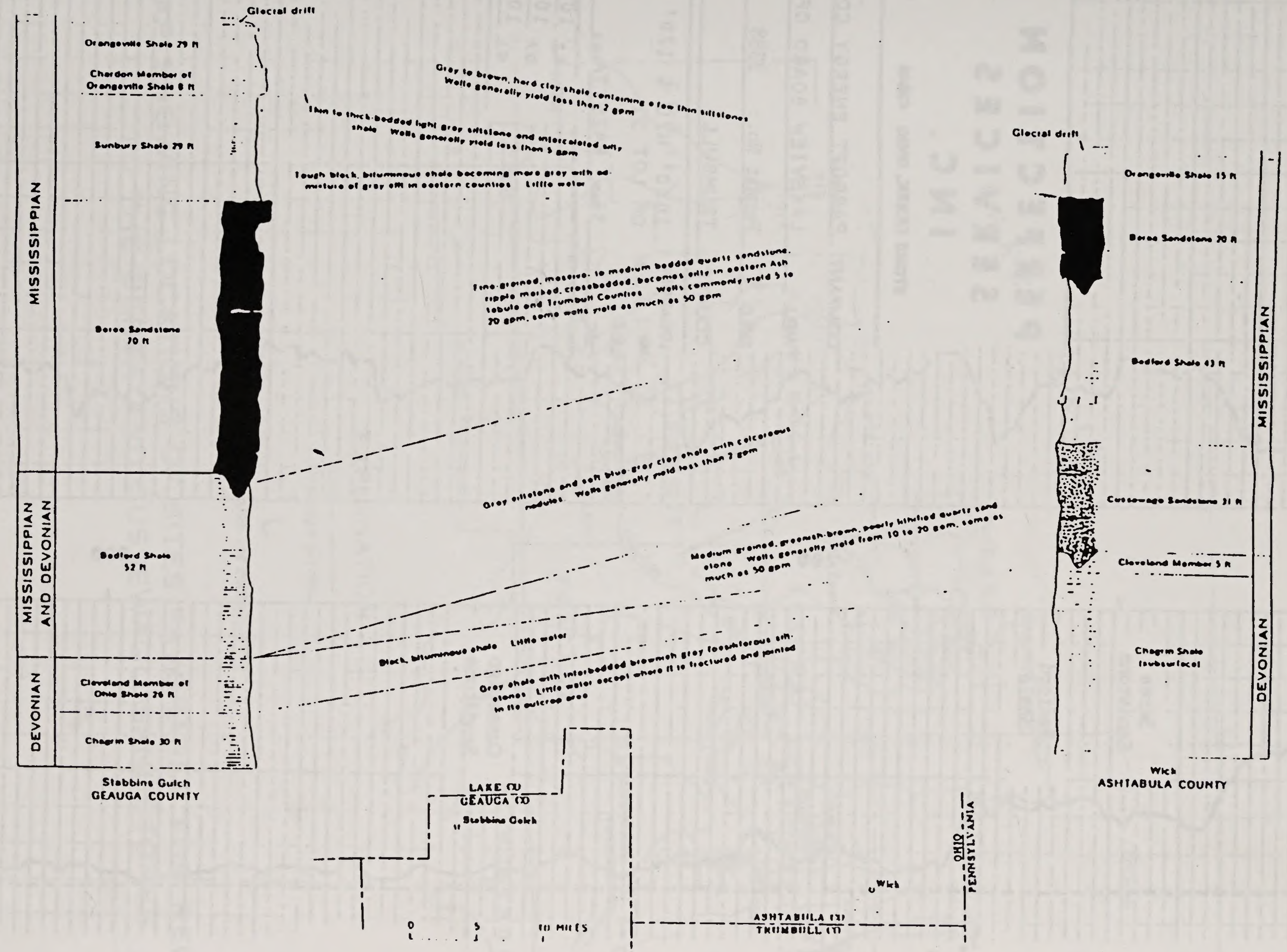
Geologist, Ground Water Protection Section, ODNR, Division of Oil and Gas.

21. Historical streamflow daily values data graph for Mosquito Creek below Mosquito Creek dam, near Cortland, Ohio, for the period from 1944-1991, United States Geological Survey, Water Resources Division, Ohio District, Columbus, Ohio, WATSTORE database.



GENERALIZED GEOLOGIC SECTION BETWEEN EASTERN LAKE COUNTY AND SOUTHWESTERN MAHONING COUNTY

Figure 1



STRATIGRAPHIC RELATIONS AND GENERAL LITHOLOGIC CHARACTER OF SECTIONS MEASURED AT STEBBINS GULCH, GEAUGA COUNTY, AND AT WICK IN ASHTABULA COUNTY

Figure 2

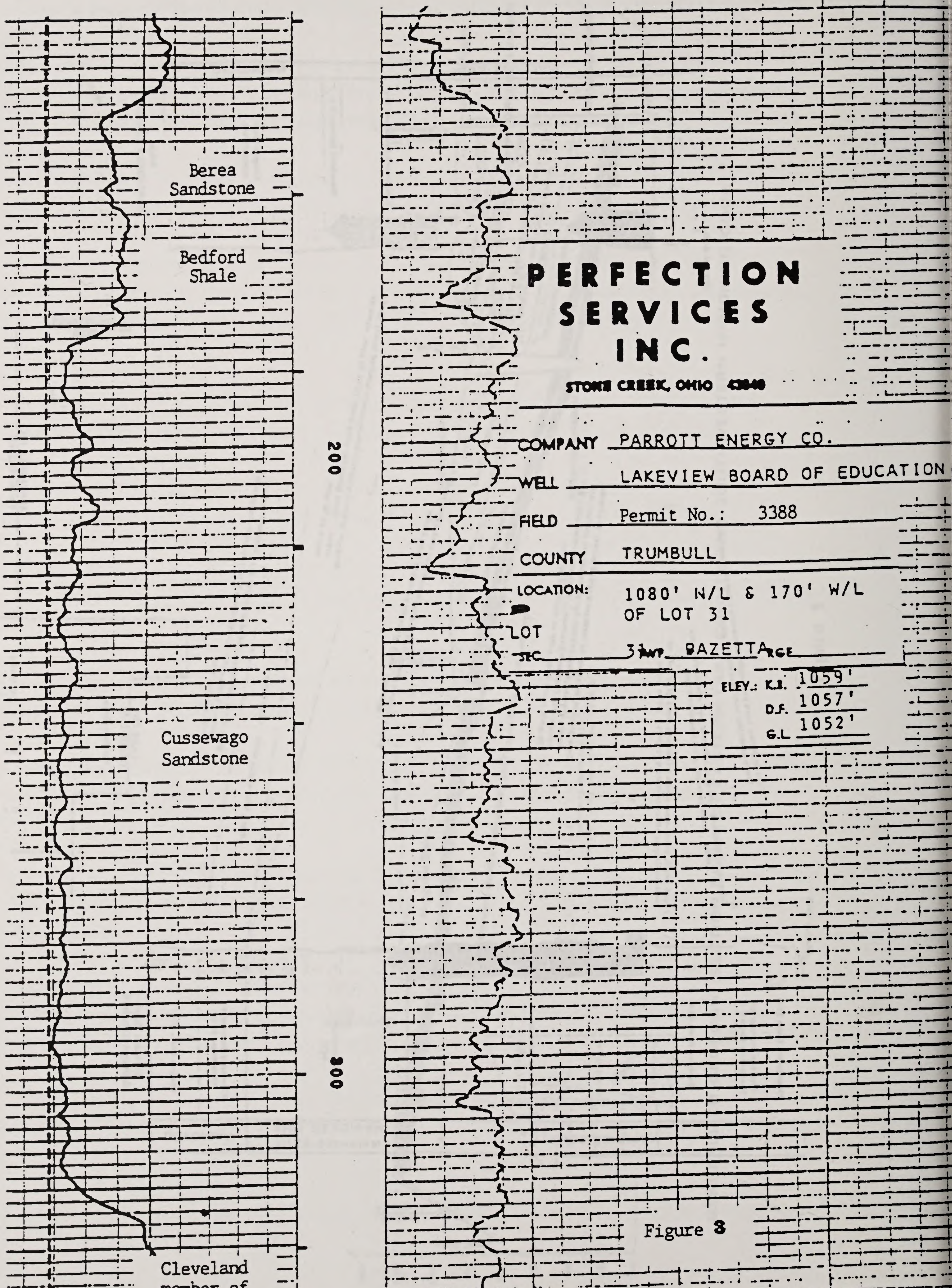
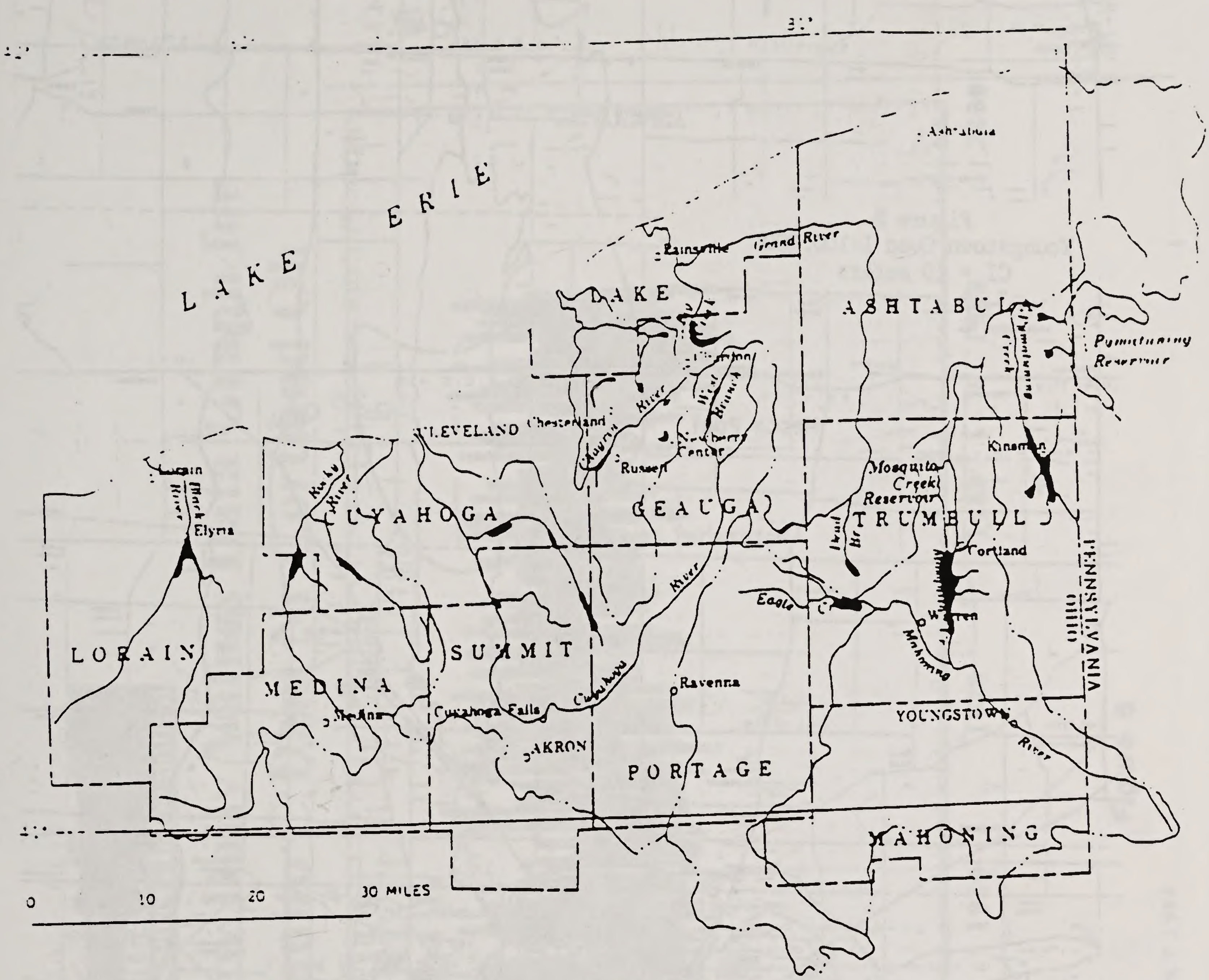

Berea
Sandstone
Bedford
Shale
200
Cussewago
Sandstone
300
Cleveland
member of
Ohio Shale
PERFECTION
SERVICES
INC.
STONE CREEK, OHIO
COMPANY PARROTT ENERGY CO.
WELL LAKEVIEW BOARD OF EDUCATION
FIELD Permit No.: 3388
COUNTY TRUMBULL
LOCATION: 1080' N/L & 170' W/L
OF LOT 31
LOT
SEC 3 TWP BAZETTA RGE
ELEV.: K.B. 1059'
D.F. 1057'
G.L. 1052'

Figure 3



EXPLANATION

Drainage divide

Sites favorable for recharge

MAP SHOWING LOCATIONS OF SITES FAVORABLE FOR RECHARGE TO THE BEREA AND CUSSEWAGO SANDSTONES

Figure 4

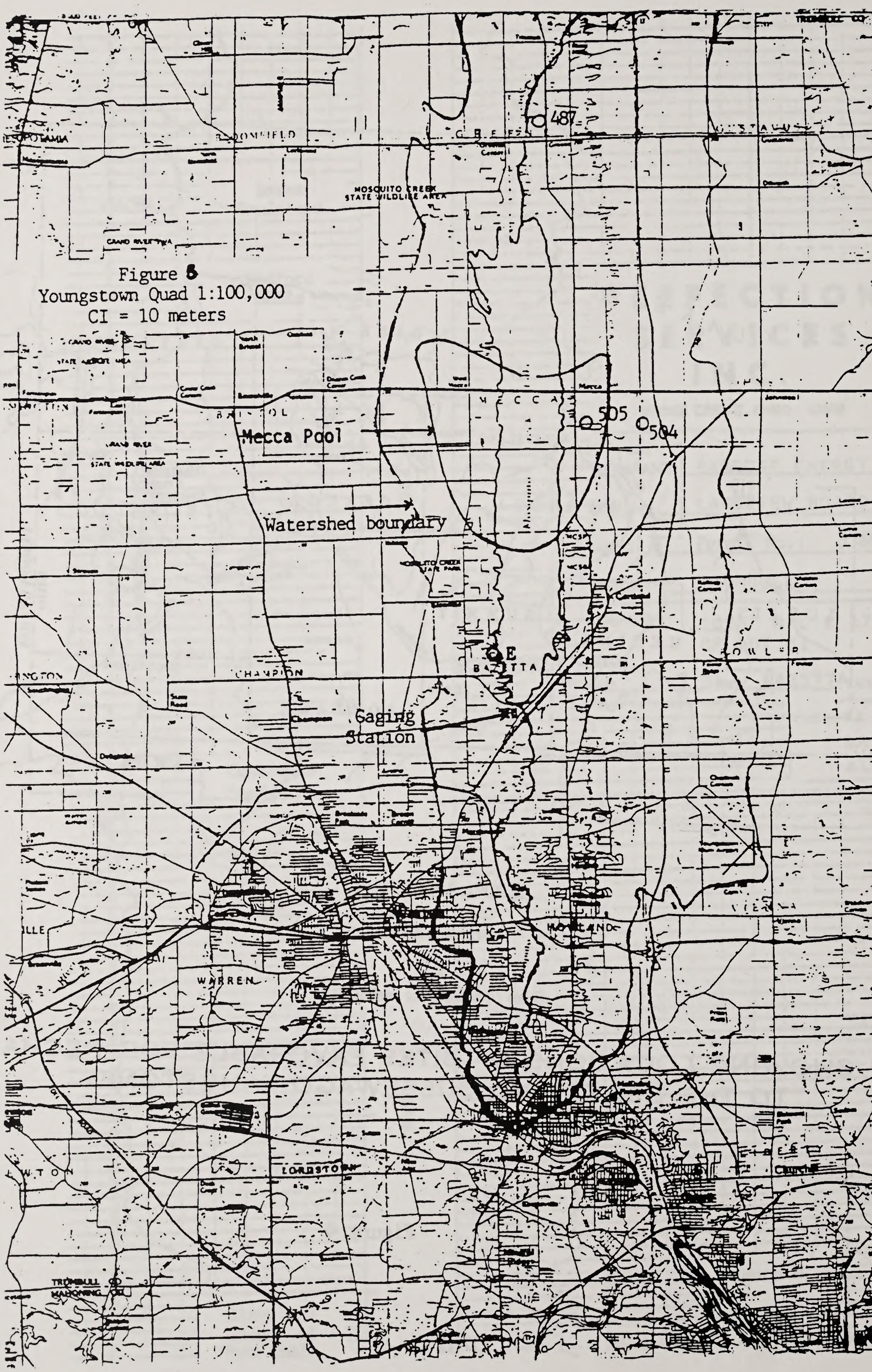


Figure 5
Youngstown Quad 1:100,000
CI = 10 meters

USGS Water Resources Information

Historical Streamflow Daily Values Data Graph for Mosquito C Bl Mosquito C Dam Nr Cortland Oh

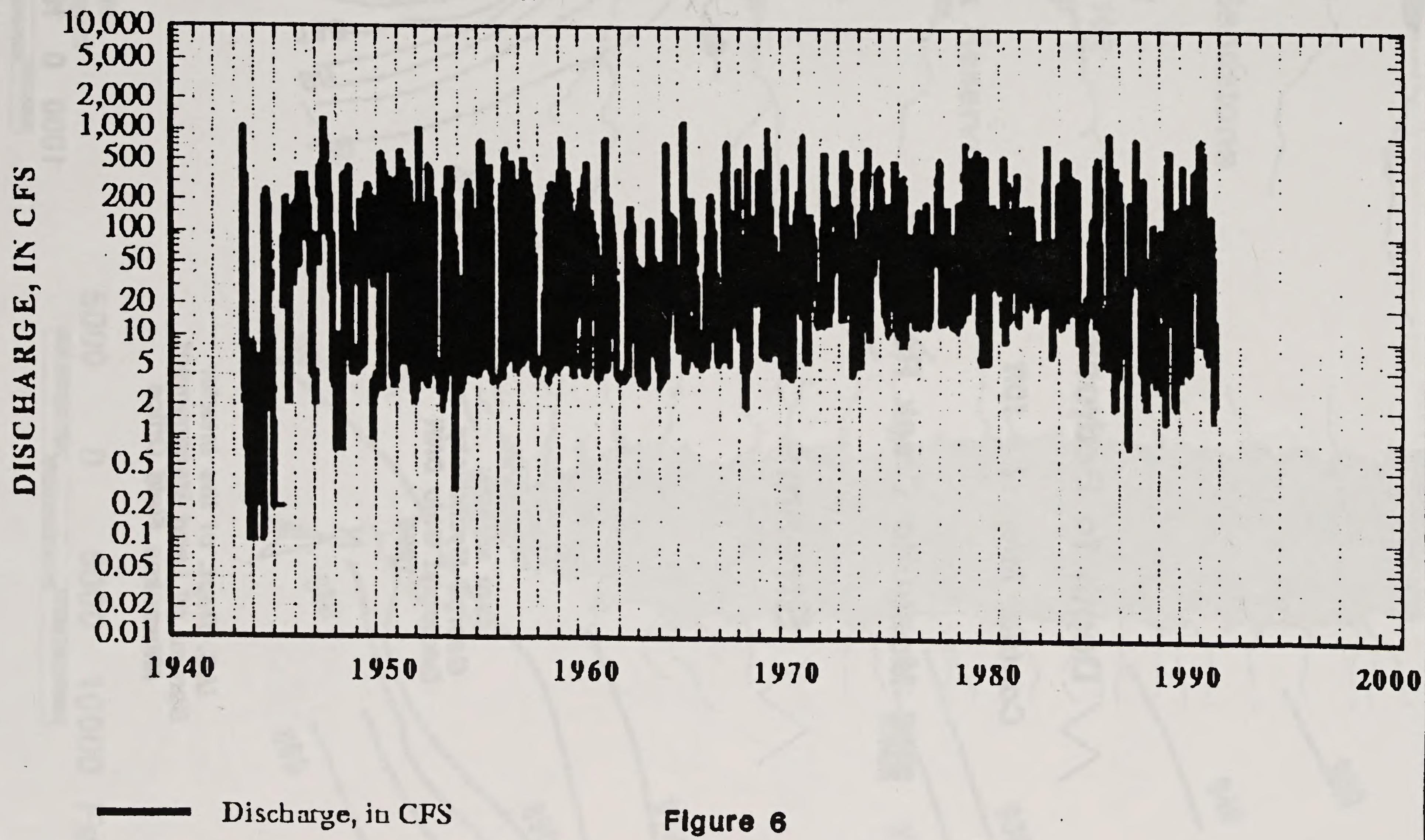


Figure 6

10:17:20 EST 199

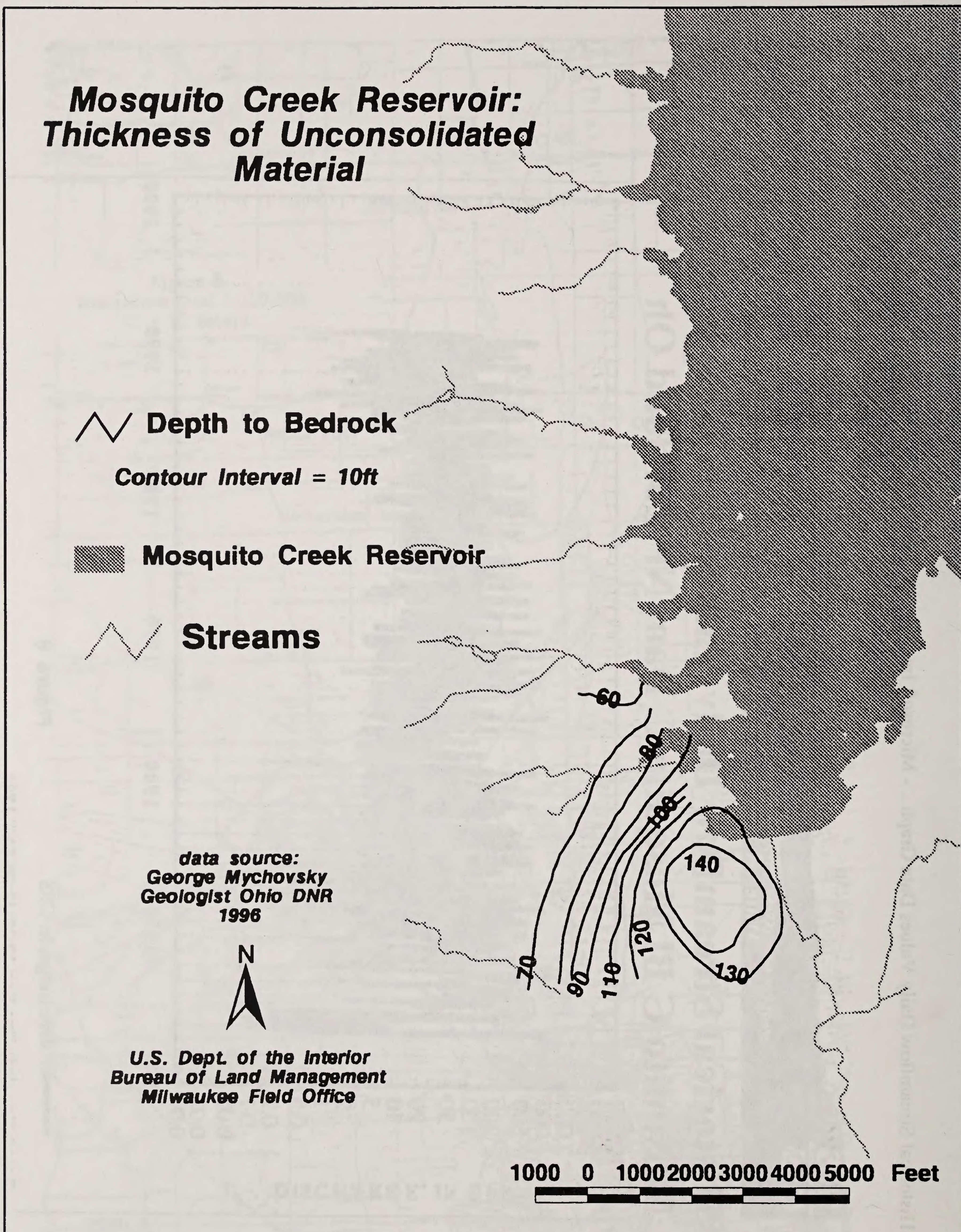

Mosquito Creek Reservoir:
Thickness of Unconsolidated
Material
Depth to Bedrock
Contour Interval = 10ft
Mosquito Creek Reservoir
Streams
data source:
George Mychovsky
Geologist Ohio DNR
1996
N
U.S. Dept. of the Interior
Bureau of Land Management
Milwaukee Field Office
60
70
80
90
100
110
120
130
140
1000 0 1000 2000 3000 4000 5000 Feet

fig. 7

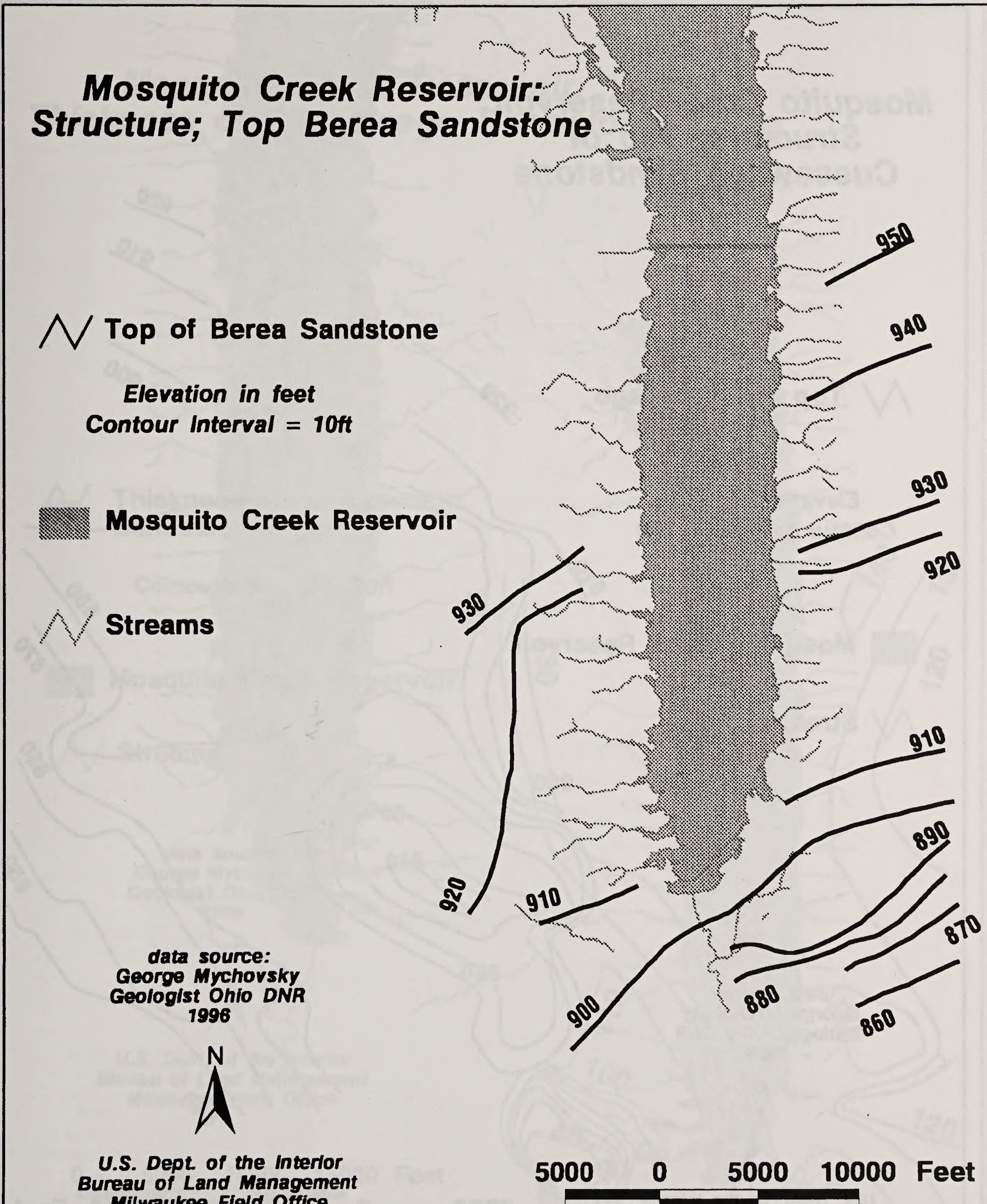

Mosquito Creek Reservoir:
Structure; Top Berea Sandstone
Top of Berea Sandstone
Elevation in feet
Contour Interval = 10ft
Mosquito Creek Reservoir
Streams
950
940
930
920
930
920
910
910
900
890
880
870
860
data source:
George Mychovsky
Geologist Ohio DNR
1996
N
U.S. Dept. of the Interior
Bureau of Land Management
Milwaukee Field Office
5000 0 5000 10000 Feet

fig. 8

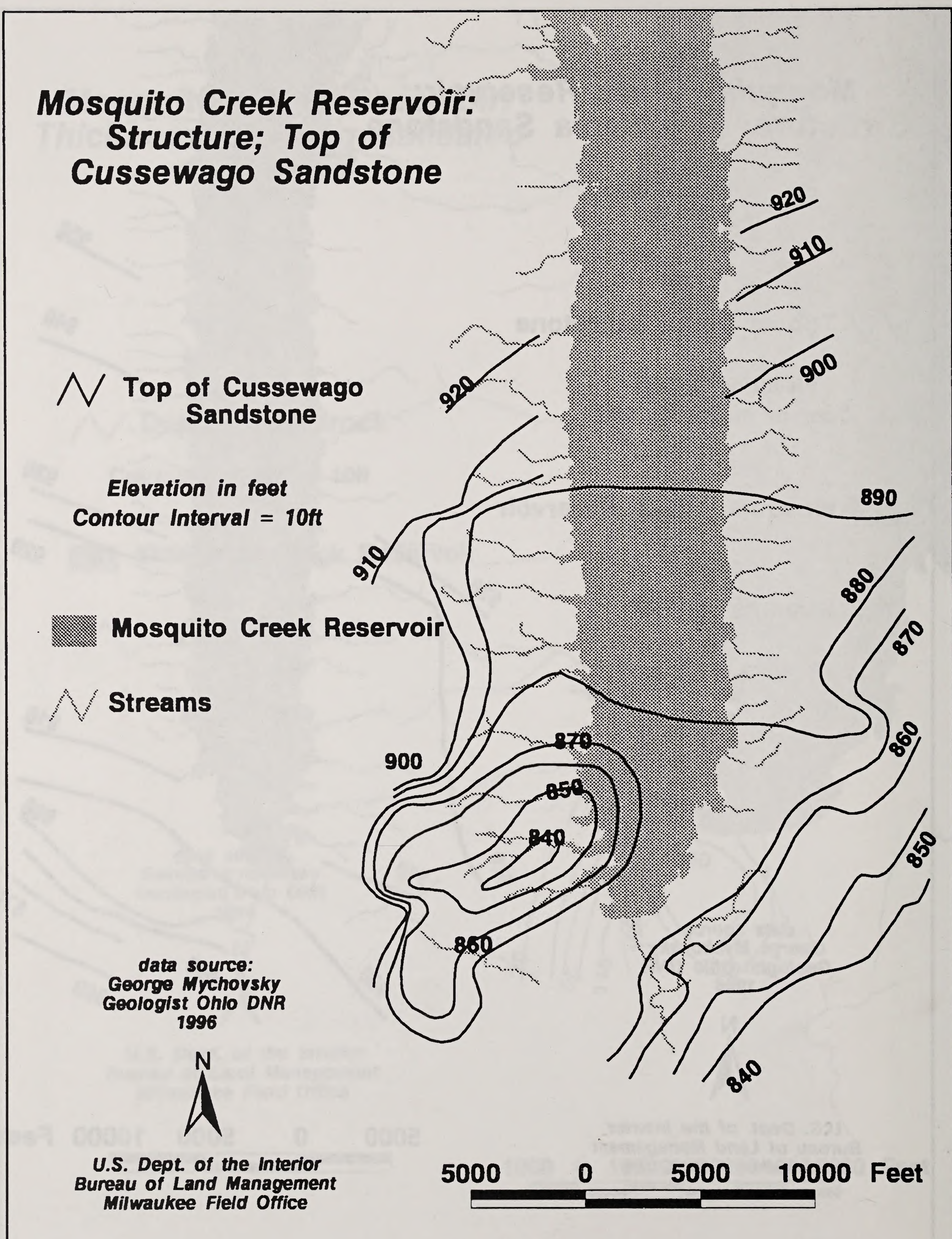

Mosquito Creek Reservoir:
Structure; Top of
Cussewago Sandstone
Top of Cussewago Sandstone
Elevation in feet
Contour Interval = 10ft
Mosquito Creek Reservoir
Streams
data source:
George Mychovsky
Geologist Ohio DNR
1996
N
U.S. Dept. of the Interior
Bureau of Land Management
Milwaukee Field Office
5000 0 5000 10000 Feet
920
910
900
920
890
910
880
870
900
870
860
850
840
860
850
840

fig. 9

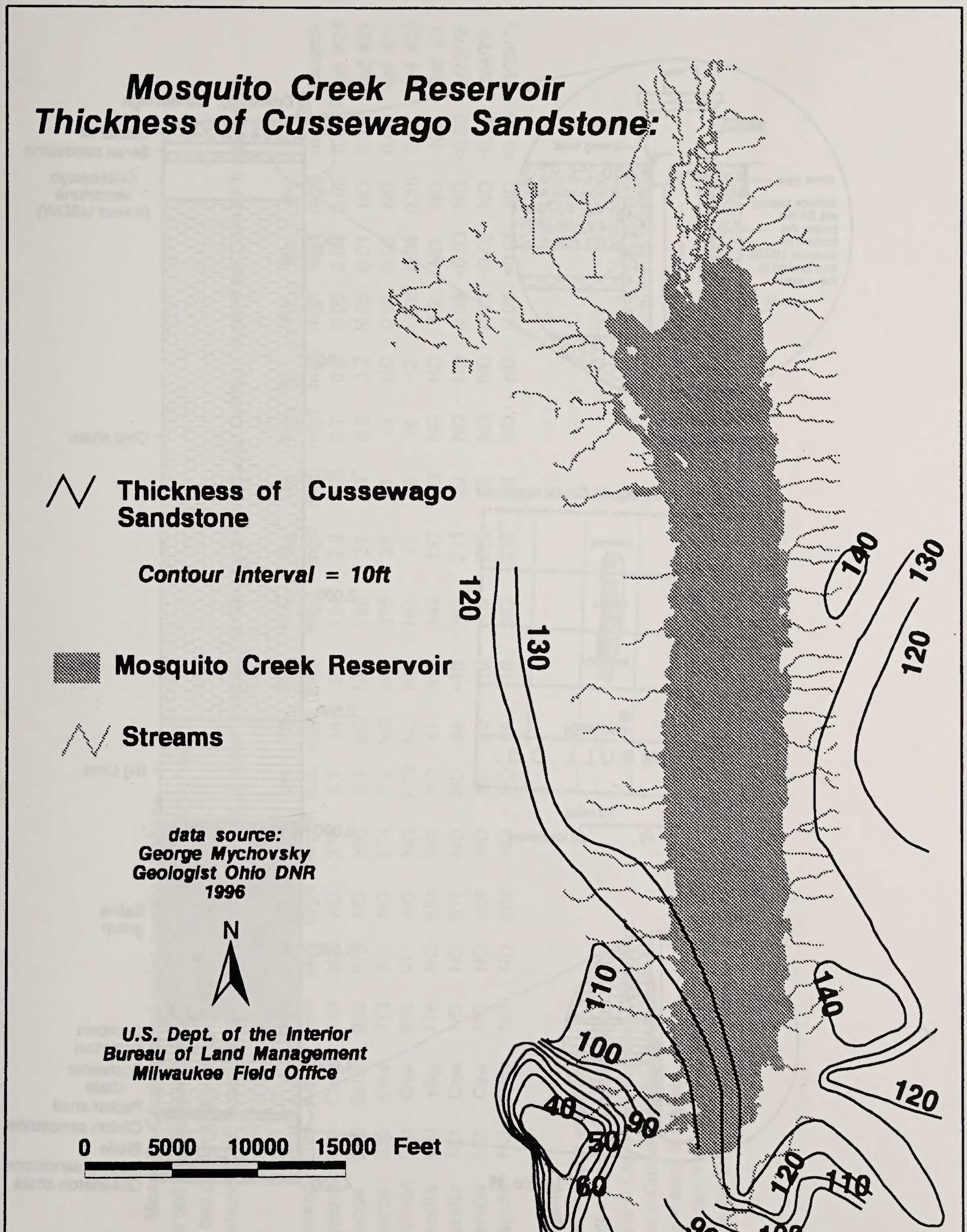

Mosquito Creek Reservoir
Thickness of Cussewago Sandstone:
Thickness of Cussewago Sandstone
Contour Interval = 10ft
Mosquito Creek Reservoir
Streams
data source:
George Mychovsky
Geologist Ohio DNR
1996
N
U.S. Dept. of the Interior
Bureau of Land Management
Milwaukee Field Office
0 5000 10000 15000 Feet
120
130
140
130
120
110
100
40
90
50
60
70
80
140
120
120
110
90
100

fig. 10

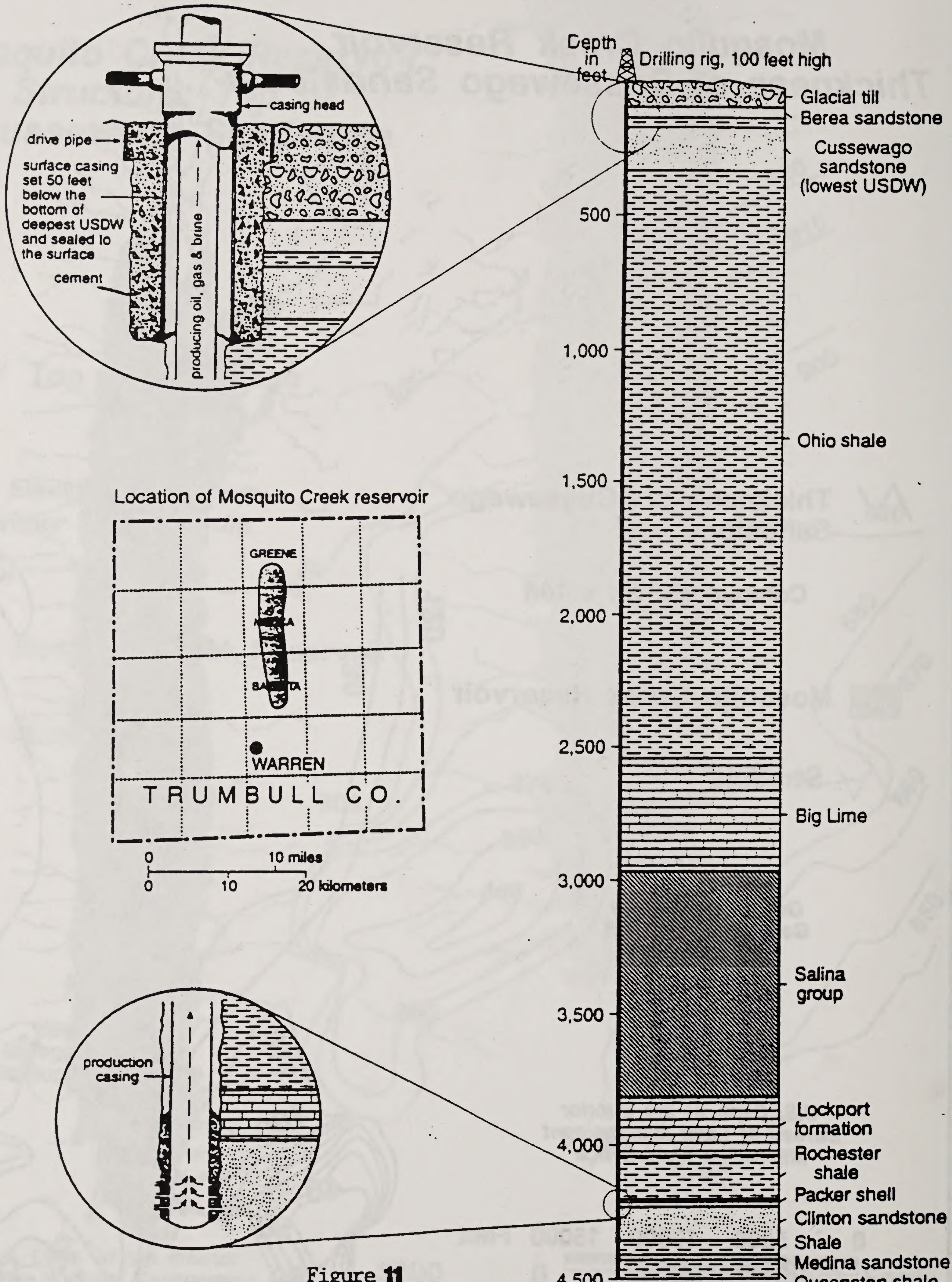


Figure 11

Schematic showing the relative scale of oil and gas wells and typical geology encountered during drilling in the Mosquito Creek area of Trumbull County

TABLE I: Mosquito Creek ground water quality database

Note: Site 505 was misidentified as a Berea well by Clabaugh, 1991.

Kraft well had oil film in the Berea.

City of Cortland (Cort) water well data taken from Ohio Dept.of Health records provided by the Northeast District Office of the Ohio EPA **(Ref: #28)**.

Well	Twnshp	Elev	Aquif	Scrn btm elev	SWL elev	TDS mg/l	Spec Cond us/cm	pH s.u.	Cl mg/l	SO_4 mg/l	HCO_3 mg/l	Na mg/l	Ca mg/l	Mg mg/l	K mg/l	Fe mg/l	Mn mg/l	Sr mg/l	Zn mg/l	Source
487	Greene	930	Cleve	850	ND	ND	376	7.7	14	30	194	2.9	52	9.7	0.8	0.05	0.01	0.05	0.01	Ref. #21
504	Mecca	980	Berea	930	970	ND	395	7.1	ND	ND	188	24	29	6.9	3.2	0.05	0.01	ND	0.12	Ref. #21
505	Mecca	930	Csw	773	912	ND	574	7.4	ND	ND	375	25	51	13	ND	0.05	0.08	ND	0.01	Ref. #21
Kraft	Kinsman	940	Csw	903	917	ND	ND	7.79	ND	ND	ND	13	59	16	<2	<.005	0.08	0.15	0.01	Ref. #22
ND	Bazetta	910	s&g	776	ND	554	ND	ND	47	ND	ND	137	ND	ND	ND	4.2	ND	ND	ND	Ref. #3
Cort	Bazetta	ND	Csw	ND	ND	617	ND	ND	84	<10	ND	211	20	ND	ND	0.08	<0.03	ND	<0.03	8/22/78
Cort	Bazetta	ND	Csw	ND	ND	609	ND	ND	40	<10	ND	202	19	ND	ND	0.28	<0.03	ND	<0.03	5/4/79
Cort	Bazetta	ND	Csw	ND	ND	608	ND	ND	86	<10	ND	212	20	ND	ND	0.08	<0.05	ND	<0.03	10/29/79

Legend

SWL = Static water level

TDS = Total dissolved solids

Cleve = Cleveland member, Ohio Shale

Csw = Cussewago Sandstone

s&g = sand & gravel

scrn btm = screen bottom

ND = No Data

TABLE II: Mosquito Creek aquifer summary table

Note: Aquifers are listed in descending stratigraphic order.

Aquifer	Lithology	Thickness (ft)	Aq Base Dpth (ft)	Use	Contaminants	Yield (gpm)	Transmissivity (gpd/ft)	Confined/ Unconf.	Areal extent
alluvial/glacial	sand & gravel	120-140	140	d	n	<100	ND	unconfined	south end of reservoir
Sharon	sandstone	0-200	ND	d	ND	25	2600	ND	in Fowler Township to the east
Sunbury	shale	10-45	40-80	d	n	15-34	ND	confined	isolated in SE Mecca & WC Bazetta
Berea	silty sandstone	3-59	50-165	d	o,g,b,s	20-60	6700	confined	east of Mecca
Cussewago	sandstone	40-147	45-330	d,m,i	o,g,b,s	20-50	13000	confined	widespread
Cleveland	blk shale w/sltst	10	165	d	g?	<20	ND	ND	very isolated

Legend

b = brine
d = domestic
g = natural gas
i = industrial
m = municipal
n = none
ND = No Data
o = oil
s = sulfur

TABLE III: Mosquito Creek surface water quality database
Data from samples collected at USGS gage station 03095500
Sample Period 1965-1977

Parameter	Units	Minimum	Maximum	OEPA-ALS	OEPA-PWSS
pH-whole field	s.u.	6.6	7.9	6.5 - 9.0	
specific conductivity	us/cm	202	382	2400 - 30 day avg	1200 - max; 800 - 30 day avg
total dissolved solids	mg/l	110	234	1500 - 30 day avg	750 - max; 500 - 30 day avg
total alkalinity	mg/l as $CaCO_3$	41	115		
total hardness	mg/l as $CaCO_3$	78	160		
Cations					
dissolved sodium	mg/l	12	17		
dissolved potassium	mg/l	2.6	3.3		
dissolved calcium	mg/l	16	41		
dissolved magnesium	mg/l	5.4	7.2		
dissolved iron	ug/l	<10	100	1000 - **total** iron	300
dissolved manganese	ug/l	<10	150		50
Anions					
dissolved chloride	mg/l	13	27		250
dissolved sulfate	mg/l	33	44		250

Legend
OEPA-ALS = Aquatic Life Standard
OEPA-PWSS = Public Water Supply Standard

Note: OEPA Surface Water standards established by OAC 3745-1-07

TABLE 6.18: Mosquito Creek surface water quality database
Data from samples collected at USGS gage station 03095500
Sample Period: 1962-1977

Parameter	Units	Minimum	Maximum	OEPA ALS	OEPA PWSS
pH-whole field (field)	s.u.	6.6	7.9	6.5 - 9.0	
specific conductivity	us/cm	207	382	2400 - 30 day avg.	1200 - max; 800 - 30 day avg
total dissolved solids	mg/l	110	234	1500 - 30 day avg.	750 - max; 500 - 30 day avg
total alkalinity	mg/l as $CaCO_3$	41	119		
total hardness	mg/l as $CaCO_3$	76	160		
Cations					
dissolved sodium	mg/l	13	17		
dissolved potassium	mg/l	2.6	3.3		
dissolved calcium	mg/l	19	44		
dissolved magnesium	mg/l	6.4	7.5		
dissolved iron	ug/l	<10	300	1000 - total iron	300
dissolved manganese	ug/l	<10	150		50
Anions					
dissolved chloride	mg/l	13	47		
dissolved sulfate	mg/l	33	46		

Legend
OEPA ALS = Aquatic Life Standard
OEPA PWSS = Public Water Supply Standard

Note: OEPA Surface Water standards established by OAC 3745-1-07

APPENDIX D - PUBLIC HEALTH AND SAFETY

Appendix D - Public Health and Safety

Introduction

This section summarizes current health and safety requirements, bonds and liability coverage required of operators, inspections and emergency response.

Existing Regulations and Ordinances that Apply to Public Health, Safety, and Welfare - Common to Both Alternatives

Federal Acts and Programs

Table D-1 briefly summarizes Federal Acts and programs implemented for protection of public health, safety and welfare and the environment and which have application to aspects of oil and gas operations. The table includes Federal and State agencies mandated to implement the programs and identifies the Planning Analysis/Environmental Assessment (PA/EA) section/chapter which addresses the program. BLM regulations conform to the requirements of these Acts.

Bureau of Land Management

Table 4.1 and and Appendix A summarize existing constraints and mitigation measures designed to protect public health and safety.

Tables D-2, D-3 and D-4 provide information regarding the bonds/cash deposit requirements, BLM inspections, and facility location and emergency information, respectively. BLM may specify additional safety measures in the Federal drilling permit based on an evaluation of site specific safety concerns.

Table D-1. Federal Acts and Programs Related to Public Health and Safety

Act	Program	Federal Agency	State Agency	PA/EA Section/Chapter and Related Oil and Gas Activity
Clean Air	State Implementation Plan (SIP)	USEPA	Ohio EPA (OEPA)	Air Quality -no air permit required; Federal actions must conform to SIP
Clean Water	Spill Prevention, Control, and Countermeasure (SPCC) Plans	USEPA	OEPA	Water Quality, Public Health and Safety-SPCC Plans for oil and gas production facilities (tank batteries) with potential to discharge to navigable U.S. waters; SPCC Plans for drilling rigs
	National Pollutant Discharge Elimination System (NPDES) Permits	USEPA	OEPA	Water Quality, Soils: NPDES permits for storm water discharge from construction site greater than 5 acres and contaminated storm water from industrial activity site
Safe Drinking Water	Underground Injection Control (UIC); protection of underground sources of drinking water (USDW)	USEPA	ODNR-Division of Oil and Gas (DOG)	Water Quality: Class II UIC Wells-disposal of drilling/production liquid wastes; proposed oil and gas well casing and cementing programs
Comprehensive Environmental Response, Compensation Liability Act	Superfund (CERCLA)	USEPA	OEPA	Hazardous Materials, Public Health and Safety - Reporting and cleanup requirements for release of hazardous substances
Superfund Amendments and Reauthorization Act	Emergency Planning and Community Right-to-Know	USEPA	OEPA-SERC**	Hazardous Materials, Public Health and Safety - Community notification (SERC, LEPC*, Fire Dept.) of presence of hazardous materials at site
Resource Conservation and Recovery Act	Subtitle D-Solid Waste/ Subtitle C-Hazardous Waste Management	USEPA	OEPA and ODNR-DOG	Hazardous Materials, Public Health and Safety- Management of solid and hazardous wastes, including oil and gas exploration and production exempt and non-exempt wastes
Natural Gas Pipeline Safety Act	Minimum Federal Standards	USDOT	Ohio Public Utility Commission (OPUC)	Public Health and Safety - Pipeline material selection, design, protection from corrosion, safety requirements for populated areas

*Local Emergency Planning Committee, **State Emergency Response Commission

State of Ohio

Ohio Department of Natural Resources, Division of Oil and Gas (ODNR, DOG)
Primary responsibility for the regulation of oil and gas activity in Ohio rests with the ODNR, DOG. Chapter 1509 of Ohio Revised Code-Oil and Gas Laws, Section 1509.23 Safety Regulations, specifies practices for protection of public health and safety or to prevent damage to natural resources. The primary regulations for public health, welfare and safety are set forth in Chapter 1501 of Ohio Administrative Code-Oil and Gas Rules, Rules of the ODNR, DOG and include:

- Rule 1501:9-1-05 Safety (drilling);
- Rule 1501:9-1-07 Prevention of contamination and pollution (any phase of well operation);
- Rule 1501:9-3-04 Prevention of contamination and pollution (saltwater disposal-Underground Injection Control (UIC) program-Class II wells);
- Rule 1501:9-3-09 Safety (saltwater injection - Underground Injection Control (UIC) program-Class II wells);
- Safety Practices For Drilling And Producing Oil And Gas Wells - Rule 1501:9-9-01 through 1501:9-9-07 (1501:9-9-03 gives special requirements for air drilling);
- Pipelines - Rule 1501:9-10-01 through 1501:9-10-06;
- Plugging of Wells - Rule 1501:9-11-01 through 1501:9-11-13.

Distance setbacks required in these rules for public health and safety are summarized on pages D-20 and 21. In addition to distance setbacks, these rules contain other operational requirements to assure safe operations which will be referred to in the impact analysis. Tables D-2, D-3 and D-4 summarize the bonds/cash deposit requirements, DOG inspections, and facility location and emergency information, respectively. DOG may specify additional safety measures in the State drilling permit based on an evaluation of site specific safety concerns.

DOG regulates management of exploration and production (E and P) wastes at oil and gas sites and disposal of E and P liquid waste in Underground Injection Control (UIC) Class II disposal wells. E and P wastes include drilling fluids, including completion and workover fluids, brine and associated wastes. In the UIC program, brine is defined such that it covers 99 percent of all oil and gas E and P wastes generated in Ohio (IOGCC/USEPA, 1995b). DOG evaluates applications to drill, or convert, a well for brine disposal and requires registration of all vehicles used to transport brine commercially and certification of all commercial waste haulers. All UIC brine disposal facilities are considered commercial facilities. Brine haulers, who must be registered and bonded, are authorized to transport waste only to those disposal facilities listed upon registration. DOG is responsible for tracking the transport of brine. The waste generator, hauler, operator of a disposal facility, and political subdivisions are required to submit annual or quarterly reports to DOG concerning waste transport. DOG can reconcile these reports to account for disposition of all reported brine (ibid). More information in regard to waste management is provided below under the section on OEPA and in Appendix E (Hazardous Materials).

DOG pipeline rules at 1501:9-10 apply to pipelines used in the drilling or operation of oil/natural gas wells, the producing of oil/natural gas wells, and the transportation of leasehold gas. The rules apply only where the pipelines lie outside the limits of:

- incorporated or unincorporated cities, town, or village; and
- any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

Details of the rules are included in the Summary found on page D-21. Gas pipelines within the limits of the areas listed above are discussed below under the Ohio Public Utility Commission section.

Ohio Environmental Protection Agency (OEPA)
OEPA regulates non-liquid oil and gas waste that may be transported off-site to a municipal landfill or commercial disposal facility. It is the decision of the local landfill operator whether to accept E and P waste. All materials received by a landfill must be non-hazardous and contain no free liquids. OEPA has jurisdiction for oil spills that enter navigable waters. This is further addressed under Oil Spill Response in Section 4.2.12, Public Health and Safety. The Ohio State Emergency Response Commission (SERC) implements the Federal Community Right-to-Know and Emergency Planning Act. The SERC requires that oil and gas operators submit inventory forms which list tank batteries (facilities), their location and storage capacity, plus a township map showing the locations of the facilities. The SERC requires that this same information be provided to the Trumbull County LEPC and the local Fire Department. Table D-3 summarizes facility location and emergency information required.

Ohio Public Utility Commission (OPUC)
As a result of the Natural Gas Pipeline Safety Act of 1968, as amended, the U.S. Department of Transportation issued regulations at 49 CFR Part 192 that set forth minimum Federal safety standards for transportation of natural gas and other gas by pipeline. 49 CFR 192 applies to onshore gathering of gas within the limits of:

- any incorporated or unincorporated city, town, or village; and
- any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

The State of Ohio has adopted these regulations in full and developed additional regulations. OPUC administers the requirements of these regulations.

Ohio Department of Transportation (DOT)
Ohio DOT has requirements for oversize/overweight road permits and road bond requirements which apply to the truck mounted drilling rig and other trucks which

exceed 80,000 pounds. Road permits and bonds are addressed in Section 4.2.9, Transportation, and are detailed on Table D-2.

Trumbull County

While Trumbull County has no health and safety regulations specific to oil and gas operations, the county oversize/overweight road permit and road bond requirements apply to truck mounted drilling rigs and other trucks which exceed 80,000 pounds. Road permits and bonds are addressed in Section 4.2.9, Transportation, and are also detailed in Table D-2. Additional information about county involvement with oil and gas operations is addressed under Emergency Response in Section 4.2.12, Public Health and Safety.

Bazetta Township

Bazetta Township Ordinances address protection of safety, health and welfare at Section 28: Gas and Oil Well Regulations. These rules include requirements for Certification of Compliance, bonds/cash deposits, distance setbacks, notification of residents, water well testing, some aspects of operations, and describe the type of inspections that will be performed by the township. The township may specify additional safety measures in the Certification of Compliance based on an evaluation of site specific safety concerns. Page D-22 provides a summary of township public health and safety setbacks and public notification requirements for oil and gas operations.

Mecca and Greene Townships

Mecca and Greene Townships do not have ordinances specific to oil and gas operations.

City of Cortland

The City of Cortland has ordinances for oil and gas operations at Chapter 761: Oil and Gas Wells. These regulations contain provisions for issuance of city drilling permits, bonds and liability insurance, site plans, site inspections prior to any construction activities, restoration plans, and site maintenance.

Permitting, Bonds, and Liability

In order to drill an oil and gas well, oil and gas operators must obtain a variety of permits and arrange for surety or personal bonds, as well as liability coverage for bodily injury and property damage. The operator must also obtain permits for certain subsequent well operations and to plug and abandon the well. Table D-2 summarizes the permits, bonds and liability coverage that an oil and gas operator would have to obtain in order to drill a Federally permitted oil and gas well. Except for BLM requirements, private wells would be subject to the same requirements listed on the table.

The Application for Permit to Drill (APD) filed with the BLM includes detailed drilling and surface use programs and site maps. In regard to health and safety, BLM personnel evaluate the APD to assure for proper well control equipment and procedures, isolation and protection of fresh water aquifers, appropriate waste containment, handling and disposal, appropriate well pad location and layout, and proper soil erosion and sedimentation control measures. Operators do not apply to the BLM for approval of brine disposal until after a well is placed into production.

The State drilling permit application, filed with the ODNR, DOG, includes a drilling plan, restoration plan, plan for storage and disposal of brine and other waste substances, and site maps. Division of Oil and Gas personnel evaluate the proposal to assure that it meets State requirements for safety setbacks, well control, protection of freshwater aquifers, and appropriate waste containment, handling and disposal.

The application for a Certification of Compliance to the township includes, among other things, a copy of the State permit, detailed location and proposed facility maps, emergency contact information. The township evaluates the proposal to assure that it meets all township health, safety, and welfare requirements.

Other items the operator may need to obtain include various surface use agreements, easements, or rights-of-way with private land owners or other entities for use of the land. Such agreements would usually specify requirements for protection of surface resources and reclamation of disturbed areas and/or payment for damages in lieu thereof.

Table D-2. Required Permits, Bonds, and Liability Coverage

Activity	Permit	Agency	Bond/Deposit	Liability Coverage
Drilling	Drilling Permit	BLM	bond*-$10,000 lease; or $25,000 statewide; or $150,000 nationwide	Liability for damages to 3rd parties governed by applicable law**
	Drilling Permit	ODNR, DOG	bond***- $5,000 individual or $15,000 blanket	Liability insurance coverage- min. $300,000 bodily injury/$300,000 property damage for all of owner's wells
	Special Hauling Permit - drilling rig	Ohio DOT	$200,000 Road Bond OR	$200,000 liability insurance coverage
	Special Hauling Permit- excess weight /oversized vehicle)	County	$100,000 Road Bond OR	$100,000 liability insurance coverage
	Certificate of Compliance	Bazetta Township	$3,000 cash deposit****; $50,000 Road Bond	N/A
Subsequent Operations for Well	Sundry Notices	BLM	Original bond applies	Same as above
		ODNR, DOG	Original bond applies	Liability coverage continues
Production Phase:	Sundry Notice - Produced Water Disposal	BLM	Original bond applies	Same as above
Salt water injection well	UIC Permit	ODNR, DOG	Same as for oil and gas wells	Same amount of coverage as for oil/gas wells
Brine hauler	Registration Certificate/ UIC Permit	ODNR, DOG	$15,000 surety bond	Same amount of coverage as for oil/gas wells
Plugging and abandonment	Notice of Intent to Abandon	BLM	Original bond applies	Same as above
	Permit to Plug and Abandon	ODNR, DOG	Original bond applies	Liability coverage continues
	Certificate of Compliance	Bazetta Township	$1,500 Plugging Standards Deposit*****	N/A

Activity	Permit	Agency	Bond/Deposit	Liability Coverage
After well plugging and abandonment	Subsequent Report of Abandonment; Final Abandonment Notice	BLM	Terminates period of liability if well plugged, reclaimed properly	Same as above
	Plugging Record/Report of Abandonment of Well	ODNR, DOG	Owner liability for well ends when well is plugged in accordance with applicable rules	Liability coverage continues until all wells operator has in State are plugged, reclaimed properly
		Bazetta Township	$1,500 refunded if area is satisfactorily restored	N/A

*43 CFR Part 3100, Subpart 3104, 3104.1 Bond Obligations - "to ensure . . . complete and timely plugging of the well(s), reclamation of the lease area(s), and the restoration of any lands or surface waters adversely affected by lease operations after the abandonment of oil and gas operations on the lease(s)" The BLM may require an increase in the Federal bond amount if the BLM determines that the operator poses a risk for reasons including, but not limited to, a history of violations, uncollected royalties due, or if the total cost of plugging existing wells and reclaiming lands exceeds the present bond amount.
**Onshore Order #2, III, F. Surface Use - "The operator/lessee is responsible for, and liable for, all building, construction, and operating activities and subcontracting activities conducted in association with the APD."
***Chapter 1509 of Ohio Revised Code Oil and Gas Laws, 1509.07 - "conditioned on compliance with the restoration requirements of section 1509.072, plugging requirements of section 1509.12, permit provisions of section 1509.13 of the Revised Code and all rules and orders of the chief relating thereto."
****Section 28 Gas and Oil Well Regulations, Section 4.A. - "...to insure compliance of the health and safety standards of the Township during the period of drilling and completion of the oil and gas well..." Refundable upon Township determining that all health and safety standards have been complied with.
*****Section 28 Gas and Oil Well Regulations, Section 4.C. - ". . .to insure compliance with the health and safety standards of the Township during the plugging reclamation process."

Inspections and Enforcement

Table D-3 outlines inspections performed by the various regulatory agencies during all phases of oil and gas operations. The agencies may make additional inspections on an as-needed basis at any time. BLM inspects Federally permitted wells to assure that the wells are in compliance with all the requirements of BLM lease terms, regulations, Orders, Notices to Lessees and Conditions of Approval on the APD. In cases of non-compliance, BLM takes measures that become progressively more severe if an operator continues in non-compliance. In order from least to most severe, these measures include Notice of Incidents of Non-Compliance (INC), which requires correction within a specified time frame; monetary assessments; shutting down operations; civil penalties; claiming the Federal bond; and finally lease cancellation. In cases of non-compliance that threaten severe environmental damage or loss of life, BLM can enforce immediate shut down of operations.

The ODNR has a similar program of progressively more severe enforcement measures if an operator continues in non-compliance.

Table D-3. Inspections

Activity	BLM	ODNR-DOG	Bazetta Township
Inspection of Areas Proposed for Use/Disturbance	Pre-drilling inspection with landowner, operator*, ODNR, DOG, other State/Federal agency - all wells authorized through Federal drilling permit or agreement	Separate inspection or with BLM, if a well authorized through Federal drilling permit or agreement	ZI**- proposed site ZI, FC***, RS**** - proposed ingress/ egress of public roads ZI, RS, operator - township roads
Construction Phase	Witness construction activities - all wells authorized through Federal drilling permit or agreement	Witness digging of reserve pit when required as a condition of the permit (usually in sensitive groundwater areas or municipal water well fields)	Inspection, if needed
Drilling Phase	Witness Blowout Preventor test, setting and cementing of surface casing - all wells authorized through Federal drilling permit or agreement	Witness surface casing (Statewide-85% of wells witnessed)	Inspection, if needed
Completion Phase	Normally no inspection	Normally no inspection	At end of phase, ZI and operator inspect drilling unit; ZI, RS, and operator inspect roads
Production Phase	Inspect well and tank battery once per year - all wells authorized through Federal drilling permit or agreement	Variable number inspected/also inspected in response to citizen complaints	Inspection, if needed

Activity	BLM	ODNR-DOG	Bazetta Township
Plugging and Abandonment Phase	Witness well plugging - all wells authorized through Federal drilling permit or agreement	Witness well plugging (Statewide - 85%+ of wells witnessed)	
	Inspect surface restoration with landowner	Inspect surface restoration-all sites	ZI, operator, landowner whose lands include well site/tank battery inspect drilling unit

*Operator-oil and gas operator, **ZI-Zoning Inspector, ***FC-Fire Chief, ****RS-Road Superintendent

Spills and Accidents

Location and Emergency Information

Table D-4 summarizes location, sign, and emergency information required of operators by the BLM, ODNR, Ohio SERC, and Bazetta Township. In addition, notice of pending well sites is available to the public through an ODNR County Engineer's Report, which is mailed to the County Engineer on a weekly basis. The County Engineer provides the list to the Trumbull County LEPC. Additional emergency information is available from Spill Prevention, Control and Countermeasure (SPCC) Plans developed for tank batteries that have potential to discharge crude oil to navigable water.

Table D-4. Location and Emergency Information

Agency Requiring	Access Road	Well	Flowline	Tank Battery	Gathering Line
BLM:					
Location	Application for Permit (APD) map of existing/ proposed roads	APD well plat, well site layout; Site Facility Diagram (SF Diag.)	APD OR Sundry Notice (SN) map of existing/ proposed facilities; SF Diag.*	APD OR SN map of existing/ proposed facilities; SF Diag.*	None
Signs Required	None	Well sign**	None	Sign***	None
Emergency: No special emergency information required; APD includes name, address, phone number of land owner; name, address, phone number of operator field personnel; issued APD lists inspector/emergency names and numbers of BLM personnel					
Other: -APD includes map of all wells (including water) within 1 mile of proposed well -APD includes estimated starting date and anticipated duration of the total operation.					
ODNR, DOG:					
Location	Application for Permit (AP) map of roads for ingress/egress	AP map of well	No site specific location information required	No site specific location information required	Pipeline operator must keep record of location, identification, type, size at office
Signs	N/A	SEE Tank Battery; for multiple wells with common tank(s) - each wellhead identified with owner/permit number/well number/lease name	N/A	All producing leases must be legibly identified in a conspicuous place on or near the wellhead or storage tanks****	Pipeline operator must identify route of pipeline on the surface of the ground in a manner customary to the industry
Emergency: AP provides Fire and Medical Dept. phone numbers; issued permit lists these numbers plus inspector's phone number					
Other: AP includes map showing buildings, public roads, railroads, streams within 150' of well.					

Agency Requiring	Access Road	Well	Flowline	Tank Battery	Gathering Line
OHIO STATE EMERGENCY RESPONSE COMMISSION:					
Location	N/A	N/A	N/A	Provide to SERC, LEPC, local Fire Dept.- Facility Identification Form for Oil and Gas Extraction (includes list of facilities by lease/well name, maps by township, address, location)	N/A
Signs	N/A	N/A	N/A	N/A	N/A
Emergency:Provide name of facility emergency response coordinator (ERC); phone number of ERC, both daytime and 24 hour emergencynumber; do same for alternate					
Other: Operator must also provide maximum storage capacity in gallons at site.					
BAZETTA TOWNSHIP:					
Location	Certification of Compliance application (CCA) - map of ingress/egress from public road	CCA provides map of surveyed well location	CCA provides map with flowline location	CCA provides map with tank battery location	N/A
Signs	None	None	None	None	None
Emergency: -CCA. provides list of emergency numbers of all parties responsible for the digging, drilling, fracing, or operation of the well including the operator and the pumper who oversee the well as it is producing.					
Other: -CCA provides map of approx. location of every residence in drilling unit and list of all property owners in drilling unit -CCA provides schedule of operation of the well including estimated starting date and estimated life of well.					

* Site Facility Diagram - required by 43 CFR 3162.7-5 for all facilities storing oil/condensate from Federal leases; details all storage vessels, piping, metering system, and valves that will be sealed.

** Well sign includes well number/name, name of operator, lease serial number, surveyed location.

*** Tank battery sign includes name of operator, lease serial number or agreement number, and location description.

**** Information includes owner, lease name, well number, permit number, county and emergency phone numbers.

General Reporting Requirements
BLM requires at 43 CFR 3162.5 Environment and Safety, 3162.5-1 Environmental obligations, (c), that:

> "All spills or leakages of oil, gas, produced water, toxic liquids, or waste materials, blowouts, fires, personal injuries, and fatalities shall be reported by the operator in accordance with these regulations and as prescribed in applicable order or notices. The operator shall exercise due diligence in taking necessary measures, subject to approval by the authorized officer, to control and remove pollutants and to extinguish fires . . . ."
>
> "When reasonably required by the authorized officer, a contingency plan shall be submitted describing procedures to be implemented to protect life, property, and the environment."

In regard to incidents listed above, BLM Notice to Lessees NTL-3A, Reporting of Undesirable Events describes major and other-than-major undesirable events and reporting requirements to BLM. All such events which occur on State or private leases included in Federal agreements must also be reported as required in the NTL. The NTL also states that the BLM can require the operator to submit an SPCC Plan or other acceptable contingency plan. The plans must list the names, addresses and telephone numbers (business and private) of company or contract personnel authorized to order equipment or supplies and to expend funds necessary to control emergencies. At COE reservoir projects, the MFO has a standard Condition of Approval that SPCC Plans be provided to the MFO as well as the COE Project Manager.

At this time ODNR, DOG does not have specific reporting requirements for spills or accidents.

Oil and gas operators must provide annual reports to the Ohio SERC, the LEPC, and local Fire Department for use of certain types of hazardous chemicals that exceed certain quantities. There are also reporting requirements to these same entities for spills of hazardous chemicals.

Bazetta Township ordinances at Section 28: Gas and Oil Well Regulations, subsection 10, A require the following:

> "It is the responsibility of the Applicant to notify the Township of any material spills, leaks, explosions, fires, or potential hazards immediately through the Township Police Dispatcher. Failure to notify the Township shall be a violation of this Section. A written report of each incident shall be filed with the Township Zoning Inspector within five days of the occurrence describing the problem, the reason for same, actions taken to correct or mitigate the

problem and stating whether there are any long term effects anticipated."

Oil Spills and Spill Response
Table D-5 summarizes reporting requirements for crude oil spills. The agency responsible for oversight of oil spill clean-up efforts depends upon where the spill occurred and the size of the spill. State oversight for clean-up of most spills would be the responsibility of either the OEPA (spills on water) or ODNR, DOG (dry land spills). For oil or other chemical spills into Mosquito Creek Lake or on project area lands, the COE would implement the reporting and procedures outlined in the COE's Operational Management Plan (Pollution Surveillance and Mitigation section) for the reservoir. For Federally permitted wells/facilities, the BLM would work with the appropriate entities to ensure timely clean-up and conservation of the resource. The Trumbull County LEPC and the local fire department would also be involved in oil spill response and clean-up efforts. HazMat teams in the county may also be called in on a case-by-case basis.

Under the Federal Clean Water Act (CWA), as amended, an operator is required to prepare an SPCC Plan if, due to the facility's location, one could reasonably expect a discharge into or upon the navigable waters of the United States if a spill occurred. Mosquito Creek Lake and its tributaries are covered by the definition of "navigable waters". The OEPA is responsible for administering the SPCC program. BLM, MFO has a standard drilling permit Condition of Approval for wells at or adjacent to COE projects which requires submission of copies of SPCC Plans for tank batteries to both the BLM, MFO and the COE Project/Park Manager. Drilling rig operators also prepare a general SPCC Plan that is in effect when the rig is in a fixed, operating mode.

SPCC Plans address predictions of direction, rate of flow, and quantity of oil that could be released as a result of equipment failure; descriptions of prevention and containment equipment; training procedures to prevent spills; notification procedures that would be used in event of a spill; and secondary means of containment of tank batteries. Because diking of flowlines is not practical, an oil spill contingency plan (also called "Action Plan") is required for virtually all oil and gas extraction facility SPCC plans.

In the event of a spill, the operator of the well/facility has a responsibility to notify the proper authorities. The CWA requires the reporting of any discharge of oil in harmful quantities into a navigable water. The National Response Center (NRC) must be immediately notified. The State also requires notification of spills of reportable quantities (in navigable waters this is defined as any amount which causes a film or sheen upon or discoloration of the surface or causes a sludge or emulsion to be deposited beneath the surface of the water - for land spills, the reportable quantity is 210 gallons in a 24 hour period). The OEPA Emergency Response Unit, LEPC, and local fire department must be notified. If there are wildlife mortalities such as a fish kill, the owner must notify the ODNR, Division of Wildlife. Reports of spills may also be reported by the public. In this instance, the entity receiving the report will coordinate with other appropriate entities for response action.

State and Federal inspectors are on call 24 hours a day. Although oversight responsibility for clean-up activities lies with State/Federal entities, the operator is ultimately responsible for ensuring adequate measures are taken to minimize contamination. In the event clean-up actions are inadequate, the State may take over and seek reimbursement for any costs incurred.

Emergency Response (Other Than Oil Spills)
ODNR, DOG personnel, county and township agencies, including the Trumbull County LEPC and the local fire department, would likely be involved in response to an emergency such as a fire or explosion at an oil and gas site. The Trumbull County LEPC's Emergency Operations Plans address oil and gas well emergencies in general terms. In light of the large number of oil and gas wells in the county (over 2,000 wells), the Trumbull County LEPC is currently developing a free-standing oil and gas well emergency plan which is expected to be finalized during 1998. According to the Trumbull County LEPC, local fire departments, which are usually the first responders to an emergency situation, make the determination whether a HazMat team should be called in. There are four HazMat teams available for emergency response including the county HazMat team, as well as teams from the City of Warren, Mineral Ridge Township, and the City and Township of Hubbard (Bartlomain, pers. comm., 1998).

Table D-5. Reporting Requirements for Crude Oil Spills

Reportable Quantity		Report To						
Impact	**Volume**	**National Response Center**	**OEPA**	**LEPC**	**Fire Dept.**	**BLM**	**Federal Surface Management Agency**	**ODNR, Division of Wildlife**
Navigable Water	Sufficient to cause sheen	Yes	Yes	Yes	Yes	No	No	No
Environment (anywhere outside an SPCC dike)	> 210 gallons (5 barrels) in a 24 hour period	No	Yes	Yes	Yes	No	No	No
On Federal Land	> 10 barrels	No	Yes	Yes	Yes	Yes (Federal oil)	Yes (Not Federal oil)	No
Wildlife Mortality	Non-applicable	No	No	No	No	No	No	Yes

Source: Bioremediation of Crude Oil Spills: A Non-Technical Field Guide, developed by the ODNR-DOG, 1997

Summary of BLM Regulations, Orders, Notices to Lessees

Onshore Oil and Gas Operating Regulations at 43 CFR 3162.1 (General Requirements) and 43 CFR 3162.5 (Environment and Safety) require operators to perform operations and maintain equipment in a safe and workmanlike manner and provide adequate protection for health and safety of life and the protection of property.

Onshore Order #1 (Approval of Operations on Onshore Federal and Indian Oil and Gas Leases) requires site specific surface use and drilling programs in the Application for Permit to Drill, including a description of well control devices and testing procedures; expected bottom hole pressures, anticipated abnormal pressures or temperatures or potential downhole hazards and contingency plans to mitigate such hazards; and methods and locations for safe containment and disposal of each type of waste material that results from drilling of the proposed well. Also specifies filing requirements for subsequent operations, including well and production operations and surface disturbing operations, and well abandonment.

Onshore Order #2 (Drilling Operations) details requirements for well control equipment and testing; casing and cementing requirements in regard to lost circulation zones, abnormally pressured zones, and protection of usable water; mud program requirements and drilling abandonment. Has special requirements for air drilling operations including use of special equipment and locations and distances for the blooie line discharge/air compressors.

Onshore Order #7 (Disposal of Produced Water) specifies requirements and standards Federal oil and gas operators must comply with for the protection of surface and subsurface resources when disposing of produced water from oil and gas wells completed on Federal leases. For each Federally permitted well, operators must apply to the BLM for approval of the disposal of produced water.

Notice to Lessees and Operators 3A (NTL 3A - Reporting of Undesirable Events) specifies the requirements for reporting of spills, discharges, equipment failures, fires, venting, blowouts, accidents, life-threatening injuries, and fatalities.

Summary of ODNR, DOG Public Health and Welfare Setbacks

Chapter 1501 of Ohio Administrative Code - Oil and Gas Rules

Well Drilling and Operation Permits

Oil and Gas Rule Section 1501:9-1-02 (Permits)

In the application for a permit operators are required to provide location of all buildings, public roads, railroads and streams within 150 feet of the proposed well site, and their distances from the proposed well site.

Oil and Gas Rule Section 1501:9-1-05 (Safety):

Minimum Distances* Between:	Inhabited Dwelling	Public Building**	Public Street, Road, Highway	Railroad Track	Other Wells
Oil/Gas Well	100 feet	100 feet	50 feet	50 feet	100 feet***

*these also apply to a drilled/converted salt water injection well;
**which may be used as a place of resort, assembly, education, entertainment, lodging, trade, manufacture, repair, storage, traffic, or occupancy by the public;
***ODNR allows variances to this requirement.

These setbacks do not apply to a building or structure which is incident to agricultural use of the land on which it is located, unless such building is used as a private dwelling house or in the business of retail trade.

Safety Practices for Drilling and Producing Oil and Gas Wells- Oil and Gas Rule Section 1501:9-9-03 (Drilling and Deepening Operations):

Additional distances related to safety:

- no fires permitted within 50 feet of a drilling well when oil and/or gas are exposed to the atmosphere at the well, unless the oil or gas is properly vented or controlled;
- when drilling within 200 feet of an inhabited structure with rotary tools and liquid drilling medium - Rule gives specifications for Blowout Preventor system;
- when drilling within 200 feet of an inhabited structure with rotary tools and air or other gaseous drilling medium - Rule gives specifications for Blowout Preventor system;
- discharge line from the annulus between the casing and drill pipe must be vented not less than 60 feet from the well into a pit of sufficient size to contain drill cuttings, foam, produced water, oil and/or casinghead gas.

Safety Practices for Drilling and Producing Oil and Gas Wells- Oil and Gas Rule Section 1501:9-9-04 (workover, reconditioning, plugging back, completion, and plugging operations)

- no fires are permitted within 50 feet of a well being worked over, reconditioned, plugged back, completed, or plugged if oil and/or gas are exposed to the atmosphere at the well.

Safety Practices for Drilling and Producing Oil and Gas Wells- Oil and Gas Rule Section 1501:9-9-05 (Producing operations)

Minimum Distances Between:	Inhabited Dwelling	Public Road	Tank	Well	Separator
Oil Production Tank	100 feet	50 feet	3 feet	50 feet from well	10 feet
Mechanical Separator	100 feet	-	10 feet	50 feet from well	-
Indirect Fire Heater	100 feet	-	50 feet from oil production tanks	50 feet from well	-
Direct Fire Heater (excluding under tank)	100 feet	-	50 feet from oil production tanks	50 feet from well	50 feet

Portable heaters may be closer than 50 feet to the oil production tanks under conditions specified in Rule.

Oil production tanks must be located in a position so that any escaping oil cannot drain onto public roads or towards existing inhabited structure or other areas which could cause a safety hazard.

There would be no gas flares during production; therefore, gas flare setbacks are not summarized here.

Oil and Gas Rule Section 1501:9-10-01 (Pipelines)

- All pipelines and related fittings used in drilling, operating or producing of oil and/or natural gas wells must be designed for at least the greatest anticipated operating pressure or maximum regulated relief pressure;
- For an oil and/or natural gas pipeline used in the producing of oil and/or natural gas, pipeline owners/operators must keep a record or sketch showing the location, identification, type and size of the pipeline on file at their office;
- With certain exceptions, oil and/or natural gas pipeline used in the producing of oil and/or natural gas must be buried at least 24 inches below the ground surface;
- If a pipeline meets one of these exceptions the owner of the pipeline must provide the ODNR, DOG the owner's name and address, the location of the pipeline and the exceptions that justify the construction.

For safety setbacks between pipelines and residences or public areas, ODNR, DOG defers to local zoning ordinances; for OPUC regulated pipelines, safety requirements are based on population density within 220 yards on either side of the centerline of any continuous one mile length of pipeline. Higher safety factors for design, testing and operation apply in more populated areas.

SUMMARY OF BAZETTA TOWNSHIP PUBLIC HEALTH AND WELFARE SAFETY SETBACKS AND RESIDENT NOTIFICATION

Section 28: Gas and Oil Well Regulations, subsection 3.B.

Oil and gas operators must apply to the Township Zoning Inspector for a Certification of Compliance (must provide copy of State drilling permit, well, facility, and flowline locations, means of ingress/egress from public roads, connection of access road to public road, locations of residences in the drilling unit, a list of all property owners in the drilling unit, a schedule of the operation of the well including the estimated starting date and estimated life of well).

Section 28: Gas and Oil Well Regulations, subsection 3.B.ix
Access Road to Well Site

Minimum Distance Between:	Nearest Residence Building Outside Drilling Unit	Nearest Residence Building Inside Drilling Unit
Access Road to Well Site	100 feet	50 feet*

*unless the prior written consent of all property owners within the drilling unit has been obtained and submitted to the Zoning Inspector.

Notification of residents - Operators must notify all occupants within 200 feet of access road that drilling activity will be commencing and give an approximate time schedule; proof of this notice must be given to Zoning Inspector.

Pre-existing well access road

- Operators may utilize road without prior written consent of occupants within the drilling unit; and
- Operators must notify occupants inside drilling unit.

Section 28: Gas and Oil Well Regulations, subsection 5
Tank battery and related equipment

Minimum Distance Between:	Any Residence Building Outside Drilling Unit	Any Residence Building Inside Drilling Unit
Tank Battery/ Related Equipment	130 feet	100 feet*

*unless the prior written consent of all occupants within the drilling unit has been obtained and submitted to the Zoning Inspector.

APPENDIX E - HAZARDOUS MATERIALS

any subsurface line, and length of pipeline. Higher safety factors for design, testing and operation apply in more populated areas.

ORDINANCE PROVISIONS PROVIDING PUBLIC HEALTH AND WELFARE SAFETY SETBACKS AND ENHANCED NOTIFICATION

Section 22. Gas and Oil Well Regulations, subsection 1.E.

Gas and oil operators must apply to the Township Zoning Inspector for a Certification of Compliance. [illegible] must provide copy of State drilling permit, well, facility, and flowline locations, means of ingress/egress from public roads, connection of access road to public road, a list of residences in the drilling unit, a list of all property owners in the drilling unit, a schedule of the operation of the well including the estimated drilling time and estimated life of wells.

Section 22. Gas and Oil Well Regulations, subsection 3.B in [illegible]

Minimum Distance Setbacks	Nearest Residence Building Outside Drilling Unit	Nearest Residence Building Inside Drilling Unit
Setback From the Well Site	100 feet	50 feet*

*unless the p[illegible] consent and approval of the Zoning Inspector.

Notification to occupants - Operators must notify all occupants within 200 feet of access road that drilling activity will be commencing and give an approximate time schedule; proof of this notice must be given to Zoning Inspector.

For drilling well access road

- Operators may utilize road without prior written consent of occupants within the drilling unit, and
- Operators must notify occupants inside drilling unit.

Section 22. Gas and Oil Well Regulations, subsection 3.

Tank battery and other equipment

Minimum Distance Setbacks	Any Residence Building Outside Drilling Unit	Any Residence Building Inside Drilling Unit
Tank Battery or Related Equipment	150 feet	100 feet*

*unless the party [illegible] consent of the occupant within the drilling unit has been obtained and [illegible] of the Zoning Inspector.

APPENDIX E - HAZARDOUS MATERIALS

EXISTING CONTROLS

Existing laws, regulations and policies that relate directly to the use, handling and management of hazardous materials are described below.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), enacted by Congress in 1976, deals specifically with the management of solid and hazardous wastes and promotes conservation through waste recycling. Subtitle C is designed to provide "cradle to grave" management of hazardous wastes while Subtitle D provides for Federal guidance to the States in regulating non-hazardous solid wastes. A waste may be considered to be hazardous if is listed as a hazardous waste under RCRA or if it exhibits one of the following characteristics: ignitibility, corrosivity, reactivity, or toxicity. A "solid" waste can be anything that is discarded or may be discarded. Non-hazardous solid waste regulation is delegated to the States in Subtitle D of RCRA.

In 1988, USEPA issued a regulatory determination stating that control of exploration and production wastes under RCRA Subtitle C regulations is not warranted. These wastes have remained exempt from Subtitle C regulations. Oil and gas exploration and production waste (including drilling fluids, produced water, and other wastes associated with the exploration, development, or production of crude oil or natural gas) are regulated under the authority of Subtitle D, which has been delegated to the States. This exemption does not mean these wastes could not present a hazard to human health and the environment if improperly managed.

RCRA Subtitles C and D require that operators/lessees would ensure that all project related activities involving the production, use, storage and/or disposal of hazardous or non-hazardous wastes would be conducted in such a manner as to minimize potential environmental impacts.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) gives the government the authority to clean up any site where there is an unremedied release of a hazardous substance. It authorizes the U.S. Environmental Protection Agency (USEPA) and the U.S. Coast Guard to provide emergency response for specified hazardous substances released into the environment. CERCLA hazardous substances are those hazardous substances listed under the Clean Water Act, Clean Air Act, and the Toxic Substances Control Act, as well as hazardous wastes listed under RCRA. The USEPA is charged with setting the allowable limits for releases of each of these hazardous materials. These limits are called the "Reportable Quantities"

(RQs). RQs are dependent upon the hazardousness of a substance and they range from one to 5000 pounds. If a release exceeds the RQ, CERCLA requires that the owners or operators notify the National Response Center immediately. Petroleum spills are not specifically covered by CERCLA release reporting, but they are subject to reporting under the Clean Water Act. (See Clean Water Act discussion below and refer to Appendix A)

Superfund Amendments and Reauthorization Act

Title III of the Superfund Amendments and Reauthorization Act is sometimes called SARA Title III, or Emergency Planning and Community Right to Know Act (EPCRA). EPCRA guarantees communities and the public the right to know about chemical hazards that might affect them. Facilities must gather information on types and quantities of hazardous materials at each site and share that information with local authorities. The act is administered by the USEPA.

Occupational Safety and Health Act

The Occupational Safety and Health Act established the Occupational Safety and Health Administration (OSHA) as a Federal agency. The act outlined the 1989 Hazard Communication Standard (HAZCOM), which guarantees employees the right to know about chemical hazards on the job and how to protect themselves from those hazards. It requires that a Material Safety Data Sheet (MSDS) must accompany every chemical or hazardous material brought on-site. All employees must receive proper training in receiving, storage, handling, and disposal of hazardous and non-hazardous materials.

Clean Water Act

The Clean Water Act requires Spill Prevention, Control, and Countermeasure (SPCC) plans be written, implemented, and modified as necessary in accordance with 40 CFR Part 112 to prevent discharge into navigable waters of the United States. Oil Spill Emergency Response Plans (OSERP) must be maintained and updated as necessary.

Pollution Prevention Act

The Pollution Prevention Act requires substitution of a less toxic chemical for hazardous substances.

BLM Policy on Identification of Hazardous Materials through NEPA Process

BLM Instruction Memorandum WO-93-344 requires that all National Environmental Policy Act (NEPA) documents list and describe any hazardous and/or extremely hazardous substances that would be produced, used, stored, transported or disposed of as a result of a proposed project. Hazardous substances are those substances listed in the *Consolidated List of Chemicals Subject to Reporting Under Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 (USEPA, 1995a),* and extremely hazardous substances are those identified in the USEPA's *List of Extremely Hazardous Substances* (40 CFR 355).

BLM Milwaukee Field Office Standard Requirement

The BLM Milwaukee Field Office (MFO) has developed a standard condition of approval relating to reporting requirements for drilling additives. Under this condition, operators are required to furnish an inventory of all drilling, completion, testing and workover additives used during well operations within 30 days after the end of the drilling phase. The operator must provide the name of the additive, chemical description, the percentage by weight of each chemical component, and the amount of chemical stored on site.

HAZARDOUS SUBSTANCES

Introduction

Oil and gas drilling/production operations may utilize both hazardous and non-hazardous materials. This section provides specific information regarding the types and quantities of hazardous materials that may be produced or used during oil and gas drilling/production operations at Mosquito Creek Lake.

Potentially hazardous substances that may be used in small, unquantifiable amounts have been excluded from this section. These substances may include: wastes, as defined by the Solid Waste Disposal Act; wood products; manufactured items and articles which do not release or otherwise result in exposure to a hazardous substance under normal conditions of use (i.e., steel structures, automobiles, tires, etc.); food, drugs, tobacco products, and other miscellaneous substances (i.e., WD-40, gasket sealants, glues, etc.). Solid wastes generated at well locations would be collected in approved waste containers (e.g., trash baskets or dumpsters) and would be regularly removed from well locations and transported to approved disposal facilities.

Construction, Drilling, Production and Reclamation

Hazardous and extremely hazardous substances used during typical project implementation fall into the following categories:

- fuels,
- lubricants,
- coolant/antifreeze and heat transfer agents,
- certain drilling fluid additives,
- certain fracturing fluids,

- certain cement and additives, and
- some miscellaneous materials.

Gasoline, diesel fuel, and natural gas are the fuels that will most likely be used during drilling/production operations. All of these fuels contain substances that are deemed hazardous.

Gasoline would be used to power vehicles travelling to and from drilling/production sites. Hazardous substances present in gasoline include benzene, toluene, ethylbenzene, and xylene (BTEX). No large scale storage of gasoline is anticipated on the drilling/production sites.

Diesel fuel would be used to power construction equipment, transport vehicles, drilling rigs, workover rigs, and pumping equipment. The hazardous substances potentially present in diesel fuel include: BTEX and polycyclic (e.g. anthracene, napthacene) organic matter. During drilling operations, each well location would have an above-ground storage tank containing diesel. These tanks would be filled as needed by a qualified, licensed fuel supplier. Use, transport, and storage of diesel fuel would be conducted in accordance with all relevant state and/or federal rules, regulations, and guidelines.

If the oil and gas reservoir pressure decreases over time, wells may need to be converted to a beam pump for artificial lift of the oil. Gas compressors, installed on the gathering lines, may also be required. Both the beam pump and gas compressor may run on natural gas from the producing wells. Hazardous substances in the natural gas are hexane, polynuclear hydrocarbons and polycyclic organic matter.

Various lubricants including motor oils, hydraulic oils, compressor lube oils, and greases would be utilized for vehicles, rigs, compressors, and other machinery. Some of these lubricants would likely contain polynuclear aromatic hydrocarbons and polycyclic organic matter and some may additionally contain compounds of lead, cadmium, nickel, copper, manganese, barium, zinc, and or lithium. The exact quantity of each lubricant to be used on-site is unknown.

Ethylene glycol and triethylene glycol would be utilized as coolant/antifreeze and heat transfer agents. The exact total volume of ethylene glycol and triethylene glycol to be used, stored, transported and disposed of is unknown.

The producing zone of the wellbore would be stimulated by hydraulic fracturing in order to increase the flow capacity and productivity. Fracturing fluids would be brought on site by large volume tanker trucks. All transportation of fracturing fluids and additives would be in adherence with Ohio Department of Transportation rules and regulations. The hydrofracturing material would be pumped from the tanker trucks or steel tanks downhole. Any flowback from the hole would be directed into a flowback tank for disposal at a State approved facility. Fracturing fluids would not be released into the reserve pit.

The constituents listed below are typical of those used during oil and gas well drilling/cementing operations at the COE Berlin Lake Project:

- Water
- Foamer
- Bentonite
- Portland Cement, Pozzolan
- Calcium Chloride
- Cellophane Flakes
- Gypsum/Calcium Sulfate

The products listed below are typical of those used during stimulation operations:

- Cationic Homopolymer
- Oxyalkylated Alcohol, Aromatic Solvent
- Hydrocarbon/Alcohol Solvent, Amino Neutralized Arylsulfonates
- Guar Gum
- Cationic Copolymer
- Aqua Ammonia, Citric Acid

The exact quantities of materials and type of additives cannot be known until the well bore has been drilled and evaluated. The chemical constituents of the various additives may vary depending upon the specific brand name of the product. Based on drilling additive reports for wells drilled at Berlin Lake, there were two products used during the hydrofracturing process that contained hazardous substances as defined under CERCLA. The table below shows the type of additive, identifies CERCLA listed hazardous substances contained in the additive (with Reportable Quantities), quantity of material stored on-site, and total quantity of additive used (including quantity of hazardous substance based on percentage contained in additive).

Table E-1. Potential Drilling Additives with Constituents Defined as Hazardous Substances

Additive[1]	**CERCLA-listed Hazardous Substance (% in additive)**[2]**, Reportable Quantity**	**Quantity Stored on Site**[1]	**Quantity Used**[1] **(Total Product/ Total Hazardous Substance)**
Cationic Homopolymer	Ethylene Glycol (5-20%), RQ 5,000 lbs.	None	50 Gal./100 lbs.
Oxyalkylated Alcohol, Aromatic Solvent	Methyl Alcohol (30%), RQ 5,000 lbs.	None	50 Gal./100 lbs.

Sources: (1) MFO, Unpublished Drilling Additive Forms; (2) MFO, Material Safety Data Sheets

Additional site specific evaluation of drilling additives would be conducted at the time a well is proposed.

Summary

During drilling operations, there is a potential for leakage of fuels, lubricants, and other materials on the well site during routine operations. Prompt clean up of spills or releases at the well site may prevent contamination of soil horizons, water resources, or other natural resources. There is also potential that drill crews may dispose of substances such as spent or used lubricants, solvents, antifreeze, motor oil or hydraulic fluids in the reserve pit. If this occurs, the pit contents could be rendered hazardous. A standard condition of approval requires only drilling muds, drilling additives, drilling fluids, cuttings, cementing materials, native soils and/or approved pit solidifying materials be placed in the reserve pit.

No hazardous substances would be used during drilling of the surface section of the hole. Once the surface casing is cemented in place, aquifers would be protected from any potential contamination from other additives that may be introduced downhole. CERCLA-listed hazardous substances that may be contained within the completion/ stimulation additives include ethylene glycol and methyl alcohol. These constituents would not be permitted in the reserve pit. They would be circulated downhole from a truck or tank and any flowback would go to a steel tank for removal to a State approved disposal facility. As stated above, the operator must provide BLM an inventory of all drilling completion, testing and workover additives used within 30 days after the end of the drilling phase.

The environment is at risk of exposure during transportation, storage, handling, and disposal of hazardous chemicals/materials that will be used in association with exploration and production activities. The threat of environmental exposure is contingent upon proper handling of the chemicals. Additional analysis of potential impacts has been documented in Chapter 4.

GLOSSARY

Additional site specific evaluation of drilling additives would be conducted at the time a well is proposed.

Summary

During drilling operations, there is a potential for leakage of fuels, lubricants, and other materials on the well site during routine operations. Prompt clean up of spills or releases at the well site would prevent contamination of soil horizons, water resources, or other natural resources. There is also potential that drill crews may dispose of substances such as spent or used lubricants, solvents, antifreeze, motor oil or hydraulic fluids in the reserve pit. If this occurs, the pit contents could be rendered hazardous. A standard condition of approval requires only drilling muds, drilling additives, drilling fluids, cuttings, cementing materials, native soil and/or approved pit stabilizing materials be placed in the reserve pit.

No hazardous substances would be used during drilling of the surface section of the hole. Once the surface casing is cemented in place, aquifers would be protected from any potential contamination from other additives that may be introduced downhole. CERCLA listed hazardous substances that may be contained within the completion/ stimulation additives include ethylene glycol and methyl alcohol. These constituents would not be permitted in the reserve pit. They would be circulated downhole from a truck or tank and any flowback would go to a steel tank for removal to a State approved disposal facility. As mentioned, the operator must provide BLM an inventory of all drilling, completion, testing, and workover additives used within 30 days after the end of the drilling phase.

The environment is at risk of exposure during transportation, storage, handling, and disposal of hazardous chemicals/materials that will be used in association with exploration and production activities. The threat of environmental exposure is contingent upon proper handling of the chemicals. Additional analysis of potential impacts has been documented in Chapter 4.

Glossary

A-WEIGHTED SCALE A scale of sound measurement that approximates the way that sound is heard by humans.

ABANDON To cease producing oil and gas from a well when it becomes unprofitable or to cease further work on a newly drilled well when it proves to contain unprofitable quantities of oil or gas. Usually several steps are involved including removal and salvaging of part of the casing, placing cement plugs in the borehole to prevent migration of fluids between the different formations penetrated by the borehole.

ACQUIRED MINERALS Mineral rights that were obtained by the United States through purchase, gift, or condemnation proceedings.

AIR DRILLING A method of rotary drilling that uses compressed air as the circulation medium.

AIR POLLUTANTS Substances generated and released into the atmosphere which may affect public health and welfare, as well as damage to crops, animals, vegetation and materials.

ALLUVIAL Deposited by a stream or running water.

AMBIENT AIR That portion of the atmosphere, external to buildings, to which the general public has access.

AMBIENT AIR QUALITY STANDARDS The permissible level of various pollutants in the atmosphere, as contrasted with emission standards which are the permissible levels of pollutants emitted by a given source.

APPLICATION FOR PERMIT TO DRILL (APD) A written plan that describes use of the surface and drilling equipment/procedures for wells that would penetrate leased Federal minerals.

AQUIFER A permeable layer of rock, sand, or gravel capable of yielding groundwater to wells or springs.

ATTAINMENT AREA Any geographic area wherein the ambient air concentration of a criteria pollutant is equal to or less than the primary National Ambient Air Quality Standard for that pollutant.

BARREL 42 gallons (US).

BENTONITE A clay that swells when wet. Because of its gel-forming properties, bentonite is a major component of water-base drilling muds.

BIOTA Animal and plant life of a region; flora and fauna collectively.

BLOOIE LINE The discharge pipe from a well being drilled by air drilling. Used to move air away from the drilling rig and transport the rock cuttings a suitable distance from the well.

BLOWOUT An uncontrolled escape of gas, oil, or other fluids from a well to the atmosphere or to an underground formation. A blowout occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

BOTTOMHOLE n. The lowest or deepest part of a well; adj. Pertaining to the bottom of the wellbore.

BRINE 1.Water that has a large quantity of salt, especially sodium chloride, dissolved in it; salt water. 2.Liquid wastes from oil and gas exploration and production.

CASING Steel pipe placed in an oil or gas well to prevent the drilled hole from collapsing or moving of fluids from one formation to another, and to improve the efficiency of extracting hydrocarbons if the well is productive.

CATHODIC PROTECTION A means of preventing corrosion of a metal object.

CHECK-VALVE A valve with a free-swinging tongue or clapper that permits fluid in a pipeline to flow in one direction only; back-pressure valve.

COMMUNITIZATION AGREEMENT (CA) A written contract which allows Federal oil and gas to be combined with private oil and gas for the purpose of being developed by a single well. The well may be drilled into either the Federal or private ownership.

COMPENSATORY ROYALTY AGREEMENT A written contract which requires an owner of a well located on non-federal lands to pay royalties to the United States for the portion of the well's production determined to be Federal oil and gas.

COMPLETION The activities and methods to prepare a well for production; includes installation of equipment for production from an oil or gas well.

COMPRESSOR A device that raises the pressure of a compressible fluid such as air or gas.

CONDITION OF APPROVAL (COA) Requirements attached to an approved BLM Application for Permit to Drill. Conditions of approval may be either standard conditions or they may be site-specific measures developed during environmental analysis at the time a well is proposed.

CONDUCTOR PIPE (or casing) A well's surface pipe used to seal off near-surface water, prevent the caving or sloughing of the walls of the hole, and conduct drilling mud through loose, unconsolidated shallow layers of sand clay and shales.

CRITERIA POLLUTANTS The six pollutants for which the U.S. Environmental Protection Agency has established National Ambient Air Quality Standards. The pollutants include carbon monoxide, lead, nitrogen dioxide, ozone, particulates, and sulfur dioxide.

CUMULATIVE IMPACTS The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taken place over a period of time. (40 CFR 1508.7)

CULTURAL RESOURCE (PROPERTY) A definite location of human activity, occupation or use identifiable through field inventory, historical documentation, or oral evidence. The term includes archaeological, historic or architectural sites, structures or places with important public and scientific uses. Cultural resources may include definite locations (sites or locations), of traditional cultural or religious importance to specified social and/or cultural groups.

DECIBEL (dB) A unit for measuring sound intensity, usually measured on the decibel A-weighted scale (dBA) which approximates the sounds heard by the human ear at moderate sound levels. Changes in five decibels or more are normally discernible to the human ear.

DEEPEN To increase the depth of a well.

DE MINIMIS LEVEL In regard to criteria air pollutants, the level of pollutant below which the U.S. Environmental Protection Agency (EPA) has determined that there would be no significant detriment to the environment.

DEVONIAN A period of the Paleozoic era corresponding to a time between 400 and 345 million years ago.

DIRECT IMPACTS (see impacts)

DIRECTIONAL DRILLING Intentional deviation of a wellbore from the vertical. Controlled directional drilling makes it possible to reach subsurface areas laterally remote from the point where the drill bit enters the earth.

DISPOSAL WELL A well used to dispose of completion and workover fluids, brine and associated wastes.

DISSOLVED SOLIDS The total amount of organic and inorganic material contained in a liquid solution.

DISTRIBUTION LINE A system of pipelines and other equipment by which natural gas is distributed to customers.

DOLOMITES Carbonate rocks containing a high percentage of magnesium in place of calcium.

DRAINAGE The uncompensated removal of reservoir fluids and production potential from lands not included in spacing units by adjacent, legally-drilled wells.

DRILL STRING Drill pipe with attached tool joints that transmits fluid and rotational power from the kelly to the drill collars and bit.

DRILLING The operation of boring a hole in the earth, usually for the purpose of finding and removing subsurface formation fluids such as oil and gas.

DRILLING FLUID Circulating fluid

which lifts rock cuttings out of the wellbore to the earth's surface, cools the drill bit, provides hole stability, and counteracts downhole formation pressure; drilling fluids may include drilling mud, water, air, or gas.

DRILLING MUD Specially compounded liquid circulated through the well bore during rotary drilling operations.

DRILLING RIG The mast or derrick, draw-works and attendant surface equipment of a drilling unit.

DRILLING TARGET A geologic formation or zone known or believed to have commercial quantities of hydrocarbons.

DRILLING UNIT The minimum acreage on which one well may be drilled. For wells drilled to the Clinton formation in Trumbull County, a drilling unit is 40 acres.

DRY HOLE Any well that cannot produce oil or gas in commercial quantities. A dry hole may produce water, gas, or oil, but not enough to justify production.

ENVIRONMENTAL ASSESSMENT (EA) An analysis of environmental impacts of federally-permitted or authorized actions. EAs are prepared in accordance with the *National Environmental Policy Act of 1969* and 40 CFR 1500, *et seq.* Final EAs are accompanied by a Decision Record/Finding of No Significant Impact.

FEDERAL AGREEMENTS Agreements which include compensatory royalty agreements and communitization agreements (see compensatory royalty agreement and communitization agreement).

FLARE v. To dispose of excess combustible vapors by igniting them in the atmosphere.

FLOODPLAIN (see also 100-year floodplain) Land areas susceptible to being flood-inundated from any source, including small and often dry water courses and areas adjoining coastal waters, areas along rivers, streams, and lakes.

FLOWAGE EASEMENT An easement granted to the U.S. Army Corps of Engineers (COE) by a non-federal land owner that allows the COE to flood the easement area during high water events.

FLOWLINE The surface pipe through which oil (and gas) travels from a well to processing equipment or to storage.

FORMATION A bed or deposit composed throughout of substantially the same kind of rock.

FORMATION WATER Water originally in place in a geologic formation.

FRACTURING (fracing) A method of increasing production from a well by creating cracks, or fractures in the producing formation. Under extremely high hydraulic pressure, a specially designed fluid is pumped into the formation which creates the fractures. This fluid contains sand or glass beads which become wedged in the open fractures, leaving channels for oil and gas to flow into the well after the hydraulic fracture pressure is released. This process is often called a "frac job."

FREEBOARD The vertical distance between the surface of a liquid or solid waste contained inside a pit or berm and the top of the pit wall or berm.

FUGITIVE DUST Airborne particulate matter composed of soil resulting from construction or industrial activity

GATHERING LINE A pipeline, usually of small diameter, used to move crude oil or gas from the field to a main pipeline.

GEOLOGIC TARGET A rock layer believed to hold valuable quantities of oil and gas or other natural resources for which drilling or other operations are conducted.

HIGH DEVELOPMENT POTENTIAL AREA The geographic area designated by BLM as having a greater than 75% potential for drilling to develop the oil and gas resources.

HORIZONTAL DRILLING Deviation of the borehole at least 80 degrees from vertical so that the borehole penetrates a productive formation in a manner parallel to the formation. A single horizontal hole can effectively drain a reservoir and eliminate the need for several vertical boreholes.

HUMAN ENVIRONMENT The factors that include, but are not limited to biological, physical, social, economic, cultural and aesthetic factors that interrelate to form the environment.

HYDRAULIC FRACTURING (see fracturing)

HYDROCARBONS Organic compounds of hydrogen and carbon whose densities, boiling points and freezing points increase as their molecular weights increase. The smallest molecules of hydrocarbons are gaseous; the largest are solids. Petroleum is a mixture of many different hydrocarbons.

IMPACTS (a) Direct impacts, which are caused by the action and occur at the same time and place; (b) Indirect impacts, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Impacts include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative. Effects can be beneficial or detrimental.

INDIRECT IMPACTS (see impacts)

INTERMITTENT STREAM Streams which flow only during certain times of the year.

KAME A mound or low ridge composed of sand and gravel deposited by glacial streams

KICK-OFF POINT The depth in a vertical hole at which a deviated or slant hole is started; used in directional drilling.

LACUSTRINE Related to lakes or lake processes.

LDN Scientific notation for the term "day-night sound level" which is the A-weighted equivalent sound level for a 24-hour period with 10 decibels added to nighttime sounds (10 p.m. to 7 a.m.).

LOW DEVELOPMENT POTENTIAL AREA The geographic area designated by BLM as having a less than 25% potential for drilling to develop the oil and gas resources.

MALODOROUS Having an unpleasant odor.

MAST A portable derrick that is capable of being raised as a unit, as distinguished from a standard derrick, which cannot be raised to a working position as a unit. For transporting by land the mast can be divided into two or more sections to avoid excessive length extending from truck beds on the highway.

MESOPHYTIC Describing plants incapable of surviving extremes of temperature or water supply.

MITIGATION Actions developed in response to impacts identified in the analysis which could be taken to avoid or reduce projected impacts.

MODERATE DEVELOPMENT POTENTIAL AREA The geographic area designated by BLM as having between a 25% and 75% potential for for drilling to develop the oil and gas resources.

MOSQUITO CREEK LAKE PLANNING AREA The COE's land, the Lakeview Local School District tract and land up to one-half mile from the boundaries of these tracts. The half-mile buffer is a reasonable estimate of the extent of direct impacts that could occur from potential well locations given current directional drilling technology and existing land use.

MISSISSIPPIAN A period of the Paleozoic era corresponding to a time span between 345 and 320 million years ago.

MONOCLINE A steepening of a uniformly dipping geological surface.

MOSQUITO CREEK LAKE PROJECT AREA The COE's land and the Lakeview Local School District property.

MUD TANK Above-ground tank that may be used instead of an excavated pit for holding drilling mud.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) Levels of air quality established by the U.S. Environmental Protection Agency as necessary for protection of public health and welfare.

NATIONAL GEODETIC VERTICAL DATUM (NGVD) The determination of mean sea level that has been adopted as a standard measure for elevation.

NATIONAL REGISTER OF HISTORIC PLACES (NRHP) The National Register lists cultural properties found to qualify for listing because their local, state or national significance. The Register is expanded and maintained by the Secretary of the Interior and administrative responsibility is delegated to the National Park Service.

NATURAL GAS A highly compressible, highly expansible mixture of hydrocarbons and occurring naturally in gaseous form. Natural gas is nearly pure methane.

NON-ATTAINMENT AREA Any geographic area wherein the ambient air concentration of a criteria pollutant exceeds the primary National Ambient Air Quality Standard for that pollutant.

NO SURFACE OCCUPANCY (NSO) A restriction that is imposed on certain lands if it is determined that oil and gas operations cannot coexist with certain resource values. Oil and gas well sites or other permanent facilities are not permitted in areas that are classified as "no surface occupancy".

NOXIOUS Harmful or injurious to health or physical well being.

100-YEAR FLOODPLAIN As defined by Executive Order 11988, as amended, lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year; or floodplain associated with the 100-year storm event which is the size storm or greater that occurs on average once in 100 years.

OUTGRANT Leases, licenses, easements, and permits issued by the COE to second parties.

PALEOZOIC An era of geologic time corresponding to the period from 570 to 225 million years before the present, during which life on earth became widespread and diverse.

PARTICULATES/PARTICULATE MATTER (PM) Small particles in the air generally considered to be pollutants; may include dust, dirt, soot, smoke and liquid droplets.

PERENNIAL STREAM Streams which flow continuously.

PERFORATE To pierce the casing wall and cement of a wellbore to provide holes through which formation fluids may enter.

PLANNING ANALYSIS (PA) A document that reviews options for the management of BLM-administered lands and minerals. It is prepared in accordance with the *Federal Land Policy and Management Act of 1976* and is accompanied by an environmental document.

PLUG To fill a well's borehole with cement to prevent the flow of water, gas or oil from one strata or another when a well is abandoned.

PLUG AND ABANDON (P & A) v. To place cement plugs into a dry hole and abandon it.

PLUG BACK To fill up the lower section of a well bore to produce from a formation higher up. If the well has been cased, the casing is plugged back with cement to a likely formation and perforated.

POOLING To combine oil and gas resources of different ownerships into one drilling unit. Royalties are shared in proportion to the amount of acreage of each ownership included in the drilling unit.

PRECURSOR COMPOUND Chemical compound which must be present for chemical reactions to occur to create another compound.

PREFERRED ALTERNATIVE The preferred alternative identifies which alternative is favored by the agency. For internally initiated proposals, the preferred alternative is the proposed action.

PRESSURE RELIEF VALVE A valve that opens at a pre-set pressure to relieve excessive pressures within a vessel or line.

PRESSURE SWITCH Device that senses changes in pressure, which shuts off the well.

PRIVATE WELL Any well where the bottomhole is located in private or State mineral interest.

PRODUCING ZONE The zone or geologic formation from which oil or gas is produced.

PRODUCTION AGREEMENT A contractual agreement between an oil and gas operator and a landowner by which land is included in spacing (drilling) units for royalty payments resulting from oil and gas well production. Such agreements usually involve prorated payments based on acreage included in a spacing unit.

PRODUCTION CASING The last string of casing set in a well, inside of which is usually suspended a tubing string.

PRODUCTION RIG A portable servicing or workover outfit, usually mounted on wheels and self-propelled. A well-servicing unit consists of a hoist and engine mounted on a wheeled chassis with a self-erecting mast. A workover rig is basically the same with the addition of a substructure with rotary, pump, pits, and auxiliaries to permit handling and working a drill string.

PROPPANT (propping agent) A substance, such as sand grains or glass beads, that is carried in suspension by the fracturing fluid and that serves to keep the cracks open when fracturing fluid is withdrawn after a fracture treatment (may be called a frac job, fracing, or hydrofracing).

REPORTABLE QUANTITY The quantity of released hazardous materials that, when exceeded, must be reported under CERCLA. The EPA is charged with setting the allowable limits for releases of each hazardous material. If a release exceeds the EPA reportable quantity, CERCLA requries that the owners or operators of the facility notify the National Response Center immediately.

RESERVE PIT Usually an excavated

earthen-walled pit that holds rock cuttings and waste mud.

RESERVOIR A natural underground porous and permeable rock formation in which water, oil, or natural gas has accumulated

RESIDUAL IMPACTS Direct, indirect or cumulative impacts which remain after application of mitigation measures.

RETURN PERIOD The time period between certain rainfall events based on recorded measurements in a particular area. Return periods are described in terms of specific rainfall events, length of event, and rate of reoccurrence. An example could be a six-hour, 2" event occurring every two years.

RIG DOWN To dismantle a drilling rig and auxiliary equipment following the completion of drilling operations.

RIG UP To prepare the drilling rig for making hole, that is, to install tools and machinery before drilling is started.

ROCK CUTTINGS Fragments of rock dislodged by the drill bit and brought to the surface by the drilling fluid.

RUNNING SURFACE The surface of a constructed road on which vehicles travel.

SALES LINE Any line through which oil, gas, or products flow to a sales point.

SCOPING An early and open process for determining the scope of issues to be addressed in an environmental analysis and for identifying the important issues related to a proposed action. Scoping may involve public meetings, field interviews with representatives of agencies and interest groups, discussions with resource specialists and managers, and written comments in response to news releases, direct mailings, and articles about the proposed action and scoping meetings.

SEISMIC SURVEY An exploration method in which strong low-frequency sound waves are generated on the surface to find subsurface rock structures that may contain hydrocarbons.

SEPARATOR (oil and gas separator) Production equipment used to separate liquid components of the well fluid from gaseous elements.

SETBACK (1) Minimum distance permitted between the bottomhole of a wellbore and the boundary of the subject tract or drilling unit (see well spacing). (2) Minimum distance permitted between a proposed well pad/associated facilities and another designated point or feature, usually for safety or resource protection purposes (i.e. residences, roads, or streams).

SHUT IN To close the valves on a well so that it ceases production.

SPACING See well spacing.

SPUDDING Beginning to drill a well.

STATE IMPLEMENTATION PLAN (SIP) The State's plan for achievement of the National Ambient Air Quality

Standards.

STIPULATION A legal requirement, specifically a requirement that is part of the terms of a mineral lease. Some stipulations are standard on all Federal leases.

STUFFING BOX A device that prevents leakage along a piston, rod, propeller shaft or other moving part that passes through a hole in a cylinder or vessel.

SUPERFUND SITE Site where hazardous waste has been disposed of improperly and that is targeted for government cleanup under CERCLA.

TANK BATTERY A group of production tanks located in a field to store crude oil or brine.

THIEF-HATCH An opening in the top of a tank large enough to admit a device for sampling contents of tank and other oil-sampling equipment.

TOTAL SUSPENDED PARTICULATES (TSP) All particulate solid and liquid matter, except water, suspended in the atmosphere. Includes dusts, smoke and pollen particles, and liquid and solid aerosols

TRADITIONAL USE A category applied to any cultural resource known to be perceived by a specified social and/or cultural group as important in maintaining its cultural identity, heritage or well-being.

TRANSMISSIVITY The rate at which water passes through an aquifer.

VENT LINE A horizontal 4- to 6- inch pipe that vents gases from oil storage tanks. A vent line lets the tank breathe as the oil is warmed during the day and cooled at night.

VOLATILE ORGANIC COMPOUND (VOC) Pollutants that are gases at room temperature and contain carbon as the primary element. Any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) which participates in complex chemical reactions in the atmosphere in the presence of sunlight.

WELLBORE (also borehole) A circular hole made by drilling; especially a deep hole of small diameter, such as an oil and gas well or a water well.

WELLHEAD Equipment used to maintain surface control of a well.

WELL SERVICING Maintenance work performed on an oil or gas well to improve or maintain production. Usually, it involves repairs to the pump, rods, gas-lift valves, tubing, packers, and so forth.

WELL SERVICING UNIT See production rig.

WELL PAD Level surface area that contains equipment and facilities used to drill, complete, and produce a well.

WELL SPACING The regulation of the number and location of wells over an oil and gas reservoir. Under Ohio Oil and Gas Rules (Chapter 1501:9-1-04), wells deeper than 4,000 feet shall be located upon a drilling unit containing not less than 40 acres; be not less than 1,000 feet from any well drilling to, producing from, or capable of producing from the same pool; and be not less than 500 feet from any boundary of the subject or drilling unit.

WELL STIMULATION Any of several operations used to increase the production of a well, such as acidizing or fracturing.

WETLAND(S) Those areas that are inundated or saturated by surface or groundwater at a sufficient frequency and duration to support a prevalence of vegetation typically adapted to life in these soil conditions. Wetlands generally include swamps, marshes bogs and similar areas.

WORKING PIT Term for the excavated pit which holds the drilling mud.

WORKOVER The performance of one or more of a variety of remedial operations on a producing oil or gas well to try to increase production. Examples of workover jobs are deepening, plugging back, pulling and re-setting liners, squeeze cementing, and so forth.

WORKOVER RIG See production rig.

SOURCES AND REFERENCES

Sources and References

Abing, Timothy F., Professional Engineer. 1997. Bureau of Land Management, Milwaukee Field Office, Milwaukee, WI.

Ahmad, M.U. and J.A. Smith. 1988. "Earthquakes, injection wells, and the Perry nuclear power plant," Geology. vol. 16, p. 739. Cleveland, Ohio.

American Petroleum Institute. 1988. "Basic petroleum data book - petroleum industry statistics," VIII:3. API: Washington, D.C.

______. 1991. "Evaporative Loss From Fixed Roof Tanks," Bulletin 2518. API: Washington, D.C.

______. 1991. "Energy consumption/gross state product ratios in the United States," Research Study 061. API: Washington, D.C.

Bartholomew, William. 1996. Greene Township Zoning Inspector, Trumbull Co., OH. Personal communication.

Bartlomain, Joseph. 1997 and 1998, various dates. Trumbull County Local Emergency Planning Committee, Warren, OH. Personal communication.

______. 1997. Trumbull County Emergency Management Agency, Warren., OH. Letter dated December 1.

Baudo, Dave. 1997. Office of Trumbull County Building Inspector, Warren, OH. Personal communication.

Bazetta Township. 1997. Road Department. Personal communication.

Beauregard, Robert A. 1989. Economic Restructuring and Political Response. Sage Publications Inc.: Newbury Park, CA

Barton, Gary J. and Peter R. Wright. 1997. "Ground-water resrouces in the vicinity of Courtland, Trumbull County, Ohio." USGS Water Resources Investigations Report 97-4130 Columbus, OH.

Blank, J.E. 1970. "The Ohio archaic: A study in culture history," unpublished PhD Dissertation. University of Massachusetts, Department of Anthropology. Amherst, MA.

Bowens, Diana. 1996. Ohio Department of Public Safety, Columbus, OH. Letter to Bureau of Land Management dated August 5.

Boyk, Jerome. 1996. American Telephone and Telegraph. Personal communication.

Brady, Nyle. 1996. The Nature and Properties of Soils. Prentice Hall: Princeton, NJ. .

Brewer-Coon, Che'. 1996. Ohio Environmental Protection Agency, Division of Air Pollution Control. Letter.

_______. 1996. Ohio Environmental Protection Agency, Division of Air Pollution Control. Personal Communication.

Brose, David S. 1994. "Archaeological investigations at the Paleo Crossing site, A Paleoindian occupation in Medina County, Ohio." in The First Discovery of America: Archaeological Evidence of the Early Inhabitants of Ohio Area. William S. Dancy, ed. The Ohio Archaeological Council, Inc.: Columbus, Ohio. pp. 61-76.

______. 1978. "Late prehistory of the Upper Great Lakes area." in Handbook of North American Indians: Northeast. Bruce G. Trigger, vol. ed. Smithsonian Institution: Washington, D.C. pp. 569-882.

Brown, David. 1997. Trumbull County Soil and Water Conservation Service. Warren, OH. Personal communication.

BLM (Bureau of Land Management). 1987. Blackleaf Field Development EIS, Technical Report on Climate, Air Quality, and Noise. Lewiston, MT.

______. 1988. National Environmental Policy Act Handbook H-1790-1. Washington, D.C.

______. 1989. Programmatic Environmental Impact Statement for Oil and Gas Drilling and Production in Montana: Air Quality Technical Appendix 4. Billings, MT.

______. 1990. "Planning for fluid mineral resources." Handbook H-1624-1. Washington, D.C.

______. 1992. Draft Oil and Gas Management, Billings-Powder River-South Dakota Resource Management Plan/Environmental Impact Statement Amendment Montana State Office, Miles City District.

______. 1993a. Managing the nation's public lands: Annual report of the DOI BLM. Fiscal Year 1993. 56 pp.

______. 1993b. "Interim policy on identification of hazardous materials impacts through the National Environmental Policy Act review process." Instruction

Memorandum No. 93-344. September 9.

______. 1994. "Evaporation losses from oil tanks and associated variance requests." Milwaukee Field Office. Memorandum from Timothy Abing.

______. 1995a. Beaverhead National Forest oil and gas leasing final environmental impact statement: Air quality analysis. Report prepared jointly by BLM and USDA, Forest Service.

______. 1995b. Draft Environmental Impact Statement on the Fontonelle Natural Gas Infill Drilling Projects, Sweetwater and Lincoln Counties, Wyoming. Wyoming State Office.

______. 1995c. Draft Environmental Impact Statement on the Expanded Moxa Arch Area Natural Gas Development Project, Sweetwater, Lincoln, and Uinta Counties. Wyoming State Office.

______. 1996a, Moxa Arch and Fontenelle EISs, Air Quality Technical Support Document, Cumulative Impact Analysis of Southwestern Wyoming Natural Gas Development Projects on Air Quality. Report prepared by TIC Environmental Corp. for Rock Springs District Office, Kemmerer and Green River Resource Areas. DES-95-15 and 20.

______. 1996b. Draft Environmental Impact Statement: Price Coalbed Methane Project. Report prepared by Woodward-Clyde Co. for Moab District Office, Moab, UT.

______. 1997. Draft Environmental Impact Statement: Cave Gulch-Bullfrog-Waltman Natural Gas Development Project. Casper District Office, Platte River Resource Area. Casper, WY. DEIS-97-4.

______. Various dates. Drilling additive report forms. Milwaukee Field Office. Unpublished data.

______. Various dates. Material safety data sheets. Milwaukee Field Office. Unpublished data.

Bush, David R. 1977. Archaeological Resources for the Proposed Gas Well Drilling Sites in Lorain and Trumbull Counties, Ohio. Cleveland Museum of Natural History: Cleveland, OH.

Bush, Dennis. 1996. Ohio Environmental Protection Agencies, Division of Air Pollution Control. Personal communication.

California Public Utilities Commission. 1995. Draft Environmental Impact Statement/Supplemental Environmental Impact Report (EIS/SEIR), Pacific Pipeline Project, Part C.16. Sacramento, CA.

Callender, Charles. 1978. "Shawnee." in Handbook of North American Indians: Northeast. Bruce G. Trigger, vol. ed.. Smithsonian Institution: Washington, D.C. pp. 622-635.

Chapple, Geraldine. 1997. Bazetta Township Zoning Commission. Personal communication.

Clawson, M. 1987. From Sagebrush to Sage. Ana Publishing: Washington, D.C.

COE (U.S. Army Corps of Engineers). 1977 (revised 1978). Ohio River and Tributaries: Mosquito Creek Lake Reservoir Regulation Manual. Pittsburgh District. Pittsburgh, PA. 71 pp.

______. 1987. Lakeshore Management Plan, Part II.7.A of the Operational Management Plan, Mosquito Creek Lake, Ohio. Pittsburgh Distirct. Pittsburgh, PA. 17 pp.

______. 1992. Mosquito Creek Lake Operational Management Plan. Pittsburgh District. Pittsburgh, PA. 67 pp.

______. 1993. Mosquito Creek Lake, Trumbull County, Ohio: Master Plan, Design Memorandum No. 1, Pittsburgh District. Pittsburgh, PA. 143 pp.

______. 1998. Shoreline Management Plan (revision of 1987 Lakeshore Management Plan). Pittsburgh District. Pittsburgh, PA.

______. 1998. Pittsburgh District. Pittsburgh, PA. Letter dated February 19.

DOI (U.S. Department of the Interior). 1995. Our Living Resources. National Biological Survey. Washington D.C.

Curtain, John. 1996. Ohio Environmental Protection Agency, Division of Air Pollution Control. Personal communication.

Dubiaga, Dave. 1997. Trumbull County Planning Commission, Warren, OH. Personal communication.

Dunsmoor, Mark. 1997, various dates. Director of Public Service, City of Cortland, OH. Personal communication.

Ecology and Environment, Inc. 1989. Screening Site Inspection for Village of Cortland Landfill. US EPA ID:OHD980039895. Cortland, Ohio.

Eastgate Development and Transportation Agency. 1995. Unpublish count traffic data.

Ethridge, M., and U. Guerrieri. 1983. Survey of Oil and Gas Activities on Federal Wildlife Refuges and Waterfowl Production Areas. Research Study 031. American Petroleum Institute: Washington, D.C.

Federal Energy Regulatory Commission. 1997. Northern Border Project, Final Environmental Impact Statement. Office of Pipeline Regulation, FERC-EIS-0110, Washington, D.C.

Foster, George. 1997. Agricultural Research Service: College Station, TX. Personal communication.

Fry, Gary F.. 1983. "Additional archaeological reconnaissance: Cortland-Mosquito Creek intercepting sewer, Trumbull County, Ohio." Manuscript on file in State Historical Preservation Office.

Funk, Robert E. 1978. "Post-Pleistocene adaptations." in Handbook of North American Indians: Northeast. Bruce G. Trigger, vol. ed. Smithsonian Institution: Washington, D.C. pp. 16-27.

Glenn, Jonathan and Mark A. Kollecher. 1995. "Phase I archaeological field survey of the proposed MAH/TRU-711 highway project area, Mahoning and Trumbull Counties, Ohio." Prepared by the Center for Cultural Resource Research, University of Pittsburgh, Pittsburgh, PA for GPD Associates. Akron, OH.

Goga, John N. 1998. U.S. Army Corps of Engineers. Letter to Bureau of Land Management, Milwaukee Field Office. dated Feruary, 19.

Goulish, Bob. 1996a. Ohio Enviornmental Protection Agency, Division of Air Pollution Control, Letters.

______. 1996b. Ohio Environmental Protection Agency, Division of Air Pollution Control. Personal communication.

Grahl, James. 1997. Ohio Department of Natural Resources. Personal communication.

Gregston, Terry G. 1993. An Introduction to Federal Environmental Regulations for the Petroleum Industry. Petroleum Extension Service, Division of Continuing Education. The University of Texas at Austin. Austin, TX.

Griffen, James B. 1978. "Late prehistory of the Ohio Valley." in Handbook of North American Indians: Northeast, Bruce G. Trigger, vol. ed. Smithsonian Institution: Washington, D.C. pp. 547-559.

Gundy, Barbara J., et al. 1992. Phase I Cultural Resource Investigations of the Proposed MAH/TRU-711, Mahoning and Trumbull Counties, Ohio. Prepared by the Center for Cultural Resource Research, University of Pittsburgh, Pittsburgh, PA, for GPD Associates. Akron, OH.

Hansen, Mike. 1996. Ohio Department of Natural Resources, Division of Oil and Gas.

Hausenbuiller, Robert. 1980. Soil Science. William C. Brown Company: Dubuque, IA.

Hayes, Paul. 1997. Trumbull County Engineer's Office. Warren, OH. Personal communication. October 22.

Holliday, Dr. George H. 1995. Environmental/Safety Regulatory Compliance for the Oil & Gas Industry. PennWell Publishing Company: Tulsa, OK.

Hunter, William A. 1978. "History of the Ohio Valley." in Handbook of North American Indians: Northeast, Bruce G. Trigger, vol. ed. Smithsonian Institution: Washington, D.C. pp. 588-593.

Independent Petroleum Association of America. 1995. "The oil and gas producing industry in your state 1995-1996." Hart's Oil and Gas World. Houston, TX.

Interstate Oil and Gas Compact Commission. 1995a. IOGCC/EPA State Review of Oil and Gas Exploration and Production Waste Management Regulatory Programs. Ohio State Review.

______. 1995b. Marginal Oil and Gas: Fuel for Economic Growth. IOGCC: Oklahoma City, OK.

Jones, H.W., ed. 1979. Noise In the Human Environment, vol. 1 and 2. Environmental Council of Alberta. Edmonton, Alberta.

Judson, Harry. 1996 and 1997. Ohio Environmental Protection Agency, Division of Air Pollution Control. Personal communication. Various dates.

Kell, Scott. 1997 and 1998. Ohio Department of Natural Resources, Division of Oil and Gas. Personal communication. Various dates.

Knapp, Allen. 1996. Trumbull County Planning Office, Warren, OH. Personal communication.

Kotkin, J. 1996. "Flight to the fringes." The Washington Post. March 10.

Kunz, Dan. 1996. State of Ohio, Division of Wildlife. Personal communication.

Lander, Edward. 1996. Trumbull County Planning Office, Warren, OH. Personal communication.

Langenkamp, Robert D., ed. 1985. The Illustrated Petroleum Reference Dictionary, 3rd ed. PennWell Books: Tulsa, OK. p. 696.

Lee, Alfred M. 1982. Archaeological Survey of Trumbull County. Prepared by the Cleveland Museum of Natural History and the Trumbull County Planning Commission, Cleveland, OH.

Lierle Public Relations. 1996. U.S. Lease Price Report. Aurora, CO. January/February, 15:1.

Loehlein, Werner. 1996. U.S. Army Corps of Engineers, Hydrology and Hydraulics Branch, Pittsburgh District. Personal communication.

Malloy, Dennis. 1997. Ohio Department of Natural Resources, Division of Wildlife, Cortland, OH. Personal communication.

Marshall, Robert L. 1996. U.S. Army Corps of Engineers, Management and Disposal Branch, Pittsburgh District. Letter.

Massey, Stephen D. 1997. U.S. Army Corps of Engineers. Letter to Bureau of Land Management, Milwaukee Field Office dated May 23.

Mauger, Jerry. 1997. Bazetta Zoning Office, Bazetta, OH. Personal communication.

McCormac, Michael P., et al. 1996. "Lower silurian Cataract/Medina group ("Clinton") sandstone play." in The Atlas of Major Appalachian Gas Plays, John B. Roen and Brian J. Walker, eds. Pub. no. V-25. West Virginia Geological and Economic Survey: Morgantown, WV. pp. 156-163.

McDonald, H. Gregory. 1994. "The Late Pleistocene vertebrate fauna in Ohio: Coinhabitants with Ohio's Paleoindians." in The First Discovery of America: Archaeological Evidence of the Early Inhabitants of Ohio Area. William S. Dancy, ed. The Ohio Archaeological Council, Inc.: Columbus, Ohio. pp. 23-41.

McGann, Thelma. 1996. Sprint Great Lakes. Personal communication.

McGraw-Hill Co. 1995. World Energy Services-U.S. Outlook Supplement. Lexington, MA. Spring-Summer. 70 pp.

Minerals Management Service. 1996. Federal Mineral Revenues Disbursed by State and County, Fiscal Year 1995. Royalty Management Program, Department of the Interior: Denver, CO.

______. 1994. Mineral Revenues 1994: Report on Receipts from Federal and Indian Leases. Denver, CO.

Monago, Gene. 1996. The East Ohio Gas Company. Letter.

MTBOGC (Montana Board of Oil and Gas Conservation). 1989. Final Programmatic Environmental Impact Statement on Oil and Gas Drilling and Production in Montana. Technical Appendix 4: Air Quality.

______. Final Programmatic Environmental Impact Statement on Oil and Gas Drilling and Production in Montana Technical Appendix 7: Noise.

National Weather Service. 1961. "Rainfall frequency of the United States for durations of 30 minutes to 24 hours and return periods from 1 to 100 years." Technical Paper 40.

New York Department of Environmental Conservation. 1992. Final Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program. Albany, N.Y.

Nuskiewicz, Trish. 1997. Trumbull County Planning Commission, Warren, OH. Personal communication.

Ohio Auditor of State. 1987. Ohio Lands: A Short History. 2d ed. Columbus, OH. 54 pp.

ODNR (Ohio Department of Natural Resources). 1989. Division of Oil and Gas. Ohio Nonpoint Source Management Plan.

______. 1997a. Bioremediation of Crude Oil Spills: A Non-Technical Field Guide.

______. 1997b. 1996 Annual Report.

______. 1996. Division of Real Estate and Land Management. Letter to Bureau of Land Management, Milwaukee Field Office dated June 6.

______. 1977, Ohio Land Capability Analysis-Land Use Layer.

______. 1997. Division of Wildlife. Mosquito Creek Wildlife Area files.

______. 1997. Ohio 1997-98 Hunting and Trapping Regulations. Publication 85.

Ohio Department of Public Safety. (n.d.) Integrated traffic records system listing traffic accidents.

Ohio Department of Transportation. 1995. Operational Guide for Vehicles Operating with an Oversize/Overweight Special Hauling Permit.

______. 1997. Ravenna, Ohio. Personal communication, Oct. 17.

OEPA (Ohio Environmental Protection Agency). 1994. "The Youngston Re-Designation Request." (for attainment of NAAQS).

______. 1995. Division of Air Pollution Control. Emission Trends Report for Stationary Air Contaminant Sources Within the State of Ohio, 1980-1990.

______. 1996a. Air Quality and Analysis Unit. Ohio Air Quality Report. 1996.

______. 1996b. 1996 Ohio Air Quality Report. Columbus, OH. 92 pp.

______. 1996c. Unpublished list of CERCLA sites.

______. 1996. Division of Solid and Infectious Waste Management. 1995 Ohio Solid Waste Facility Data Report.

Ohio Geological Society. 1978. Clinton sandstone papers presented at the Ohio Oil and Gas Association meetings, 1961-1978. Columbus, OH. 455 pp.

Ohio Historical Society. (n.d.) Archaeological Site Files. Site record forms.

Ohio Oil and Gas Association. 1996. Letter to BLM dated May 30.

Ohio Utility Protection Service. 1996 and 1997. Personal communication.

Oil and Gas Producers Underground Protection Service. 1997. Personal communication.

Oleksa, Paul. 1997. The East Ohio Gas Company. Personal communication.

Page's Ohio Revised Code, Annotated. 1995. Title 55: Roads-Highways-Bridges (Supplement). Section 5577.04 (E)

Paradise, Joe. 1996. Ohio Department of Transportation. Personal communication. July 18.

Parmeter, Sharon. 1996. Ohio Department of Health, Environmental Health and Toxicology Section. Personal communication.

Parsons, Misty. 1996. State of Ohio, Environmental Protection Agency, Division of Air Pollution Control. Personal communication.

Payette, Jacqueline M. 1996. "Phase I archaeological reconnaissance of federal lands included in proposed Bazetta township park site in Mosquito Creek Lake, Trumbull County, Ohio." Report on file at the U.S. Army Corps of Engineers, Pittsburgh District. Pittsburgh, PA. Submitted to the Ohio Historical Society. April 30.

Peterson, Gil, ed. 1997. "Mosquito Creek reservoir report." Youngstown State University. Center for Urban Studies. Youngstown, OH. 51 pp.

Pollock, S. R., ed. 1995. Statistical Forecasts of the United States. 2d ed. Gale Research, Inc.: Detroit, MI. 813 pp.

Porter, E.H. 1992. U.S. Petroleum Supply: History, Prospects, and Policy Implications. API Research Study 064. API: Washington, D.C. 57 pp.

Powers, Robert. 1997 and 1998. Ohio Department of Natural Resources, Division of Wildlife. Personal communication.

Purdy, James. 1996. U.S. Army Corps of Engineers. Facsimile to Bureau of Land Management, Milwaukee Field Office. Aug. 22.

Raidel, Richard. 1996. Lakeview Local School District. Personal communication.

______. 1996. Lakeview Local School District, Letter.

Rand McNally, Inc. 1996 Commercial Atlas & Marketing Guide 1996. N.Y., NY.

Raymond, Martha. 1996. Letter to Bureau of Land Management dated April 7.

Rodocker, Dick. 1996. The East Ohio Gas Company. Personal communication.

Roeloffs, E., Craig Nicholson, and Robert L. Wesson. 1989. comment to "Earthquakes, injection wells, and the Perry nuclear power plant, Cleveland, Ohio." Geology col. 17 p. 382.

Ruszkiewicz, Dianne P. 1996. Letter to Bureau of Land Management dated July 28.

______. 1997. COE Park Ranger, Mosquito Creek Lake Project. Personal communication.

Scott, Willard J. 1996. Orwell Natural Gas Company. Letter.

Scrip, John. 1996. Mahoning-Trumbull Air Pollution Control Agency (MTAPCA). Personal communication.

Shane, Linda C.K. 1994. "Intensity and rate of vegetation and climatic change in the Ohio region between 14,000 and 9,000 yr. B.P." in The First Discovery of America: Archaeological Evidence of the Early Inhabitants of Ohio Area. William S. Dancy, ed. The Ohio Archaeological Council, Inc.: Columbus, OH. pp. 7-21.

Sherwood, James. 1997. City of Warren, Ohio, Water Department. Personal communication.Smith, Randy. 1996. Personal Communication. Trumbull County Engineer's Office

Simmers, Rick. 1997 and 1998.Ohio Department of Natural Resources, Division of Oil and Gas, Northern Region. Personal communication.

Simpson, Ken. 1977. Eastgate Development and Transportation Agency. Youngstown, OH. Personal communication. October 17.

Slater, C.M., and G.E. Hall, eds. 1995 County and City Extra: Annual Metro, City, and County Data Book. Bernan Press: Lanham, MD.

Smith, Randy. 1996a. Trumbull County Engineer's Office. Warren, OH. Personal communication. May 31.

______. 1996b. Facsimile transmission. February 16.

Sofsky, Charles. 1956. "The Mosquito Lake sites."iIn Eastern States Archaeological Federation. Bulletin 15.

State Yellow Book. 1994. vol. VI:2. Monitor Leadership Directories, Inc.: N.Y., NY. 1103 pp.

Steele, Ed. 1997. Ohio Public Utility Commission. Personal communication.

Stewart, Thomas. 1996. Ohio Oil and Gas Association (OOGA). Letter.

Stewart, W.L., E.G. Schuster, and W. J. McGinniss. 1996. Economic Indicator Maps for Rural Development In the East. US Department of Agriculture, Forest Sevice. Publ. No. INT-GTR-329. 24 pp.

Stone, Lyle M., and Donald Chaput. 1978. "History of the Upper Great Lakes Area." in Handbook of North American Indians: Northeast, Bruce G. Trigger, vol. ed. Smithsonian Institution: Washington, D.C. pp. 602-609.

Tabb, William M., and Linda A. Malone. 1992. Environmental Law: Cases and Materials. The Michie Co.: Charlottesville, VA. 922 pp.

Tanner, Helen Hornbeck, ed. 1987. Atlas of Great Lakes Indian history. The University of Oklahoma Press: Norman, OK and London.

Thoms, Christopher. 1996. Ohio Department of Natural Resources, Division of Water, Floodplain Management Section. Personal Communication.

Tuckey, Todd. 1996. Personal communication, February 5.

Trumbull County Planning Commission. 1995. Engineer's Office Road Bonding Requirements.

Trumbull County Planning Commission and Cleveland Museum of Natural History. 1982. Trumbul County Archaeological Study.

U.S. Department of Agriculture, Soil Conservation Service. 1992. Soil Survey of Trumbull County, Ohio.

USDA (U.S. Department of Agriculture-Forest Service). 1980. "Predicting impact of noise on recreationists, equipment development and test group (ED and T)." Project No. 2688.

______. 1995. Beaverhead National Forest Oil and Gas Leasing Final Environmental Impact Statement: Air Quality Analysis.

______. 1994. "Determination of General Conformity to State Implementation Plans" Memorandum.

U.S. Department of Health, Education and Welfare. 1978. Health and Safety Guide for Oil and Gas Well Drilling and Servicing. National Institute for Occupational Safety and Health.

U.S. Department of Housing and Urban Development. 1978. "Flood insurance study: Trumbull County, Ohio." Federal Insurance Administration.

U.S. Department of Labor, Occupational Safety and Health Administration. "Occupational Noise Exposure (29 U.S.C. 653 et seq.) 29 Code of Federal Regulations Part 1910.95 .

USEPA (U.S. Environmental Protection Agency). "Noise emission standards for construction equipment (42 U.S.C. 4905)." 40 Code of Federal Regulations Part 204.

______. "Transportation equipment noise emission controls (42 U.S.C. 4905 et seq.)." 40 Code of Federal Regulations Part 205.

______. 1974. "Information on levels of environmental noise required to protect public health and welfare with an adequate margin of safety." EPA 550/9-74-004. Office of Noise Abatement and Control.

______. 1978, "Protective noise levels: condensed version of EPA levels document." EPA 550/9-79-100. Office of Noise Abatement and Control.

______. 1982. "Guidelines for noise impact analysis." EPA 550/9-82-105. Office of Noise Abatement and Control.

______. 1985. "Storage and organic liquids." AP-42 Handbook, Compilation of Air Pollution Emission Factors, Evaporation Loss Sources. Section 4.3

______. 1991. "Mobile sources." AP-42 Handbook, Compilation of Air Pollution Emission Factors. Supplement A, Vol. II.

______. 1995a. Title III list of lists, consolidated list of chemicals subject to the Emergency Planning and Community Right-To-Know Act and Section 112(r) of the Clean Air Act, as amended. U.S. Government Printing Office.

______. 1995b. Crude oil and natural gas exploration and production wastes: Exemption from RCRA Subtitle C Regulation. Washington, D.C.

______. 1995c. "Stationary and area point sources." AP-42 Handbook, Compilation of Air Pollution Emission Factors. Vol. 1.

USFWS (U.S. Fish and Wildlife Service). 1986. North American Waterfowl Plan.

______. 1993. Northern States Bald Eagle Recovery Plan.

U.S. General Accounting Office. 1987. Mineral revenues - Corps of Engineers Management of Mineral Leases. GAO/RCED-88-49, 9 pp.

USGS (United State Geological Survey). 1997. "Ground-Water Resources in the Vicinity of Cortland, Trumbull County, Ohio." U.S. Geological Survey Water Resources Investigations Report 97-4130. Columbus, OH.

Walsh, E. 1996. "Economic renewal puts luster on the rust belt." The Washington Post. March 19. p. A-1.

Ward, Andrew D., and William J. Elliot. 1995. Environmental hydrology. CRC Press: Boca Raton, FL.

Weesies, Glenn. 1997. National Soil Erosion Laboratory, Purdue University, Lafayette, IN.

West, Daniel L. 1997. Ohio Department of Natural Resources, Ohio State Parks. Letter to Bureau of Land Management, Milwaukee Field Office dated December 16.

White, Dr. John. 1979. Phase I (locational) Archaeological Reconnaissance of the Mosquito Creek - Cortland 201 Planning Area. Youngstown State University. Youngstown, OH.

Widman, Norm. 1997. USDA, National Resource Conservation Service. Personal communication.

Williams, P. 1995. "Operators take Ohio's best prospect into New York state drilling activity." Hart's Oil and Gas World. October, p. 42.

Wilson, D. 1996. "Targeting your market-interpreting demographic data series." (Part 1). Image of Greater Springfield. Greater Springfield COC. 16:9, May. p. 9.

Yovich, Steve. 1996. Trumbull County Health Department. Warren, OH. Personal communication.

Yue, Bob. 1996. U.S. Army Corps of Engineers, Hydrology and Hydraulics Branch. Pittsburgh District. Personal communication.